Annex 1

Evaluation Strategy

Evaluation and trials SUPERCOMET2 Harvey Mellar IoE, London

1 Ethics

The research will be conducted in accordance with the code put forward by the RESPECT project which was funded by the European Commission's Information Society Technologies (IST) Programme, to draw up professional and ethical guidelines for the conduct of socio-economic research. (http://www.respectproject.org/main/index.php). Partners should make themselves familiar with the requirements of this code.

The research will also be conducted in accordance with the ethical guidelines of the British Educational Research Association (http://www.bera.ac.uk/publications/guides.php).

2 Expert review

Carried out January 2006, and results collated by Vegard Engstom - report available on the intranet at xxx

3 Organisation of user trials

3.1 Organisation

Work Group 1 will organise the trials

3.1.1 Members of WG1

P40 Harvey Mellar

P07 Nadezhda Nancheva

P17 Jose Miguel Zamarro

P09 Erika Mechlova

P33 Vitor Duarte Teodoro

S01 Anders Isnes

3.2 The product

Final product to be evaluated is a single CD-ROM application translated into a number of languages, Low Tech and a High Tech hands-on kits, plus support materials (including Teacher Seminar and Guide) available in electronic form and containing customisable national content.

3.3 Aims

Achievement of some of the aims set out below will provide a basis of comparison between the countries involved, and the achievement of others will enable us to create a picture of specific national contexts..

A) To demonstrate that the SUPERCOMET materials (CD-ROM, Teacher Guide and Seminar, hands on kit) are a valuable and useful addition to the physics education resources available (for example by contributing to students' learning or interest).

This to be determined by a common set of questions for students and teachers, enabling some degree of comparison between countries.

B) To determine which aspects of the materials need to be changed or added to.

C) To determine the relative value of various parts of the materials,

Each part of the materials (i.e. each of the modules 1-5, Teacher Guide, Teacher Seminar, Low Tech hands-on kit, High Tech hands-on kit) to be assessed according to the following criteria:

- possibilities of use – to what extent can these parts of the materials be effectively deployed within the specific national context?
- curricular value – to what extent are these parts of the materials of value within, and offer content relevant to, the curriculum being taught in that school/country?
- academic achievement – to what extent do these parts of the materials contribute to the achievement of learning goals within that context?

D) To determine how best to use the materials within the specific pedagogic context of a particular country. The description of best use to include an account of the context of use including:

- number of students in the class
- number of computers and network connections inside classroom
- teacher training in ICT

E) To provide case studies of actual use in each country.

3.4 National reports

There will be some commonality in the trials across countries to aid comparisons, but this will not be enforced at the expense of capturing richness and national diversity.

Each country will produce its own evaluation report in English. The Contact person for WG1 is responsible for the delivery of this report

3.4.1 Contact people for WG1

P03 Gerhard Rath

P05 Wim Peeters

P07 Nadezhda Nancheva

P09 Erika Mechlova

P11 Raimund Girwidz

P15 Bernadette Schorn

P17 Jose Miguel Zamarro

P18 Monique Vindevoghel

P23 Federico Corni

P28 Peter Uylings

P31 Andrzej Karbowski

P33 Vitor Duarte Teodoro

P39 Gren Ireson

S01 Anders Isnes

S02 Carmen Holotescu

3.5 Synoptic report

To be produced by Harvey Mellar, based on national reports.

4 User trials of CD-ROM materials, Teacher Guide and Seminar

The materials are to be tested as they are on 1 January 2007.

The testing period is from January 3007 to August 2007

4.1 Teaching the teachers

4.1.1 Goals

Formative evaluation

How did you train teachers to use the CD-ROM materials?

How were the Teacher Guide and Seminar used in practice in your context? (We need good reasonably detailed descriptions of what is actually done.)

What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

Why are these aspects useful? Why are the other aspects not useful?

How might the materials be improved so as to be of greater use?

4.1.2 Methods

This is the range of possible methods, Partners may choose to use only some of these methods. However, if Partners wish to use additional methods then they should inform Harvey so that he has a record of the methods used.

Questionnaires

Interviews

Focus groups

On-line Forum

4.1.3 Participants

This is the range of possible participants, Partners may choose to work with only some of these participants. However, if Partners wish to work with additional participants then they should inform Harvey so that he has a record of participants.

Teachers

Teacher trainers

4.1.4 Partners

The following Partners have agreed to take part in these trials:

S01 Naturfagsenteret, NO

P33 U_Nova_Lisboa, PT

P05 U_Antwerpen, BE

P11&P15 U_Ludwigsburg, DE & U_Munich, DE

P18 U_Lille, FR

P26 U_Daugavpils, LV

S02 Timsoft Ltd., RO

4.2 Teaching with SUPERCOMET materials

4.2.1 Goals

Illuminative evaluation

"The investigator hangs out with the participants (students, teachers, etc.) to pick up how they think and feel about the situation, and what the important underlying issues are."

How are the SUPERCOMET CD-ROM materials used in practice? (We need good reasonably detailed descriptions of what is actually done.)

Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice?

How are the SUPERCOMET CD-ROM materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

How do teachers and/or students feel about these different methods of integration?

What difficulties do teachers find in integrating the materials into their teaching?

4.2.2 Methods

This is the range of possible methods, Partners may choose to use only some of these methods. However, if Partners wish to use additional methods then they should inform Harvey so that he has a record of the methods used.

Questionnaires

Interviews

Focus groups

Observations of student interactions

Video/audio and computer recording

On-line Forum

4.2.3 Participants

This is the range of possible participants, Partners may choose to work with only some of these participants. However, if Partners wish to work with additional participants then they should inform Harvey so that he has a record of participants.

Teachers

Teacher trainers

4.2.4 Partners

The following Partners have agreed to take part in these trials:

P05 U_Antwerpen, BE

P23 U_Udine, IT

P26 U_Daugavpils, LV

P31 U_PAP, PL

P39 U_Loughborough, UK

S02 Timsoft Ltd., RO

4.3 CD-ROM materials

4.3.1 Goals

Summative evaluation

To provide evidence that the materials 'work'.

Assess the fit to teacher's curriculum and practice

What aspects of the CD-ROM (if any) are useful in your national context?

Why are these aspects useful? Why are the other aspects not useful?

Assess impact on learning

How long, on average, does it take to complete each module?

Do students learn from the materials? Which aspects of the materials are useful for learning?

Is there improved learning overall, improved learning of specific aspects, quicker learning?

Assess impact on motivation

Do students like working with materials? What do they like? What do they not like?

Assess whether the materials have differential impacts on specific groups of students

Two areas of particular interest are:

- High/average/low ability
- Boys/girls

Formative evaluation

How might the materials be improved so as to be of greater use?

This aspect of the evaluation of the CD-ROM materials is 'optional' - partners may choose not to pursue this.

4.3.2 Methods

This is the range of possible methods, Partners may choose to use only some of these methods. However, if Partners wish to use additional methods then they should inform Harvey so that he has a record of the methods used.

Questionnaires

Interviews

Focus groups

Observations of student interactions

Video/audio and computer recording

Tests

On-line Forum

4.3.3 Participants

This is the range of possible participants, Partners may choose to work with only some of these participants. However, if Partners wish to work with additional participants then they should inform Harvey so that he has a record of participants.

Students

Teachers

4.3.4 Partners

The following Partners have agreed to take part in these trials:

P03 U_Graz, AT

P05 U_Antwerpen, BE

P07 U_Rousse, BG

P09 U_Ostrava, CZ

P11&P15 U_Ludwigsburg, DE & U_Munich, DE

P17 U_Murcia, ES

P18 U_Lille, FR

P23 U_Udine, IT

P26 U_Daugavpils, LV

P31 U_PAP, PL

P33 U_Nova_Lisboa, PT

P39 U_Loughborough, UK

S01 Naturfagsenteret, NO

S02 Timsoft Ltd., RO

4.3.5 Topics

As a guide to what we might wish to test for in terms of learning, there are five modules:

- Magnetism
- Electromagnetic induction
- Electric conduction
- Introduction to superconductivity
- History of superconductivity

Learning objectives of the individual modules

1. Magnetism

Based on work with the SUPERCOMET material, the pupils shall be able to:

Knowledge

- recognise that the Earth has a magnetic field.
- recognise that some rocks are magnetic, and that this lead to the discovery of magnetism.
- recognise that electricity and magnetism are two faces of the same phenomenon.
- recognise that there is always a magnetic field associated with an electric current.
- recognise that electricity and magnetism are two faces of the same phenomenon.
- recognise that the magnetic field around a sole-noid is similar to the field of a bar magnet
- recognise the different properties of paramagnetic, diamagnetic and ferromagnetic materials.
- recognise that a ferromagnetic material can be magnetized by an external magnetic field.
- recognise that a ferromagnetic material can lose its magnetization if it is heated up sufficiently.

Understanding

- describe the significance of the Ørsted experiment
- describe how the shape of the magnetic field from a solenoid is related to that of a straight wire
- describe the significance of using ferromagnetic cores in electromagnets
- give a simplified account of the domain theory of magnetism.

Skills

- apply the right hand rule to determine the direction of the magnetic field around a wire
- draw the magnetic fields around common magnet geometries (bar magnets, horseshoe magnets).
- apply the right hand rule to determine the direction of the magnetic field through a coil or solenoid
- draw the magnetic field around a single coil, or around a solenoid

2. Electromagnaetic induction

Based on work with the SUPERCOMET material, the pupils shall be able to:

Knowledge

- use the terms induction, coil, circuit, current, magnetic flux, generator, rotor, stator, dynamo
- recognize that an AC motor in principle is an AC generator «running backwards»
- identify some applications of induction coils in everyday technology (e.g. transformers, electrical motors and generators, loudspeakers, microphones)

Understanding

- describe the phenomenon of induction
- describe how an electromagnet functions in terms of induction
- describe how AC current is generated in terms of induction, magnet, coil and rotation

3. Electric Conduction

Based on work with the SUPERCOMET material, the pupils shall be able to:

Knowledge

- use the terms conductor, semi-conductor, resistor, insulator, cross-section, resistivity, conductivity, temperature coefficient, mean free distance, lattice, charge carrier, electrons, holes, ions, power loss
- recognize electrons, holes and ions as charge carriers
- identify some well-known conductors, insulators and semi-conductors

Understanding

- describe the relationship between the kinetic energy of the lattice (temperature of the material) and resistance
- describe the differences between AC and DC in terms of charge carriers and electric field.
- describe the relationship between voltage, current and resistance (Ohm's first law)
- describe the relationships between resistance, cross-section, length and resistivity of the material (resistance law or Ohm's second law)

Skills

- use Ohm's first law in algebraic manipulations
- use Joule's law to calculate power loss in power lines
- calculate the resistance of a piece of (conducting) material using parameters like cross-section, length and resistivity of the material

4. Introduction to Superconductivity

Related to phenomenon

By the end of this module students should:

- be intrigued by the behaviour of superconductors;
- be able to describe both electrical and magnetic phenomena associated with superconductors;
- be able to compare the behaviour of superconductors with that of semiconductors and 'normal'conductors;
- be able to identify differences between 'ordinary' magnets and magnetic properties of super-conductors;
- be able to give an account of the following terms related to phenomena in superconductivity: resistivity; ceramic materials; rare earths; critical temperature; critical magnetic field; critical current density; diamagnetism; phase transition; levitation; Meissner effect; pinning; type I and Type II superconductors

Related to theory

By the end of this module students should be:

- able to recognise the theoretical puzzles which superconductivity presented (and still presents) to scientists;
- able to use existing knowledge of electricity and electromagnetism", and of lattice vibrations and internal energy, to understand some of the explanations;
- able to recognize that the rules of quantum mechanics dictate behaviour at low temperatures – and that some explanations of superconductivity cannot be accounted for in simple terms ;

- aware that the following terms are used in explanations of superconductivity: drift velocity of electrons; eddy currents; penetration depth of magnetic field; Cooper pairs; phonons; vortices; fermions; bosons.

5. History of Superconductivity

Based on work with the SUPERCOMET material, the pupils shall be able to:

Knowledge

- recognize some major discoveries and theories related to superconductivity
- recognize the scientists and the collaboration behind these discoveries and theories
- recognize current efforts to improve experimental knowledge and theories of superconductivity

Understanding

- describe how the superconductivity scientists gained and interpreted their data
- argue how the superconductivity theories for conventional and high temperature superconductors are related to experimental evidence
- discuss whether superconductivity development has been driven by experiments or by theory

5 User trials of new materials produced during SUPERCOMET2

To be carried out between September 2007 and November 2007.

Details to be provided later.

5.1 Materials

5.1.1 New superconductivity teaching materials

Partners

No volunteers so far

5.1.2 Revised Teacher Guide/Seminar

Partners

The following Partners have agreed to take part in these trials:

P05 U_Antwerpen, BE

P28 REC_AMSTEL, NL

P39 U_Loughborough, UK

5.1.3 High Tech hands-on kit

Partners

The following Partners have agreed to take part in these trials:

P09 U_Ostrava, CZ

P11&P15 U_Ludwigsburg, DE & U_Munich, DE

P18 U_Lille, FR

P26 U_Daugavpils, LV

P28 REC_AMSTEL, NL

P39 U_Loughborough, UK

5.1.4 Low Tech hands-on kit

Partners

The following Partners have agreed to take part in these trials:

P05 U_Antwerpen, BE

P09 U_Ostrava, CZ

P11&P15 U_Ludwigsburg, DE & U_Munich, DE

P18 U_Lille, FR

P26 U_Daugavpils, LV

P28 REC_AMSTEL, NL

5.2 Goals

5.2.1 Formative evaluation

How might the materials be improved so as to be of greater use?

5.3 Methods

This is the range of possible methods, Partners may choose to use only some of these methods. However, if Partners wish to use additional methods then they should inform Harvey so that he has a record of the methods used.

5.3.1 Questionnaires

5.3.2 Interviews

5.3.3 Focus groups

5.3.4 Observations of student interactions

5.3.5 Video/audio and computer recording

5.3.6 On-line Forum

5.4 Participants

This is the range of possible participants, Partners may choose to work with only some of these participants. However, if Partners wish to work with additional participants then they should inform Harvey so that he has a record of participants.

5.4.1 Students

5.4.2 Teachers

5.4.3 Teacher trainers

Annex 2

Evaluation Strategy adopted by Research Unit in Physics Education of Udine University, Italy

MONITORING OF THE EXPERIMENTATION

For an evaluation of the didactic intervention the teachers used the following protocol composed of 6 points, experimented and validated through previous research in teaching physics.

A. At the beginning of the experimentation the teacher writes up a report for the initial presentation to the class, developing the points indicated in WORKSHEET A.

B. The teacher then makes an initial evaluation of each student (students are identified with a code and name) compiling WORKSHEET B which concerns the evaluation of capacity, interest, application, socialization and scholastic performance. For each student we indicate a number from 1 to 5 with the following meaning:

1. well above average
2. slightly above average
3. average
4. slightly below average
5. well below average

The average does not refer to the specific class, but to the general situation, according to the teacher's judgement. The separation of the five categories must be thought out in such a way that the categories are, over a broad sample, distributed fairly equally. Therefore in a hypothetical class of an average 25 students, we expect to find around 5 in the first category, 5 in the second, and so on. However in a "good" class there will be a prevalence of the lower categories and vice versa for a "difficult" class.
The capacity may be different with "theory" work or laboratory activities; we attempt to give a response that takes this into account in a balanced way. Where there are obvious discrepancies, we note this in the relevant box, eventually assigning this with two distinct "marks". The student's interest must refer to physics in particular. Socialization also refers to active participation in regular class life.

C. Through the course of the experimentation, at the end of every class task, the teacher will write up a brief comment on "what happened" using WORKSHEET C (possibly straight after the task or at the end of the working day).

D. At the end of the experiment the teacher writes up a final paper, in an open format, attempting to produce a synthesis of what was written in the daily comments. WORKSHEET D suggests the grid.

E. The teacher makes a final evaluation of each student (utilising the codes indicated in WORKSHEET B), referring only to what was carried out in the course of the experiments. He or she completes WORKSHEET E where for each student we register effort and scholastic performance using the same criteria as indicated for the initial evaluation. This naturally refers to an average scholastic situation.

F. At the end of the experimentation it would be advisable if possible to proceed to an oral interview of each student (at least 3 with a low category profile and 3 with a medium-high profile, maintaining the identification codes assigned) and to a collective discussion in the presence of the teacher. The interviewed student may consult the material collected during the activities he or she has carried out, and before the interview he or she will asked to review (at home or, given sufficient time, in class) the whole work session. The interview should take place in an area different from the classroom.

WORKSHEET A

1) Possible experiments taking place (PNI, Brocca, assisted projects, mini experiments, max,ecc.)
   Possible previous experiments
2) Program effectively taken place before experimentation
3) Physics arguments treated before experimentation
4) Laboratory usage
   a. Frequency (percent of laboratory hours of the total) ....%
   b. Modality: in small groups ....% demonstration from teacher's desk ....%
5) Laboratory equipment
6) Usual operating modalities (percentages)
   a. Class lesson........% discussion(free or guided)……….....% laboratory........%
   b. Collective resolution of problems........% work in small class groups........%
   c. Work on calculator...........% oral interrogation..........% test......%
   d. Other test instruments. (specify)....................................%
   e. other (specify)..%
7) Use of calculator
   a. Frequency (percentage of calculator use) ....%
   b. Modality: small groups ....% demonstrations ....%
   c. Use of calculator:
   d. software simulation (specify)..................................%
   e. programming...........%
   f. electronic sheet..........%
   g. on-line measures...........%
   h. use of hypertexts /multimedia (specify).........%
   i. building hypertexts /multimedia.......%
   j. other (specify).............%
8) Global attitude of class
   a. effort..profit...
   b. interest in physics...............................interest in mathematics...........................
   c. degree of homogeneity...

WORKSHEET B

For each student

IDENTIFIER OF STUDENT
CAPACITY
INTEREST
EFFORT
SOCIALIZATION
SCHOLASTIC PERFORMANCE

WORKSHEET C

Date

Argument discussed

Type of work carried out (for each activity the time assigned in minutes, for those that require at least 10 minutes)

Presentation

Discussion

Laboratory experiences

Use of CD modules

Evaluation

Other

Possible homework

Possible problems arising

Interest and involvement shown by students

Degree of satisaction of teacher

WORKSHEET E

For each student

IDENTIFIER OF STUDENT	EFFORT	SCHOLASTIC PERFORMANCE

WORKSHEET D

Final report

At the end of the experimentation the teacher writes up a final paper, in an open format which attempts to synthesize what was written in the daily comments. We wish to highlight the following in particular:

1. an evaluation of the materials involved (worksheets, CD modules, short films, laboratory experiences,…)
   - 1.1 if these results were clear and easy to utilize
   - 1.2 in what measure these were effectively broadened
   - 1.3 if the time foreseen proved adequate
   - 1.4 if the conceptual difficulty proved appropriate for students
   - 1.5 if there were problems
2. if there were specific difficulties in using CD modules
3. if there were difficulties, in what way were they resolved
4. the possible link created with other specific themes found in physics or other disciplines, in particular mathematics;
5. the global attitude of the students with regard to the experimentation: if on average they were interested, willing, critical (with respect to normal attitudes outside of the experimentation), if they worked well together;
6. possible situations where the behavior of single students during the experimentation was visibly different (in a positive or negative manner) from usual;
7. a subjective and synthesized evaluation, independent from the ad hoc proof results, about how the experimentation could be useful both for a specific end (for example, an understanding of electromagnetic induction) or a general end (involvement, understanding of the use of models, development of positive attitudes with regard to the discipline....)
8. possible suggestions for revision (specific or general) for the material utilized

We advise you to conclude by saying in a few words if you believe the tasks carried out were useful or if the time spent could have been used more profitably in a more traditional manner.

WORKSHEET E

For each student

IDENTIFIER OF STUDENT	EFFORT	SCHOLASTIC PERFORMANCE

WORKSHEET F

Interview grid

1. What do you think you have learned through these experiments?

The list may be organized for

- concepts;

- laws and formulae;

- forms of representation:

capacity of the laboratory
capacity for software usage
in another manner according to what students are used to.

2. What aspects did you like most? Why?

3. What aspects did you like least? Why?

4. How do you think you learnt most: through discussion, through laboratory work, with a calculator, studying at home ... ?

5. Let's review a part of the work carried out.

We select an area of discussion and check the degree of acquisition of specific points by asking precise questions.

Annex 3

Pro Forma for the National Testing Report

PARTNER:	**<partner name>**		
AUTHOR:	**<author name>**	DATE:	**yyyy-mm-dd**
REVIEWER:	**<reviewer name>**	DATE:	**yyyy-mm-dd**
NATIONAL EVALUATION REPORT		VERSION:	**A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide

Teacher Seminar

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit

High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions
- Length of sessions

- Number of trainee teachers involved (please give numbers of male and female trainee teachers)
- Number of teachers involved (please give numbers of male and female teachers)
- Number of students involved (please give numbers of male and female students)
- Number of schools involved.

(You will not always be able to give exact answers to these questions, so please give your best estimate.)

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

3.4 What is your evidence for your response to question 3.3?

3.5 Why are these aspects useful? Why are the other aspects not useful?

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?
- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to

complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?

- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general					
4.2	CD-ROM Module 1 Magnetism					
4.3	CD-ROM Module 2 Electromagnetic induction					
4.4	CD-ROM Module 3 Electric conduction					
4.5	CD-ROM Module 4 Introduction to superconductivity					
4.6	CD-ROM Module 5 History of superconductivity					
4.7	Low-Tech hands on kit					
4.8	High-Tech hands on kit					

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

		Suggested changes
5.1	CD-ROM - general	
5.2	CD-ROM Module 1 Magnetism	
5.3	CD-ROM Module 2 Electromagnetic induction	
5.4	CD-ROM Module 3 Electric conduction	
5.5	CD-ROM Module 4 Introduction to superconductivity	
5.6	CD-ROM Module 5 History of superconductivity	
5.7	Low-Tech hands on kit	
5.8	High-Tech hands on kit	

5.9 What is your evidence for your response to questions 5.1 to 5.8?

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

6.4 What difficulties do teachers find in integrating the materials into their teaching?

6.5 How do teachers and/or students feel about these different methods of integration?

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

9.2 What is your evidence for your response to question 9.1?

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

9.4 What is your evidence for your response to question 9.2?

Annex 4

Evaluation Instruments

Trialling the SUPERCOMET2 materials

These materials are offered for you to use and adapt as is appropriate for your situation. You are not expected to use all of them, just the ones that fit with your trialling regime, and to adapt them as appropriate. These materials are a compilation of materials provided by the partners[1]. All of the sheets have a space for class/teacher/pupil code numbers – these are to ensure that the various results can be correlated with one another should this be required. If you are not interested in doing this correlation then there is no need to put in these numbers. It is possible to use actual names, but this can cause problems over confidentiality.

Some partners have well worked out trialling schemes and we have taken much from their examples, we do not expect them to change what they have been doing, but the materials attached here will allow those with less well developed plans to develop a trialling plan. If there any Masters students who could use these materials in the final trialling stage then that would be a valuable addition to the output of the project.

Expert review of materials

Most partners will have completed this part of the trialling, but if there is anyone new looking at the materials, or if you are carrying out a review of revised materials then two approaches are presented here. The first one is the one you should normally use, and is the same as the one we used in the first round of expert reviews. I have also included a translation of a form used by our Spanish partners in Murcia[2] in their own research on hypermedia more generally because it has some interesting additional detailed questions that you may want to use in your own research.

SC2_computer_application_feedback_form_20050430_VE
SC2_multimedia_evaluation_Murcia_20070423_HGM.doc

Teachers' comments on the materials

These are materials to use if you want a fairly quick method of getting responses from teachers:

- Questionnaire (SC2_teacher_questionnaire_20070423_HGM.doc)
- Suggestions for focus group questions, or for material for on-line discussion (SC2_teacher_focus_group_questions_20070423_HGM.doc)

Pupils ICT background

It can be useful to know about the pupils' knowledge about ICT in order to see how this affects their use of the materials. This questionnaire should only be used where you have

[1] It is important to note that though some of the original instruments have been trialled and validated, these materials have not been trialled and validated in their present form.
[2] This and some of the other instruments used by the Murcia partners are derived from the PhD thesis 'Teaching Hypermedia Assessment' by Lucía Amorós Poveda, University of Murcia (2004).

plenty of time with the pupils, as their comments on the materials (see next section) are more relevant for this project.

- Questionnaire about ICT background (SC2_pupil_questionnaire_ICT_20070423_HGM.doc)

Pupils' views about the materials

Here are suggestions for a questionnaire and an interview:

- Questionnaire about SUPERCOMET materials (SC2_pupil_questionnaire_20070423_HGM.doc)
- Interview (SC2_pupil_interview_20070423_HGM.doc)

Classroom observation

More detailed information about the SUPERCOMET materials can be obtained by a series of classroom observations, the following materials provide a basis for carrying out this activity. Three instruments are given here:

- Classroom background data – for a series of observations with the same class this would only be completed once (SC2_classroom_background_data_20070423_HGM.doc)
- Observations of a specific lesson (SC2_classroom_lesson_observation_20070423_HGM.doc)
- A final report and reflection of a series of lessons carried out by the same teacher (SC2_classroom_observations_teacher_final_report_20070423_HGM.doc)

Knowledge testing

Here are some tests which can be used to determine pupils' knowledge after using the materials (some partners have used these as pre- and post-tests).

- Magnetism module (SC2_magnetism_module_test_20070423_HGM.doc)
- Electromagnetic induction module (SC2_electromagnetic_induction_module_test_20070423_HGM.doc)
- Electric conduction module (SC2_electric_conduction_module_test_20070423_HGM)
- Superconductivity modules:
  - A short version (from Graz) (SC2_superconductivity_modules_test_short_20070423_HGM.doc)
  - A long version (from Udine) (we have provided suggested answers and comments in red for this test, these should, of course, be removed before the test is given to pupils) – (SC2_superconductivity_modules_test_long_20070423_HGM.doc)

General

Whilst carrying out trials look out for points for the FAQ, Glossary and References section of the Guide, and make a separate note of these.

Some example studies

We present here outlines of the evaluations carried out by the groups at Udine and Murcia as a potential guide to carrying out a full evaluation (though few partners will be able to test in this degree of thoroughness, and many will choose to use just one or two questionnaires).

1. Udine:

A. At the beginning of the study the teacher drew up a short background report on the class (in a document such as SC2_classroom_background_data_20070423_HGM.doc).

B. The teacher then produced an initial evaluation of the individual pupils (identified by a code), evaluating their (1) skills, (2) interest[3], (3) involvement, (4) socialization[4] and (5) performance. Teachers rated the pupils on each item with a number between 1 and 5, according to the following definitions[5]:

1. clearly above average
2. just above average
3. average
4. just below average
5. clearly below average

C. At the end of each session, the teacher drew up (as soon as possible after the session) a brief description of the sessions (in a document such as SC2_classroom_lesson_observation_20070423_HGM.doc).

D. At the end of the study the teacher drew up a final report, in a free format, trying to synthesize the daily comments (in a framework such as SC2_classroom_observations_teacher_final_report_20070423_HGM.doc).

E. The teacher generated a final evaluation of each pupil using the same codes as in stage B. The scores refer to what has been done during the study.

---

[3] Refers to physics

[4] Refers to active participation of everyday life in the classroom

[5] The average does not refer to the specific class, but to the general situation, according to the teacher's experience. The breaking down in the five categories has to be conceived in a way that the categories among a big sample will be, roughly, evenly distributed. That is to say that in a hypothetic classroom with 25 pupils, one would expect to find 5 pupils in the first category, 5 in the second, and so on. But in a 'good' class the low numbered categories would prevail and the opposite would happen with a 'difficult' class.

The abilities of each pupil can vary depending on the kind of activity, whether theoretical or laboratory activities; teachers should take this into consideration and should try to evaluate the pupils in a balanced way. In the case of evident discrepancies, teachers should write that down in the relevant space and possibly assign two different marks.

F. At the end of the study some of the pupils were interviewed (at least three with low achievement and three with medium-high achievement) and, if possible, a collective discussion moderated by the teacher was organised. When interviewed, the pupils were allowed to look up the material gathered during the activities carried out. Before the interview pupils were asked to revise (at home or, if there is enough time, in the class) the whole work carried out.

2. Murcia

The Electric conduction module was used in this study. An exercise book was prepared, which students had to carry out while they were using the SUPERCOMET materials. The teaching process lasted 5 class sessions; the learning process was as autonomous as possible, so that students could carry out the exercises based on observation and manipulation of the animations and text in the materials. From time to time the teacher provided additional information that could not be extracted from the slides or he/she explained some concepts when asked by the pupils.

Several questionnaires and tools, designed for a PhD thesis "Teaching Hypermedia Assessment", by Lucía Amorós Poveda, from University of Murcia (2004) were used. Since the instruments were already validated it was unnecessary to validate the questionnaires. Data collection was carried out according to the following timetable:

<table>
<tr><th>MAY – 2006</th><th>INSTRUMENTS</th><th>MULTIMEDIA WORK</th></tr>
<tr><td>16, Tuesday
14:20 – 15:15 H.</td><td>ICT attitudes and knowledge questionnaire</td><td rowspan="2"></td></tr>
<tr><td>17, Wednesday
14:20 – 15:15 H.</td><td>Electric conduction pre-test</td></tr>
<tr><td>18, Thursday
9.00 – 10.00 H.</td><td></td><td rowspan="6">STUDENTS WORK WITH MULTIMEDIA MATERIAL</td></tr>
<tr><td>19, Friday
11:20 – 12:15 H.</td><td>Observation</td></tr>
<tr><td>19, Friday
12:30 – 13:25 H.</td><td>Observation</td></tr>
<tr><td>23, Tuesday
14:20 – 15:15 H.</td><td></td></tr>
<tr><td>24, Wednesday
14:20 – 15:15 H.</td><td></td></tr>
<tr><td>25, Thursday
9.00 – 10.00 H.</td><td>Electric conduction post-test</td></tr>
<tr><td>26, Friday
11:20 – 12:15 H.</td><td>SUPERCOMET questionnaire</td><td></td></tr>
</table>

PARTNERS: **University of Ostrava, University of Rousse, Simplicatus**

AUTHORS: **EM, NN, PD, PS, LK, VE** DATE: **2005-04-14**

Developed at Project meeting 3, Ostrava VERSION: **D**

Feedback form for evaluation of SUPERCOMET electronic materials

Instructions

- Please complete the background data, questions 1.1 - 1.4 and 2.1 - 2.2
- The remaining questions are voluntary
- Write your answers into this word document at the bullet points
- Electronic return: Email the completed form to feedback@supercomet.no
- Non-electronic return: Write your answers on the reverse and fax to ++47 7355 1870

Background data about the reviewer

Country AT, BE, BG, CZ, DE, ES, FR, IT, LV, NL, NO, PL, PT, RO, UK

Institution University of…

Name Firstname Lastname

Position E.g. Professor of Physics Education, Professor of Physics

Expertise E.g. Superconductivity physics
E.g. Java simulations of mechanics
E.g. Evaluation of using animations in upper secondary physics
E.g. Use of data logging equipment (computer assisted experiments)

General comments in connection with review

- Write your overall comments that do not fit anywhere else here.

1. Technical aspects of the computer application

1.1. Which operating system do you use (Windows XP, Windows 2000, Mac, UNIX, Linux)?
   - Write your answer here

1.2. What browser do you use (Internet Explorer, Netscape, Mozilla Firefox, Opera, Safari, AOL)?
   - Write your answer here

1.3. Do you have technical difficulties starting up and using the application (p 11-12)?
   - Write your answer here

1.4. Are all characters displayed correctly on your screen? This is especially relevant for special characters and Greek characters like æ ø å ç č š α β ε θ φ ω. Note: Superscript and subscript is not possible in the current Flash version, so we have used small typeface for subscript and the notation "^2" and "^3" for superscript "squared" or "cubed".
   - Write your answer here

1.5. Hotkeys for navigation are not implemented in this version, so navigation must be done with mouse clicks. Would you recommend implementation of hotkeys for the next version? This is also a pedagogical issue regarding how to let the user focus on the contents.
   - Write your answer here

2. Scientific aspects of the computer application

2.1. Scientific errors in the animations and suggested improvements

2.1.1. Module 1. Magnetism of wires and magnets
- Write your answer here

2.1.2. Module 2. Magnetism of coils and materials
- Write your answer here

2.1.3. Module 3. Electromagnetic induction
- Write your answer here

2.1.4. Module 4. Electric conduction
- Write your answer here

2.1.5. Module 5. Introduction to superconductivity
- Write your answer here

2.1.6. Module 6. History of superconductivity
- Write your answer here

2.2. Scientific errors in the text explaining the animations and suggested improvements

2.2.1. Module 1. Magnetism of wires and magnets
- Write your answer here

2.2.2. Module 2. Magnetism of coils and materials
- Write your answer here

2.2.3. Module 3. Electromagnetic induction
- Write your answer here

2.2.4. Module 4. Electric conduction
- Write your answer here

2.2.5. Module 5. Introduction to superconductivity
- Write your answer here

2.2.6. Module 6. History of superconductivity
- Write your answer here

2.3. Does the scientific content of the animations and text correspond with the stated prerequisites and learning objectives for each module (see p. 29-37 in Teacher Guide)?

2.3.1. Module 1. Magnetism of wires and magnets
- Write your answer here

2.3.2. Module 2. Magnetism of coils and materials
- Write your answer here

2.3.3. Module 3. Electromagnetic induction
- Write your answer here

2.3.4. Module 4. Electric conduction
- Write your answer here

2.3.5. Module 5. Introduction to superconductivity
- Write your answer here

2.3.6. Module 6. History of superconductivity
- Write your answer here

2.4. How does the material in each module cover that particular part of physics? What is missing?

2.4.1. Module 1. Magnetism of wires and magnets
- Write your answer here

2.4.2. Module 2. Magnetism of coils and materials
- Write your answer here

2.4.3. Module 3. Electromagnetic induction
- Write your answer here

2.4.4. Module 4. Electric conduction
- Write your answer here

2.4.5. Module 5. Introduction to superconductivity
- Write your answer here

2.4.6. Module 6. History of superconductivity
- Write your answer here

3. Pedagogical aspects of the computer application

3.1. How does the application achieve its overall aims and learning objectives (p. 10)?
- Write your answer here

3.2. Pedagogically, how do the animations and text correspond with the stated prerequisites and learning objectives for each module (p. 29-37)? What improvements could be made?

3.2.1. Module 1. Magnetism of wires and magnets
- Write your answer here

3.2.2. Module 2. Magnetism of coils and materials
- Write your answer here

3.2.3. Module 3. Electromagnetic induction
- Write your answer here

3.2.4. Module 4. Electric conduction
- Write your answer here

3.2.5. Module 5. Introduction to superconductivity
- Write your answer here

3.2.6. Module 6. History of superconductivity
- Write your answer here

3.3. Are the existing modules too small or too big? Should they be organized differently (e.g. should module 1 and 2 be merged into a bigger module on Magnetism)?
- Write your answer here

3.4. Pedagogically, should the contents inside each module be organized differently? How?

3.4.1. Module 1. Magnetism of wires and magnets
- Write your answer here

3.4.2. Module 2. Magnetism of coils and materials
- Write your answer here

3.4.3. Module 3. Electromagnetic induction
- Write your answer here

3.4.4. Module 4. Electric conduction
- Write your answer here

3.4.5. Module 5. Introduction to superconductivity
- Write your answer here

3.4.6. Module 6. History of superconductivity
- Write your answer here

3.5. What other modules would you like to see in the next version (within the physics curriculum of your country and related to the understanding of superconductivity)?
- Write your answer here

3.6. How can the animations and text be improved in order to help pupils imagine the studied effects and phenomena, and to increase the pupils' interest in physics?
- Write your answer here

3.7. Is the Glossary helpful in its current format? How could it be improved?
- Write your answer here

3.8. Are the Frequently Asked Questions (FAQ) helpful in their current format? How could it be improved?
- Write your answer here

3.9. Imagine that you will be able to type in a question and get it answered through the online community. Would this be a useful feature? Any suggestions as to how this should be done?
- Write your answer here

3.10. Any other pedagogical suggestions for the next version of the computer application?
- Write your answer here

EDUCATIONAL MULTIMEDIA EVALUATION FORM

1. IDENTIFICATION DETAILS AND DESCRIPTIVE ANALYSIS

1.1. IDENTIFICATION DETAILS

TITLE: ____

AREA: ____

SUBJECT: ____

DIDACTIC UNIT: ____

EDUCATIONAL LEVEL: ____________________________________

PRODUCTION DATE: ______________/______________/______________

UPDATES OR ADJUSTMENT DATES: ___________________________________

1.2. TECHNICAL ASPECTS AND GRAPHICAL DESIGN.

1.2.1. DESIGN.

		Nothing	Little	Quite a lot	A lot	Observations
Linear.						
Branching	Linear.					
	Parallel.					
	Concentric.					
	Hierarchical.					
Hypertextual (network).						
Mixed.						

1.2.2. IMAGE.

		Appraisal				
	Observations.	1	2	3	4	5
Colour.						
Movement.						
Size.						
Position.						
Technical quality.						

Types of mages:	**Nothing**	**Little**	**Quite a lot**	**A lot**
Schematic: graph, map, table.				
Real-fixed.				
Real-animated.				
Animated-computer created.				
Others:				

1.2.3. TEXT.

		Appraisal				
	Observations.	1	2	3	4	5
Relative space used.						
Position.						
Characters.						
Font size.						
Technical quality (readability).						

1.2.4. SOUND.

		Appraisal				
	Observations.	**1**	**2**	**3**	**4**	**5**
Frequency.						
Use.						
Appropriateness of the soundtrack to the images.						
Technical quality.						

Sound type	**Nothing**	**Little**	**Quite a lot**	**A lot**
Natural reproduction, environmental sound.				
Echoes/artificially manipulated voices.				
Soundtrack.				
Onomatopoeia.				
Voice ‘off’.				
Silences.				

1.2.5. OTHER ELEMENTS.

	YES	NO	Observations.
Buttons.			
Icons.			
Tool bars.			
Menus.			
Others.			

2. EVALUATION OF LEARNING AND TEACHING ASPECTS.

2.1. PURPOSE AND OBJECTIVES EVALUATION.

2.1.1. GENERAL USE GIVEN.

Educative/ Instructive.	Teach, review content or practice.	
	To complete class explanations.	
	Enables creativity.	

2.1.2. OBJECTIVES DEFINED IN THE MATERIAL.

		Observations.
General objectives.		
Specific objectives.		
Capacities to stimulate.		
Appropriateness to curricular needs.	YES	
	NO	

2.1.3. PEDAGOGICAL OBJECTIVES.

	YES	NO
To motivate.		
To teach skills.		
To promote discussions.		
To stimulate imagination.		
To inform.		
To learn concepts.		
To modify attitudes.		
Others.		

2.1.4. OBJECTIVES.

	Nothing	Little	Quite a lot	A lot
Defined at the beginning of the teaching sequence.				
Accurate and simple formulation.				
Adaptation to curriculum.				
Adaptation to the user.				
Promote the development of capacities.				
Allow individual initiative.				
Clearly express the program's intention.				
The program fulfils its stated purposes.				

2.2. EVALUATION OF CONTENTS.

	Nothing	Little	Quite a lot	A lot
Suitability for the objectives.				
Suitability to curriculum.				
Appropriateness of manual (clear and sufficient).				
Suitability of language.				
Logical sequence of content.				
Organization of materials supports transference.				
The information transmitted is enough for comprehension.				
Information is up-to-date.				
The difficulty levels are properly distributed.				
Incorporates theoretical elements.				
Incorporates practical elements.				

2.2.1. CONCPTUAL ELEMENTS.

		Observations.
Previous knowledge required in:	The subject.	
	Use of computers.	
	Others.	
Concepts in the multimedia	Present.	
	Absent.	
	Principles underlying the concepts.	
	Connections between concepts.	

2.2.2. PROCEDURAL ELEMENTS.

2.2.3. ATTITUDINAL ELEMENTS.

2.3. ACTIVITIES.

	Nothing	Little	Quite a lot	A lot
Have direct connection with the objectives and content.				
Are stimulating.				
Promote creativity and exploration.				
Support transference.				
The program gives information about mistakes made.				

2.4. ASSESSMENT.

		Nothing	Little	Quite a lot	A lot
Answer presentation format:	Multiple choice formats.				
	True/false.				
	Fill-in answers.				
	Open answers.				
Related with objectives, contents and activities.					
Gathers and shows students the results.					
Guides the student in the learning sequence.					
Allows easy access for the teachers in order to follow up students.					
Allows comparison of results of all the students and global results.					

2.5. ADDITIONAL MATERIALS.

Educational Documentation:	**Description**	**Outstanding aspects**	**Aspects to improve**
Teacher's guidebook.			
Student's guidebook.			
Worksheets, complementary activities.			
Extension materials, bibliographic references.			

Technical Documentation:		**Description**	**Outstanding Aspects**	**Aspect to improve**
User instructions.				
Possibilities for adapting the program.	Regarding teacher needs.			
	Regarding students needs.			

2.6. HELP SYSTEMS.

	Description	**Outstanding aspects**	**Aspects to improve**
Navigation guides:			
Reference guide:			
Error messages:			
Presentation of help messages:			
Demonstrations:			

2.7. OPTIMISING THE TEACHING/LEANING PROCESS.

		Nothing	Little	Quite a lot	A lot
Teacher ICT skill needs.					
Student ICT skill needs.					
Relevance of program to the curriculum.					
To what extend do the sources:	Contribute to achieve objectives.				
	The material helps skills development.				
	Promote exploration.				
	Promote discovery.				
User:	Follows a linear sequence.				
	Chooses the order to follow.				
	Chooses what he/she wants to learn.				
	Chooses how to learn.				

3. EVALUATION OF PSYCHO-PEDAGOGICAL ISSUES.

3.1. MOTIVATION.

	STIRS THE INTEREST	KEEPS THE INTREST
Content.		
Screen design.		
Technical quality.		
Others.		

3.2. INTERACTIVITY.

		Nothing	Little	Quite a lot	A lot
Promotes interactivity:	Individual				
	Group				
	Instrumental				
Control over programme difficulty level.					
Sound and/or visual feedback.					
Allows addition of new data.					
Possibility to return to the point where the program was left.					
Navigation:	Free with possibility to go back.				
	Dependent on correct answers with possibility to go back.				
	No possibility to go back.				
Offers different ways for interaction					
Presents exercises with several valid solutions.					
Feedback for each user's response.					
Allows personal design activities.					
Facilitates free associations of ideas and elements.					
Allows the correction of mistakes.					
Formulates closed questions.					

3.3. ATTENTION.

It keeps the attention:	Nothing	Little	Quite a lot	A lot
Related to the content.				
Related to the design.				
Because of the technical quality.				
Others.				

3.4. CREATIVITY.

Factors contributing to its development:	Nothing	Little	Quite a lot	A lot
Promotes over-learning and self discipline.				
Stimulates creative and divergent processes.				
Free associations between given information.				
Proposes solutions to problems.				
Sets up open tasks.				
Surprise and originality.				
Help in order to learn from mistakes.				

3.5. COGNITIVE OPERATION.

	WHAT IT DEMANDS	WHAT IT ALLOWS	Observations
To observe			
To compare			
To classify			
To order			
To retain			
To retrieve			
To present			
To interpret			
To infer			
To transfer			
To assess			

4. ECONOMIC ASPECTS/DISTRIBUTION.

Total cost of the system.	
Cost compared to similar others in the market.	
Cost-benefits	
Stability of official distributor.	
Alternative seller.	
Market.	
Existence of technical support from dealer.	

5. GLOBAL APPRAISAL.

5.1. TECHNICAL QUALITY.

5.2. PEDAGOGICAL QUALITY.

5.3. SUGGESTIONS.

ASSESSOR:

____

DATE: ______/_______________/__________

Questionnaire (Teachers)

Teacher code number:

1. Male/Female:					
	Not at all useful	A little bit useful	Quite useful	Extremely useful	Don’t know
2. To what extent you consider the following parts of the materials useful for your teaching?					
Subject information (Superconductivity)					
Experiments					
Learning program					
Comment:					
	Not al all attractive	A little bit attractive	Quite attractive	Very attractive	Don’t know
3. In your opinion, how attractive and interesting are the materials for your pupils?					
Subject information (Superconductivity)					
Experiments					
Learning program					
Comment:					

4. How might the materials be improved?

5. How would you use the materials in your classroom? (e.g. as preparation or as revision, for class work or for homework, display to the whole class using a data projector, or in a computer room where each pupil has access to a computer, as a replacement for the text book, or as an extra as well as the text book etc))

6. Problems:

- Did you notice any ‘bugs’ in the software Bug reports? (Please give a list of any bugs noticed)
- Did you notice any mistakes in the physics content? (Please give a list of any errors noticed)
- Were there any significant difficulties in using the materials?

Focus groups/on-line discussion (Teachers)

Teacher code numbers:

Physics:

- How important is it to introduce contemporary Physics topics?
- Is superconductivity an appropriate topic to introduce in the national curriculum of Physics?
- Does the use of contemporary Physics topics, such as superconductivity, motivate our students? Does it make the learning of Physics contents easier or more difficult?

SUPERCOMET materials

- How useful for Physics education are the SUPERCOMET CD-ROM materials?
- Do the materials contain the right modules? Is balance between topics correct?
- Is possible to use a resource such as the SUPERCOMET CD-ROM in order to approach content that isn't included in the national curriculum and yet also to cover the national curriculum?

ATTITUDES AND KNOWLEDGE ABOUT ICT - PUPIL QUESTIONAIRE

Pupil code number:

This is NOT a test; there are no right or wrong answers. Please answer all the questions.

Mark your opinion for each pair of descriptions from the following list.

Here is an example:

For you, ice cream is:

Good					X		**Bad**
	Very good	Quite good	Slightly good	Slightly bad	Quite bad	Very bad	

This answer means that you think that ice cream is quite bad.

✐ **Now mark your answer with an X for each pair of descriptions.**

The computer for you is*:*

Entertaining														Boring
Manageable														Unmanageable
Dynamic														Clumsy
Necessary														Unnecessary
Pleasant														Unpleasant
Ineffective														Effective
Complex														Simple
Valuable														Worthless
Time-saving														Time-demanding
Educational														Uninstructive
Impractical														Practical
Useful														Useless
Hindering														Helpful
Important														Trivial
Social facilitator														Social insulator

Smart														Stupid
Motivating														Demotivating
Novel														Normal
Individual														Group
Beneficial														Harmful

You do not have to write your name but... do not forget to fill in this chart!!

Sex	***Age***	***Academic Year***	***School***

Now we want you to answer some questions about your knowledge and training in computers. Mark only one X where appropriate.

.

Do you use computers?

(Just mark one X)

Daily	
Frequently	
Sometimes	
Hardly ever	
Never	

Do you have a computer at home?

YES	
NO	

What do you use it for?

(You can use more than one X in this answer)

To play	
To work	
To study	
Almost for nothing	
Other tasks:	

How would you summarise your computer knowledge/skills (choose the more appropriate alternative for you)?

1	I do not know even how to turn it on.	
2	I am able to use it, but with difficulties.	
3	I know it very well, although sometimes I have difficulties.	
4	I can manage it without problems.	
5	I have a perfect command of it.	

1. ***How would you describe your command of the computer as a work/study tool (word processor, data bases, spreadsheets, etc.)?***

Very bad		Bad		Average		Good		Very good	

2. ***Have you received any sort of computer/ICT training (lectures, courses, seminars)?***

YES		NO	

If your answer is NO, then go to the question number 4

3. ***How would you qualify the computer/ICT training that you received?***

Very bad		Bad		Average		Good		Very good	

4. ***Even if you have never used some of the following programs, mark whether you know about them or do not know about them.***

	Known	Not known
Word processors		
Data bases		
Spreadsheets		
Drawing programs		
Games/videogames		
Simulation		
Hypertexts		
Multimedia		
Tutorial Programs		
Other:		

5. ***From the programs you know choose 5 and put them in order. Put in the first place (1) the one best known by you and in the last place (5) the least known.***

	1
	2
	3
	4
	5

6. Indicate which of the following programs (up to five) is the most frequently USED by you. Please indicate them in order (from 1- most frequent to 5- least frequent).

Word processors	
Data bases	
Spreadsheets	
Drawing programs	
Games/videogames	
Simulation	
Hypertexts	
Multimedia	
Tutorial Programs	
Other:	

Questionnaire (Pupils)

Pupil code number:

In order to help us improve the SUPERCOMET materials, please answer the following questions.

1.	Male/Female:					
2.	Age: (years old)					
		Strongly disagree	Disagree	Agree somewhat	Strongly Agree	Don't know
3.	I find the subject of physics interesting					
4.	I find the subject of superconductivity interesting					
5.	The SUPERCOMET materials are interesting					
6.	The SUPERCOMET materials stimulate my imagination					
7.	The SUPERCOMET materials are easy to use					
8.	The SUPERCOMET materials are attractive					
9.	The SUPERCOMET materials helped me to learn					
10.	The SUPERCOMET materials offer meaningful experiences					
11.	The quantity of text appearing in the SUPERCOMET materials is about right					
12.	The text in the SUPERCOMET materials is easy to read and understand					
13.	The quantity of images appearing in the SUPERCOMET materials is about right					
14.	The images in the SUPERCOMET materials are clear and understandable					
15.	The images in the SUPERCOMET materials explain the topic well					
16.	The page design in the SUPERCOMET materials is good					
17.	The movement in the animations in the SUPERCOMET materials and the speed of the screen changes are good					
18.	The animations in the SUPERCOMET materials helped me to understand					
19.	I found surprising things in the SUPERCOMET materials					
20.	The SUPERCOMET materials promoted class discussions.					

21.	The SUPERCOMET materials changed my attitude about some things					
22.	The experiments performed in the superconductivity course were interesting					
23.	Which parts of the superconductivity course using the SUPERCOMET materials did you particularly like and find easy to use?					
24.	Do you think that you have learned through using the SUPERCOMET materials? Please give reasons for your answer.					
25.	List two things that you thought were good about the SUPERCOMET materials A B					
26.	List two things that you thought were not good about the SUPERCOMET materials A B					
27.	Would you recommend the SUPERCOMET materials for the other pupils? Give reasons for your answer.					
28.	What should be changed/improved about the SUPERCOMET materials?					
29.	In order to use the SUPERCOMET materials do you think you needed previous knowledge in using computers? Please give reasons for your answer.					

	In order to use the SUPERCOMET materials do you think you needed previous knowledge in science? Please state what areas you needed knowledge in Please give reasons for your answer.
30.	Do you have any other comments about the SUPERCOMET materials:

Thank you for your answers

Interview (Pupils)

Pupil code number:

(Interviewer record age and sex of interviewee).

1. What have you learnt from this work on superconductivity using the SUPERCOMET materials?

The answers can be organized according to:

- concepts
- laws and formulae
- different ways of representation
- ability in the lab
- abilities connected with the use of software

2. Which sections of the course did you enjoy most? Why?

3. Which sections of the course did you enjoy least? Why?

4. What have you learnt by:

- discussing
- working in the lab
- on the computer
- studying at home

5. Let’s go through some of the work we have done.

The teacher chooses a section of a topic and verifies the degree of acquisition of specific content by asking the student specific questions.

Classroom background data

General

Code number:
School:
Grade:
Number of pupils enrolled:

History

Is the class involved in any other ongoing projects?
Has the class been involved in any previous projects?
What was the teaching programme in use before this study?
What physics topics were covered out before the study?

Teacher

What is the level of physics knowledge of the teacher?
What is the level of training in use of ICT or experience in use of ICT of the teacher?

Pupils

What is the average overall level of the class?
How would you describe their commitment to study?
How would you describe their achievements?
What is the level of experience of the pupils in the use of ICT?
What is the level of interest in physics?

Teaching (normal way of working)

Use of the laboratory

Frequency (percentage of hours in the lab in total) %
Procedure:
In small groups %
Demonstrations from the teacher's desk %

Laboratory equipment used:

Teaching techniques)

Lessons from the teacher's desk %
Discussion (free or facilitated) %
Laboratories %
Collective problem solving %

Work in small groups	%
Work on the computer	%
Oral tests	%
Tests	%
Other testing instruments (specify)	%
Other (specify)	%

Use of computer in class

Frequency (percentage of hours in the lab in total)	%
Procedure:	
In small groups	%
Demonstrations	%
Software:	
Simulations (specify)	%
Programming:	%
Spreadsheet	%
Data logging	%
Use of hyper-text/multimedia (specify)	%
Development of hyper-text/multimedia	%
Other (specify)	%

Classroom lesson observation

General

Class code number:
Teacher code number:
Pupil code numbers:
Number of pupils present:
Allocated time:
Access to computers (number of machines etc):
Date:

Goals of the lesson (topic)

Please briefly describe the goals of the lesson, topics to be covered, and the learning objectives.

Procedure

Provide a short description of the type of work carried out in the lesson (please write down the time needed for each activity when it requires more than 10 minutes).
Indicate the use of presentation, discussion, laboratory experiments, modules from the CD, and further materials (handouts, textbooks, and multimedia) provided to the pupils.

Here are three grids which may help to record what is going on in the classroom:

Computer handling								
Observation		**Appraisal of intensity of use**						
		+++	++	+	-	--	---
Students **ask the teacher**	About the computer						
	About multimedia						
	Other						
Students **ask classmates**	About the computer						
	About multimedia						
	Other						
They do not ask							

Problem solving strategies						
Observation	**Appraisal of intensity of use**					
	+++	++	+	-	--	---
There are writing (paper, pen, pencil...)						
They use the help and support material.						
They take notes.						

Class Atmosphere							
Calm							Tense
Individual							Group
Noisy							Quiet
Pleasant							Unpleasant
Good							Bad
Bored							Enjoyable

Problems

If problems occurred then please describe them, and what action was taken to overcome them.

General Observations/Evaluation

Were the materials motivating and did they keep the pupils' attention. Which parts did they enjoy most?
Did the pupils understand the materials? Indicate any area they had particular difficulty with, or where they asked for additional explanations.
How did the pupils respond to the animations?
How satisfied were you as a teacher with the lesson? Give reasons for you're your answer.
Any other comments?

Classroom_obervation_teacher_final_report

Teacher code number:

Class code number:

At the end of the study, the teacher should draw up a final report. This should be in whatever form the teacher wishes, but they should be asked to address the following points within their report:

An evaluation of the materials employed:

- Were they user friendly?
- Were they effectively understood by the pupils?
- Was the time planned for each activity appropriate?
- Was the conceptual difficulty materials appropriate for the level of the students?
- Were there any problem (please make a specific note of any problems with the use of the modules on the CD)?

Provide a synthetic and subjective evaluation, independent of the results of possible tests, on how the study has been useful both for specific purposes (for example the understanding of electromagnetic induction) and more general ones (involvement, understanding of the use of models, development of positive attitude towards the subject etc)

If there were any difficulties, how were they solved?

Were connections established with other themes in physics or other subjects?

How did the students behave during the study, were they interested, keen, critical (compared to their normal behaviour outside the study); did they work well together? Were there situations during the study in which the behaviour of individual students has been clearly different (either in a positive or negative way) from their usual behaviour?

Please provide any other comments (either specific or general) about the materials, and make any suggestions that you wish about how they might be changed or improved.

Please, conclude by telling us briefly if you think that the work carried out has been useful or whether you think that if the costs of the project would have been better employed in a more traditional way.

Magnetism

Pupil code number:

1) What does the Orsted's experiment tell us?

2) Would you be able to draw the field lines of a magnetic field produced by a wire? and by a magnet?

3) Which difference have you observed between the field lines of a magnetic field produced by a wire and those produced by a magnet?

4) What does the Ampere's experiment suggest? and Pohl's experiment?

5) The magnetic field is described as the magnetic induction vector (B), which relation do you think this vector has with the field lines? Which relation do you think the vector B has with the interaction strength that is experienced by a wire of length 1, undergoing a current I, immersed in the magnetic field in such a way as to create an angle (theta) with the field lines of the field itself?

6) Have you noticed that there is a strong analogy between the field lines generated by a solenoid and those of a bar magnet. Can you comment on the field lines within a magnet? What will be their direction? (please, justify you answer)

7) What is the peculiarity of field lines that suggests that the magnetic field within a solenoid can be considered homogeneous (uniform) ?

8) What is the origin of a magnetic field produced by a magnet?

9) Do you think that a ferromagnetic body should be attracted or repelled by a magnet? And how about a diamagnetic one? (please, justify you answers)

10) Consider the behaviour of ferromagnetic and magnetic materials (magnets) when they get close to a magnet. Try the experiment either at home or in the laboratories by using materials made up of different substances (e.g. wood, rubber (gum), iron, aluminium, copper, other magnets…) and list the similarities and differences. Which hypothesis can be formulated in relations to what you have observed?

11) What is the typology of metals that become superconductors once cooled down?

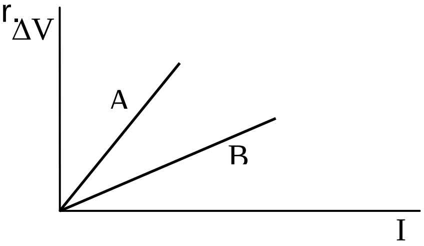
12) What are Weiss' domains?

13) What is the meaning of Curie's temperature for a ferromagnetic object?

ELECTRIC CONDUCTION

Pupil code number:

1. What is electric current?
2. Define current intensity. What are its units?
3. How can we classify of materials according to their behaviour with electric current?
4. Why are metals good conductors?
5. Conventionally, what is the direction of electric current?
6. What is needed to produce an electric current between two points?
7. Define electrical resistance, R, between two points of a conductor.
8. If we have a piece of a conductor, on what intrinsic factors of this piece of conductor does electrical resistance depend? Express R as a function of those factors.
9. A piece of copper cable has 5cm length and is 0,5 mm^2 thick. The resistance of copper is $1{,}7 \cdot 10^{-8}$ $\Omega \cdot m$. If there is a potential difference of 4v between this ends of this piece, what is the intensity of the current flowing through it?
10. What does the Ohm's law say?
11. Do all materials obey Ohm's law? If some of them do not, why?
12. Draw diagrammatically (with standard symbols to represent electric circuits) a circuit with one battery, a resistor, an ammeter to measure the current going through this resistor and a voltmeter to measure the difference of potential between the ends of a resistor.
13. This graph represents, for two pieces of conductors A and B, the potential difference between its ends ΔV, in terms of the current intensity I. What can you say about each of them?



14. When an electric current runs through a piece of a conductor, it warms up. Where does the energy transformed into heat come from?
15. Write down Joule's law: where, Q is the quantity of heat generated in a piece of conductor by function of the current intensity I running through it, R is its resistance and of the time interval considered Δt.
16. If the temperature of the piece of conductor increases, how will it affect its electric resistance? What is the explanation for this change?

Electromagnetic Induction

Pupil code number:

1) What is the definition of the flux of a magnetic induction vector? (please, specify the meaning of the symbols utilized in the answer, maybe even with an explicative drawing). In the International System of the units of measurement, the unit of measurement for the flux is called weber (Wb). What is the relation between the Wb and Tesla?

2) Consider a solenoid, not connected to current generators. In which case is the solenoid crossed by current: (i) when inside the solenoid the flux B is constant; (ii) when it increases; or (iii) when it decreases?

3) If instead of oscillating the coil around the magnet, the magnet was oscillated around the coil, would there still be current generated within the coil? (please justify the answer)

4) What does Lenz's law state?

5) Is a transformer a device that transforms direct current into alternate current and vice versa? (if so, please explain the working principle, if not, please specify the role of the device)

6) We know that an electric current generates a magnetic field and that a magnetic field can generate electric current. Which are the similarities and differences between both processes?

Superconductivity test

Pupil code number:

1. What special properties do superconductors possess?

2. How can one explain these properties?

3. What types of superconductors do you know?

4. Where are superconductors applied?

Superconductivity

Pupil code number:

1. How can the way in which materials interact with a magnetic field classified and how do these interactions vary?

Magnet, magnetic and non-magnetic; repel or attract another magnet, attracted to a magnet, not affect by a magnet.

Diamagnetic, paramagnetic;

2. In a closed circuit a change in magnetic flux will generate a current and this current is maintained as long as the flux varies
   a. Is this always the case?

   ☐ Yes

   ☐ No

   b. Justify your answer.

No; the current in a superconducting loop will exist indefinitely, as long as the loop remains below T_c

3. In metals and conductors in general the electrical resistance is a function of temperature, when the temperature increases so does the resistance. Why?

Something that refers to change of mean free path between collisions for the conduction electrons.

4. By superconductivity we mean that the resistivity of the material is zero below some critical temperature, T_c. Is this transition a reversible or irreversible process? Justify your answer.

Must be reversible; above T_c resistivity is non-zero. The change can be observed in both directions and repeated with the same sample.

5. Do you think that a normal magnetized conductor – moved into a state of 'perfect conductor' (T < Tc) – and a superconductor immersed into a magnetic field and then taken below critical temperature behave in the same way? (Consider that a superconductor below critical temperature, immersed in a magnetic field, becomes perfectly diamagnetic). Justify your answer.

Students should describe the Meissner-Ochsenfield effect hence the field which penetrates the sample above T_c is expelled below T_c as opposed to bringing a magnet close to a superconductor below T_c where the field never penetrates.

6. Why is the electric field inside a superconductor, taken below critical temperature, equal to zero?

This will be different for type I and type II superconductors

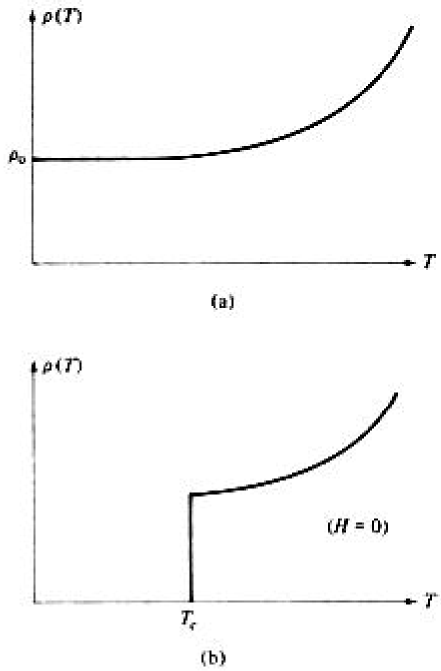
7. How can superconductors be divided into groups and how are they characterized?

Type I and Type II; type I only one transition temperature, type II has 2.

8. Which are the critical differences between the superconducting state and the normal state of a material and that influence their behaviour?

Near perfect diamagnetism, zero resistivity leading to the expulsion of magnetic field.

9. The graphs (a) and (b) below illustrate the relationship between resistivity and temperature for conductors and superconductors.
    a. Which graphs represent which?
    b. What is the difference between the relation between resistivity and temperature in a superconductor and in a normal conductor?



a. is type one and b. type two. The change to zero resistivity at T_c

10. In which commercial sectors are superconductors employed?

Almost any now; transport, medical imaging etc

11. What difficulties are found in the manufacture of technological components that utilize superconductors?

Components need to be below T_c, superconducting materials tend to be brittle and hence ‘wires’ are difficult.

Annex 5

National Testing Reports

PARTNER: **University of Graz , university of Munich and Ludwigsburg**

AUTHOR: **Gerhard Rath, B. Schorn & R. Girwidz** DATE: **2007-11-1**

REVIEWER: **<reviewer name>** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

- Teacher Guide
- Teacher Seminar
- CD-ROM
  - Module 1. Magnetism
  - Module 2. Electromagnetic induction
  - Module 3. Electric conduction
  - Module 4. Introduction to superconductivity
  - Module 5. History of superconductivity
- Low-Tech hands on kit
- High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

We used the version of the Supercomet CD-ROM, sometimes completed by the Web-version 2006, 2007.

School testing in Stuttgart refers to the version downloaded in Febr. 2007.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions

Teacher training: one. Trials in classrooms: 5 (evaluated). There were some more trials without received evaluation

Testing in school with 6 sessions

- Length of sessions

Teacher training: 4 hours. Trials: 1 to 3 lessons each

Each session in Stuttgart school lasted 2 hours.

- Number of trainee teachers involved (please give numbers of male and female trainee teachers)

2 (female), 3 (male),

- Number of teachers involved (please give numbers of male and female teachers)

7 (male), 1 (female)

- Number of students involved (please give numbers of male and female students)

70 (total), 30 female

- Number of schools involved

3

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

Introduction to the project, overview

Introduction to superconductivity

Manufacturing of high temperature superconductors (explanation, movies)

Presentation of the computer application

Working with the application in groups

Experiments with superconductors

We did not use the teacher guide, mainly because of the language (no German version available at that time).

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

Teacher Training in Graz, 02-04-2006, BRG Keplerstrasse 1

Chair: G. Rath, L. Mathelitsch (University of Graz)

Trainers: C. Ambrosch-Draxl (Physics of Superconductivity), B. Schorn (How to make your own superconductors, experiments with superconductors), V. Engstrom (About SUPERCOMET 2), G. Rath (The application)

Teachers: T. Bintritsch, D. Triebl, B. Lackner, T. Mairold, N. Schweighofer, R. Puntigam, E. Meralla: All of them are physics teacher in high schools, with some ICT experience.

Materials for the schools: See Appendix 1: Folder, CD, teacher guide

Students: Some pupils joined the workshop (experiments).

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

Physics of Superconductivity, Teaching methods, experiments, ICT in science teaching

3.4 What is your evidence for your response to question 3.3?

Experience of the participating teachers

3.5 Why are these aspects useful? Why are the other aspects not useful?

Physics of Superconductivity: Is important because most of the teachers have little knowledge in this field

Teaching methods, ICT in science teaching: Active learning is necessary for a reasonable use of learning software.

Experiments: The most motivating and exciting part, for teachers and for pupils.

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

The last proposal (Wim Peters) gives a good structure. Our concept should become changed in this way.

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?
- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?
- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general					
4.2	CD-ROM Module 1 Magnetism	Some lessons, depending on equipment To use in secondary I to secure knowledge	Appropriate for Junior High school (age 14) and high school (17) in Germany in secondary I for age 8th graders	2-4 lessons. Helps learning in combination with real experiments and further tools (Web, books)	Students like to work with the animations, they don't like to read the text	Animations: For all groups suitable; text: for higher ability pupils.
4.3	CD-ROM Module 2 Electromagnetic induction	Some lessons, depending on equipment To use in secondary I to secure knowledge	Appropriate for Junior High school (age 14) and high school (17) in Germany in sec. I for age 10th graders	2-4 lessons. Helps learning in combination with real experiments and further tools (Web, books) Phenomena better to show with real experiments, only illustration of field lines helpful	Students like to work with the animations, they don't like to read the text	Animations: For all groups suitable; text: for higher ability pupils.
4.4	CD-ROM Module 3 Electric conduction	Some lessons, depending on equipment To use in secondary I to secure knowledge	Appropriate for Junior High school (age 13) and high school (17) in Germany in sec. I for age 8th graders	2-4 lessons. Helps learning in combination with real experiments and further tools (Web, books) This basics should be introduced using real experiments	Students like to work with the animations, they don't like to read the text However some of the animations were assessed to explain simple facts to long-winded	Animations: For all groups suitable; text: for higher ability pupils. Partly to simple.

4.5	CD-ROM Module 4 Introduction to superconductivity	Some lessons, depending on equipment To use in secondary II to introduce super-conductivity	SC version of the application was not convenient in Germany in sec. II for age 12th graders, as a choice (5 alternatives) or partly sec. I 10th graders	Useful only in some parts. It gives not really an introduction. important information missing or not adequately explained	Students like to work with some of the animations, they don't like to read the text	Modul had more impact on higher ability students Girls from Stuttgart accepted the new kind of learning, but did not learn very effectively.
4.6	CD-ROM Module 5 History of superconductivity	Some lessons, depending on equipment	SC version of the application was not convenient in Germany in sec. II for age 12th graders, as a choice (5 alternatives) or partly sec. I 10th graders	Partially useful for projects; students prefer wikipedia	quite interesting	
4.7	Low-Tech hands on kit	-	-			
4.8	High-Tech hands on kit	Only with borrowing of materials from the University	-	1 lesson, motivating	Most of the students like to work with experiments,	

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

Experience with own teaching, experience of the testing teachers, the evaluations we did (questionnaire).

Comprehensive test (6 sessions a 2 hours) with 12 students and feedback from questionnaire.

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

		Suggested changes
5.1	CD-ROM - general	More flexible and adaptable, Hypertext-Structure, not linear More figures and pictures, less text
5.2	CD-ROM Module 1 Magnetism	Animations should not primarily rebuild real experiments, but integrate and focus on explaining model thinking.
5.3	CD-ROM Module 2 Electromagnetic induction	Animations should not primarily rebuild real experiments, but integrate and focus on explaining model thinking.
5.4	CD-ROM Module 3 Electric conduction	Animations should not primarily rebuild real experiments, but integrate and focus on explaining model thinking.
5.5	CD-ROM Module 4 Introduction to superconductivity	A complete renewed structure was proposed by our group (meeting at Munich) and will be implemented. Superconductivity should be explained better.
5.6	CD-ROM Module 5 History of superconductivity	aceptable
5.7	Low-Tech hands on kit	
5.8	High-Tech hands on kit	

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Our experience with the materials in teaching.

Comprehensive test (6 sessions a 2 hours) with 12 students, interviews and feedback from questionnaire

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

The materials were used in different kinds, depending of the technical situation, e.g.

Pupils worked in groups, following guiding questions and exercises

The teacher showed parts of the modules, the pupils listened and took notes

Learning in stations: experiments, computers

Tested was also individual and self determined learning.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

We did not follow these proposals, they came too late.

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

For normal a combination of methods were used, the materials were integrated in different ways.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

- Computer equipment: too less computers, too slow, problems with installation (Flash-player)

- lack of ideas concerning the teaching methods: some teachers do not know how to work with computer applications within their teaching

The integration into the local school network causes made some problems with security barriers.

A CD-version should run without installation of e. g. flashplayer. The CD-version should contain a full runtime version (without necessity for any installation).

6.5 How do teachers and/or students feel about these different methods of integration?

We did not evaluate this question

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

The experience of the testing teachers

Problems in practice.

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

See Appendix 2,3 and 4.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

For the results see the table in appendix 5 and the graph.

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

All the tests were carried out in Stuttgart with one class of 12th graders.

The first three tests related to contents that were already known and therefore are not reported here.

The longer test on superconductivity was not fully satisfactory – only 45 % of the points were reached in average.

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

The computer application can be a useful contribution to the teaching of physics, but it must become improved, in particular the module "Introduction to Superconductivity". The tested version did not enhance the interest of the pupils considerable. And there are a lot of more attractive resources on the web for free.

Unfortunately the High-Tech-kit as well as the Low-Tech-kit was not finished within Supercomet2. Experiments with superconductors offered high interest and excitement.

The demands differ strongly. The module about conductivity is quite simple and even easily to understand for 8th graders, while the module about superconductivity does not explain the demanding topic adequately.

The method of using computers for illustrations can expand the possibilities in teaching and learning. However more measures should be integrated to lead to an effective and goal-directed learning.

9.2 What is your evidence for your response to question 9.1?

The main problem was, that the tested materials were not finished before. The teachers themselves were not so enthusiastic with the CD-ROM.

Besides of our experience the results of the evaluations brings us to this opinion.

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

In none.

10. Appendix

10.1 Materials for a teacher training in Graz, 02-04-2006

Folder

Programm
Lehrerhandbuch: Modul1 – Modul6
B. Schorn: Herstellung von YBaCu-Supraleitern
K.H. Zwittlinger: Herstellung von Hochtemperatur-Supraleitern (aus: Praxis der Naturwissenschaften Physik, 1/2006
Anwendungen von Supraleitern – Gliederung
Wikipedia: Supraleiter
P. Canfield, S. Bud'ko: Heiße Aussichten für Tieftemperatur-Supraleiter. (aus: Spektrum der Wissenschaft, 6/2005)

CD

SC2 Computer applikation: Zip-Datei
SC2 Computer applikation: Start.bat (oder /sc_anwendung/index.html)
Supraleiter Experimente:
- Gefilmte Experimente
- Präsentation B. Schorn

Sc_anwendung.ppt: Präsentation G. Rath
SC teacher guide
SC2 Lehrerhandbuch Deutsch
Supercomet Poster: Geschichte der Supraleitung

Appendix 2: Evaluation report 2006

With regard to their realization in teaching, the main objects of the project are to be investigated.

Supercomet aims at making physics teaching more attractive by interactively presenting a modern research area (superconductivity) within a multi-media learning environment. Since also experiments with superconductors should show their special properties, the evaluation focuses basically on these three areas: subject, learning environment, experiments.

Hypotheses

Subject, learning environment, and experiments are attractive for teachers and interesting for using them in their teaching.
Subject, learning environment, and experiments are interesting and stimulating for students.
After the lessons the students have a basic knowledge of superconductivity.

Methods

Teachers: questionnaire directly after the teacher-seminar
Documentation of the application in teaching
Students: questionnaire after the end of the lessons

1. Teacher questionnaire

At the end of the workshop it should be evaluated to what extent the various parts are considered to be applicable and attractive. In order to have a comparison with the answers of the students, the school has to be asked for.

The further items are concerned with the following questions:

- *For how useful do the teachers consider the material?*
- *How do they estimate the effect on the students?*
- *What ideas do they have for the actual application?*

2. Teacher documentation

It should mainly show how the teachers have actually used subject and material.

Some additional questions aim at possible problems and suggestions for improvement.

3. Student questionnaire

Goals: Evaluation of attitudes, testing basic knowledge

With the help of scales the interest in the three areas in comparison with the basic interest in physics teaching should be evaluated – (how) has the attractiveness increased?

Four open questions should show whether a basic knowledge of the subject has been acquired.

Questionnaire (Teacher)

School:

1. To what extent do you consider the following parts of the seminar useful for your teaching?

1: not at all .... 6: extremely useful

Subject information (Superconductivity)	1	2	3	4	5	6
Experiments						
Learning program						

Comment: ....

2. In your opinion, how attractive and interesting is the subject for your students?

1: not at all .... 6: very attractive

Subject information (Superconductivity)	1	2	3	4	5	6
Experiments						
Learning program						

Comment: ....

3. How could an actual application of the material in your teaching look like?

Sketch your ideas:

Description of the intended lessons

School: Grade:

Number of students: Allocated time:

Goals:

Procedure:

(short description of individual units, use of Supercomet-material, further material for students)

How useful has the material been for you?

1: not at all .... 6: very useful

Subject information	1	2	3	4	5	6
Experiments						
Learning program						
Teacher guide						

Comment:

Have problems occurred?

If yes, what?

Should the material be changed/improved?

If yes, how?

Questionnaire (Students)

1. Male/Female:

2. How interesting have you found physics courses over the years?
   1: not at all .... 6: very interesting

1	2	3	4	5	6

3. How interesting do you personally find the subject superconductivity?
   1: not at all .... 6: very interesting

1	2	3	4	5	6

Comment:

4. How interesting were the experiments performed?
   1: not at all .... 6: very interesting

1	2	3	4	5	6

Comment:

5.How much did it bring you personally to work with the learning program?
   1: nothing at all .... 6: very much

1	2	3	4	5	6

Comment:

6.What should be changed/improved?

1. Subject questions

1. What special properties do superconductors possess?

2. How can one explain these properties?

3. What types of superconductors do you know?

4. Where are superconductors applied?

Results

Following a workshop for teachers, the presented material has been tested in 3 schools: BRG Kepler Graz, BG/BRG Seebacher Graz, BG/BRG Gleisdorf. 40 students from 3 classes took part.

Description of the intended lessons (teacher)

Different methodical realizations have been followed. Only the presentation of the experiments proceeded similarly.

School 1: With the help of guiding questions the students worked independently with the modules, or parts of them, respectively (approximately 3 hours, distributed over one semester). For superconductivity by itself, however, only one hour has been used. Conclusion: Experimental hour (presentation)

School 2: Introduction into superconductivity by the teacher; presentation of the experiments: students were allowed to test themselves. Presentation of parts of the learning program (3 hours)

School 3: Learning program (modules 1 – 5) presented by the teacher (beamer), about one hour per module. 6th hour: presentation of the experiments. There also tests have been performed and the results integrated into the grade.

All teachers remarked that the treatment of the subject (near the end of the year) had to occur too short and superficially.

Feedback of the teachers

Uniformly, satisfaction with the experiments has been noted:

„Experiments have been appreciated much“

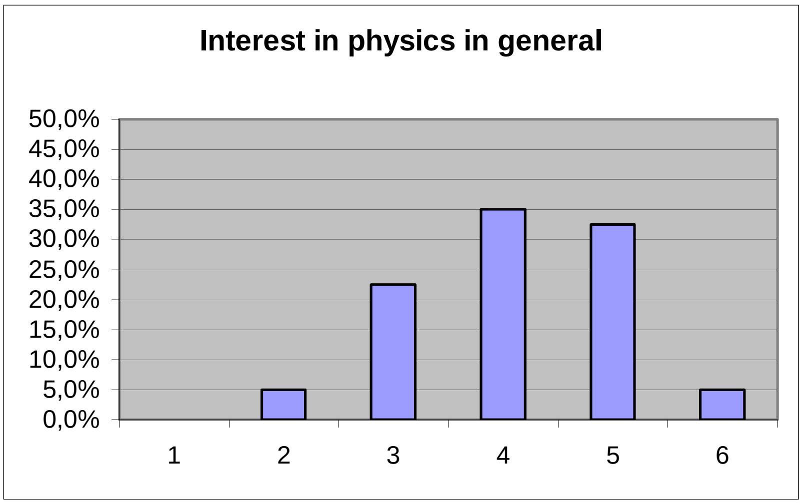
„Experimental material is excellent!“

The learning program has been assessed in differentiated ways. In the application also practical problems occurred (long loading times, errors)

„Topics are being explained very clearly“.

„Sometimes somewhat long-winded“

Apparently the Teacher Guide (handed out at the workshop in electronic form) had not been used.



Questionnaire of the students

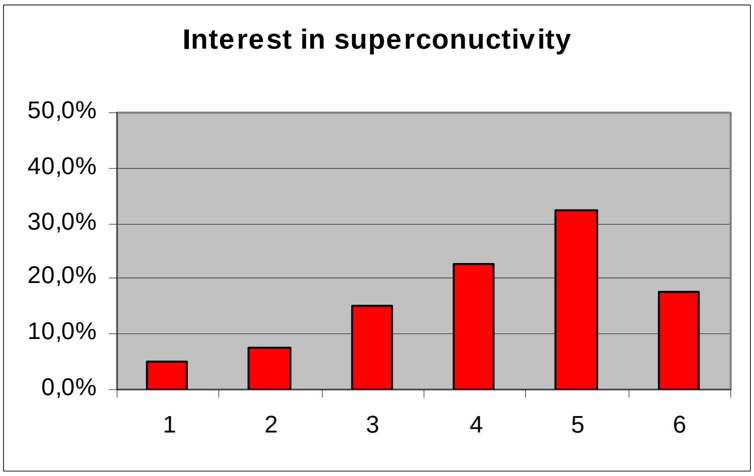
1. Interest in physics

The interest in the subject physics has been asked for as a parameter for comparison. The average over 40 students was 4.1 – this lies just above the mean (3.5) on a scale from 1 to 6. The distribution also shows this rather positive attitude.

2. Interest in the subject

This, on the average, has been only slightly higher than the interest in physics in general (4.2), the subject superconductivity does not seem to have increased the interest of the students essentially.

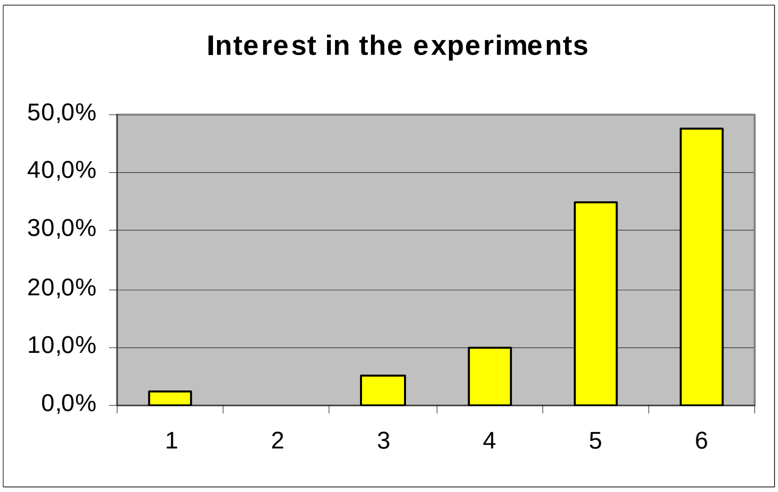
A detailed inspection of the data, however, yields further information. The distribution showed that more positive, but also more negative ratings appeared. Secondly, although the correlation (with physics interest) has been positive with 0.27, it was lower than in the other questions – it can therefore be concluded that the subject polarized the students more than the rest of the course, and that relatively independent of their initial interest.



3. Interest in the experiments

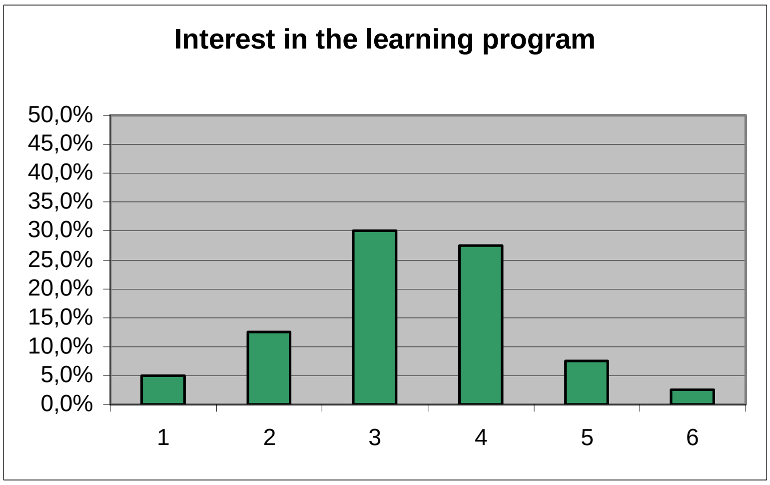
There the outcome was clearly positive: the mean was 5.2, almost half of the students noted the highest value of 6.

The correlation with the physics interest (0.39) was higher than with the subject.



4. Interest in the learning program

With regard to the average, this lay below the mean (3.5), as well as clearly below the interest in physics. There the correlation with the physics interest was highest with 0.42 – for interested students the program was better suited than for less interested. The differences between schools were minor, the problems therefore rested rather in the program itself than in the mode of application.



Subject questions

1. Properties of superconductors

50% of the students listed the magnetic properties (expulsion of external magnetic fields at low temperatures) an, 45% the vanishing of the resistance, and 15% the suspension in a magnetic field. About a quarter of the students gave no or a false answer (23%).

2. Explanation of the properties

There, more than half of the students gave no answer (53%), most of the rest named Cooper-pairs.

„Not the electrons conduct, but Cooper-pairs".

3. Types of superconductors

60% of the students named type1- and type2-superconductors, partially mixed up with low- and high-temperature superconductors. No answer was given by only 13 % of the students.

4. Applications

4 students did not know what to say there (10%). The majority of the entries were:

magnetic levitation train (78%), MRI (43%), improved generators and motors (38%, resp. 10 %), in addition particle accelerators, fusion reactors, power transmission, and measurements of magnetic fields were named.

Summary

There, once again the initial hypotheses should be referred to.

Subject, learning environment, and experiments are attractive for teachers and interesting for using them in their teaching

This statement could be verified definitely only for the experiments. The learning program turned out to be partially attractive, need of improvement has been noted. With regard to the subject a certain attractiveness may have been surmised, that has, however, been superimposed by factual or supposed uncertainties. In any case, some other teachers could not be persuaded to use the material, and those, who did so nevertheless, used too little time for it according to their own feeling.

Subject, learning environment, and experiments are interesting and stimulating for students

Like with the first hypothesis a positive answer can be given only for the experiments. The learning program has rather been rejected, and reached the least exactly those students that were the least interested in physics. The subject polarized, and appealed also more to the physics-interested.
Thus, indications for the need for action with regard to the quality of the program were confirmed, independent of the mode of application. And this, because especially it should make the subject accessible and understandable.

After the lessons the students have a basic knowledge of superconductivity

The results concerning the content confirm the above findings. Well remembered were applications in particular, the least knowledge was evident in explanations of the properties of superconductors – which certainly represents the most difficult part of the subject.
The teaching, as differently as it was designed, concentrated on the experiments, but otherwise remained rather on the surface, both with teachers and students.

Appendix 3: Classroom testing of the module 1, 2007

The module Magnetism was tested with 32 pupils at the age of 17 (9 female). Within the basic course about Magnetism they had to work with the application mainly as a recapitulation. We asked some questions about the interest and the preferred method to work with the module.

Questionnaire

1. Gender: m f

2. How interesting is the topic magnetism for you?

1: not at all .... *6: very interesting*

1	2	3	4	5	6

3. How interesting is the work with the application?

1: not at all .... *6: very interesting*

1	2	3	4	5	6

comment:

4. How should have been worked with it?

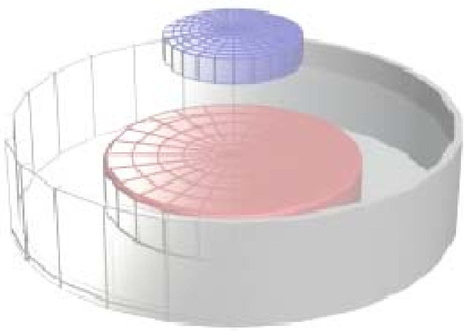
⑨ the teacher presents

⑨ work autonomous in groups

⑨ answering guiding questions

⑨ alone as a homework

Others: ....



5. Which page of the module did you like most?

Nr: ....

Comment::

6. Which page of the module did you dislike?

Nr: ....

comment:

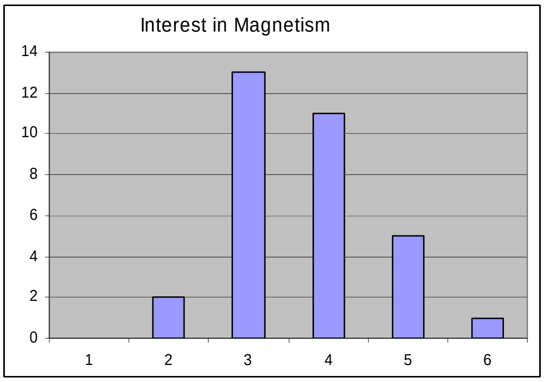
7. Do you want to work with this application in another lesson?

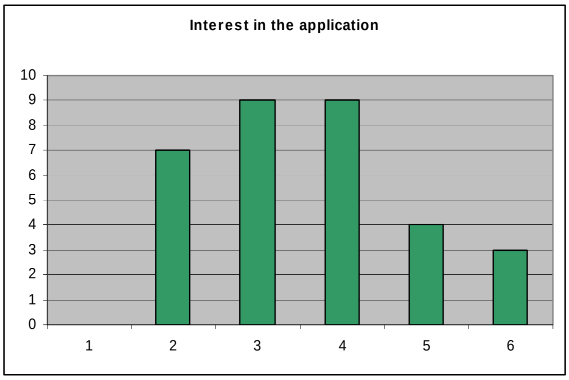
1: no, not at all ... *. 6: yes!*

1	2	3	4	5	6

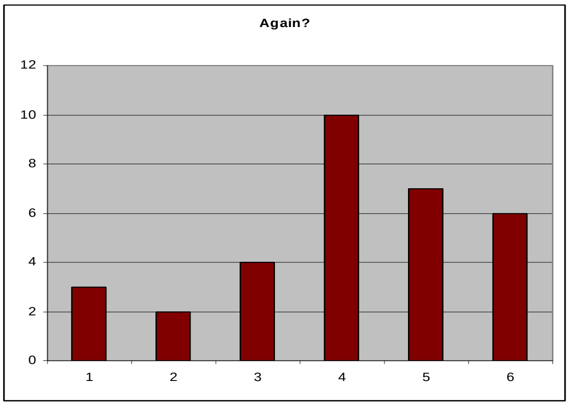
Some results:

The topic magnetism achieved nearly the same interest as the module: average 3,8 – 3,7. This is a little above the mean value of 3,5. The spreading of the answers shows a bit more accordance but also more pupils disliking the work with the module.





A majority of the pupils wanted to work again with the SC2 modules (question 7).



Teaching method: (qu. 4)

Two methods were preferred:
Working autonomous in groups (56 %) and presentation by the teacher (44%). Not one student wanted to work with the application as a homework.

Conclusions

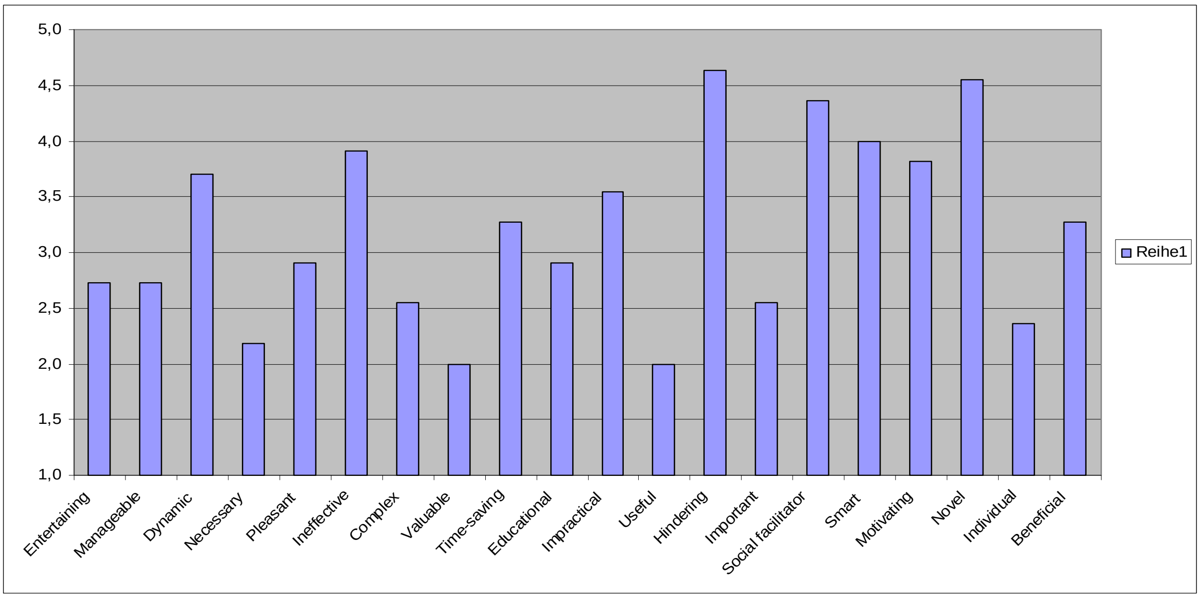
Similar to our first study this evaluation showed, that the impact of the application concerning the interest is rather small. One reason for that was the functioning of the program however, it was not stable and sometimes slow.

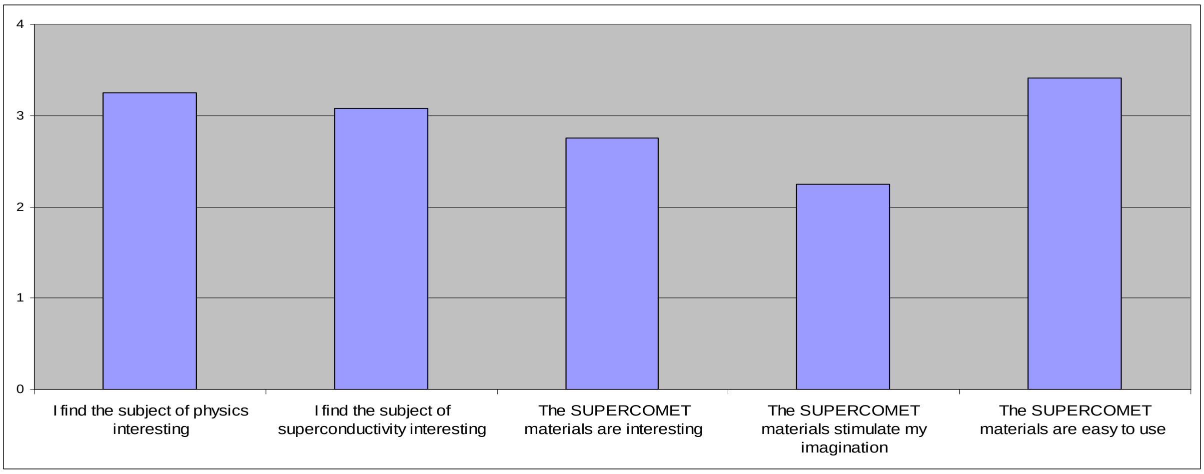
Appendix 4: Classroom case studies

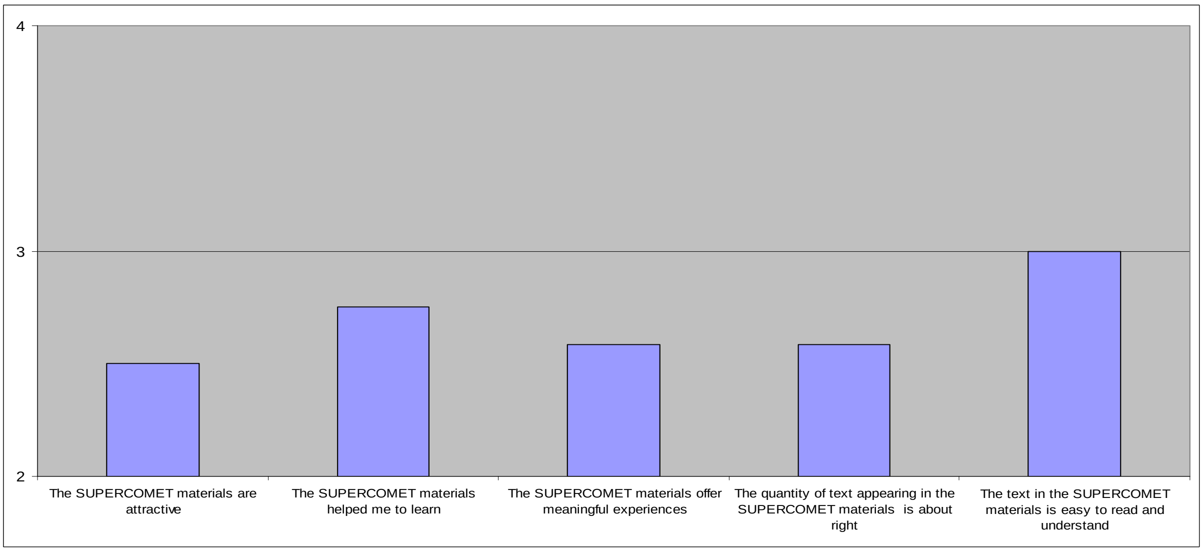
A group of 12th graders worked through all the modules during 6 sessions, each of 2 hours.
Everyone had a computer and the supercomet material installed on it. The teacher was present all the time and gave a helping hand when there were technical problems. Students could also contact him to clear content questions. They could also contact their classmates.
After the 6 lessons they answered the questionnaire and the items of the knowledge test.

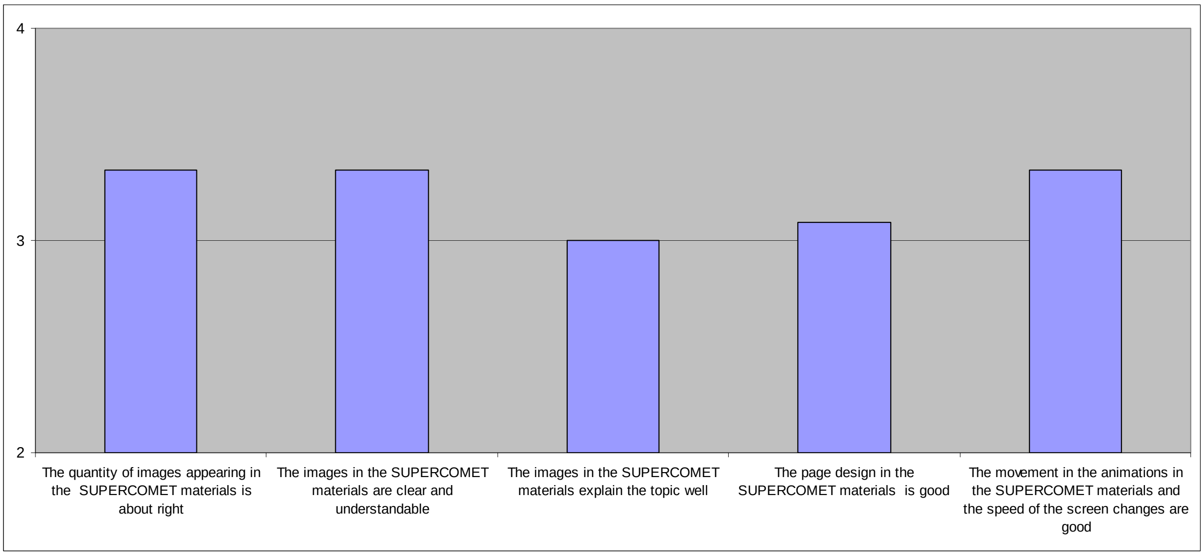
Appendix 5: Shared tests – SC2_pupil_questionaire

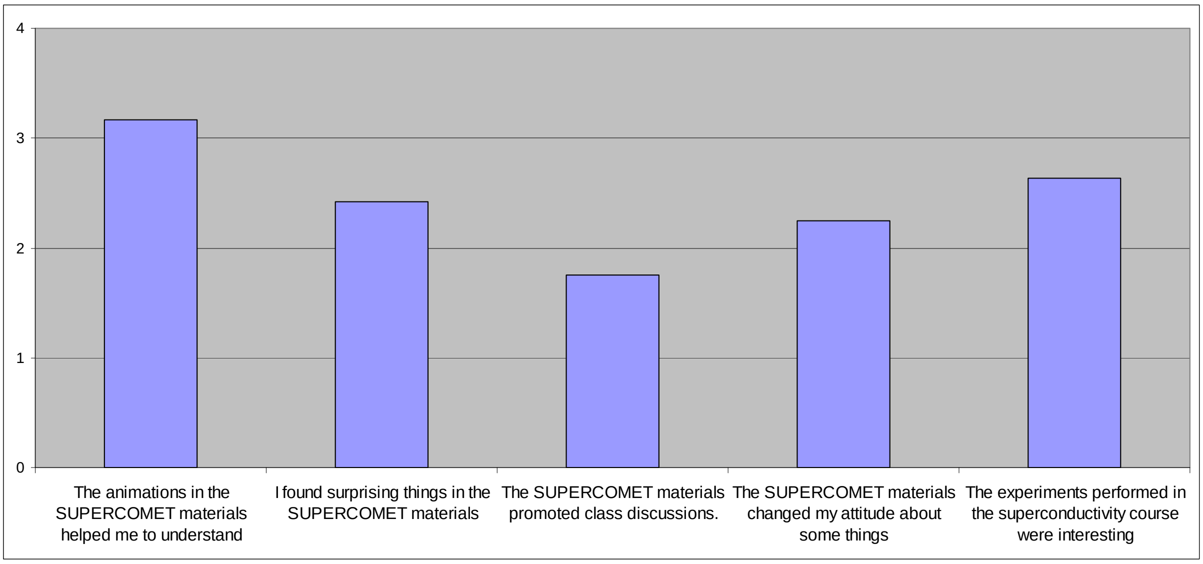
For all the data see the excel-sheet "SC2_pupil_questionaire_stuttgart2007"

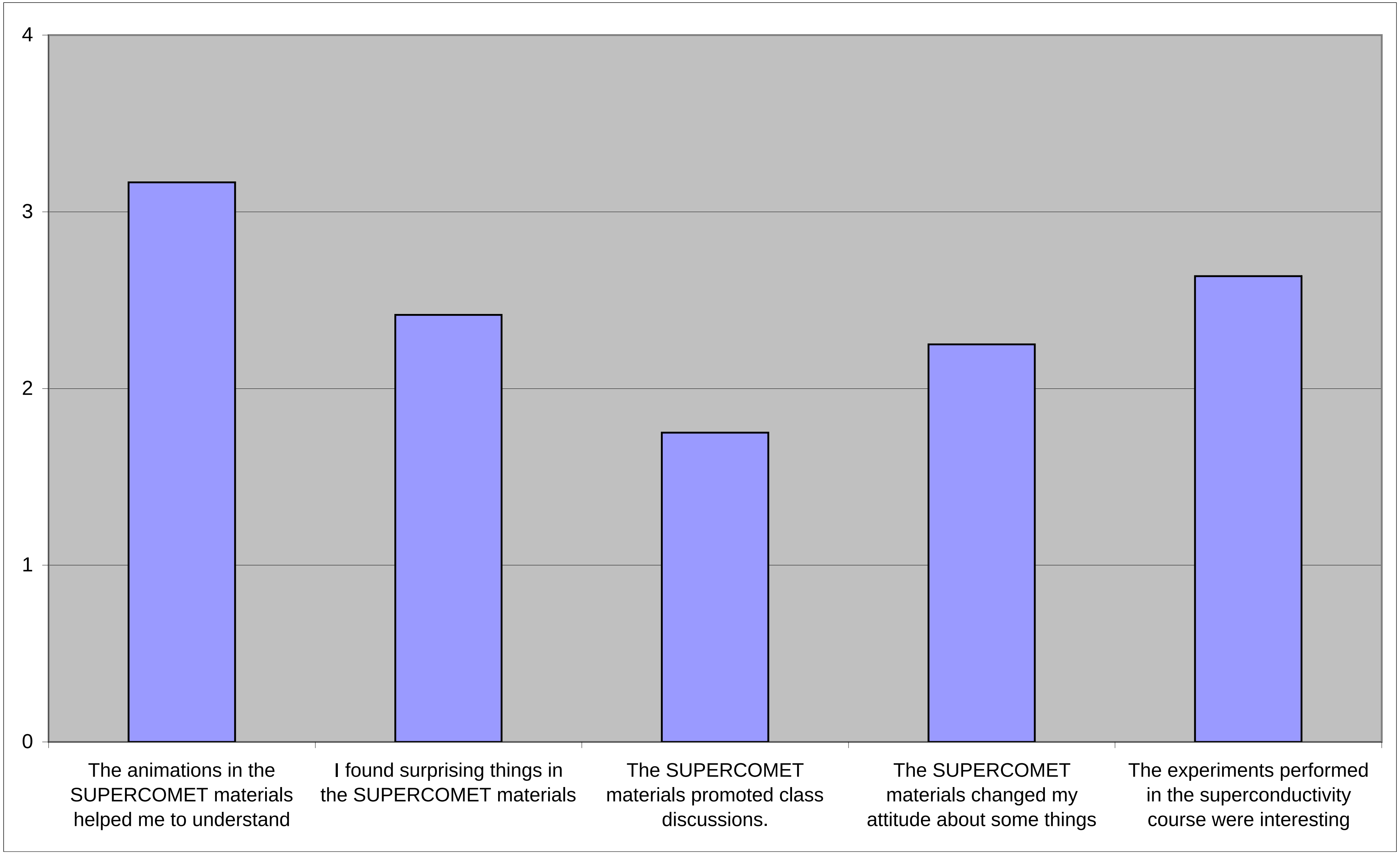

5,0
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
Entertaining
Manageable
Dynamic
Necessary
Pleasant
Ineffective
Complex
Valuable
Time-saving
Educational
Impractical
Useful
Hindering
Important
Social facilitator
Smart
Motivating
Novel
Individual
Beneficial
Reihe1


4
3
2
1
0
I find the subject of physics interesting
I find the subject of superconductivity interesting
The SUPERCOMET materials are interesting
The SUPERCOMET materials stimulate my imagination
The SUPERCOMET materials are easy to use


4
3
2
The SUPERCOMET materials are attractive
The SUPERCOMET materials helped me to learn
The SUPERCOMET materials offer meaningful experiences
The quantity of text appearing in the SUPERCOMET materials is about right
The text in the SUPERCOMET materials is easy to read and understand


4
3
2
The quantity of images appearing in the SUPERCOMET materials is about right
The images in the SUPERCOMET materials are clear and understandable
The images in the SUPERCOMET materials explain the topic well
The page design in the SUPERCOMET materials is good
The movement in the animations in the SUPERCOMET materials and the speed of the screen changes are good


4
3
2
1
0
The animations in the SUPERCOMET materials helped me to understand
I found surprising things in the SUPERCOMET materials
The SUPERCOMET materials promoted class discussions.
The SUPERCOMET materials changed my attitude about some things
The experiments performed in the superconductivity course were interesting


4
3
2
1
0
The animations in the SUPERCOMET materials helped me to understand
I found surprising things in the SUPERCOMET materials
The SUPERCOMET materials promoted class discussions.
The SUPERCOMET materials changed my attitude about some things
The experiments performed in the superconductivity course were interesting

Nr.	1	2	3	4	5	6	7	8	9	10	11	
1	1	1	2	2	0	0	0	0	2	1	1	10
3	2	0	2	2	1	0	0	0	2	1	1	11
5	0	0	2	0	0	0	2	0	2	2	1	9
6	0	0	2	0	0	0	0	0	2	2	0	6
7	0	1	2	0	0	0	1	1	1	2	0	8
8	0	1	2	0	0	0	1	0	2	2	0	8
9	1	1	2	1	0	1	2	1	2	1	1	13
10	1	0	2	1	1	0	2	1	2	1	1	12
11	0	0	2	0	0	0	0	0	0	0	0	2
12	0	0	1	1	0	1	2	1	2	1	1	10
2	1	1	2	2	1	2	1	1	2	2	1	16
4	1	0	2	2	1	1	2	1	2	1	1	14
	0.4	0.3	1.9	0.6	0.2	0.2	1.1	0.4	1.7	1.3	0.6	
max	2	2	2	2	2	2	2	2	2	2	2	22

45%
50%
41%
27%
36%
36%
59%
55%
9%
45%
73%
64%
45%

PARTNER: **University of Antwerp**

AUTHOR: **Wim Peeters** DATE: 2007**-10-16**

REVIEWER: **<reviewer name>** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide

Teacher Seminar

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit

High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

CD-ROM

Module 1. Magnetism (normal)

Module 2. Electromagnetic induction (normal)

Module 3. Electric conduction (intensively)

Module 4. Introduction to superconductivity (not much)

Module 5. History of superconductivity (not much)

Low-Tech hands on kit (partially)

High-Tech hands on kit (not available)

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

Event/School	Number of sessions	Length of sessions	Number of trainee teachers involved (please give numbers of male and female trainee teachers)	Number of teachers involved (please give numbers of male and female teachers)	Number of students involved (please give numbers of male and female students)	Remarks
Science on Stage	1	120 MIN		M: 20 F: 10		Workshop
Torun	1	60 MIN		M:10 F:10		Workshop, incl.translation
GroeMer 5WWi 2006	2	100			M:18 F:7	Testing CA
GroeMer 5LWe-MWe 2006	2	100			M:8 F:6	Testing CA
GroeMer 5WWi 2006	1	50			M:18 F:7 (same group as above)	Independent Learning
GroeMer 5LWe-MWe 2006	1	50			M:8 F:6 (same group as above)	Independent Learning
AnnWij	5	250			M:6	Full scale use of CA (4 modules) in

TW 2006					F:1	testing
AnnWij TW 2006	6	300			M:6 F:1	Full scale use of CA (4 modules) as rehearsal (3 modules) and learning (1 mod)
AnnWij 5WWi 2007	2	100			M:9 F:6	Learning after introduction
SGC Boe 5WW61 2006	2	100			M:15 F:6	Learning after introduction
SGC Boe 5WW62 2006	2	100			M:12 F:12	Learning after introduction
SGC 5WW61 2006	3	150			M:12 F:12	Testing CA, not learning
SGC 5WW62 2007	3	150			M:14 F:10	Learning from CA
SGC 5WW61 2007	2	100			M:16 F:9	Learning from CA, electric conduction
SGC 5EcWi/5LW8 2007	1	50			M:12 F:6	Learning from CA electric conduction
SGC 5LW6 2007	3	150			M:9 F:16	Learning from CA
MatWuus 5TW 2006	1,5	75			M:8 F:5	Reading critically
OHvMLummen Mixed group 2006/07	6	300			M:7 F:5	Superconductivity: projectwork, independent learning
SMLeuven All techn. science classes 2006/07	2	100			M: 20 F:8	All modules “scanned via proj
SMLeuven	3	150			M: 10	Superconductivity as projectwork

Mixed group 2006/07					F:6	
SMLeuven All science classes 2006	2	100			M: 34 F:22	All modules "scanned via proj
SUL 5 WeWi 5LWe-MWe 2006	1	50			M:12 F:12	Testing CA and independent learning
SUL 5 WeWi 5LWe-MWe 2007	1	50			M: 8 F: 17	Independent learning
SUL 5 WeWi 5LWe-MWe 2006	2	100			M:12 F:12	Testing CA and independent learning
SUL 5 WeWi 5LWe-MWe 2007	2	100			M:8 F:17	Independent learning
SUL 5 WeWi 5LWe-MWe 2006	3	150			M:12 F:12	Testing CA and independent learning
SUL 5 WeWi 5LWe-MWe 2007	3	150			M:8 F:17	Independent learning
MDI 5 L-We, We-Mt, We-Wi 2006	2	100			M: 7 F: 12	Rehearsal (mod 1)
MDI 5 L-We, We-Mt, We-Wi	2	100			M: 9 F: 10	As illustration, projected on screen (mod 2)

2006						
MDI 5 L-We, We-Mt, We-Wi 2006	2	100			M: 9 F: 10	Independent Learning (mod 3)
MDI 6We-Wi 2006	2	100			M: 1 F:2	Independent learning (mod 4)
MDI 6We-Wi 2007	2	100			M: 3 F:4	Independent learning (mod 4)
MDI 5 L-We, We-Mt, We-Wi 2007	2	100			M: 9 F: 10	Rehearsal + Independent Learning (mod 1)

- Number of schools involved.

8 schools involved: SGC= Sint-Gabriëlcollege, Boechout, GroeMer= Groenendaalcollege Merksem AnnW= Annuntiainstituut, Wijnegem, MDI = Mater Dei- Sint Pieters-Woluwe (near Brussels), SMLeuven Sancta Mariainstituut - Leuven SUL= Sint-Ursula lyceum-Lier, OHvMLummen = Onbevlekt Hart van Maria- Lummen, MatWuus= Matutinainstituut-Wuustwezel

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

The teachers were trained/informed more on the content and the objectives of Supercomet. Only some suggestions were done regarding teaching methods.

The place in the curriculum was indicated

Some small experiments were shown; most teachers used traditional experiments in addition to the CA.

The teacher guide was used as background information, but in general the subjects chosen did not need scientific explanations.

In the list above one can see that there were trials regarding different teaching methods. Most of them were adapted to the situation. In most cases independent learning was used/tried out. This method is new and requires materials such as the SC CA, which was very useful.

Also for visualizing phenomena during lectures it was used with a positive appreciation.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

The science on stage seminar:

A group of 30 teachers was divided in 5 groups: there were 5 "corners with activities: the CA group, 3 small experiments corners and the high tech experiment corner. Every corner was provided with tasks which the teachers had to carry out and discuss among each other. The goal in this case was to show a specific teaching method, all the materials that were developed by the SC project and also the scientific background of SC.

Most of the teachers who attended were highly motivated and skilled in ICT.

The seminar took two hours and the answers of a questionnaire showed a very positive result on both the content and the format of the seminar.

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

- questionnaires regarding the content of the modules
- links to curriculum
- new teaching methods
- background information on the superconductivity item

3.4 What is your evidence for your response to question 3.3?

- most teachers asked/were concerned about the effectiveness of this digital teaching methods: the in general wanted to test this via cognitive questions
- these items were raised during discussions

3.5 Why are these aspects useful? Why are the other aspects not useful?

- it safes work
- links to curriculum gives answers to criticism/questions
- new didactical tools/teaching materials demand for new methods
- additional information does make one feel more confident
- too many materials are not usable (limited time)

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

- too extended guides are not read. Short and to the point is enough. Flexible if possible
- evaluation tool for new methods, looking at attitudes and skills, apart from cognitive test

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?

- the CA needs PC's: this is within a school mostly a problem: reservation of pc class, which makes it necessary to leave the physics class, which make sit impossible to integrate the CA in the normal teaching process. Whenever this problem was solved, the CA was used with mostly very positive responses of the students

- the low tech experiments can support the content and the teaching method: it gives more and better understanding and draws pupils attention better

- the PowerPoints are not used too much. They will only be useful for the seminar itself, where teachers will be trained in the "new" content. It is normally not usable towards students.

- the high tech kit would need good organisation. It will be only for schools able to visit the university (where it can be used) or exceptionally a school who can organise it itself. Most schools (and students) will have big difficulties getting to work with this high tech kit.

- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?

- the introductory modules (electric conduction, magnetism and induction) are of very interesting value: it links directly to the curriculum and can be used without hesitation. The extension towards superconductivity is used only by "inspired" teachers: a non-physicist (the majority !!!!) will be very reluctant. It is not part of the curriculum. Time pressure in general will prevent some teachers to go into the more advanced items.

- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?

- there has been no scientific study on this in Belgium. The only sources are the findings of the cooperating teachers. In general they find it not "normal" to teach this way. Students react positively however: this generates a good atmosphere for learning. Connected to other tools (experiments, explanation of teacher) the learning shows a bigger variety of methods.

- how long?

Module 1. Magnetism (normal): 100 min

Module 2. Electromagnetic induction (normal): 150 min (because additional information is needed

Module 3. Electric conduction (intensively): most schools need 100 minutes

Module 4. Introduction to superconductivity (not much)

Module 5. History of superconductivity (not much) 4&5 together: minimum 200 min excl. additional information or films.

- The few didactical experiments on independent learning show bigger hesitation: it goes slower because students are not used to this kind of working, they not yet have the ideal attitude. The learning gain is also a little doubtful. It can serve as a training which is very valuable.

- Motivation - Do students like working with materials? What do they like? What do they not like?

- in general students are prepared to work with computers. However, using it as a real and effective learning tool is new to them. They always expect this kind of work to be without further consequences (as it is in many courses: a paper, and finished). Realising that it should be used as a real "interactive" textbook takes some time.

- they are motivated by the CA and its animations. They in general skip the reading at first. As a result they do not know what the animations stand for. After 2-3 lessons they realize that text and animations go together in a united effort to explain things. After this phase, the learning gain rises to a satisfying level. A real pre and post test was not done in Belgium. The teachers feelings (see reports) however show that they were satisfied with the gained knowledge and especially the improved attitude towards self learning of the students via the CA.

- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

- Low ability are slower and more reluctant to self learning. But a CA means that the materials are continuously available, so that this can be solved. No teachers have noticed particular gender differences in using SC materials.

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	This causes in some schools organizational problems	The extension to superconductivity needs time (which is not always available)	Positive, many added values	Very positive	Low ability are slower and more reluctant. But it means more permanent
4.2	CD-ROM Module 1 Magnetism	positive	high		Very positive	
4.3	CD-ROM Module 2 Electromagnetic induction	Positive	High		Positive	
4.4	CD-ROM Module 3 Electric conduction	positive	High		Very positive	
4.5	CD-ROM Module 4 Introduction to superconductivity	positive	High		Positive	

4.6	CD-ROM Module 5 History of superconductivity	Lower mossibilities	Low		Moderate	
4.7	Low-Tech hands on kit	positive	High		Very positive	
4.8	High-Tech hands on kit	Low	Low		Exceptional	

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

- reports of the different teachers
- Wim Peeters being chairman of the curriculum committee for physics
-

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

- in general the first round of testing was looking at the CA itself and commenting. This resulted in changes. After these initial changes the following comments till count:

		Suggested changes
5.1	CD-ROM - general	-some animations are not clear - it should be made easier to make changes - the teacher seminar should stress the fact that local experiments can and maybe should be integrated in the use of the CA
5.2	CD-ROM Module 1 Magnetism	- this in general is ok after the changes made - help of low tech experiments is a good thing, links to them should be made
5.3	CD-ROM Module 2 Electromagnetic induction	- this in general is ok after the changes made - help of low tech experiments is a good thing, links to them should be made
5.4	CD-ROM Module 3 Electric conduction	this in general is ok after the changes made - help of low tech experiments is a good thing, links to them should be made - good link to traditional experiments available in the classroom is possible, links can be made here
5.5	CD-ROM Module 4 Introduction to superconductivity	- a good aid
5.6	CD-ROM Module 5 History of superconductivity	- should be linked to applications
5.7	Low-Tech hands on kit	- should be linked to content of CA
5.8	High-Tech hands on kit	- should be linked to content of CA

5.9 What is your evidence for your response to questions 5.1 to 5.8?

- reports of the teachers of the test schools

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

- see last column of table in section 2.2
- as an additional demonstration tool for selected topics (sometimes)
- as a rehearsal tool (frequent)
- as tool for independent learning (smaller parts of the modules)(frequent)
- as project work (use it throughout the year as a main object/subject to study)(sometimes)

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

- with the group of teachers we agreed to use different and other methods. Some work, others are more difficult because not all materials were available (low tech experiments, high tech experiments)
- the teachers of the test schools were very experienced and motivated to try out methods, or to use these new materials in their advanced teaching method (project work, independent learning). This was no problem. Evaluation of attitudes and skills was the only point of criticism, but this counts not only for SC and its CA, but for most of the newer methods, aiming at independent learning

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

- integration was difficult. Mostly due to the different rooms in which activities take place: CA in pc room and experiments etc. in the physics laboratory or physics class.
- only when used as a support for the normal lessons (projecting the CA with a beamer) it was nicely integrated.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

- see 6.3
- if used as a rehearsel, of course, it is not integrated in a learning cycle. Then it only gives an alternative and enriching view on the content

6.5 How do teachers and/or students feel about these different methods of integration?

- the teachers in the test schools are positive (of course, they selected themselves)
- in general, practical problems and curriculum pressure prevent them from being very positive
- there is a positive tendency however towards newer methods and materials

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

- discussions with teachers of the test schools

- hundreds of talks and contacts with teachers thanks to my job of teacher coach for 400-500 teachers in 200 schools

- reports of inspection teams in schools: these show some pressure to work on independent learning, newer materials, better equipped class rooms and a variation of methods

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

7.1

SGC 5WW62 2007 Highest level of science oriented students	3	150	11 pc's connected to internet	Teacher skilled very well on ICT	M:14 F:10	Learning from CA

After an introduction on electrostatics, the students had to study Module 3 Electric conduction up to 30/31 in groups of 2 or 3. They had to take notes individually and discuss difficulties among themselves. At the end of their notes, they had to come up with 5 questions touching the heart of the content of the module. This was their "summary".

Different groups were finished with great time intervals (30min and more). The groups finished first had to test Ohm's law with an experiment: get the materials needed, built the set up based on 17/31, start measuring for different resistors. After doing this they had to put the data in an excel file and find the formula of the curve fitting and see that the coefficient of the straight line actually was the resistance of the resistor.

The groups finishing last also had to do this, but they were helped by the groups working quickly. Also, the slower groups had to finish analysing data in excel at home.

During this work all students and groups got feedback on their way of working by the teacher, however without real evaluation. This will happen next time.

Their excel file was evaluated, and their notes too.

At the end of this 3 hour cycle, there was a small cognitive test.

7.2

SGC 5EcWi/5LW8 2007 Mixed talented group of non-science oriented students	1	50	11 pc's connected to internet	Teacher skilled very well on ICT	M:12 F:6	Learning from CA electric conduction

The module was divided between 6 groups of 3, each had to study a part of the module (1/6th).

After 15 minutes, each group presented and explained its part to rest, using the beamer.

Every body had to note the crucial information

The students were highly motivated to learn physics (for the first time this school year !) and presented with enthusiasm their share of the job.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM

Results post test: elektric conduction

(translation of SC2_electric_conduction_module_test_20070423_HGM.doc)

Class: 5 wetenschappen-wiskunde
Date: 5/10/2007
M/F: 9/6

question	%
1	66
2	80
3	95
4	56
5	
6	50
7	65
8	78
9	29
10	23
11	73
12	60
13	65
14	63
15	80
16	68

Weighted (not all questions equally appreciated) average: 65 %

Remarks

- Q 5: not selected Q 9: the question was wrong: resistivity and resistance were mixed up. Many took wrong numbers for their calculations.
- Q10: the difference between a definition and the meaning of Ohm's law was difficult.

- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

- absolutely: CA: apart from the inherent content, which is of a revealing quality, the tool itself triggers new methods of teaching. It can persuade people to try new ways of teaching. It not only can be implemented easily because the match with the curriculum, but it is also possible, for highly motivated teachers to go beyond the curriculum, and touching frontier science with students: always a challenge in case of a somewhat "traditional" curriculum.

- apart from this tool, the two sets of experiments are absolutely necessary to have complementary teaching methods and trainings: digital materials only are not sufficient to provide good lessons and teaching; not all skills and attitudes (for both teachers and students!) can be trained with only the CA

- the teacher guide and seminar are of another level: given the fact that teacher trainings are organised, they form a professional base of working and they provide the way to professionalize physics teachers in their teaching.

9.2 What is your evidence for your response to question 9.1?

- all reports of teachers of the testing schools. These reports are available on the intranet.

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

- the table in 2.2 tells us that there is no specific difference regarding gender in dealing with SC materials

9.4 What is your evidence for your response to question 9.2?

PARTNER: **University of Rousse**

AUTHOR: **Nadezhda Nancheva** DATE: **2007-10-10**

REVIEWER: DATE: **2007-10-10**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The Bulgarian partner has carried out the following tasks:
A. Review of the material in CD-ROM
B. Translation and adapt of the text in CD-ROM
C. Translation and adapt of the text in Teacher Guide
D. Development of supporting materials for the Teacher Seminar
E. Seminars with teachers **(2 in total)**
F. Collection and development of materials for WG3
G. Presentation of the project at the National Conferences in **Varna (2005), Jambol (2006), Pleven (2007)**

The SUPERCOMET materials examined are:

Teacher Guide N/A

Teacher Seminar N/A

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit N/A

High-Tech hands on kit N/A

2 Description of trials

2.1 In the trials the first version of **SUPERCOMET** has been used.

Partners and testing schools
The initial partner schools **(2, all from Rousse)** have been incremented by other **3 testing schools.** The following is the complete list of the schools involved in the experimentation (bold are the school which have been involved in 2005-2006 and 2006-2007, the others – only in 2006-2007.

English Language School “Geo Milev”- Rousse
Baba Tonka High School of Mathematics - Rousse
Secondary School of European Language - Rousse
Secondary School “Cristo Botev” - Rousse
Primary and Secondary School with Intensive Study of Languages – Sofia

Teacher Seminars
The Teacher Seminars have been carried out in Rousse.

The timetables were the following:

1. Rousse, **22/10/2005 – 8 hours** (Nancheva, Docheva – **2 trainee teachers - female**; **4 attending teachers** - 2 from English Language School “Geo Milev”; 2 from Mathematical School; - **female 4**;
   2 PhD students – **male 1; female 1**)
   - Introduction about Supercomet project
   - The CD –ROM and the teacher guide
   - How to introduce CD –ROM in the didactic practice
   - Introduction to:

     Module 1. Magnetism

     Module 2. Electromagnetic induction

     Module 3. Electric conduction
   - Introduction to the experiments and the videos
   - Discussion with teachers and task assignment

2. Rousse, **03/02/2007** - **8 hours** (Nancheva, Docheva - **2 trainee teachers - female**; **7 attending teachers** - 2 from English Language School “Geo Milev”; 2 from Mathematical School; 1 from Secondary School of European Language; 1 from the Secondary School “Cristo Botev”; 1 from Primary and Secondary School with Intensive Study of Languages – Sofia); –**male 1; female 6**; **2 PhD students** -– **male 1; female 1**).
   - The history of superconductivity
   - What is superconductivity - introduction
   - Superconducting materials
   - The BCS theory
   - Application of superconductivity
   - How to introduce superconductivity in the didactic practice
   - Introduction to the experiments and the videos
   - Discussion with teachers and task assignment

2.2 The material in CD-ROM has been tested and it is testing now.

- During **2005/2006** in English Language School “Geo Milev” **one teache**r and about **100 pupils** have been involved in CD-ROM testing; in Mathematical School **one teacher** and about **50 pupils** have been involved in CD-ROM testing **(total 150 pupils; 2 teachers).**

- During **2006/2007** in English Language School “Geo Milev” **one teacher** and about **125 pupils** have been involved in CD-ROM testing; in Mathematical School **one teacher** and about **100 pupils** have been involved in CD-ROM testing; in Secondary School of European Language **one teacher** and about **100 pupils** have been involved in CD-ROM testing; in Secondary School “Cristo Botev” **one teacher** and about **50 pupils** have been involved in CD-ROM testing; in Secondary School with Intensive Study of Languages (Sofia) **one teacher** and about **25 pupils** have been involved in CD-ROM testing **(total 400 pupils; 5 teachers).**

- Number of sessions – **36 h/year** for one school according curriculum
- Length of sessions – different in length; some of teachers have used CD for demonstration of different phenomena; other are organized seminars and used materials for discussion on studied material.
- Number of trainee teachers involved - **2 trainee teachers - female** (Nancheva, Docheva)
- Number of teachers involved– **7 (male – 1; female – 6)**

- Number of students involved – **550 (male – 200; female – 350); 2 PhD students (male - 1; female – 1)**
- Number of schools involved **- 5**

We have not possibility to realize HANDS-ON KITS and HIGH-TECH HANDS ON KIT experiments in the field of superconductivity. We need of help and experimental equipment to prepare HANDS-ON KITS and HIGH-TECH HANDS ON KIT experiments in the field of superconductivity.

3 Teaching the teachers

3.1 We trained teachers to use the SUPERCOMET materials during Workshops with teachers **(2 in total).**

3.2

3. Rousse, **22/10/2005 – 8 hours** (Nancheva, Docheva – **2 trainee teachers - female**; **4 attending teachers** - 2 from English Language School "Geo Milev"; 2 from Mathematical School; - **female 4**;
   2 PhD students – **male 1; female 1**)
   - Introduction about Supercomet project
   - The CD –ROM and the teacher guide
   - How to introduce CD –ROM in the didactic practice
   - Introduction to:

     Module 1. Magnetism

     Module 2. Electromagnetic induction

     Module 3. Electric conduction
   - Introduction to the experiments and the videos
   - Discussion with teachers and task assignment

The teachers` backgrounds in science and ICT are satisfying.

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

N/A

3.4 What is your evidence for your response to question 3.3?

N/A

3.5 Why are these aspects useful? Why are the other aspects not useful?

N/A

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

N/A

4 Classroom materials

- The classroom materials (modules 1-5 of the CD-ROM) are effectively deployed within our (Bulgarian) national context.
- The possibilities of use are good; there are access to computers and restricted laboratory time. The text in the SUPERCOMET materials is easy to read and understand but the most of pupils prefer the text on CD to be in Bulgarian. The experiments performed in the superconductivity course are

interesting. Some of pupils suggest including sound or music to the text and animations. The most of pupils think that previous knowledge in science are need and prefer to have CD at home.

- The classroom materials offer content relevant to the curriculum in our country. The SUPERCOMET materials are interesting, attractive, stimulate imagination and provoke thinking. The animations in the SUPERCOMET materials help to understand the presented phenomena. It is easy to use and only basic knowledge in using computers is need. The images in the SUPERCOMET materials are clear and understandable and explain the topic well. The text in the SUPERCOMET materials is easy to read and understand
- The classroom materials contribute to the achievement of learning goals and improve learning.The most of pupils think that such materials are need for whole course of physics.
- Students like working with materials because the SUPERCOMET materials are interesting, attractive and easy to use. The images in the SUPERCOMET materials are clear and understandable and explain the topic well. The text in the SUPERCOMET materials is easy to read and understand. The experiments performed in the superconductivity course are interesting.
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	average	high	high	average	girls/boys
4.2	CD-ROM Module 1 Magnetism	average	high	high	average	girls/boys
4.3	CD-ROM Module 2 Electromagnetic induction	average	high	high	average	girls/boys
4.4	CD-ROM Module 3 Electric conduction	average	high	high	average	girls/boys
4.5	CD-ROM Module 4 Introduction to superconductivity	average	high	high	high	girls/boys
4.6	CD-ROM Module 5 History of superconductivity	average	high	high	high	girls/boys

4.7	Low-Tech hands on kit	N/A	N/A	N/A	N/A	N/A
4.8	High-Tech hands on kit	N/A	N/A	N/A	N/A	N/A

4.9 The evidence for responses to questions 4.1 to 4.8 are data from pupils` questionnaires that are prepare on separate summary spreadsheet.

Pupils' and teacher' questionnaires have been carried out in June 2007.

5 Changes in classroom materials

		Suggested changes
5.1	CD-ROM - general	Additional explanatory materials needed
5.2	CD-ROM Module 1 Magnetism	Additional materials needed – magnetic field of moving charge; moving charge in magnetic field; Hall effect; magnetic field of toroid.
5.3	CD-ROM Module 2 Electromagnetic induction	Additional materials needed – self-induction
5.4	CD-ROM Module 3 Electric conduction	
5.5	CD-ROM Module 4 Introduction to superconductivity	Further explanation of superconductivity needed. It is better to include in CD additional text for superconducting materials and additional text for the application of superconductors.
5.6	CD-ROM Module 5 History of superconductivity	
5.7	Low-Tech hands on kit	N/A
5.8	High-Tech hands on kit	N/A

5.9 What is your evidence for your response to questions 5.1 to 5.8?

The evidence for our response to questions 5.1 to 5.8 are Teachers Questionnaire.

6 Use in the classroom

6.1 The classroom material, i.e. the CD- ROM, is used in practice in all schools if they have the CD-ROM and computers.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

Yes

6.3 The classroom material is integrated well with other text books, multimedia materials, teacher talk, experiments etc

6.4 The difficulties that teachers find in integrating the materials into their teaching are mainly connected with restricted hours in curriculum for lectures connected with Superconductivity.

6.5 Teachers and/or students like these different methods of integration.

6.6 The evidence for our responses to questions 6.1 to 6.5 are Teachers and pupils Questionnaires.

7 Classroom case studies

7.1

- Number of students in the class – 25
- Number of computers and network connections inside the classroom – 5
- The teachers have experience in using ICT.

8 Shared tests

8.1 Pupil' and teacher' questionnaires are separately and are provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' and teachers' answers to open questions. The results are presented in Table1 (for teachers), Table 2 (for all pupils) and Table 3 (only for boys).

THREE ADDITIONAL DOCUMENTS

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

Yes

9.2 What is your evidence for your response to question 9.1?

The evidence for our response to question 9.1 is the teachers' and pupils' questionnaires.

9.3 In our opinion the SUPERCOMET materials (the CD-ROM) contribute to promoting equality between men and women in our national context.

9.4 What is your evidence for your response to question 9.2?

The evidence for our response to question 9.2 is the teachers' and pupils' questionnaires.

Table 2 - Data from Pupils Questionnaire (in %)

Pupils: 214

1.	**Male/Female: 76/138**					
2.	**Age: (16 years old – 115; 17 years old - 99)**					
		Strongly disagree	Disagree	Agree somewhat	Strongly Agree	Don't know
3.	I find the subject of physics interesting	3.0	5.0	**59.0**	**30.0**	3.0
4.	I find the subject of superconductivity interesting	6.0	14.0	**41.0**	**21.0**	18.0
5.	The SUPERCOMET materials are interesting	3.0	2.0	**34.0**	**58.0**	3.0
6.	The SUPERCOMET materials stimulate my imagination	4.0	14.0	**35.0**	**39.0**	8.0
7.	The SUPERCOMET materials are easy to use	2.0	3.0	**25.0**	**65.0**	5.0
8.	The SUPERCOMET materials are attractive	3.0	9.0	**38.0**	**45.0**	5.0
9.	The SUPERCOMET materials helped me to learn	2.0	10.0	**45.0**	**36.0**	7.0
10.	The SUPERCOMET materials offer meaningful experiences	5.0	5.0	**31.0**	**53.0**	6.0
11.	The quantity of text appearing in the SUPERCOMET materials is about right	4.0	14.0	**27.0**	**43.0**	12.0
12.	The text in the SUPERCOMET materials is easy to read and understand	4.0	4.0	**34.0**	**53.0**	5.0
13.	The quantity of images appearing in the SUPERCOMET materials is about right	4.0	5.0	**25.0**	**60.0**	6.0
14.	The images in the SUPERCOMET materials are clear and understandable	1.0	2.0	**42.0**	**52.0**	3.0
15.	The images in the SUPERCOMET materials explain the topic well	4.0	5.0	**41.0**	**45.0**	5.0
16.	The page design in the SUPERCOMET materials is good	3.0	5.0	**43.0**	**45.0**	4.0
17.	The movement in the animations in the SUPERCOMET materials and the speed of the screen changes are good	2.0	9.0	**36.0**	**48.0**	5.0
18.	The animations in the SUPERCOMET materials helped me to understand	3.0	6.0	**40.0**	**48.0**	3.0
19.	I found surprising things in the SUPERCOMET materials	**10.0**	**35.0**	**22.0**	**16.0**	17.0
20.	The SUPERCOMET materials promoted class discussions.	**18.0**	**41.0**	**15.0**	**15.0**	11.0
21.	The SUPERCOMET materials changed my attitude about some things	**14.0**	**42.0**	**23.0**	**8.0**	13.0
22.	The experiments performed in the superconductivity course were interesting	3.0	5.0	**34.0**	**55.0**	3.0

Table 3 - Data from Pupils Questionnaire – boys (in %)

1.	**Male: 76**:					
2.	**Age: (16 years old – 23; 17 years old - 53)**					
		Strongly disagree	Disagree	Agree somewhat	Strongly Agree	Don't know
3.	I find the subject of physics interesting	2.0	7.0	**49.0**	**38.0**	4.0
4.	I find the subject of superconductivity interesting	13.0	18.0	**33.0**	**22.0**	14.0
5.	The SUPERCOMET materials are interesting	6.0	2.0	**39.0**	**49.0**	4.0
6.	The SUPERCOMET materials stimulate my imagination	9.0	22.0	**20.0**	**41.0**	8.0
7.	The SUPERCOMET materials are easy to use	4.0	6.0	**30.0**	**55.0**	5.0
8.	The SUPERCOMET materials are attractive	8.0	9.0	**37.0**	**41.0**	5.0
9.	The SUPERCOMET materials helped me to learn	9.0	10.0	**43.0**	**34.0**	4.0
10.	The SUPERCOMET materials offer meaningful experiences	8.0	8.0	**33.0**	**47.0**	4.0
11.	The quantity of text appearing in the SUPERCOMET materials is about right	8.0	10.0	**31.0**	**46.0**	5.0
12.	The text in the SUPERCOMET materials is easy to read and understand	8.0	7.0	**27.0**	**51.0**	7.0
13.	The quantity of images appearing in the SUPERCOMET materials is about right	7.0	4.0	**22.0**	**57.0**	10.0
14.	The images in the SUPERCOMET materials are clear and understandable	6.0	4.0	**37.0**	**50.0**	3.0
15.	The images in the SUPERCOMET materials explain the topic well	6.0	5.0	**45.0**	**37.0**	7.0
16.	The page design in the SUPERCOMET materials is good	7.0	9.0	**50.0**	**29.0**	5.0
17.	The movement in the animations in the SUPERCOMET materials and the speed of the screen changes are good	4.0	16.0	**40.0**	**36.0**	4.0
18.	The animations in the SUPERCOMET materials helped me to understand	8.0	12.0	**33.0**	**45.0**	2.0
19.	I found surprising things in the SUPERCOMET materials	**23.0**	**33.0**	**21.0**	**12.0**	11.0
20.	The SUPERCOMET materials promoted class discussions.	**30.0**	**30.0**	**20.0**	**12.0**	8.0
21.	The SUPERCOMET materials changed my attitude about some things	21.0	34.0	**23.0**	**12.0**	10.0
22.	The experiments performed in the superconductivity course were interesting	4.0	8.0	**45.0**	**39.0**	4.0

23.	
24.	Do you think that you have learned through using the SUPERCOMET materials? Please give reasons for your answer.
25.	List two things that you thought were good about the SUPERCOMET materials A B
26.	List two things that you thought were not good about the SUPERCOMET materials A B
27.	Would you recommend the SUPERCOMET materials for the other pupils? Give reasons for your answer.
28.	What should be changed/improved about the SUPERCOMET materials?
29.	In order to use the SUPERCOMET materials do you think you needed previous knowledge in using computers? Please give reasons for your answer. In order to use the SUPERCOMET materials do you think you needed previous knowledge in science? Please state what areas you needed knowledge in Please give reasons for your answer.

30.	Do you have any other comments about the SUPERCOMET materials:

Thank you for your answers

Table 1 - Data from Teachers Questionnaire (in %)

Teacher 7:

1.	**Male/Female: 1/6**				
	Not at all useful	A little bit useful	Quite useful	Extremely useful	Don't know
2. To what extent you consider the following parts of the materials useful for your teaching?			57.0	43.0	
Subject information (Superconductivity)			43.0	57.0	
Experiments			28.0	72.0	
Learning program			86.0	14.0	
Comment:					
	Not al all attractive	A little bit attractive	Quite attractive	Very attractive	Don't know
3. In your opinion, how attractive and interesting are the materials for your pupils?			72.0	28.0	
Subject information (Superconductivity)			86.0	14.0	
Experiments				100.0	
Learning program			57.0	43.0	
Comment:					

PARTNER: **<University of Ostrava>**

AUTHOR: **<Erika Mechlova, Libor Konicek>** DATE: **2007-10-10**

REVIEWER: **< >** DATE: **2007-10-10**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide

Teacher Seminar

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit

High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials – version .EN_SC2_computer_application_text_EN_20050513

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions: 2

- Length of sessions: 6
- Number of trainee teachers involved: 2, male 1, female 1
- Number of teachers involved: 10, male 7, female 3
- Number of students involved: 257, male 82, female 175
- Number of schools involved: 6

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

Teachers were introduced to the problems of SUPERCOMET project. They were interested in CD-ROM especially.

The Teacher Guide was not useful for them as they argued.

The Teacher Seminar gave survey of all materials and how to use its. We demonstrated only CD-ROM, we couldn't perform the Low-Tech hands on kit and the High-Tech hands on kit. Teachers wished to buy both kits.

The teachers saw that every teacher of physics knows how to use CD-ROM and that Teacher Seminar is not needed because of free using of CD-ROM in different ways.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

Teacher seminar was hold for 10 teachers by 2 trainee teachers. All physics teachers were graduated in Physics and in Teaching Training in Physics. As concern ICT all the Czech teachers passed courses of ICT literacy on basic or higher level in the so called "the State Information Policy in Education" (2001-2006).

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

Teacher Guide was not needed. Seminar was not needed and will be useful for demonstration of Kits.

3.4 What is your evidence for your response to question 3.3?

The teachers of physics are educated in physics and in teacher training in physics. They argued that Teacher Guide is not useful and Seminar will be needed for demonstration of Kits.

3.5 Why are these aspects useful? Why are the other aspects not useful?

The Teacher Seminar would be useful for presentation of Low-Tech hands on kit and High-Tech hands on kit.

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

The problems for solving by pupils in Physics lessons will be very useful if Low-Tech hands on kit will be at schools.

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?

Excess to computers is good for teachers and for pupils at schools. home

- Curricular values – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?

Content of CD-ROM is compatible with the national curriculum and the theme superconductivity was obligatory (recommendation 1 lesson) in the Curriculum that was valid to this time. Content of CD-ROM is compatible with the new national curriculum that is called the Educational Programme Framework for Grammar School (valid from 2007) and the Educational Programme Framework for Vocational Education (will be valid from 2008). On these basics the schools create now School Educational Programme and Electric conduction, Magnetism, Electromagnetic induction, are obligatory but it depends on school if superconductivity will be in this School Programme.

- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?

Using of CD-ROM in class contribute to achievement of learning goals strongly; it enhanced deeply understanding of electromagnetism by pupils, especially very sophisticated interactive animations in form of teachers demonstrations after real teachers demonstrational experiments. We couldn't estimate how long take to complete each module because of different using material, it depends on number of physics lessons per week and total number of lessons per week during study (from 6 to 12 lessons during secondary school). Many Vocational Schools have themes Electric conduction, Magnetism, and Electromagnetic induction in subject Electrotechnics and content CD-ROM is very useful for these parts. Pupils learned from CD-ROM in special ICT classroom at schools (special lesson of Physics take place in this) and pupils asked the teachers for access to this interactive programme.

- Motivation - Do students like working with materials? What do they like? What do they not like?

Pupils are like working with material on CD-ROM at school and at home. They like interactive animations; they don't like solving of problems.

- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

The highest interest had high ability pupils but all pupils were interesting in. We didn't investigate interest of boys and girls in whole sample of pupils.

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	Teacher – lessons of Physics, lesson of Electrotechnics Pupils - at home	Very good acces to computers, Compatible with national curriculum	Materials improved learning over all, deeper understanding	Pupils likes work with CD-ROM, with interactive animations	
4.2	CD-ROM Module 1 Magnetism		Teachers used in average in physics	Materials improved learning over all, deeper		

			lessons of 94 % - animations	understanding		
4.3	CD-ROM Module 2 Electromagnetic induction		Teachers used in average in physics lessons of 93 % - animations	Materials improved learning over all, deeper understanding		
4.4	CD-ROM Module 3 Electric conduction		Teachers used in average in physics lessons of 93 % - animations	Materials improved learning over all, deeper understanding		
4.5	CD-ROM Module 4 Introduction to superconductivity		Teachers used in average in physics lessons of 50 % - animations	Materials improved learning over all, deeper understanding	Motivation for Physics	
4.6	CD-ROM Module 5 History of superconductivity		Teachers used in average in physics lessons of 47 % - short survey of history			
4.7	Low-Tech hands on kit		N/A			
4.8	High-Tech hands on kit		N/A			

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

Evidences are in questionnaires of teachers, evidences follow from discussion with the physics teachers involved. Teachers of physics ask if can give pupils access to CD-ROM.

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: ‘Additional explanatory materials needed’, Teacher Seminar: ‘Further explanation of superconductivity needed’.)

		Suggested changes
5.1	CD-ROM - general	Support for other browsers than MS Explorer (Mozilla, Opera). Pupils have different types of browsers at home.
5.2	CD-ROM Module 1 Magnetism	
5.3	CD-ROM Module 2 Electromagnetic induction	
5.4	CD-ROM Module 3 Electric conduction	
5.5	CD-ROM Module 4 Introduction to superconductivity	
5.6	CD-ROM Module 5 History of superconductivity	Shorter and more understanding for pupils on CD-ROM.
5.7	Low-Tech hands on kit	N/A
5.8	High-Tech hands on kit	N/A

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Pupils cannot use access to CD-ROM at home. MS Explorer is at all the Czech schools in the frame of the State Information Policy in Education.

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

Only CD-ROM was used. The strategy of using is given School Framework Curricula and by experience of Physics teacher.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

All teaching methods and forms are using in practice in the Czech schools.

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

Textbooks of physics are different for different type of schools. CD-ROM is compatible with textbooks but order of lessons is different, the first theme is Electric conduction in all types of materials. The Czech physics teachers make real experiment and after this use interactive animation for deeper understanding of pupils; pupils work with interactive animation individually, or in pairs or in groups of four, and discuss this animation, afterwards solve given problems. Given materials on CD-ROM is easy integrated to the lesson scenario by physics teachers.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

Some of concepts are presented in the Czech textbooks different way to compare with SUPERCOMET CD-ROM, for example Ohm's Law.

6.5 How do teachers and/or students feel about these different methods of integration?

For teachers and pupils are these methods of integration normal.

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

The items of the Czech questionnaire for pupils and the Czech questionnaire for teachers give evidence, and evidence is support with interviews with teachers that were involved.

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

- Lesson of physics is in normal classroom. Teacher of physics uses interactive animation after real demonstrative experiment for deeply explanation of Physics phenomenon. Animations are very useful in part of the Czech curricula Electromagnetism because of many misunderstanding of pupills. In this case one computer and dataprojector are used, pupils give hypothesis before of changing parameters in animation, animation verify pupils hypothesis.
- The lesson of Physics is in computer classroom. Pupils work individually, or in pairs, or in small groups and solve problems prepared by teachers of physics or from the SUPERCOMET CD-ROM.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

The Czech pupils' questionnaire (226 pupils from 6 scchools all over the Czech Republic)

	Questions	**Percentage of pupils answers YES**	**Percentage of pupils answers NO**
1.	Were lessons of Electricity and Magnetism interesting with interactive animations from the Superconductivity program?	90	10
2.	Has you understood physics phenomenon with interactive animations of the Superconductivity program better?	77	21
3.	Has you recommended to create for the other part of physics programme with interactive animations as the Superconductivity program?	99	9
4.	Do you recommend the Superconductivity program for the others classes as suitable?	84	16
5.	Do you think that the Superconductivity program is enough for understanding physics without teachers´ explanations?	24	76
6.	Do you recommend the Superconductivity program for repetition of subject matter?	87	13
7.	Do you have possibility to work with the Superconductivity program individually?	76	24

The Czech teachers´questionnaire (10 teachers from 6 schools all over the Czech Republic)

1.	Is the work of physics teacher facilitated with the SC program in part of explanation phenomena? Answers: All answer yes, the pupils like to work with.
2.	In which parts of lessons is suitable to use the SC2 program? Answers: In all part sof physics lessons, expecially after demonstration of real experiments for deeper explanations, in repetition of subject matter, the best are interactive animation for deeper understanding and for solving problems as concern alternating current and field lines.
3.	Do you recommend to your colleagues from the others schools the SC2 program? Give evidence your answer! Answers: Yes. The subject matter is suitable for secondary school physics (pupils from 16 to18), subject matter is given understandable and well-arranged. Subject matter gives opportunity to work individually, e.g. repetition. Some of interactive animations can use if the real experiment cannot demonstrate. The videos in part Superconductivity replaces the real experiments if the Kit is not available. All animations are very vivid, e.g. from the part of the structure of mater and its properties (conductivity, superconductivity) or electromagnetic induction.
4.	Is the Teacher Seminar useful for qualified teacher of physics? Answers: No, all the secondary school teachers graduated from university physics a teacher

	training in physics and know how to use ICT. The using of the SC program is very intuitive.
5.	There is special Kit for demonstrations of superconductivity phenomena on the temperature of liquid nitrogen. Do you think that for your school will be ease to receive the liquid nitrogen? The Kit is expensive. Has you interest to buy this Kit? Answers: No, we have not access to liquid nitrogen and we don't know it is possible to use liquid nitrogen in secondary school as concerns safety of pupils, the expensive Kit don't buy school probably. One exception: Yes, I have superconductor and LN2 is no problem for us.
6.	Give percentage to the different parts of the SC program how you can use this part in your lessons. Answers: Module 1. Magnetism of conductor with current and permanent magnet: from 30 % to 100 % - average 90 % Module 2. Magnetism of solenoids and other materials: from 40 % to 100 %, average 95 % Module 3. Electromagnetic induction: from 30 % to 100 %, average 93 % Module 4. Electric current: from 25 % to 100 %, average 93 % Module 5. Introduction to superconductivity: from 15 % to 100% (special seminar), average 50% Module 6: History of superconductivity: from 10 %to 100 % (special seminar), average 47%
7.	Which modules of the SC2 program did you use in physics lessons? Answers: All modules but 5 and 6 in special seminar.
8.	Will you use the SC program in your lessons of physics? If yes, give number of modules, Answers: Yes, all modules 1, 2, 3, 4. Modules 5 and 6 in optional seminar and partly in lessons of phyhsics.
9.	Give briefly your opinions to the SC program. Answers: Pupils have access to internet at home but different browsers at home, only exceptionally Explorer, they cannot work with program at home. The pupils that could see real experiments in laboratory of low temperature at University were more interesting in the module 5 and 6.

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM – Test was given at the end of part Superconductivity to 17 years old pupils, 3 schools, 169 pupils)

Number of question	1	2	3	4	5	6	7	8	9	10	11
Perxcentage of pupils with right answers	64	60	78	75	48	36	62	77	80	75	66

- SC2_superconductivity_modules_test_short_20070423_HGM

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

All SUPERCOMET materials are very valuable for physics education**. Recommendation – all Universities with Teacher Training of Physics have to keep all SUPERCOMET materials (Kits) but not only CD-ROM.**

9.2 What is your evidence for your response to question 9.1?

We demonstrated SUPERCOMET project to future physics teacher at course at the University of Ostrava. Students wanted to see original materials that were developed for the secondary school but not this that are at the university in voluntary course Introduction to superconductivity.

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

Deeper understanding of physics contributes to women enhanced interest in physics especially.

9.4 What is your evidence for your response to question 9.2?

I have discussion on this theme (I am women) with university students – women. Many girls learn physics by heart without understanding and lost interest in physics in this way.

PARTNER: **University of Murcia** SPAIN

AUTHOR: **Lucía Amorós, Luisa Ma. Fernández, Miguel Cañizares, Francisco Esquembre, Francisco Martínez, Ma. Paz Prendes, Isabel Ma. Solano, José Miguel Zamarro (Coord)** DATE: **2007-10-20**

REVIEWER: **< >** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **B**

INDEX

1 Introduction

Content of this report is derived from experiences with materials of SUPERCOMET2 (SC2) that have served for teachers training and for education in class. This work has been organized by the equipment of the University of Murcia, in collaboration with the Institute of Secondary Education Juan of the Cierva and Codorniu, located in the Region of Murcia.

This report is separate from the expert review of the materials that we and others have already carried out, and which we have already reported. The SUPERCOMET materials examined in these trials include four resources SC2 examined in the set of experiences.

For one hand, **Teacher Guide** is digital (pdf) and printed. For the other, **Teacher Seminar** has been very useful resource to planning teacher training. It was distributed in digital format, it using documents with processor of texts and visual presentations. Moreover, we have used **CD-ROM** available in a new version that contains 6 modules. This version has been object of study in the Region of Murcia (Spain). Its structure appears in table 1.1. Finally, we used **Low-Tech hands on kit and High-Tech hands on kit**.

Table 1.1: CD-ROM Structure. Study at Region of Murcia (Spain)

New version	Earlier versión
Module 1: Magnetism	Module 1: Magnetism currents and magnets
Module 2: Electromagnetism induction	Module 2: Magnetism of coils and materials
Module 3: Electric conduction	Module 3: Electromagnetic induction
Module 4: Introduction to superconductivity	Module 4: Electric conduction
Module 5: History of superconductivity	Module 5: Introduction to superconductivity Module 6: History of superconductivity

The organisation may not have carried out trials of all materials. In that time simply we enter N/A (not applicable) in any parts of the report that we have no data for.

We are asked to provide evidence for our answers – these has been brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report we will need to expand the boxes for our replies as appropriate for our answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in our organisation then we had needed to state this clearly.

2 Description of trials

This section describes uses of educational resources in learning contexts. In item 2.1 we indicate versions used in the experiences for. Item 2.2 shows a brief description of any trials carried out.

We work with two experiences of different nature, we described both. Of a side, the experience of teacher training is described (item 2.2.1) where has been used the Teacher Seminar and the High-Tech hands on kit. From another side, we have described use in the classroom (item 2.2.2), with students of secondary education. Here it has been used CD-ROM and Low-Tech hands on kit of SC2.

2.1 Please state which version of the materials you used in the trials

Below we show the SC2 resources used (table 2.1). Next items described CD-ROM, Teacher Guide and Seminar.

Table 2.1: Description of experiences. Version of resources used

CD-ROM – general	Copyright © 2004 by Simplicatus AS, Richard Birkelands vei 2b, 7491 Trondheim, NO
Low-Tech hands on kit	Own development
High-Tech hands on kit	Own development
Teacher Seminal	Copyright © 2004 by Simplicatus AS, Richard Birkelands vei 2b, 7491 Trondheim, NO
Teacher Guide	Copyright © 2004 by Simplicatus AS, Richard Birkelands vei 2b, 7491 Trondheim, NO

2.2 Please give a brief description of any trials carried out

This item includes both trials in teaching teachers and classroom trials. As appropriate, we indicates in our descriptions number of sessions, length of sessions, number of trainer teachers involved (giving numbers of male and female trainer teachers), number of teachers involved (giving numbers of male and female teachers), number of students involved (giving numbers of male and female students) and number of schools involved. If we give not exact answers to these questions, so we give our best estimate.

2.2.1 Training Teachers: Experience

Training teacher was in a seminar. Goals were: A) Work with teachers of secondary education which, normally and as well, they worked with students between 14/15 and 17/18 years old. B) Show CD-ROM SC2. C) Consider theirs points of view from keeping two objectives: for one side, considering if to them is possible use materials in the classroom; for the other, how is possible to them integrate superconductivity contents inside curriculum.

Session was done February - 23rd of 2006, between 16:00 to 20:00 hours, at the Faculty of Mathematics of the University of Murcia. They were 37 teachers (gender N/A; number of schools N/A). Area of contents that teachers usually teach was Physics, Chemistry and Technology. All of them worked in centres of secondary education.

Contents and methodology: 1) Introduction on the superconductivity, deepening in this concept and exploring its scientific bases and technological applications. 2) Pedagogical aspects in computer uses. We proposed uses of the computer focusing the constructivism way. 3) Show the elaborated material (CD and kit). Teachers take role-playing from pupil while speakers advise about their uses in the classroom.

Speakers: 1 university professor of physics, 1 titular doctor of mathematics (both men) and 1 educator, doctor and assistant (woman). Finally, she was not there by incompatible timetable. To registry and offer pedagogical support 1 educator in doctoral period of training was there (woman), then.

2.2.2 Use in the classroom: Experience

The experience was developed in May-16 to 26 of 2006. It was with students of Physics, in the first course of International Secondary Education (Bachillerato Internacional, I.E.S. Juan de la Cierva y Codorniu) in Totana (Region of Murcia). Experience implied 11 students, men, of social extraction average and 1 teacher, man, with more than ten years of teaching in secondary education (see table 2.2).

Table 2.2: Description. Use media in the classroom. Interesting dates

Sessions, Number	7 (of 11)
Sessions, Time	55 minutos*
Trainer Teachers, Number/ with gender	N/A
Teachers, Number/ with gender	1/ MEN
Students, Number/ with gender	11/ MEN
Centres, Number	1

Academic motivation of the students was superior to the average of students of his/her ages. This juice is based students take his personal decision, voluntarily, to course International Secondary Education, with higher competences than common Secondary Education.

Sessions (11) had different nature and session length varies. Taking care of the purpose of this report, 7 were the sessions destined to the use of media in the classroom. Use in the classroom is considered to work with CD-ROM and hand on kit with the students inside the classroom environment. Of the 5 sessions destined to use of SC2´media, 4 sessions needed 55 minutes (*) whereas 1 (Thursday May-18th) lasted 60 minutes and 2 two for experimental work measuring resistance at laboratory. Moreover, 4 sessions were dedicated to media evaluation (2 sessions) and to evaluate learned contents (2 sessions).

3 Teaching the teachers

Teacher training of Obligatory Secondary Education and Bachillerato was thanks Seminar (item 2.2.1). It was coordinated by Ricardo de la Casa, director of Center of Teachers and Resources in Lorca (municipality of Murcia).

Seminar aims were: of one hand, help to overcome fears of teachers inside classroom when they decided use ICTs in the classroom; in particular integration of content with hypertext/hypermedia characteristics. Hypertext favours exploration and autonomy. Hypertext is friendly to navigate between information and use. Nevertheless, seminar will help to use media with expert, of confidential environment. Of another hand, it shows different ways to teach Physics, thinking in methodologies. Finally, the last aim is offer inspiration to continue teaching Physics, and to extend this motivation to his/her students.

In the registry of the seminar three phases are identified: 1) Exhibition of project SC2 and multimedia materials (CD-ROM and Teacher Guide); 2) Show in practice the superconductivity phenomenon; 3) Use of media in the classroom.

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context

Training teachers made with adaptations from suggested timetables from SC2. Presentation program indicated that the result of SC2 is the elaboration of one work-guide, next to Teacher Guide, for teachers use in classroom. Medias offered by SC2 were multimedia CD-ROM and one hand on kit. It was necessary analysis of teachers about new topics on Physics teaching and ICT in classroom. Followed program was:

● Introduction of seminar: talking about SC2 and its aims, showing objectives of the seminar, details of SC2 in Murcia and how the superconductivity could motivate teaching physics. Visual presentation used was "Introduction to seminar of teachers" adapted from "SUPERCOMET_teacher_seminar_EN_1_introduction" file.
● What is the superconductivity: showing "Teacher seminar superconductivity presentation" using CD-ROM module "Introduction to superconductivity"
● Using ICT in physics teaching: we adapted visual presentation "*Teacher seminar using ICT*" after the translation of English language to Spanish. It was necessary to introduced SC2 media in curriculum of teachers from Secondary Education at the Murcia Region. This information were saved keeping the idea of "Teacher seminar lesson plan".
● Show CD-ROM and hands on kit.
● Low-Tech hands on kit in real teaching context: if was necessary we offered 5 experiences (document offered from SC2).

Finally, we build a list of conclusions together.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT)

<u>Training Teachers of Obligatory Secondary Education and Bachillerato. Summons: Center of Teachers and Resources of Lorca (Murcia). Date: 23 of February of 2006. Assistance: 37 teachers.</u>

Phase 1: Project SC2 introduction and multimedia media SC2. We facilitated to teachers a provisional copy of CD and a guide, also provisional.

Phase 2:Show superconductivity phenomenon (see table 3.1). Item 4.7.2.

Table 3.1: Superconductivity

Phase 3: Use media in the classroom (CD-ROM multimedia). It is review the modules 1 to 6 of the CD. Later, the teachers are divided approximately in teams of 5 people, grouping by subjects and/or courses that they are teaching, actually. They identify their delegates (see table 3.2).

Table 3.2: Curriculum mapping activity File: SUPERCOMET_teacher_seminar_EN_3_curriculum_mapping
<u>SUPERCOMET Teacher Seminar - Curriculum mapping activity</u> **<u>Objective of activity</u>** This exercise is designed to help the delegates become familiar with the contents of the SUPERCOMET CD-ROM and how it can be used to deliver their own curriculum.

The number of groups we had depended to some extent on the number of curricula we have to map too. The idea was have a number of different national-regional curricula, so we would try and get one group working on each curriculum. We tried as far as possible to place delegates in groups that were of particular relevance to them.

We ask each group finding curricular subject areas or learning objectives that can be taught through SUPERCOMET. Encourage them to consider the 'softer' targets, such as "*show awareness of the limitations inherent in scientific activity*" as well as the more knowledge-based objectives like "*State the factors which affect the size of the induced voltage, ie field strength, number of turns on a coil, relative movement*." We include possibilities with hardware too, according with characteristics of centres of everyone. 20 minutes spent to debate and show in common and in great group ideas. We ask them to designate a recorder who will very briefly feed back their findings to the group.

Iindications in the case study of the number of teachers/trainee teachers N/A. Teacher's backgrounds in Science and ICT N/A.

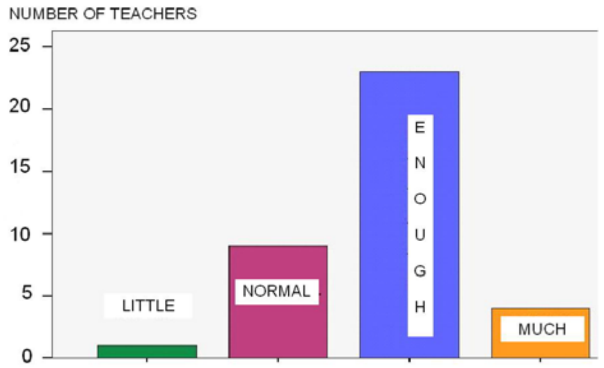
3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in our national context?

18,9% of teachers think that the seminar has shown many ways to do different Physics teaching. 37,8% consider that enough.

Seminar offers a use of the quite constructive computer for the 62,2%. 10,8% consider that it has been very useful (see table 3.3) and a 24.3% that is normal.

40,5% thinks that the seminar inspires enough to continue giving classes and to extend motivation to the students. 18,9% consider that it inspires much.

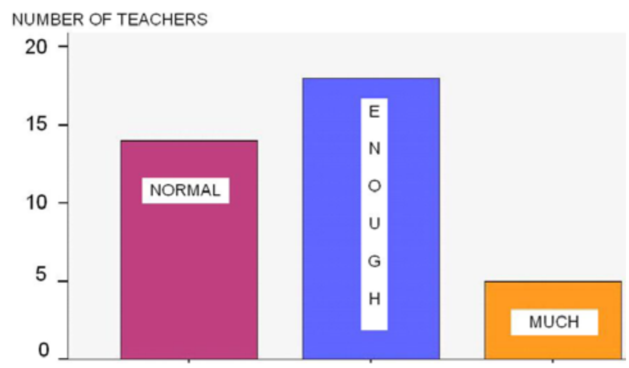
Table 3.3: Constructive use of computers, thanks Seminar - Guide



48,6% of teachers think that seminar is very useful to know SC2 media. 13,5% considers that it allows much it (table 3.4). 37.8% think it was normal.

Seminar deepens enough in detail on the phenomenon of the superconductivity for a 48.6%. 10,8% consider that much is deepened. Of the 37 teachers asked, 3 (8.1%) considers that little has been deepened. 32.4% the normal thing. 43,2% shows that seminar has allowed him/her to explore superconductivity phenomenon with exciting form enough and 13,5% that has allowed much to him/her. Normal thing is for 40.5%. About possibilities will be good to see item 4.7.2 of this report.

Table 3.4: Knowledge about media uses, thanks Seminar - Guide



3.4 What is your evidence for your response to question 3.3?

Interview, following Walker (1985), recognizes explanations of our conduct on the reflection of our actions. Questionnaire is considered like a formal, streamlined interview. Formally, it is similar to an expensive interview face to face, only that questionnaire is done without the presence of the researcher. Between his advantages it emphasizes that potentially it implies an identical stimulus to numerous subjects. The disadvantages have to do with the production of data in mass and the lack of interpretation opportunities.

Questionnaire is made up of 7 items with scale of Likert valuation. Internal items took like departure point the objectives and topics to the Project (available in http://www.simplicatus.no/web.php?action=subpagelevel2_view_single&pk=42).

Likert scale measures attitudes and is the most popular model and intuitive (Rojas et. al, 1998). The degree in agreement or discord with the statement is asked for to the subject. The obtained score informs into the position of the interviewed one with respect to the study object. Prendes (1994) indicates that the objects are used with the purpose of generating data in the subjects, improving scale-information. The scale can have different number of answer options. Usually five categories have been used and it has been verified that are equally valid (see table 3.4).

Table 3.4: Likert scale. Categories

1	2	3	4	5
Much	Enough	Normal	Fairly	Nothing

For the analysis of data has been used SPSS program (Statistical for Package the Social Sciences), in its 13 version. Analysis descriptive is unvaried, with direct readout of qualitative variables or that allows a treatment like such (variable with ordinal scale or of interval), calculation of frequencies and percentage.

3.5 Why are these aspects useful? Why are the other aspects not useful?

N/A

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

N/A

4 Classroom materials

We used all media of SC2. Classroom material are determined in terms of: possibility of use, curricular value, academic achievement, motivation and differential impacts on specific groups of students in high/average/low ability pupils when they were registered.

4. 1 Use media in the classroom: determination

In table 4.1 (see next page) there are three of five media used: CD-ROM, Low-Tech hands on kit and High-Tech hands on kit. Teacher Guide and Teacher Seminar are not included. Both have worked in the previous section. At this moment, we determined a general use of CD-ROM and, too, a particular use focused in the modular content of the CD.

4.1.1 CD-ROM - general

Possibilities of use: Hall Exhibitions and Fair, classroom and Teacher Training Seminar.

Curricular value: in the Exhibitions Hall and Fair it is appraised according to documentary sources. In the classroom and seminar it is registered using questionnaires.

Table 4.1: SC2 in Teaching

Ítems below	Media in Teaching	Dimensions				
		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impacts
4.1.1	CD-ROM - general	Exposition Hall, Fair	N/A	N/A	YES	N/A
		Training Teachers: Seminar	YES	YES	YES	N/A
		Use media in the classroom	YES	YES	YES*	YES
4.2	CD-ROM Module 1: Magnetism currents and magnets	Training Teachers: Seminar	YES	YES	YES	N/A
4.3	CD-ROM Module 2: Magnetism of coils and materials	Training Teachers: Seminar	YES	YES	YES	N/A
4.4	CD-ROM Module 3: Electromagnetic induction	Training Teachers: Seminar	YES	YES	YES	N/A
		Use media in the classroom	YES	YES	YES	YES
4.5	CD-ROM Module 4: Electric conduction	Training Teachers: Seminar	YES	YES	YES	N/A
4.6	CD-ROM Module 5: Introduction to superconductivity Module 6: History of superconductivity	Training Teachers: Seminar	YES	YES	YES	N/A
4.7	Low-Tech hands on kit	Exposition Hall, Fair	YES	YES	YES	N/A
		Training Teachers: Seminar	YES	YES	YES	N/A
4.8	High-Tech hands on kit	Exposition Hall, Fair	YES	YES	YES	N/A
		Training Teachers: Seminar	YES	YES	YES	

Academic achievement: in classroom it is registered using questionnaires. Differential impacts can see at the item 2.2.2.

About possibilities of use, curricular value, academic achievement and motivation with the CD-ROM in Exhibition Salon and Fair we offered a useful resource before new ways to teach physics. It was accompanied with an audio-visual presentation of own elaboration.

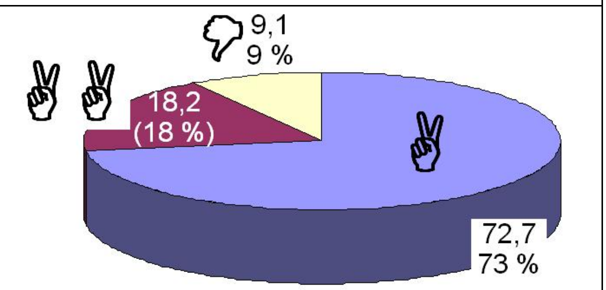
We gave information by propaganda of SC2 and teachers' seminar. Additional material resources were colour paper, text printed and processor. 2 experts were needed to the exhibition space: 1 expert of physics science and 1 expert in methods and resources in teaching-learning. To show SC2 CD-ROM and the simulations we used 2 computers.

For audio-visual presentation of own elaboration it was needed a multimedia computer, with audio and one data show. Audio-visual presentation contains images and explanations of SC2 resources integrating pedagogical aspects as well as physics sciences content. Presentation includes voice of narrator and music. About the possibilities of use thinking in the CD-ROM can see item 3.3. About the experience of the students we recommended next paragraphs.

4.2 from 4.6 CD-ROM with modules 1 to 5

Module 3 "Electrical Conduction" has 31 animations. The objectives are that the students learn the concept of electrical conduction to use suitably the terms (conductor, semiconductor, insulator, resistance, resistivity, conductivity, cross-sectional section) and to identify and to represent by means of schemes simple circuits of current. It is hoped that the students describe relation between kinetic energy of the network (material's temperature) and the resistance, differences between continue current and alternates in terms of carriers of loads and electric fields, relations between voltage, current and resistance (Law of Ohm) and relations between resistance, cross-sectional section, length and resistivity of the material.

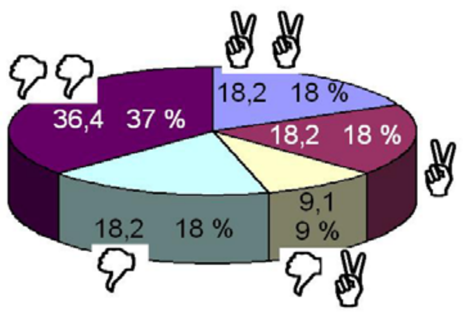
Table 4.2: Computer like work-tool. Domain



About possibilities of use, curricular value, academic achievement, motivation and differential impact, it is possible to say that module 3 has been object of study by the investigating equipment, with 1 teacher and 11 pupils. Average final qualifications in the physics subject have been of 6.5 points. Only 3 of them have obtained inferior qualifications to 5 points.

Most of the students have a good predisposition to use the computer, since they consider that it is very useful and quite effective. All have computer in house. The majority of the students use the computer every day. The utility that they give him is mainly for playing, makes they works and to study. Other tasks for which they use it are: chat, instantaneous mail (Messenger explicitly), to listen music, see DVD and to sail by Internet. Most of the students consider that they can handle the computer without problems and a smaller number declares to have a good dominion of the computer. Only one pupil affirms to have some difficulties (table 4.2).

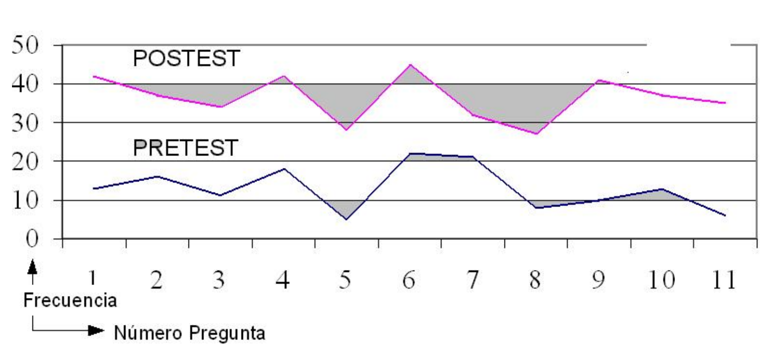
Table 4.3: About multimedia knowledge



All the students know processor text software, spreadsheets, drawing programs and videogames. They know little data bases, simulations, tutorial, hypertexts and multimedia (table 4.3). By order of greater at smaller level of knowledge they are identified: text processor software, spreadsheet, hypertext, data base and drawing tools.

It was elaborated a notebook-guides of activities, that the students had to make simultaneously they sailed by the simulations. Educational process lasted 5 sessions of class and two practical sessions. Observation was carried out in 2 sessions of class concluding that as soon as the students asked them and the companions about the computer, and they asked little about the multimedia and the activities that they are making. All students used notebook guides and took notes.

Table 4.4: Learning. Initial and final results. Comparation



Class atmosphere was very calm and pleasant, enough individual, quiet and motivator. During class sessions pupils were trims in the interaction with the material. Only in any occasion teacher took part to explain.

With respect to the learning of the students, advance of knowledge has taken place on the questions of electrical conduction (table 4.4). The average of the learning results happens of 13.0 in the initial questionnaire to 36.4 points at the end. Students advances in learning 23,4 points.

If we stop in all the module, around half of the pupils considers that the study of the conductivity with SC2 has been in certain interesting way, comprehensible and attractive, followed of a group of the students who have better valuation on the matter. All think that the animations facilitate understanding of the conductivity and most manifest that media SC2 acts as if outside they tutor. The meaning positive which the students give to the CD it is thanks: good images of the application, interactivity, interesting contents, very manageable and simple utility, easy to understand, it allows the understanding of contexts, with summarized content, explanatory, has many animations and it is of quality. Modules 1, 2, 4 and 5 N/A.

4.7. High and Low-Tech hands on kit

About the possibilities of use, the kit has been used in 2 cases. In both uses there are curricular value, academic achievement like a goal and motivation. Differential impact has considered within the use "exhibitions, fair" when we was working with two experts (1 man, 1 woman).

<u>4.7.1 Exposition Hall, Fair</u>

At VII edition of Salón del Estudiante of Lorca (exhibition), and in the pavilion Todo100cia, the kit allows to demonstrations and experiments. The event tries to motivate and to delude to learn sciences. Moreover it tries to favour the pupil-researcher roll, in the Spanish state. Objectives of the event: professional direction, educational contents and learning based on the game.

Table 4.4: Digital newspaper La Verdad.es. February – 18th, Saturday, of 2006
http://servicios.laverdad.es/extras/salonestudlorc06/

SALÓN DEL ESTUDIANTE

LA VERDAD / SÁBADO 18 DE FEBRERO 2006

Respuesta formativa

INFORMACIÓN. Esas son las claves del 'Salón del Estudiante' que cada año intenta **dar respuesta a la gran demanda de formación educativa y profesional que plantean los estudiantes** que lo visitan

LOS DATOS

- **Certamen:** Salón del Estudiante.
- **Edición:** Séptima.

T. MARTÍNEZ / P. WALS

Este año las cifras de visitantes podrían superar las del pasado año, en torno a los

La inauguración oficial del Salón del Estudiante se celebró en la mañana del pasado jueves. Un grupo de calle puso la nota de humor previa al corte de cinta que ejecutó

estos días. Tampoco dejaron de sorprenderse con las propuestas del pabellón Todo 100cia donde se demuestra que la ciencia y la física pueden resultar divertidas.

Formación, información y orientación, vuelven a ser los preceptos de un certamen que está «totalmente consolidado», palabras que salían por boca del alcalde de Lorca que se mostraba satisfecho porque en sólo siete años el Salón del Estudiante y Lorca suenen a nivel nacional. «Esto se demuestra cuando son las universidades las que acuden a nosotros para participar. Estoy hablando de universidades de prestigio reconocido. Quieren estar

The fair is to students of primary and secondary education, university, parents and mothers, educators, teachers, professors, classrooms and others. The necessary space is 3 m. x 6 m. is needed 1 pulls, 1 webcam and 1 videoproyector. Webcam gathers the movements of the professor who works with the suitcase (kit). With videoproyector their movements project on wall or screen, in tenuous space.

Personal resources: 1 expert in educational technology (educator) x 2 days. Budget: 120 euros x day financed by OTRI (UMU). 1 expert in physics teaching x 1 day. In this case teach and showed a professor, without pre-established schedule, with communicative abilities within flexible groups and with knowledge about personal security to work with liquid nitrogen.

Curricular value, academic achievement and motivation were determined from institutional indirect documentary sources as institutional webs and newspapers (see table 4.4 down and 4.5 below). Personal testimonies are satisfactory but they have not been registered.

4.7.2 Teacher Seminar

February- 23rd of 2006, at 16 to 20 hours, the Seminar to training teachers was carried out in the Faculty of Mathematics at the University of Murcia. Title of this event was "Presentación de SUPERCOMET 2. Los Superconductores en el Aula de Secundaria". (idea: offer an attractive title, in this case is like superconductors were people and these visitants stay in a secondary classroom for a time).The second phase was dedicated to show superconductivity phenomenon.

Table 4.5: Web de EDUCARM. Portal educativo de la Región de Murcia
http://www.educarm.es/

It had a demonstrative representation of the superconductivity phenomenon using kit: liquid nitrogen, the suitcase or kit, 1 container, 1 webcam, 1 notebook and 1 videoproyector (datashow). Part of the equipment takes shelter in table 4.6.

Table 4.6: Resources to superconductivity show

The interested teachers directly made the experiment with their hands. Curricular value, academic achievement and motivation are determined in items 3.2 and 3.3.

4.8 What is your evidence for your responses to questions 4.1 to 4.8?
We have used a questionnaire to teachers interviews (about seminar, CD and kit). Items were about objectives and topics from SC2 (item 3.4 of this report). With the students (module 3) it was used: questionnaire for the measurement of attitudes and abilities towards the computer, questionnaire for the evaluation of the multimedia, registry of observable conducts (adapted protocol REGICOB) and questionnaire for the evaluation of the learning. Last one was facilitated by Doctor Erika Mechlova (Poland). On the general CD, evaluation of experts registered with the questionnaire "Tool of evaluation of multimedia didactic", available in English thanks to SC2, published by Pixel-Bit (number 18, year: 2002) and available in Spanish in
http://www.sav.us.es/pixelbit/articulos/n18/n18art/art187.htm.

Finally, with CD-ROM (items 4.1.1 and 4.4) we have used questionnaire and registry of observable conducts. With kit (item 4.7) we used researcher diary, activities reports, propaganda (table 4.7) and photographs.

Table 4.7: Seminar´s propaganda. Fragment

PRESENTACIÓN

En la conferencia de " Physics on Stage", desarrollada en el CERN en Noviembre de 2000 se advirtió de la existencia de una crisis en la formación científica de los escolares europeos, y de la necesidad de revitalizar y reorientar la enseñanza de la Física.
El proyecto SUPERCOMET trata de contribuir a esa revitalización, y combinando métodos de la moderna Pedagogía(aprendizaje colaborativo o la enseñanza a través de la resolución de problemas, p.e.) con la utilización de las TIC, y el empleo adecuado del laboratorio, ayuda a conectar el fenómeno de la superconductividad (de gran actualidad) con los currículos escolares de varios países europeos.
El resultado del trabajo de este grupo es la elaboración de una guía de trabajo , junto a la guía del profesor para su utilización en el aula , materializadas en un CD y un kit de laboratorio, que se presentarán al profesorado en este Seminario, para trabajar con ellos tras un análisis de los tópicos de la enseñanza de la Física con TIC, y de la superconductividad.
Se entregará el material correspondiente

OBJETIVOS

- Ayudar a vencer los miedos que el profesorado pudiera tener cuando utiliza las TIC. La aplicación permite una exploración realizada por uno mismo y fácil de usar.
- Mostrar caminos diferentes de la enseñanza de la Física. Aunque las TIC las hayamos utilizado desde hace tiempo, las instalaciones para la enseñanza de la Física por lo general no están preparados de equipamiento ni se conocen las ventajas que las TIC pudieran tener, al menos en la enseñanza secundaria de nivel superior.
- Inspirar a los profesores para aprovechar las potencialidades de las TIC, y extender esta motivación a sus estudiantes, aprovechando el impacto social de un tema de tanta trascendencia social como los superconductores.

PROGRAMA

Introducción al seminario.(Charla acerca del proyecto SUPERCOMET, sus objetivos); los objetivos del seminario, los detalles en cuanto al SP en Murcia. Cómo la superconductividad puede solucionar algunos de los problemas en la enseñanza de la física. *(Presentación en Power Point de la Introducción al Seminario de Profesores)*
Qué es la superconductividad *(Presentación del Seminario de Profesores sobre Superconductividad)*
(Uso de las TIC en la enseñanza de la física. *(Seminario de Profesores utilizando TIC)* Repaso del currículo: Los profesores se reúnen en grupos para trazar su propio mapa de plan de introducción del tema en el currículo escolar. ** Este plan deberá guardarse en el disquete del profesorado.*
Presentación de CD y Kit: vídeo clips y advertencias sobre el uso del nitrógeno líquido. *(Presentación práctica "hands-on"del Seminario de Profesores)*
Prácticas con el Kit: Las 5 experiencias CONCLUSIONES

In Exposition Hall and Fair (item 4.7.1) we resorted to indirect documentary sources as digital newspaper (see table 4.4) and webpages (Web EDUCARM, see table 4.5). Moreover, we use the researcher diary (see table 4.8) and performs of internal activities.

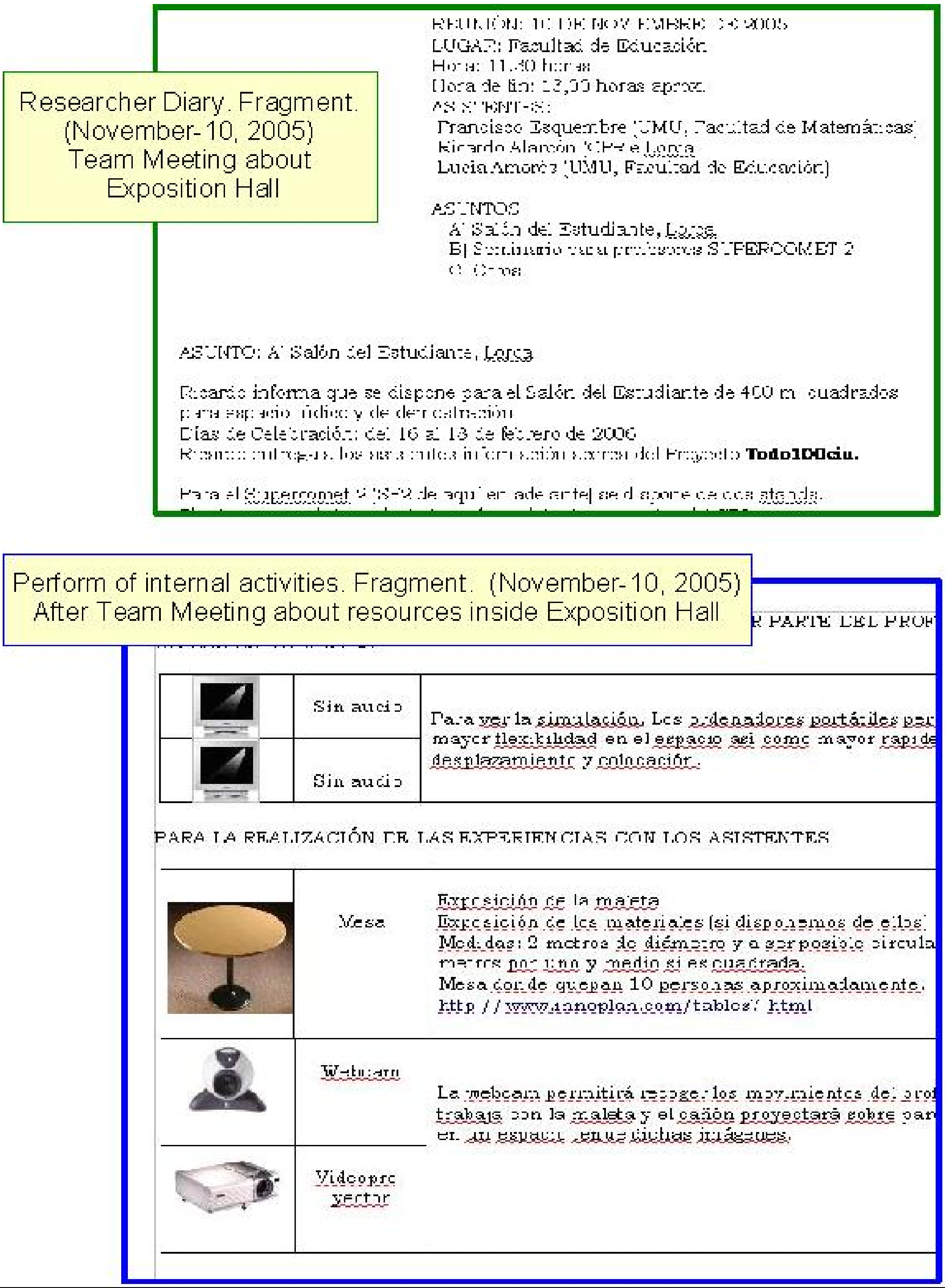
We have products of own elaboration as propaganda, audio-visual presentation and photographs. Audio-visual presentation served to spread SC2 beyond the national context as International Congress EDUTEC 2005 (Santo Domingo, Dominican Republic) celebrated from 14 to 16, February of 2006 (http://www.um.es/edutec/).

For the Seminar (item 4.7.2) questionnaire was used, internal perfom as "Report of the seminar with teaching staff referring to SUPERCOMET2 project" and advertising propaganda to participate inside Teacher Seminar (table 4.7).

5 Changes in classroom materials

We briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit) should be changed or added to so as to be of greater use in our national context.

Table 4.8: Research Diary and Perform of Internal Activities. Fragments.



Researcher Diary. Fragment. (November-10, 2005) Team Meeting about Exposition Hall

REUNIÓN: 10 DE NOVIEMBRE DE 2005
LUGAR: Facultad de Educación
Hora: 11.30 horas
Hora de fin: 13,30 horas aprox.
ASISTENTES:
Francisco Esquembre (UMU, Facultad de Matemáticas)
Ricardo Alarcón (CPR de Lorca
Lucía Amorós (UMU, Facultad de Educación)

ASUNTOS
A) Salón del Estudiante, Lorca
B) Seminario para profesores SUPERCOMET 2
C) Otros

ASUNTO: A) Salón del Estudiante, Lorca

Ricardo informa que se dispone para el Salón del Estudiante de 400 m cuadrados para espacio lúdico y de demostración
Días de Celebración: del 16 al 18 de febrero de 2006
Ricardo entregará los materiales información acerca del Proyecto **Todo100ciu.**

Para el Supercomet 2 ... se dispone de dos stands.

Perform of internal activities. Fragment. (November-10, 2005) After Team Meeting about resources inside Exposition Hall

	Sin audio	Para ver la simulación. Los ordenadores portátiles ... mayor flexibilidad en el espacio así como mayor rapide... desplazamiento y colocación.
	Sin audio	

PARA LA REALIZACIÓN DE LAS EXPERIENCIAS CON LOS ASISTENTES

	Mesa	Exposición de la maleta Exposición de los materiales (si disponemos de ellos) Medidas: 2 metros de diámetro y a ser posible circula... metros por uno y medio si es cuadrada. Mesa donde quepan 10 personas aproximadamente. http://www.... .com/tables/...html
	Webcam	La webcam permitirá recoger los movimientos del prof... trabaja con la maleta y el cañón proyectará sobre par... en un espacio ... dichas imágenes.
	Videoproyector	

We no not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.

5.1 to 5.8 Suggested changes

Supporting us of the table 5.1 changes suggested of general way, according to the students, they talk about the necessity to finish content in certain sections of the CD-ROM and the explanation of concepts. Also they notice that exercises need practitioners as theoretical as much (numerical). They missed a personal work-guide and audio inside CD-ROM.

Table 5.1: Changes in classroom materials

	MEDIA IN TEACHING	SUGGESTED CHANGES
5.1	CD-ROM - general	Pupils about multimedia: 1) Any parts are incompletes. Its need more content 2) Any concepts are not finished. Explications are incompletes 3) It need more exercises, with numbers and practices 4) Do not exist a personal work-guide 5) Do not exist sound and/or audio feed-back
5.2	CD-ROM Module 1: Magnetism currents and magnets	N/A
5.3	CD-ROM Module 2: Magnetism of coils and materials	N/A
5.4	CD-ROM Module 3: Electromagnetic induction	N/A
5.5	CD-ROM Module 4: Electric conduction	1) Computer alphabetization 2) It was necessary had materials with additional explications 3) It was necessary scholar material to had
5.6	CD-ROM Module 5: Introduction to superconductivity Module 6: History of superconductivity	N/A
5.7	Low-Tech hands on kit	N/A
5.8	High-Tech hands on kit	N/A

About module 4 "Electrical Conduction" it is interesting changes as much in personal resources as training materials. In other words, 1 student recognizes his difficulty at the time of using the computer. In general, additional use was made as much of explanations of the teacher as of support materials (exercises guide and paper for notes). About Low-Tech hand on kit N/A.

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Directed to the students: "Questionnaire of attitudes and knowledge on computers", "Questionnaire of evaluation of educational multimedia software (EVALALU)". In classroom observation we use an adaptation of REGICOB protocol. The procedures for conclusions elaboration were: content analysis, scales (semantic Differential of Osgood and Attitudes Scale of Likert), and schematic matrices of data and diagrams (conceptual maps and flow charts). For the analysis of quantitative data the package for the statistical treatment of data SPSS 12 was used.

6 Use in the classroom

Activity was developed referring to the integration of SC2 CD-ROM in the curriculum thanks actions inside Teacher Seminar. This phase we dedicated to mapping curriculum. Activity was designed to help the teaching staff to become familiar with the content of the CD-ROM and the methodology in which teachers can use software integrating own curriculum. About methodology (A, B, C and D) you can see item 6. 2. The modular structure (modules 1 to 6) is:

- M1 Module 1: Magnetism of currents and magnets
- M2 Module 2: Magnetism of coils and materials
- M3 Module 3: Electromagnetic induction
- M4 Module 4: Electrical conduction
- M5 Module 5: Introduction to the superconductivity
- M6 Module 6: History of the superconductivity

Table 6.1: Use SC2 CD-ROM in the classroom by courses, areas and methodology

COURSE			AREAS	CD-ROM SC2 CONTENTS						METHODOLOGY			
				M1	M2	M3	M4	M5	M6	A	B	C	D
Common Secondary Education (ESO)	1º Cicle	1º	TECHNOLOGY				•	•		•			
		2º	PHISIC & CHEMIST	•	•			•		•	•		
	2º Cicle	3º	TECHNOLOGY			•	•			•	•		
			PHISIC & CHEMIST			•	•	•				•	
		4º	TECHNOLOGY			•	•	•				•	
			PHISIC & CHEMIST	•	•	•	•	•		•	•		
			PROFESIONAL INICIATIÓN ELECTRICITY-ELECTRONIC		•	•	•	•		•	•		
Secondary Education (BACHILLERATO)		1º	TECHNOLOGY			•	•	•		•	•	•	•
			SCIENCE, TECHNOLOGY & SOCIETY	•	•	•	•	•	•	•		•	
			PHISIC & CHEMIST	•	•			•		•	•	•	•
		2º	TECHNOLOGY		•	•	•	•		•	•	•	•
			PHISIC & CHEMIST	•	•	•	•	•	•	•	•	•	•

6.1 How are the classroom materials used in practice?

Briefly we describe the use of classroom materials as CD- ROM and low-Tech hand on kit in our national context. It appears in two moments: A) Teacher seminar; B) classroom. Every one is explained below.

6.1.1 Teacher Seminar: class

About the activity referring to integration of SC2 CD-ROM in the curriculum, it is possible to gather some reflections thanks training teachers. Software seems very useful that the students visualize phenomena that habitually come gathered in the text book. Also it is useful so that they can appreciate importance of models like an explanation too of the reality. Moreover, it is possible to explain theoretical contents, for the accomplishment of practical exercises and to observe experiments that could not be made in the laboratories. SC2 CD-ROM is excellent to include/understand and to visualize electromagnetic phenomena with no need to have great amount of materials. It is an agile material, sure easy to handle by the student and very interactive.

High-Tech hands on kit description is in item 4.7.2.
Kit evaluation attends teachers N/A.

6.1.2 Use SC2 CD-ROM in the classroom

Experience has been made from the didactic unit on electrical conduction (module 3) using SC2 CD-ROM. For evidences it was used: "Questionnaire of attitudes and knowledge about computers", "Questionnaire of previous evaluation of knowledge on the subject to study, conduction", "Pupils work with multimedia material", "Registry of observable behaviour", "Questionnaire to evaluate knowledge on the studied subject", "Questionnaire to evaluate multimedia SUPERCOMET on pupils".

Table 6.2: Experience´s chronogram. May - 2006

CLASSROOMS - DATES	TOOLS	ESTUDY WITH SC2 CD-ROM
16 - Thuesday	Evaluation of attitudes and knowledge about computers	
17 - Wednes	Content evaluation -pretest -	
18 - Thurs		Students learning with SC2
19 - Friday	Observation	
19 - Friday	Observation	
23 - Thiesday		
24 - Wednes		
25 - Thurs	Content evaluation - postest-	
26 - Friday	Evaluación del multimedia por parte del alumnado: Evaluación de SUPERCOMET	

Tools of collected information were applied according to the chronogram of table 6.2. It is appraised that the evaluation process was made in two weeks. For it we dedicated 1 day to evaluate attitudes and knowledge on computer (computer like hardware but also like media and software), 2 days for content evaluation and 1 day (in 2 sessions) to classroom observation. Finally, last day was destined to evaluate the material with pupils' point of view.

Work of the students with multimedia supposed explanations of the didactic unit of conduction, for which they used notebook-guides of activities. Activities that the students had to make simultaneously that they sailed by the simulations. Teaching-learning process lasted 5 sessions of class, in which it was tried a learning process as independent as possible, and two practical sessions. So students made the activities of notebook-guides being based on the observation and manipulation of digital animations and reading text that supports them. However, in certain questions, teacher needed offer additional information.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

Taking care of the methods of education suggested in the guide and the teachers´ seminary, there is a question: It was used? The answer is that yes, it was made in the teachers´ seminary. The documents offered by SP2 were translated to Spanish (documents with text processor and displays on technical, pedagogical aspects and of content of the physics). In order to organize the seminary, we used a collaborative network of people.

Teachers proposed four methodologies (To, B, C and D) for the integration of contents based on his/her topics and academic courses:

- Proposal A: Teacher uses the multimedia during the explanation, using the video projector as complement to the theoretical explanation.
- Proposal B: Student is following the modules of SC2 in his/her computer. According to the guide of the teacher they make activities of the material. Learning by discovery.
- Proposal C: Students analyzed (small group) experiences and later they make an exhibition (great group) about practical application in the real experience. After, they comment the experience individually (objective test or examination).
- Proposal D: Teachers use the material like support to explain abstract concepts (virtual experiments vision and make exercises that offer CD-ROM).

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

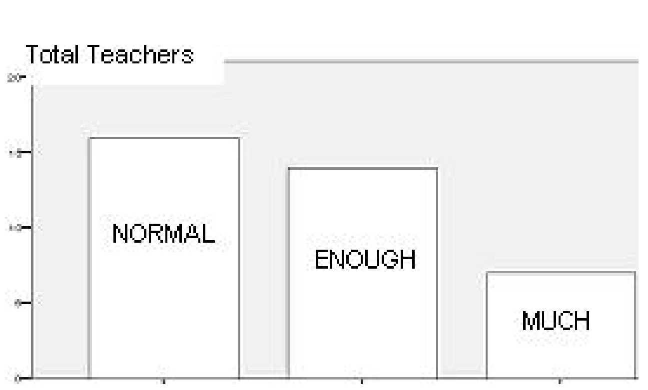
N/A

6.4 What difficulties do teachers find in integrating the materials into their teaching?

N/A

6.5 How do teachers and/or students feel about these different methods of integration?

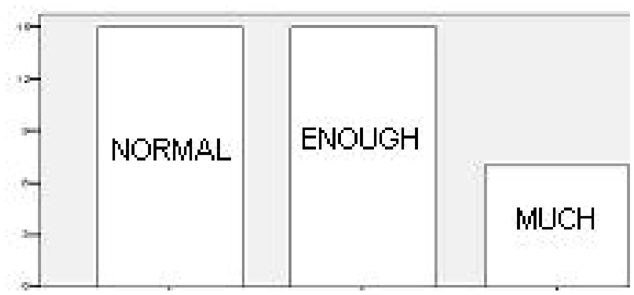
Table 6.3: Methodology in SC2. Show new ways in the Physic Teaching



Feeling about methodology has been had been researched asking teachers. Items are: "it shows new ways in the physics teaching" (table 6.3), "use of computer as a constructive way" (table 3.3), "inspiration to continue teaching and to motivate his/her students" (table 6.4) and "exploration of exciting form" (table 6.5). The answers of these items (item 3.3) recommend the networks collaboration work and seminar as teaching-learning methodology as well. The feeling in students were not researched (N/A).

When teachers knew SC2 offered four possibilities of curriculum integration (A, B, C and D, item 6.2).

Table 6.4: Methodology in SC2. Inspiration to continue teaching and to motivate his/her students

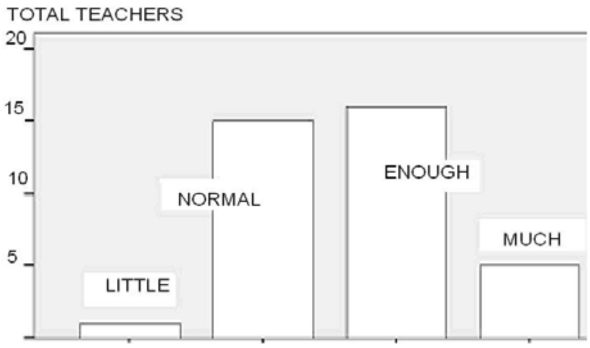


The collaboration network with people is noticed in C (learning by discovery) favouring the autonomy in B, an adaptation of the methodology of traditional education in A and D. Proposal C implies to analyze in small groups, to expose in great group, to apply the experiences in the real life and to expose individually (by objective test) helping themselves with videoproyector or data show.

Teacher's answer shows CD-ROM is useful to visualize phenomena. They recognized the blackboard is difficult to show dynamic aspect. It allows appreciating the importance of models like tools to give explanations.

CD-ROM can use to explain theoretical contents, for the accomplishment of practical exercises and to observe experiments that cannot be made in laboratory. SC2 CD-ROM is excellent to include/understand and to visualize electromagnetic phenomena with no need to have great amount of materials. Moreover it is an agile resource, sure easy to handle and very interactive.

Table 6.5: Exploration of superconductivity phenomenon with passion



6.6 What is your evidence for your responses to questions 6.1 to 6.5?

Conducted registries using questionnaires directed to the pupils, "Questionnaire of attitudes and knowledge about computer" and "Questionnaire to evaluate multimedia didactic material (EVALALU)". Conducted registries of the questionnaire directed to teachers, questionnaire made up of 7 items with Likert scale valuation. These items were made over internal aims and topics of SC2 project. Backgrounds are available on the website: http://www.simplicatus.no/web.php?action=subpagelevel2_view_single&pk=42.

About the CD, the evaluation of experts was registered with the questionnaire "Evaluation tool to educational multimedia". This questionnaire is available in English thanks to SC2 team from UK. It is published (in Spanish) by Pixel-Bit (18, 2002) in: http://www.sav.us.es/pixelbit/articulos/n18/n18art/art187.htm.

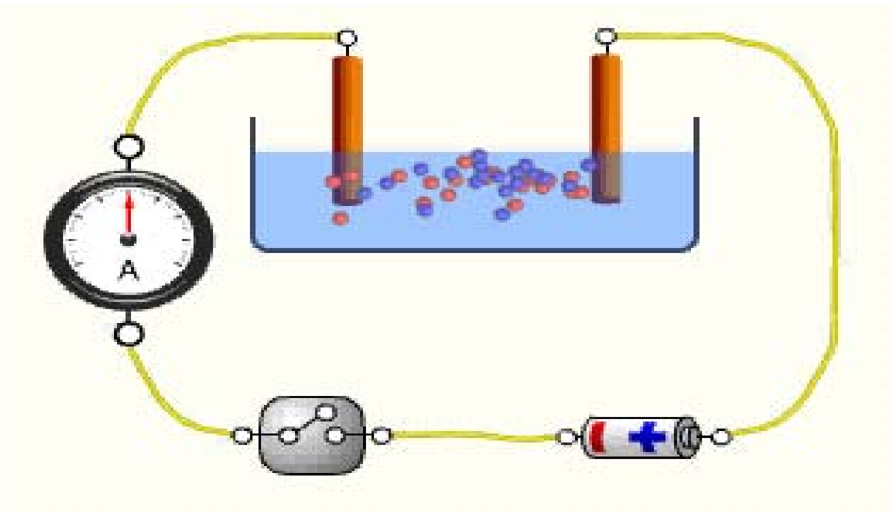
7 Classroom case studies

7.1 Classroom activities on May 2006

A short description of how we have used classroom materials (item 2.2), changes in teaching methods (item 5) and curriculum integration with the participation of the teacher that performed the experience (items 6, 6.1.2 and 7.1) has been shown previously. To perform the experience we have used SC2 module 3: Electric conduction.
Attending the process, it begins introducing electric current using a model of charged particles that behave like an ideal gas. The resistance of four elements is tested investigating the intensity through a bulb observing his brightness, a microscopic view of the electric current is offered and a quantitative research of the relation between the intensity and the voltage is done. A microscopic model of current picturing the electric field is shown, the intensity of the electric field can be changed and investigated their relation with the drift velocity. The dependence of the resistance of an object with his length, his section and his resistivity is illustrated.

To study the relation between heat and electric current an experiment with a varying resistance that is sunken in a liquid and with a thermometer for reading the temperature is simulated, the Joule law is then investigated. The module is finished with the electrolysis.

Table 7.1: Electrolysis



7.2 Classroom activities on May 2007

The same teacher as in the activity reported previously has performed a similar activity, with 7 students of the same characteristic, using 7 computers, he implement the same classroom methodology in five sessions with SP2 module 3: Electric conduction providing also a guide of activities for each slide, a practical session making each students

experiments measuring electric resistance, a pre-test and a post-test of specific knowledge, and a report.
The qualitative assessment of the results obtained this time is similar to the results of the previous year, but we we did not made this time an evaluation of the produced documents.

8 Shared tests

We have used the module 3, electric conduction, with our students, the results of pre-test and post-test has can be fund at 4.2 and 4.6 items.

9 Overall added value

In this item we will answer two questions, one about the validity and usefulness of the SUPERCOMET materials, the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit, within the physics education resources available in Murcia's context.
In a second step we explain the way, if any, SC2 resources contribute to promote equality between women and men in our national context. To do it, a report was carried out from Murcia and some contributions will be shown in this document.

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

9.1.1 About Teachers Seminar

Up to 25% of teachers do not emphasize the use of computers under a constructive set up. We conclude that it is necessary to insist in the methodologies that promote cognitive knowledge. As a result it is recommended to work with artificial environments and communication tools that help to connect such as MOODLE, wikis, weblogs, searchers, instant message, chats and so on.

More than 35% point out that the seminar, normally, allow them to know SC2 resources. To improve the satisfaction level it would be convenient to foster innovative proposals about the use of teaching resources.

More than 40% of teachers consider that superconductivity has not been treated in depth, therefore it would be important to attend the phenomenon in a particular way.

It is interesting to take time to analyze the results about the item "To explore superconductivity in a passionate way" using SP2 resources, in this question more than 40% shows a normal or low score. This data collide with the fact that up to 60% of teachers confess to be enough o very motivated. If they claim to be inspired for lecturing and to motivate students, it could be convenient to focus the way SP2 allows the exploration of the phenomenon (validity and aesthetics and pedagogic utility, new teaching and evaluation methods).

Taking into account the number of teachers trained at the seminar, it is N/A the number of schools. It is relevant to take it into consideration for an impact evaluation. We have not considered the teaching experience of the teachers neither his knowledge in Science and TICs. It would be convenient to attend them in the future.

9.1.2 About Teacher Guide

We have not established specific registers for aspects of Teacher Guide therefore it is not possible to determine what particular aspect has been valid and useful. We have use of this Guide as it is stated at item 3.3. To future actions in assessment will be good an evaluation about printed media (aesthetic and content).

9.1.3 About CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit

Classroom experience with interactive SP2 resources has increased the score by 23,4 points. It would be of interest to apply SP2 to more than a group of students in order to establish a solid conclusion.

It must be taken into account that we did not establish any specific register for the Low-Tech hands on kit, it is not possible to what aspects has been valid and useful.

9.2 What is your evidence for your response to question 9.1?

Our evidence for our response to question 9.1 is based in the analysis of the following documents: "Questionnaire about attitudes and knowledge of the computer environment", "Assessment questionnaire about the didactic multimedia material (EVALALU)". To evaluate learning using module 3, it has been used an initial questionnaire and a final questionnaire. For classroom observation it has been used the REGICOB protocol.

The strategies to elaborate the conclusions has been the content analysis, the scales (Semantic differential of Osgood and the Scale of attitudes of Likert), data matrices, schematic diagrams (concept maps, and flux diagram) and the analysis of this report from item 1 to 8.

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

Below, we show the way SC2 materials have contributed to gender equality within Murcia context. We understand *gender equality* as equality between women and men. Arguments are focused around Teachers Seminar reflecting a similar way into CD-Rom. Within the project, gender arguments can be appreciated thanks the document created after the workshop in Murcia on May- 2007 (action point 14.08).

As needs about gender considerations within SC2 resources has been detected, an item (see 9.3.2) offering suggestions has been open in three spaces: 1) from tools for evaluation; 2) eaching-learning methodology to be applied; 3) superconductivity content within SC2 modules. An example is shown at tables 9.1 and 9.2 coming from Teacher Seminar and from CD-ROM.

9.3.1 The way that SP2 resources contribute to foster equality between men and women

Teachers Seminar gender equality (GE) topic was considered within the document "Hands-on superconductivity activities and thinking task" (Jenny Frost and Gren Ireson). This document was translated by Murcia group and adapted considering language and webs sites in Spanish. Within the item "Researching secondary sources" the adaptation considering GE topic was made introducing attractive links thinking of boys and girls of the region. In table 9.3 topics "coche (car)" and muñeca (doll)" can be perceived. Last

Table 9.1: Male Coach - Nobel Award	Table 9.2: Male Coach - BCS Theory
	

visit to these sites was performed on 27th November 2005.
Besides, the need of considering the used code within the content was detected although it was not possible to proceed with adaptations because the lack of time.

Later on, at the Murcia Workshop SC2, held on 16-19 May 2007, some guide was offered about evaluation and gender considerations (action point 14.08).

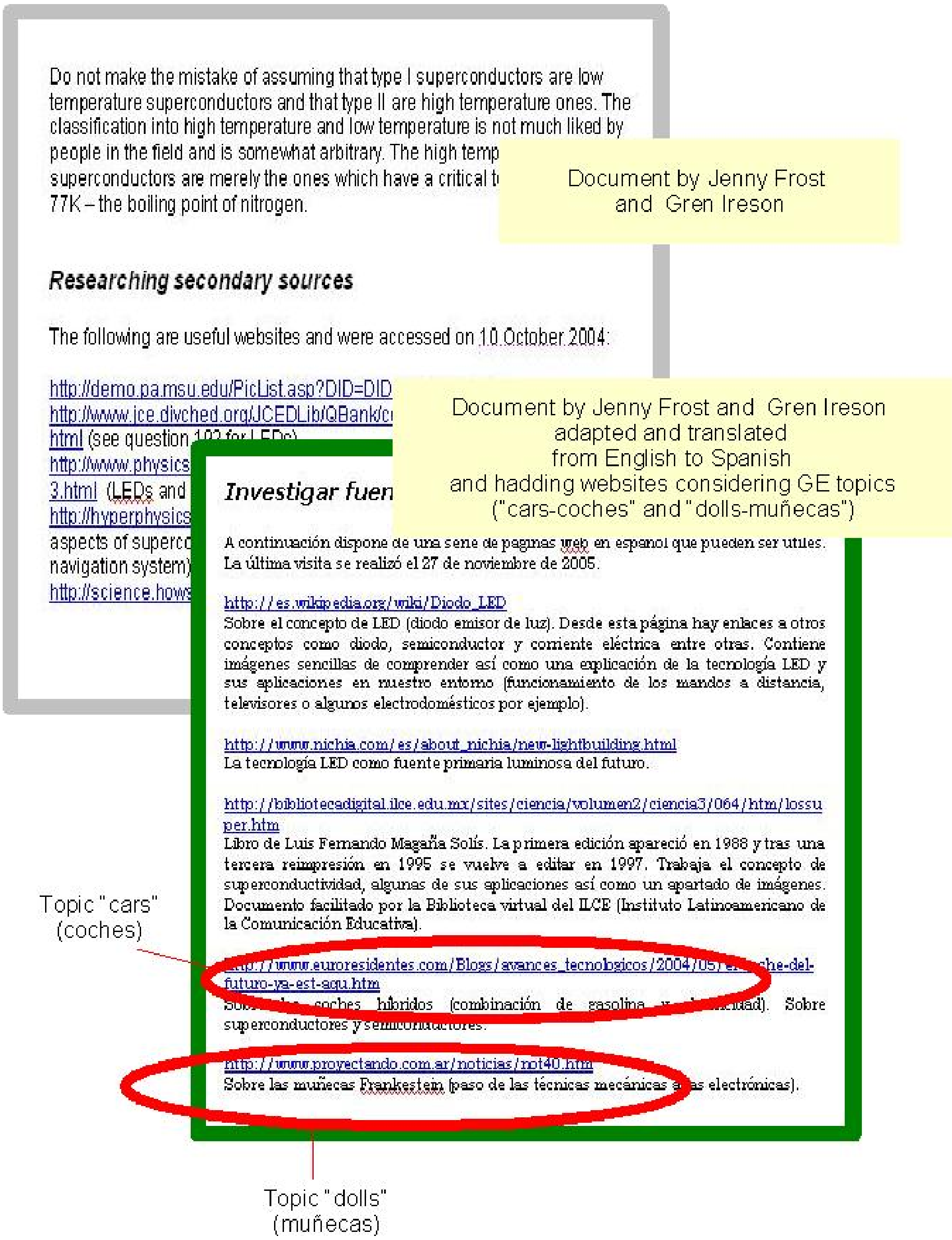
9.3.2 Suggestions

Considering used evaluation tools: a) Need of incorporating gender variable in our evaluations: in Murcia we did not consider it within Teacher Seminar. b) Population and sample: we worked with a sample of 11 males. It would be of interest to work with females students to be for a representative sample.

About teaching-learning methods: To incorporate social-cultural aspects. To do it, it is necessary to know the student to personalize the learning process and to promote a customized learning, for instance, using common phrases, popular clips of films, familiar sounds, images. It could be useful the socio cultural questionnaire by Mindy Myers and Amorós (2003-2004, University of Toronto), based on the anthropologic statements of Edward T. Hall (1959) taking in consideration also Hall (1966 and 1977), De Kerckhove (1995), Archer (1999), Martínez (1999), Darling- Hammond, (2001) and Guarro (20062). At the level "Sex/Learning" there are issues with attention in gender.

About content of teaching in SC2 modules: a) Based content: it is necessary to have a founded well support, theoretically and practically, to introduce the gender label within the available content. At present the content do not introduce the gender indicator. An example of how to work this aspect is developed at document Action Point 14.08 SP, from Prendes and Amorós; b) Considering used code: recognition (to begin lectures asking questions to detect relations with gender) and audiovisual code (aesthetics and pedagogic), it is also treated at document Action Point 14.08 SP, from Prendes and Amorós.

Table 9.3: Adaptation of content considering GENDER



Do not make the mistake of assuming that type I superconductors are low temperature superconductors and that type II are high temperature ones. The classification into high temperature and low temperature is not much liked by people in the field and is somewhat arbitrary. The high temp superconductors are merely the ones which have a critical t 77K – the boiling point of nitrogen.

Researching secondary sources

The following are useful websites and were accessed on 10 October 2004:

http://demo.pa.msu.edu/PicList.asp?DID=DID
http://www.jce.divched.org/JCEDLib/QBank/c html (see question
http://www.physics 3.html (LEDs and
http://hyperphysics aspects of superc navigation system)
http://science.hows

Investigar fuen

A continuación dispone de una serie de páginas web en español que pueden ser útiles. La última visita se realizó el 27 de noviembre de 2005.

http://es.wikipedia.org/wiki/Diodo_LED
Sobre el concepto de LED (diodo emisor de luz). Desde esta página hay enlaces a otros conceptos como diodo, semiconductor y corriente eléctrica entre otras. Contiene imágenes sencillas de comprender así como una explicación de la tecnología LED y sus aplicaciones en nuestro entorno (funcionamiento de los mandos a distancia, televisores o algunos electrodomésticos por ejemplo).

http://www.nichia.com/es/about_nichia/new-lightbuilding.html
La tecnología LED como fuente primaria luminosa del futuro.

http://bibliotecadigital.ilce.edu.mx/sites/ciencia/volumen2/ciencia3/064/htm/lossuper.htm
Libro de Luis Fernando Magaña Solís. La primera edición apareció en 1988 y tras una tercera reimpresión en 1995 se vuelve a editar en 1997. Trabaja el concepto de superconductividad, algunas de sus aplicaciones así como un apartado de imágenes. Documento facilitado por la Biblioteca virtual del ILCE (Instituto Latinoamericano de la Comunicación Educativa).

http://www.euroresidentes.com/Blogs/avances_tecnologicos/2004/05/e...che-del-futuro-ya-est-aqu.htm
Sob... coches híbridos (combinación de gasolina y ...idad). Sobre superconductores y semiconductores.

http://www.proyectando.com.ar/noticias/not40.htm
Sobre las muñecas Frankestein (paso de las técnicas mecánicas a las electrónicas).

9.4 What is your evidence for your response to question 9.2?

Evidence has been obtained from: a) Wandering around the information offered by SC2 as in internal reports as in the resources. b) Reports of Murcia group, as reports after evaluations and researcher diary; c) Revision of this final report. Below, you can find the revised sources:

- 07_ANALISIS_ACTITUDES_ALUMNADO.doc (analysis of students attitude)
- 09_ANALISIS_SOFT_ALUMNADO.doc (analysis of the multimedia evaluation by the students)
- 11_ANALISIS_EVA_SUPERC_ERIKA.doc (analysis of SUPERCOMET evaluation by the students)
- 13_RESULTDOS_OBSERVACION.doc (results of the observation in the class)
- 14_INFORME.doc (report)
- Document: SUPERCOMET_teacher_seminar_EN_2_superconductivity (slide 13, slide 27) Gren Ireson, Loughborough University
- Document: SUPERCOMET_teacher_seminar_EN_5_description_handson_activities. Title: "Hands-on superconductivity activities and thinking tasks. Instruction booklet" Jenny Frost and Gren Ireson.

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En CABERO, J. (ed.), BARTOLOMÉ, A., CEBRIÁN, M., DUARTE, A., MARTÍNEZ, F. y SALINAS, J.
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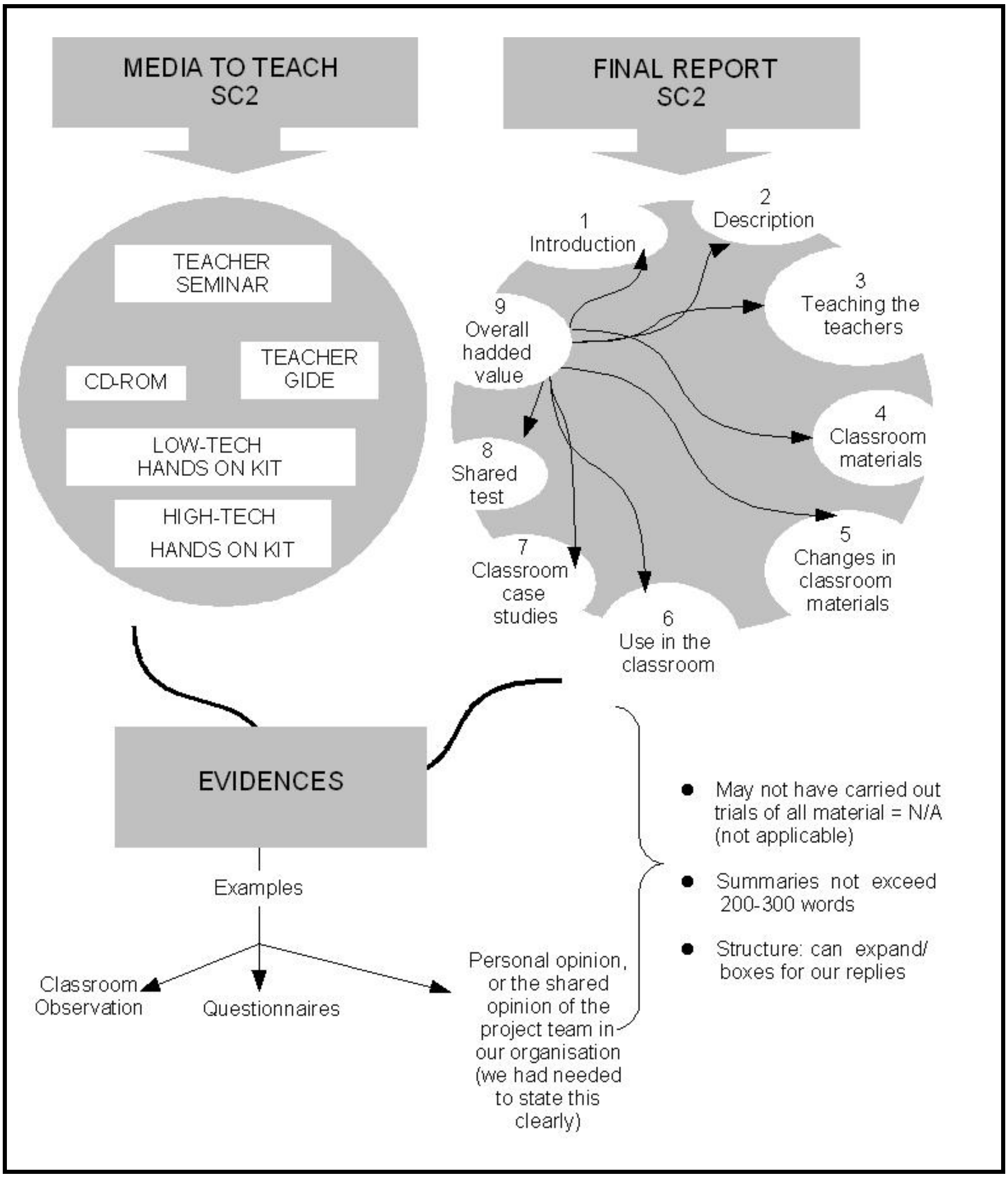
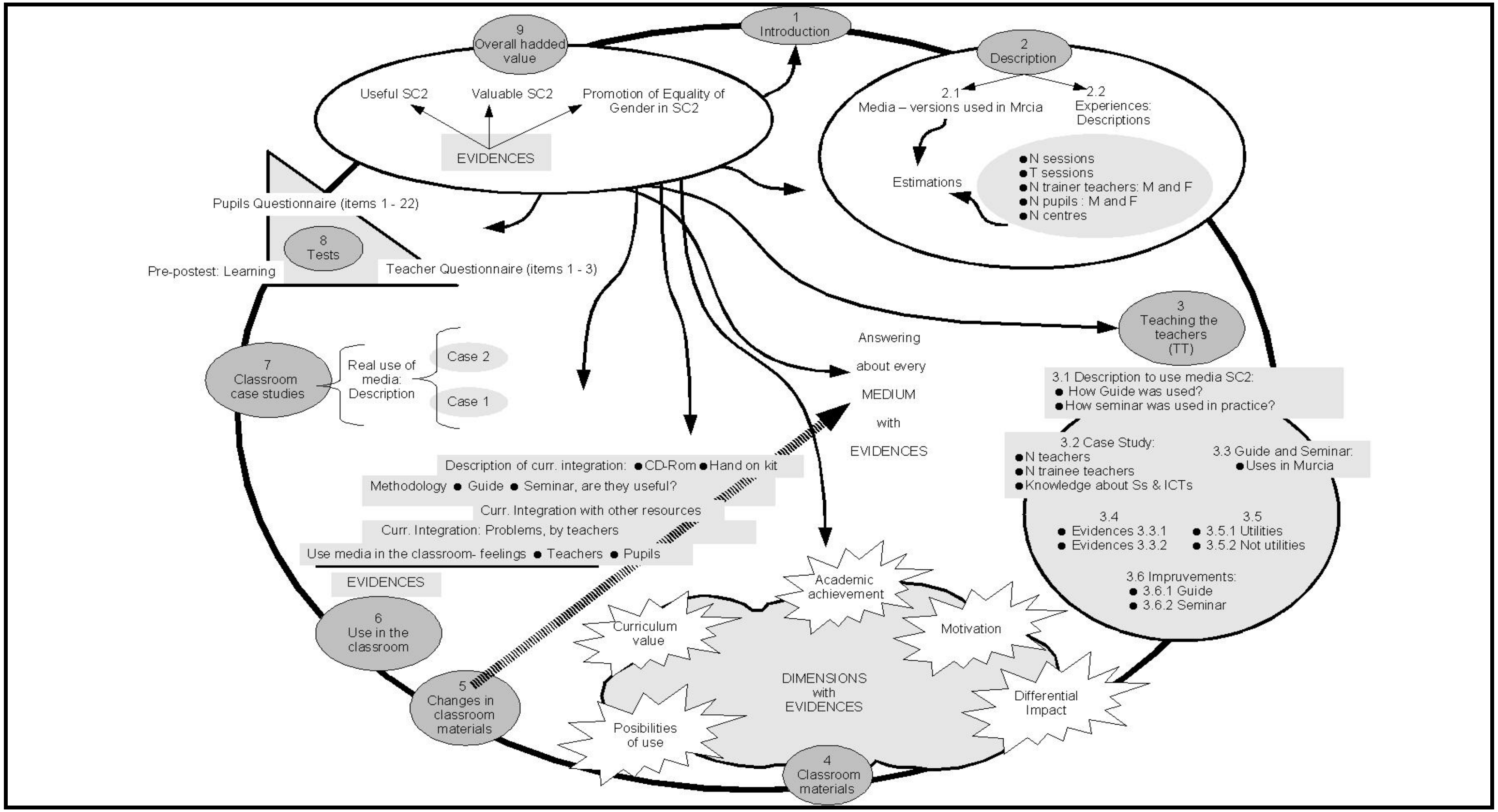
ANEXS

Anex 1: Final Report – Metaevaluation 1



Anex 2: Final Report – Metaevaluation 2



This report started to be wrote on May – 2007, in Murcia (Spain).
It was developed between July and October – 2007, in Talca (Chile), Murcia and Madrid (Spain) and it has been finished on October – 2007, in Paris (France)

Centre d' Etudes sur les Medias, les Technologies et l' Internalisation
Université Paris 8
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FECHA: 04-08-07

CRÍTICO: <nombre del crítico> FECHA: yyyy-mm-dd

INFORME DE LA EVALUACIÓN NACIONAL VERSION: A

ÍNDICE

1. Introducción

El contenido de este informe se deriva de las experiencias con los materiales de SUPERCOMET (SC2 de aquí en adelante) que han servido tanto para la formación de profesorado como para la enseñanza en clase. Esta labor ha sido organizada desde el equipo de la Universidad de Murcia, en colaboración con el Instituto de Educación Secundaria Juan de la Cierva y Codorniu, ubicado en la Región de Murcia.

Este informe se realiza como parte diferente a la evaluación de expertos sobre los recursos utilizados, realizada y divulgada con anterioridad. Los recursos SP2 examinados en el conjunto de experiencias son cuatro.

De un lado, la Guía del Profesor es un recurso que ha llegado en formato digital (en PDF) e impreso. La Guía del Seminario ha sido un recurso muy útil para la planificación de la formación de profesores. Fue distribuida en formato digital, en particular utilizando documentos con procesador de textos y presentaciones visuales. En tercer lugar, se ha utilizado el CD-ROM disponible en una nueva versión que contiene 6 módulos. Esta versión ha sido objeto de estudio en la Región de Murcia (España). Su estructura aparece en la tabla 1.1.

Tabla 1.1. Estructura del CD-ROM objeto de estudio en la Región de Murcia (España)

Versión anterior	**Nueva versión OBJETO de ESTUDIO en ESPAÑA**
Módulo 1: Magnetismo	Módulo 1: Magnetismo de corrientes e imanes
Módulo 2: Inducción al Electromagnetismo	Módulo 2: Magnetismo de bobinas y materiales
Módulo 3: Conducción eléctrica	Módulo 3: Inducción electromagnética
Módulo 4: Introducción a la superconductividad	Módulo 4: Conducción eléctrica
Módulo 5: Historia de la superconductividad	Módulo 5: Introducción a la superconductividad Módulo 6: Historia de la superconductividad

Finalmente, el último recurso utilizado ha sido el kit de manos de baja tecnología. Por su parte, el kit de manos de alta tecnología N/A.

Para concluir esta introducción conviene considerar que es importante proporcionar evidencias de las respuestas. Las respuestas son breves, es decir, se recogen a modo de resúmenes de datos que no exceden, normalmente, las 200 o 300 palabras por respuesta. El informe se ha estructurado de acuerdo a la plantilla general que ofrece de manera simple una estructura, si bien, se ha necesitado ampliar los apartados para que las contestaciones ofrezcan respuestas más apropiadas. A veces, ha sido suficiente indicar cuáles fueron las fuentes de las evidencias, por ejemplo, con la observación de la sala de clase, los cuestionarios o las entrevistas del profesor. Cuando la fuente de la evidencia ha sido, simplemente, una opinión personal o la opinión compartida del equipo de proyecto, entonces se ha indicado con claridad.

2. Descripción de experiencias

Este apartado tiene una función eminentemente descriptiva y orientada al uso de los recursos de enseñanza dentro de contextos de aprendizaje. Inicialmente (punto 2.1) se recoge la versión de los recursos de enseñanza utilizados en las experiencias para, posteriormente, ofrecer una descripción breve de una experiencia llevada a cabo.

Puesto que en nuestro trabajo se dan dos experiencias de diferente naturaleza se han descrito ambas. De un lado, se describe la experiencia de formación de profesorado (punto 2.2.1) donde se ha utilizado la guía del seminario. De otro lado, se procede a la descripción de la integración curricular de medios (punto 2.2.2) dentro de la sala de clase, teniendo como estudiantes alumnos de educación secundaria. Aquí se ha utilizado el CD-ROM y el kit de manos de baja tecnología de SP2.

2.1 Versión de los recursos de enseñanza utilizados en las experiencias.

A continuación nos detenemos en las versiones de los recursos SP2 utilizados como se advierte en la tabla 2.1. En particular, se describen en el CD-ROM, la guía del profesor y el kit de manos de baja tecnología.

Tabla 2.1. Descripción de experiencias. Versión de los recursos utilizados

CD-ROM - general	Copyright © 2004 by Simplicatus AS, Richard Birkelands vei 2b, 7491 Trondheim, NO
CD-ROM **Módulo 1: Magnetismo de corrientes e imanes**	N/A
CD-ROM **Módulo 2: Magnetismo de bobinas y materiales**	N/A
CD-ROM **Módulo 3: Inducción electromagnética**	Del 2.1. Copyright © 2004 by Simplicatus AS, Richard Birkelands vei 2b, 7491 Trondheim, NO
CD-ROM **Módulo 4: Conducción eléctrica**	N/A
CD-ROM **Módulo 5: Introducción a la superconductividad.** **Módulo 6: Historia de la superconductividad**	N/A
Kit de manos de baja tecnología	Copyright © 2004 by Simplicatus AS, Richard Birkelands vei 2b, 7491 Trondheim, NO
Kit de manos de alta tecnología	N/A
Guía del Profesor	Copyright © 2004 by Simplicatus AS, Richard Birkelands vei 2b, 7491 Trondheim, NO

2.2 Breve descripción de las experiencias.

En los apartados siguientes nos detenemos en la formación del profesorado y la integración curricular de medios dentro del aula. Para ello se han tenido en cuenta bien datos exactos, bien estimaciones aproximadas del número de sesiones, la longitud de las sesiones, el número de profesores implicados así como el número de profesores aprendices implicados. En ambos casos, cuando ha sido posible se identifica el género (masculinos y femeninos). Del mismo modo se procede con el número de estudiantes (masculinos y femeninos) y el número de escuelas implicadas.

2.2.1 Formación de Profesorado: Experiencia

La formación del profesorado se llevó a cabo en un seminario. Las metas fueron: A) Trabajar con profesorado de educación secundaria que, normalmente y a su vez, trabajaran con estudiantes de entre 14/15 años y 17/18 años. B) Mostrar el CD-ROM SC2. C) Evaluar sus puntos de vista desde dos intereses: de un lado considerando si para ellos era posible integrar los contenidos dentro del currículo; y de otro, cómo es posible integrar los contenidos de superconductividad dentro del currículo.

La sesión se llevó a cabo el 23 de febrero de 2006, de 16 a 20 horas, dentro de las instalaciones de la Facultad de Matemáticas de la Universidad de Murcia. Participaron 37 profesores (género N/A; número de escuelas N/A). El área de contenidos que el profesorado enseñaba habitualmente era física, química y tecnología. Todos ellos trabajan en centros de educación secundaria.

Contenidos y metodología: 1) Introducción sobre la superconductividad, profundizando en este concepto y explorando sus bases científicas y aplicaciones tecnológicas. 2) Aspectos pedagógicos y didácticos del uso del ordenador, proponiendo usos del ordenador de manera constructiva. 3) Conocimiento y uso del material elaborado (CD y kit). Los participantes del seminario toman el papel de un alumno/a mientras los ponentes asesoran sobre su uso en el aula.

Ponentes: 1 catedrático de física, 1 doctor titular de matemáticas. Ambos hombres. 1 pedagoga, doctora y ayudante, mujer. Finalmente no asiste por incompatibilidad de horarios. Para el registro y apoyo pedagógico se contó con una licenciada en pedagogía (mujer, en periodo de formación doctoral).

2.2.2 Integración curricular: Experiencia

La experiencia se desarrolló del 16 al 26 de mayo de 2006. Se lleva a cabo con estudiantes de primer curso de física de Bachillerato Internacional (I.E.S. Juan de la Cierva y Codorniu, Totana, Murcia). La muestra implica 11 alumnos, hombres, de extracción social media, 1 profesor, hombre, y con experiencia superior a diez años en la enseñanza de la física en educación secundaria.

La motivación académica de los estudiantes era algo superior a la media de alumnos de su edad. Ello se debe a que voluntariamente están cursando el currículo de Bachillerato Internacional, que es de mayor exigencia que el de Bachillerato del plan de estudios español (ver tabla 2.2).

Tabla 2.2. Descripción. Integración curricular de medios. Datos convenientes

Nº sesiones	5 (de 9)
Longitud sesiones	55 minutos*
Nº profesores aprendices implicados (Nº profesores masculinos y femeninos)	N/A
Nº profesores implicados (Nº profesores masculinos y femeninos)	1 HOMBRE
Nº estudiantes implicados (Nº estudiantes masculinos y femeninos)	11 HOMBRES
Nº escuelas implicadas	1

Las sesiones (9) tenían diferente naturaleza. La longitud de las sesiones varía. Atendiendo a la finalidad de este informe, 5 fueron las sesiones destinadas a la integración curricular de medios. Se considera por integración curricular al trabajo con el CD-ROM por parte del alumnado dentro de la sala de clase y el kit de manos. De las 5 sesiones destinadas a uso de medios SP2, 4 duraron 55 minutos (*) mientras que 1 (jueves 18 de mayo) duró 60 minutos. El resto de sesiones, a saber 4, fueron dedicadas a la evaluación del medio (2 sesiones) y a la evaluación de contenidos aprendidos (2 sesiones).

3. Formación de profesorado

La formación del profesorado de Educación Secundaria Obligatoria y Bachillerato se llevó a cabo por medio de un Seminario dirigido a la formación de profesores (punto 2.2.1). Fue convocado por Ricardo de la Casa, director del Centro de Profesores y Recursos de Lorca, municipio situado en la Región de Murcia (España), aprovechándose el Salón del Estudiante (punto 4.7.1) para promocionar las inscripciones y atraer al profesorado.

El Seminario partió bajo tres objetivos. De un lado, ayudar a vencer los miedos que el profesorado pudiera tener a la hora de utilizar las TICs en el aula. En particular, se propone la integración curricular de contenido dentro de un CD-ROM con características hipertexto/hipermedia. El hipertexto favorece la exploración y la autonomía y se considera amigable en su navegación y uso. Sin embargo, el seminario ayudará a que el medio sea utilizado junto con expertos, de forma confidencial. De otro lado, se pretende mostrar caminos diferentes para la enseñanza de la Física, desde el punto de vista metodológico. Finalmente, se trata de inspirar a los profesores para seguir dando clases, y extender esta motivación a sus estudiantes.

En el registro del seminario se identifican tres fases: 1) Exposición del proyecto SC2 y del material multimedia (CD-ROM y Guía del Profesor); 2) Demostración del fenómeno de la superconductividad; 3) Integración curricular de medios.

3.1 Descripción sobre la metodología de formación del profesorado. Utilidad práctica de la Guía del Profesor y Seminario de Formación Docente.

En la **presentación** se indica que el resultado del grupo SC2 es la elaboración de una guía de trabajo junto a la Guía del Profesor para su uso en aula, materializadas en un CD y un kit de laboratorio que se presenta al profesorado en el seminario tras un análisis de los tópicos de la enseñanza de la física con TICs y de la superconductividad. Se entrega el material correspondiente. El programa seguido responde a:

• Introducción al seminario: con charla acerca del SC2 y objetivos, indicando los objetivos del seminario, detalles del SP en Murcia y cómo la superconductividad puede solucionar algunos de los problemas en la enseñanza de la física. Se utiliza la presentación visual "Introducción al seminario de profesores".
• Qué es la superconductividad: se utiliza la presentación visual "Seminario de Profesores sobre Superconductividad"
• Uso de las TICs en la enseñanza de la física: la previsión fue utilizar la presentación visual "Seminario de profesores utilizando TICs". Se repasa el currículo con reunión de profesores para trazar mapa del plan de introducción del tema en el currículo escolar. Este plan se guarda en un disquete como archivo del profesor/a.
• Presentación del CD y kit: mostrando clips de película y advirtiendo sobre el uso del nitrógeno líquido (presentación práctica "hands-on" del Seminario de Profesores).
• Prácticas con el kit: poniendo a disponibilidad las 5 experiencias si se necesita.
Finalmente se establecen conclusiones.

3.2 Estudio de caso de un seminario del profesor.

Formación de Profesorado de Educación Secundaria Obligatoria y Bachillerato. Convoca: Centro de Profesores y Recursos de Lorca (Murcia). Fecha: 23 de febrero de 2006. Asistencia: 37 profesores y profesoras.

Fase 1: introduce al proyecto SC2 (origen, metas, objetivos, finalidad, miembros implicados, metodología de trabajo y financiación) y al material multimedia SC2. Se facilitó al profesorado una copia provisional de CD y una guía, también provisional.

Fase 2: demuestra el fenómeno de la superconductividad (ver tabla 3.1) utilizando el kit de manos de baja tecnología. Para mayor información recúrrase al punto 4.7.2.

Tabla 3.1. Superconductividad

Fase 3: integración de medios en el currículum. En concreto, se integra el CD-ROM multimedia. Esta fase supuso el mapeo del currículum y ayudó al profesorado a familiarizarse tanto con el contenido como con la metodología de enseñanza. La tarea consistió en la revisión de módulos (parte teórica) y la realización de una actividad (parte práctica).

Se revisaron los módulos 1 a 6 del CD. Posteriormente, el profesorado se divide en equipos de 5 personas aproximadamente, agrupándose por asignaturas y/o cursos que imparten. Identifican a un portavoz.

La finalidad de la tarea supuso la búsqueda de objetivos de aprendizaje en relación a la superconductividad como contenido curricular. Se planteó cómo considerarían la integración del contenido de acuerdo a las características de sus centros docentes, incluyendo la disponibilidad de medios (hardware). Se dedicaron 20 minutos para debate, se desarrolló una puesta en común en gran grupo y cada portavoz entregó la aportación del equipo indicando asignaturas y cursos que imparten.

Sobre diferencia entre profesores con experiencia docente de los profesores aprendices N/A. Los conocimientos en ciencia e TICS N/A.

3.3 Guía y Seminario: utilidades.

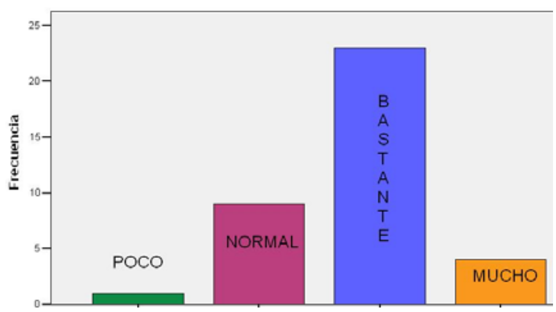
El 18.9% del profesorado manifiesta que el seminario le ha mostrado muchos **caminos diferentes** en la enseñanza de la física. Un 37.8% considera que bastante.

El seminario ofrece un **uso del ordenador** bastante **constructivo** para el 62.2%. Un 10.8% considera que ha sido muy útil (ver tabla 3.3) y un 24,3% que normal.

El 40.5% opina que el seminario **inspira** bastante **para seguir dando clases y extender esa motivación** a los estudiantes. El 18.9% considera que inspira mucho.

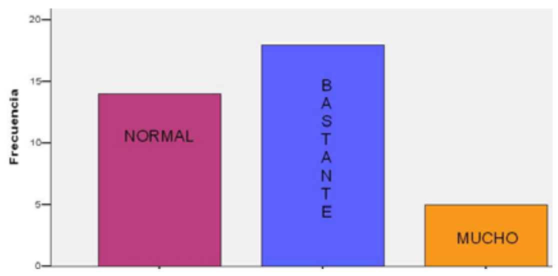
El 48.6% del profesorado manifiesta que el seminario **permite conocer** bastante **la utilidad de los recursos** SP2, el 13.5% considera que lo permite mucho (tabla 3.4). El 37,8% opina que lo normal.

Tabla 3.3. Uso del ordenador de manera constructiva, gracias al Seminario



El seminario **profundiza** bastante en detalle **sobre el fenómeno de la superconductividad** para un 48,6%. Un 10.8% considera que se profundiza mucho. De los 37 profesores encuestados, 3, es decir, un 8.1% considera que se ha profundizado poco y el 32,4% lo normal. El 43.2% manifiesta que el seminario le ha permitido bastante **explorar el fenómeno** de la superconductividad **de forma apasionante** y el 13.5% que le ha permitido mucho, lo normal es para un 40,5%. Sobre las posibilidades de uso puede recurrirse al punto 4.7.2 de este informe.

Tabla 3.4. Conocimiento de la utilidad de los medios, gracias al Seminario



3.4 Evidencias para la respuesta a la pregunta 3.3.

La entrevista, siguiendo a Walker (1985), reconoce que las personas ofrecemos explicaciones de nuestra conducta sobre la reflexión de nuestras acciones. El cuestionario es considerado como una entrevista formal, estilizada. Formalmente, es similar a una entrevista cara a cara sólo que se prescinde de la presencia del investigador. Entre sus ventajas destaca que potencialmente implica un estímulo idéntico a numerosos sujetos. Los inconvenientes tienen que ver con la producción de datos en masa y la falta de oportunidades de interpretación.

En nuestro caso, el cuestionario se compone de 7 ítems con escala de valoración Likert. Los ítems tomaron como punto de partida los objetivos y tópicos internos al Proyecto (disponibles en http://www.simplicatus.no/web.php?action=subpagelevel2_view_single&pk=42).

La escala de valoración Likert mide actitudes y es el modelo más popular e intuitivo (Rojas et.al, 1998). Se solicita al sujeto el grado de acuerdo o desacuerdo con el enunciado. La puntuación obtenida informa de la posición del encuestado con respecto al objeto de estudio. Prendes apoyándose en Arce (1994) indica que los objetos se usan con la finalidad de generar datos en los sujetos, que conlleven a su escalamiento. La escala puede tener diferente número de opciones de respuesta. Habitualmente se han utilizado cinco categorías y se ha comprobado que resultan igualmente válidas (Prendes, 1994):

1	2	3	4	5
Mucho	Bastante	Normal	Poco	Nada

Para el análisis de datos se ha utilizado el programa SPSS (***S**tatistical **P**ackage for the **S**ocial* **S**ciences) versión 13, usual en Ciencias Sociales. El análisis es descriptivo univariado, con lectura directa de variables cualitativas o que permiten un tratamiento como tales (variables con escala ordinal o de intervalo), cálculo de frecuencias y porcentajes.

3.5 ¿Por qué son estos aspectos útiles? ¿Por qué no son útiles otros aspectos?

N/A

3.6 Mejoras en la Guía y el Seminario de Formación de Profesores.

N/A

4. Medios en la enseñanza

Como se advertirá en los apartados que se encuentran a continuación, los medios de enseñanza utilizados han sido todos a excepción del kit de manos de alta tecnología. En primer lugar, se determinan los medios utilizados respondiendo a las cinco dimensiones que establece este informe: posibilidad de uso, valor curricular, éxito académico que supone, motivación e impacto asumiendo la cuestión de género y el grado de conocimientos de los implicados, cuando se dispone de registro. Posteriormente, se ofrecen las evidencias para llevar a efecto este juicio de valor.

4.1 Determinación de los medios utilizados en la enseñanza.

A continuación, en la tabla 4.1, se recogen tres de los cinco medios utilizados, a saber, el CD-ROM, el kit de manos de baja tecnología y el kit de manos de alta tecnología. No se ha incluido el Seminario de Formación de Profesorado ni tampoco la Guía del Profesor como recurso de enseñanza. Ambos se han trabajado en el apartado anterior. En este momento, se determina el uso del CD-ROM de manera general y el contenido modular del CD de manera específica. El kit de manos de alta tecnología N/A.

Tabla 4.1. SC 2 en la enseñanza

Medios de enseñanza		Dimensiones				
		Posibilidades de uso	Valor en el currículum	Éxito académico	Motiva-ción	Impacto diferencial
4.1.1	CD-ROM - general	Salón de exposiciones, Feria	N/A	N/A	Sí	N/A
		Formación del Profesorado: Seminario	Sí	Sí	Sí	N/A
		Integración curricular: Aula	Sí	Sí	Sí*	Sí
4.2	CD-ROM Módulo 1: Magnetismo de corrientes e imanes	Formación del Profesorado: Seminario	Sí	Sí	Sí	N/A
4.3	CD-ROM Módulo 2: Magnetismo de bobinas y materiales	Formación del Profesorado: Seminario	Sí	Sí	Sí	N/A
4.4	CD-ROM Módulo 3: Inducción electromagnética Conducción eléctrica	Formación del Profesorado: Seminario	Sí	Sí	Sí	N/A
		Integración curricular: Aula	Sí	Sí	Sí	Sí
4.5	CD-ROM Módulo 4: Conducción eléctrica	Formación del Profesorado: Seminario	Sí	Sí	Sí	N/A
4.6	CD-ROM Módulo 5: Introducción a la superconductividad Módulo 6: Historia de la superconductividad	Formación del Profesorado: Seminario	Sí	Sí	Sí	N/A
4.7	Kit de manos de baja tecnología	Salón de exposiciones, Ferias	Sí	Sí	Sí	N/A
		Formación del Profesorado: Seminario	Sí	Sí	Sí	N/A
4.8	Kit de manos de alta tecnología	N/A	N/A	N/A	N/A	N/A

4.1.1 CD-ROM general

Posibilidades de uso: Salón de Exposiciones - Feria, aula y seminario de formación docente.
Valor curricular: en el Salón de Exposiciones y Feria se aprecia según fuentes documentales. En el aula y seminario se registra utilizando cuestionarios.

Éxito académico: en aula se registra utilizando cuestionarios. Para el **impacto diferencial** ver punto 2.2.2.

Sobre **posibilidades de uso, valor curricular, logro académico y motivación** con el CD-ROM en Exposición-Feria se pretendía ofrecer un recurso útil ante nuevos modos de enseñar física. Se acompañó con una presentación audiovisual de elaboración propia.

Sobre una mesa se depositaron trípticos para difusión del SC2 y el seminario de formación de profesorado. Los recursos materiales adicionales fueron papel de color, impresora y procesador de textos. Se necesitaron 2 expertos para atender el espacio de exposición: 1 experto en enseñanza de la física (hombre) y 1 experta en métodos y recursos de enseñanza (mujer). Para mostrar el CD SP2 y manejar las simulaciones se utilizaron 2 ordenadores portátiles porque permiten mayor flexibilidad en el espacio así como mayor rapidez en instalación y desplazamiento. No se precisa audio en ninguno.

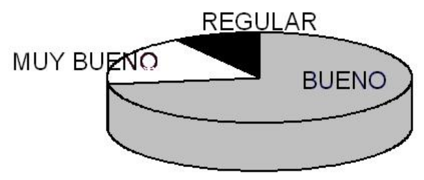
Para la presentación audiovisual de elaboración propia se necesitó un ordenador multimedia, con audio y un videoproyector. La presentación audiovisual contiene imágenes y explicaciones de los recursos SP2 integrando aspectos pedagógicos así como de la enseñanza de la física. La presentación incluye voz de narradora y música. Para ello se preparó un guión de contenidos previo. Sobre la posibilidad de uso que concede el profesorado al CD-ROM puede recurrirse al apartado 3.3. Sobre la experiencia por parte de los estudiantes se recomienda atender al apartado siguiente.

4.2, 4.3, 4.4, 4.5 y 4.6: Módulos 1 a 5 del CD-ROM

El módulo 3 "Conducción eléctrica" consta de 31 animaciones. Del trabajo con los estudiantes se espera que sean capaces de familiarizarse con el concepto de corriente eléctrica, utilizar adecuadamente los términos (conductor, semiconductor, aislante, resistencia, resistividad, conductividad, sección transversal) e identificar y representar mediante esquemas circuitos sencillos de corriente. Se espera que describan la relación entre energía cinética de la red (temperatura del material) y la resistencia, diferencias entre corriente continua y alterna en términos de portadores de cargas y campo eléctrico, relaciones entre voltaje, corriente y resistencia (Ley de Ohm) y relaciones entre resistencia, sección transversal, longitud y resistividad del material.

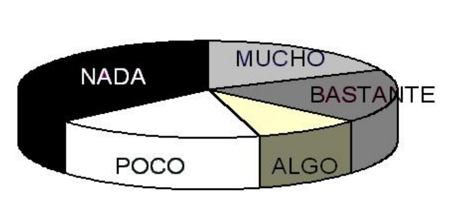
Sobre las **posibilidades de uso, valor curricular, logro académico, motivación** e **impacto diferencial** cabe decir que el módulo 3 ha sido objeto de estudio por el equipo investigador con 1 profesor y 11 alumnos. La media de calificaciones finales en la asignatura de física ha sido de 6,5 puntos. Tan solo tres de ellos han obtenido calificaciones inferiores a 5 puntos.

Tabla 4.1. Dominio del ordenador como herramienta de trabajo



La mayor parte del alumnado tiene una buena predisposición a utilizar el ordenador, ya que consideran que es muy útil y bastante eficaz. Todos disponen de ordenador en casa; la gran mayoría lo utiliza diariamente y los que no, frecuentemente. La utilidad que le dan es sobre todo para jugar, hacer sus trabajos y estudiar. Otras tareas para lo que lo usan son: chat, mensajería instantánea (Messenger explícitamente), escuchar música, ver DVD y navegar por Internet. La mayor parte de los alumnos considera que puede manejar el ordenador sin problemas y un menor número manifiesta tener un buen dominio de su manejo; tan sólo un alumno afirma tener algunas dificultades al respecto (tabla 4.1).

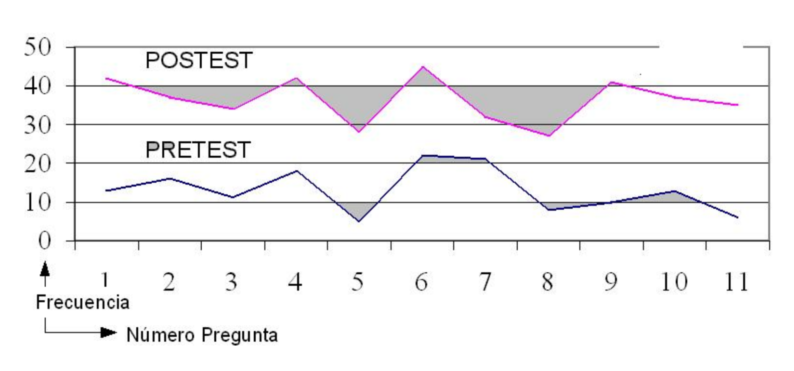
Tabla 4.2: Conocimiento multimedia



Todos conocen el procesador de texto, las hojas de cálculo, los programas de dibujo y los videojuegos. Lo que más desconocen son bases de datos, simulaciones, tutoriales, hipertextos y multimedia (tabla 4.2). Por orden de mayor a menor nivel de conocimientos se identifica el procesador de texto, la hoja de cálculo, hipertexto, base de datos y herramienta de dibujo.

Se elaboró un cuaderno-guía de actividades, que los alumnos tenían que realizar a la vez que navegaban por las simulaciones. El proceso de enseñanza duró 5 sesiones de clase. La observación se llevó a cabo en 2 sesiones de clase concluyendo que apenas preguntaron al profesor y a los compañeros sobre el ordenador, y poco sobre el multimedia y las actividades que están realizando. Todos utilizaron el cuaderno guía y tomaron notas.

Tabla 4.3. Aprendizaje. Comparación entre resultados inicial y final



El ambiente de clase fue muy tranquilo y agradable, bastante individual, silencioso y motivador. Durante las sesiones de clase, los alumnos estuvieron centrados en la interacción con el material. Tan sólo en alguna ocasión intervino el profesor para aclaraciones y/o explicaciones al grupo clase, cuestión que se dio más en la segunda sesión que en la primera.

Respecto al aprendizaje de los alumnos, se ha producido avance de conocimientos sobre las cuestiones de conducción eléctrica (tabla 4.3). La media de los resultados de aprendizaje pasa de 13,0 en el cuestionario inicial a 36,4 puntos en el final. Se avanza en el aprendizaje en 23,4 puntos.

Si nos detenemos en todos los módulo, en torno a la mitad del alumnado considera que el estudio de la conductividad con SP2 ha resultado en cierto modo interesante, comprensible y atractivo, seguido de un grupo de los alumnos que tienen mejor valoración al respecto. Todos opinan que las animaciones facilitan la comprensión de la conductividad y la mayor parte manifiesta que actúa como si fuera su tutor. Los significados positivos que dan los alumnos al CD se refieren a la buena imagen de la aplicación, la interactividad, es interesante, muy manejable y de sencilla utilidad, fácil de comprender, permite la comprensión de contextos, con contenido resumido, explicativo, dispone de muchas animaciones y es de calidad. Los módulos 1, 2, 4 y 5 N/A.

4.7 Kit de manos de baja tecnología.

Sobre las **posibilidades de uso** se exponen los dos casos en los que ha sido utilizado. Cabe reconocer que en ambos usos se aprecia valor curricular, logro académico y motivación. El **impacto diferencial** se ha considerado dentro del uso "exposiciones, feria" al trabajar con dos expertos (uno hombre y otra mujer). En el uso "seminario" N/A.

4.7.1 Salón de Exposiciones, Feria.

La VII Edición del Salón del Estudiante de Lorca (exposición), y en el pabellón Todo 100cia (feria) el kit permite demostraciones y experimentos. El evento pretende motivar e ilusionar por aprender ciencias y favorecer el rol del estudiante-investigador en el estado español. Objetivos del evento: orientación profesional, contenidos educacionales y aprendizaje basado en el juego.

Tabla 4.4. La Verdad.es, sábado 18 de febrero de 2006 http://servicios.laverdad.es/extras/salonestudlorc06/


SALÓN DEL ESTUDIANTE
LA VERDAD / SÁBADO 18 DE FEBRERO 2006

Respuesta formativa

INFORMACIÓN. Esas son las claves del 'Salón del Estudiante' que cada año intenta dar respuesta a la gran demanda de formación educativa y profesional que plantean los estudiantes que lo visitan

T. MARTÍNEZ / P. WALS

El Salón se dirige a estudiantes de primaria, secundaria, universidad, padres y madres, docentes, escuelas, colegios y otros. El espacio necesario es de 3 m. x 6 m. Se necesita 1 mesa, 1 webcam y 1 videoproyector. Sobre la mesa se expone la maleta con sus materiales (forma, medida y capacidad recomendada: 2 m. de diámetro si es circular o bien 2 m. x 1,5 si es cuadrada; 10 personas aproximadamente). La webcam recoge los movimientos del profesor que trabaja con la maleta y con ayuda del videoproyector se proyectan sus movimientos sobre pared o pantalla, en espacio tenue.

Recursos personales: 1 experto en recursos de enseñanza (pedagoga) x 2 días. Presupuesto: 120 euros x día financiado por la OTRI (UMU). 1 experto en enseñanza de la física x 1 día (catedrático, sin horario preestablecido con habilidades comunicativas dentro de grupos flexibles y de seguridad para trabajar con nitrógeno líquido).

Tabla 4.5. Web de EDUCARM. Portal educativo de la Región de Murcia http://www.educarm.es/

Valor curricular, **logro académico** y **motivación** se determina desde fuentes documentales indirectas como webs institucionales y prensa (ver tabla 4.4 y 4.5). Los testimonios personales son de satisfacción pero no han sido registrados.

4.7.2. Seminario de Formación de Profesorado.

El 23 de febrero de 2006, de 16 a 20 horas, se llevó a cabo en la Facultad de Matemáticas de la Universidad de Murcia el Seminario de Formación del Profesorado intitulado "Presentación de SUPERCOMET 2. Los Superconductores en el aula de Secundaria". La segunda fase del seminario se dedicó a la demostración del fenómeno de la superconductividad.

Tabla 4.6. Elementos para la demostración

En ella se llevó a cabo una representación demostrativa del fenómeno de la superconductividad utilizando el kit valiéndonos para ello de: nitrógeno líquido, la maleta o kit, un recipiente, una webcam, un ordenador y un videoproyector (cañón o datashow). Parte del equipo se recoge en la tabla 4.6.

Los profesores interesados realizaron el experimento directamente con sus manos, para favorecer el contacto directo con la experiencia. El **valor curricular**, **logro académico** y **motivación** se determina en los puntos 3.2 y 3.3.

4.8 Evidencias para las respuestas a las preguntas 4.1 a 4.7.

Con el profesorado (seminario, CD y kit) se ha utilizado el cuestionario. Los ítems tomaron objetivos y tópicos del SC2 (punto 3.4). Con los estudiantes (módulo 3) se utilizó: cuestionario para la medida de actitudes y habilidades hacia el ordenador, cuestionario para la evaluación del multimedia, registro de conductas observables (protocolo REGICOB adaptado) y cuestionario para la evaluación del aprendizaje. Este último facilitado por la doctora Erika Mechlova (Polonia). Sobre el CD general, la evaluación de expertos se registró con el cuestionario "Herramienta de evaluación de multimedia didáctico", disponible en inglés gracias a SC2, publicada por Píxel-Bit (18, 2002) y disponible en español en http://www.sav.us.es/pixelbit/articulos/n18/n18art/art187.htm.

En síntesis, con el CD (punto 4.1.1 y 4.4) se ha utilizado cuestionario y registro de conductas observables. Con el kit (punto 4.7) se ha recurrido al diario del investigador, informes de tareas, tríptico publicitario (tabla 4.7) y fotografías.

Tabla 4.7: Tríptico del Seminario. Fragmento

PRESENTACIÓN

En la conferencia de " Physics on Stage", desarrollada en el CERN en Noviembre de 2000 se advirtió de la existencia de una crisis en la formación científica de los escolares europeos, y de la necesidad de revitalizar y reorientar la enseñanza de la Física.

El proyecto SUPERCOMET trata de contribuir a esa revitalización, y combinando métodos de la moderna Pedagogía(aprendizaje colaborativo o la enseñanza a través de la resolución de problemas, p.e.) con la utilización de las TIC, y el empleo adecuado del laboratorio, ayuda a conectar el fenómeno de la superconductividad (de gran actualidad) con los currículos escolares de varios países europeos.

El resultado del trabajo de este grupo es la elaboración de una guía de trabajo , junto a la guía del profesor para su utilización en el aula , materializadas en un CD y un kit de laboratorio, que se presentarán al profesorado en este Seminario, para trabajar con ellos tras un análisis de los tópicos de la enseñanza de la Física con TIC, y de la superconductividad.

Se entregará el material correspondiente

OBJETIVOS

- Ayudar a vencer los miedos que el profesorado pudiera tener cuando utiliza las TIC. La aplicación permite una exploración realizada por uno mismo y fácil de usar.
- Mostrar caminos diferentes de la enseñanza de la Física. Aunque las TIC las hayamos utilizado desde hace tiempo, las instalaciones para la enseñanza de la Física por lo general no están preparados de equipamiento ni se conocen las ventajas que las TIC pudieran tener, al menos en la enseñanza secundaria de nivel superior.
- Inspirar a los profesores para aprovechar las potencialidades de las TIC, y extender esta motivación a sus estudiantes, aprovechando el impacto social de un tema de tanta trascendencia social como los superconductores.

PROGRAMA

Introducción al seminario.(Charla acerca del proyecto SUPERCOMET, sus objetivos); los objetivos del seminario, los detalles en cuanto al SP en Murcia. Cómo la superconductividad puede solucionar algunos de los problemas en la enseñanza de la física. *(Presentación en Power Point de la Introducción al Seminario de Profesores)*
Qué es la superconductividad *(Presentación del Seminario de Profesores sobre Superconductividad)*
(Uso de las TIC en la enseñanza de la física. *(Seminario de Profesores utilizando TIC)* Repaso del currículo: Los profesores se reúnen en grupos para trazar su propio mapa de plan de introducción del tema en el currículo escolar. ** Este plan deberá guardarse en el disquete del profesorado.*
Presentación de CD y Kit: vídeo clips y advertencias sobre el uso del nitrógeno líquido. *(Presentación práctica "hands-on"del Seminario de Profesores)*
Prácticas con el Kit: Las 5 experiencias CONCLUSIONES

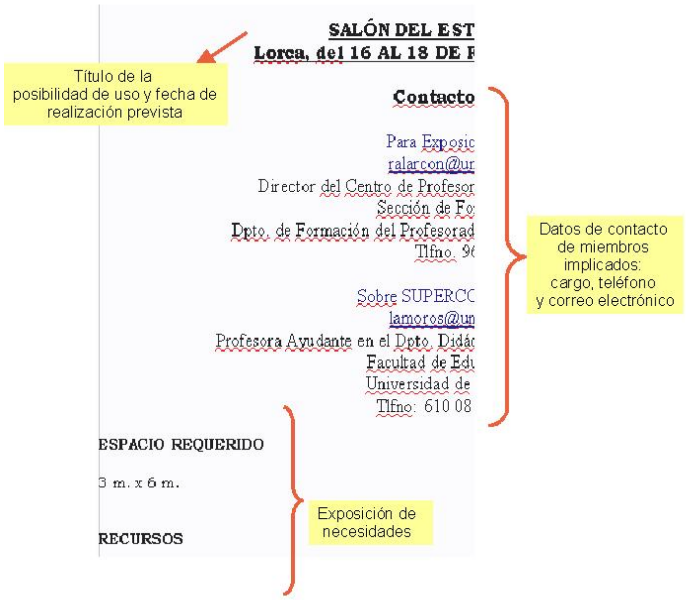
Para el Salón de Exposiciones-Feria (4.7.1) se recurre a fuentes documentales indirectas como prensa pública y páginas web (Diario La Verdad.es, web EDUCARM). Además se utilizó el diario del investigador (tabla 4.8) junto a informes internos.

Se dispone de productos de elaboración propia: tríptico, presentación audiovisual, fotografías. La presentación audiovisual sirvió para difundir SP2 más allá del contexto nacional, gracias al Congreso

Internacional EDUTEC 2005 (Santo Domingo, República Dominicana) celebrado del 14 al 16 de febrero de 2006 (http://www.um.es/edutec/).

Para el Seminario (punto 4.7.2) se utilizó cuestionario, "Informe del seminario con el profesorado referente al proyecto SUPERCOMET 2" y tríptico publicitario para participar en el Seminario de Formación de profesorado.

Tabla 4.8: Diario del Investigador. Fragmento de Informe de Trabajo



5. Cambios en los medios de enseñanza

En el apartado siguiente se indica brevemente qué aspectos de los materiales de clase, es decir, cada uno de los módulos 1 a 5 del CD-ROM y del kit de manos de baja tecnología, deben ser cambiados para su mayor uso dentro de nuestro contexto. El kit de manos de alta tecnología N/A. En este sentido, no se ofrecen modificaciones detalladas de los cambios que se necesitan, sino que se aporta una retroalimentación general con respecto a cuestiones concretas de mejora que se han detectado.

En el punto 5.7 se recogen las evidencias para fundamentar los juicios de valor emitidos en los apartados anteriores.

5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7: Cambios sugeridos

Apoyándonos de la tabla 5.1 los cambios sugeridos de manera general, según los estudiantes, se refieren a la necesidad de acabar la información en determinados apartados y la explicación de conceptos. También advierten que faltan ejercicios tanto prácticos como teóricos (numéricos). Se hecha de menos una guía de trabajo personal y retroalimentación auditiva.

Tabla 5.1: Cambios en los medios de enseñanza

	Medios de enseñanza	Cambios sugeridos
5.1	CD-ROM - general	Desde los alumnos respecto al multimedia: 1) Algunos apartados estás incompletos de información 2) No termina de explicar varios conceptos. 3) Faltan ejercicios, numéricos y/o prácticos 4) Se carece de una guía de trabajo personal 5) Carece de sonido y/o feedback sonoro
5.2	CD-ROM Modulo 1: Magnetismo de corrientes e imanes	N/A
5.3	CD-ROM Modulo 2: Magnetismo de bobinas y materiales	N/A
5.4	CD-ROM Module 3: Inducción electromagnética	1) Alfabetización informática 2) Se necesitaron materiales explicativos adicionales 3) Se necesitó material escolar adicional
5.5	CD-ROM Modulo 4: Conducción eléctrica	N/A
5.6	CD-ROM Modulo 5: Introducción a la superconductividad Módulo 6: Historia de la superconductividad	N/A
5.7	Kit de manos de baja tecnología	N/A

Sobre el módulo 3 "Conducción eléctrica" serían interesantes cambios tanto en recursos personales como materiales y en la formación. En otras palabras, en particular un estudiante reconoce su dificultad a la hora de utilizar el ordenador. En general, se hizo uso adicional tanto de explicaciones del docente como de materiales de apoyo (guía de ejercicios y papel para notas). Sobre el kit de manos de baja tecnología N/A.

5.9 Evidencias para las respuestas a las preguntas 5.1 a 5.7.

Dirigidos al alumnado: "Cuestionario de actitudes y conocimiento del medio informático", "Cuestionario de evaluación de material multimedia didáctico (EVALALU)". Para la observación en el aula se utilizó la adaptación del protocolo REGICOB. Los procedimientos para la elaboración de las conclusiones son el análisis de contenido, las escalas (Diferencial semántico de Osgood y Escala de actitudes de Likert), matrices de datos, diagramas esquemáticos (mapas conceptuales y diagramas de flujos). Para el análisis de datos cuantitativos se utilizó el paquete para el tratamiento estadístico de datos SPSS 12.

6. Integración de medios

El desarrollo de una tarea referente a la integración del CD SC2 en el currículum se realizó dentro del seminario de formación de profesores. Esta fase la dedicamos al desarrollo de una actividad de mapeo del currículum. El ejercicio se diseña para ayudar al profesorado a familiarizarse con el contenido del CD-ROM y la metodología en la que puede ser utilizado dentro del plan de estudios propio. Se han codificado los contenidos del CD-ROM por asignaturas, módulos y metodología (tabla 6.1). Recúrrase al punto 6.2. para la metodología. La estructura modular (módulos 1 a 6) se codifica de la siguiente manera:

- M1 Módulo 1: Magnetismo de corrientes e imanes
- M2 Módulo 2: Magnetismo de bobinas y materiales
- M3 Módulo 3: Inducción electromagnética
- M4 Módulo 4: Conducción eléctrica
- M5 Módulo 5: Introducción a la superconductividad
- M6 Módulo 6: Historia de la superconductividad

Tabla 6.1. Integración curricular de SUPERCOMET por asignaturas, cursos y metodología.

CURSO			ASIGNATURAS	CONTENIDOS CD-ROM SC2						METODOLOGÍA			
				M1	M2	M3	M4	M5	M6	A	B	C	D
E.S.O.	1º Ciclo	1º	TECNOLOGÍA				•	•		•			
		2º	FÍSICA Y QUÍMICA	•	•			•		•	•		
	2º Ciclo	3º	TECNOLOGÍA			•	•			•	•		
			FÍSICA Y QUÍMICA			•	•	•				•	
		4º	TECNOLOGÍA			•	•	•				•	
			FÍSICA Y QUÍMICA	•	•	•	•	•		•	•		
			INICIACIÓN PROFESIONAL ELECTRICIDAD-ELECTRÓNICA		•	•	•	•		•	•		
BACHILLER		1º	TECNOLOGÍA			•	•	•		•	•	•	•
			CIENCIA, TECNOLOGÍA Y SOCIEDAD	•	•	•	•	•	•	•		•	
			FÍSICA Y QUÍMICA	•	•			•		•	•	•	•
		2º	TECNOLOGÍA		•	•	•	•		•	•	•	•
			FÍSICA Y QUÍMICA	•	•	•	•	•	•	•	•	•	•

6.1 Descripción del CD-ROM y kit de manos.

A continuación se da respuesta a la pregunta ¿cómo se utilizan en la práctica los recursos SC2. En particular se describe el uso del CD-ROM y del kit de manos de baja tecnología dentro del contexto "sala de clase". Se presenta en dos momentos: A) seminario de formación del profesorado; B) sala de clase destinada a la formación de estudiantes. Se explica cada uno a continuación.

6.1.1 Formación del Profesorado: sala de clase.

El uso práctico del CD-ROM y del kit dentro del seminario se ha tratado en el punto 3.2 describiendo las fases del seminario y el empleo del CD y del kit. Sobre la utilidad del seminario ver punto 3.3.

Respecto a la actividad referente a integración del CD CS2 en el currículum, cabe recoger algunas reflexiones por parte del profesorado. El material parece muy útil para que los alumnos visualicen fenómenos que habitualmente vienen recogidos en el libro de texto y que a la hora de hacer los dibujos en la pizarra resultan bastante dificultosos y nunca en ellos podemos poner de manifiesto su aspecto dinámico. También es útil para que puedan apreciar la importancia de los modelos como herramienta de explicación de la realidad. Se puede utilizar para explicar contenidos teóricos, para la realización de ejercicios prácticos y para observar experimentos que no se podrían realizar en los laboratorios. El material es excelente para comprender y visualizar los fenómenos electromagnéticos sin necesidad de tener gran cantidad de materiales. Es un material ágil, claro, fácil de manejar por el alumno y muy interactivo.

Para la descripción del uso específico del kit de manos de baja tecnología ver punto 4.7.2. La evaluación del kit por parte de los profesores asistentes N/A.

6.1.2 Integración curricular: sala de clase.

La experiencia ha sido realizada a partir de la unidad didáctica sobre conducción eléctrica (módulo 3) utilizando el CD-ROM SC2. Para los registros se utilizaron: "Cuestionario de actitudes y conocimiento acerca del medio informático", "Cuestionario de evaluación previo de conocimientos sobre el tema a estudiar, conducción", "Trabajo del alumnado con el material multimedia", "Registro de conductas observables", "Cuestionario de evaluación posterior de conocimientos sobre el tema estudiado", "Cuestionario de evaluación del multimedia SUPERCOMET por parte del alumnado".

Los instrumentos de recogida de información se aplicaron conforme al cronograma de tabla 6.2. De ella se aprecia que el proceso de evaluación se realizó en dos semanas. Para ello se dedicó un día a la evaluación de actitudes y conocimientos sobre el medio informático (ordenador como hardware pero también como medio de comunicación y como software), dos días para la evaluación de los contenidos y una jornada en dos sesiones para la observación. Finalmente, el último día se destinó a la evaluación del material por parte de los usuarios, entendiendo por usuarios, en este caso, a los estudiantes.

Tabla 6.2: Cronograma de la experiencia. Mayo 2006.

DÍAS DE CLASE	INSTRUMENTOS	ESTUDIO CON CD-ROM SUPERCOMET
16, martes	Evaluación de actitudes y conocimiento acerca del medio informático	
17,miércoles	Evaluación de contenidos -pretest -	
18, jueves		Alumnado estudiando con SUPERCOMET
19, viernes	Observación	
19, viernes	Observación	
23, martes		
24, miércoles		
25, jueves	Evaluación de contenidos - postest-	
26, viernes	Evaluación del multimedia por parte del alumnado: Evaluación de SUPERCOMET	

El trabajo del alumnado con multimedia supuso la explicación de la unidad didáctica de conducción, para lo cual se elaboró un cuaderno-guía de actividades, que los alumnos tenían que realizar a la vez que navegaban por las simulaciones. El proceso de enseñanza duró 5 sesiones de clase, en el que se pretendía que el aprendizaje fuese lo más autónomo posible, de forma que los alumnos realizaran las actividades del cuaderno-guía basándose en la observación y manipulación de las animaciones informáticas y en la lectura del texto que las apoya. No obstante, en determinadas cuestiones, el profesor expuso información adicional.

6.2 Métodos de enseñanza sugeridos por SP2: uso en la práctica.

Atendiendo a los métodos de enseñanza sugeridos en la guía y el seminario del profesor se plantea la pregunta ¿se utilizaron en la práctica? La respuesta es que sí se hizo dentro del seminario de formación de profesores. Los documentos ofrecidos por SP2 fueron traducidos al español (documentos con procesador de textos y presentaciones visuales sobre aspectos técnicos, pedagógicos y de contenido de la física). Para llevar a efecto el seminario se utilizó una metodología basada en la colaboración entre redes de personas.

El profesorado participante en el seminario propuso cuatro metodologías (A, B, C y D) para la integración de contenidos en función de las asignaturas y cursos académicos. Propuesta A: El profesor utiliza puntualmente el multimedia durante la explicación de los temas relacionados con la materia, empleando el proyector, como complemento a la explicación teórica de los mismos. Propuesta B: El alumno de forma individual va siguiendo los módulos de SC2 en su ordenador, bajo la guía del profesor, realizando actividades del material y/o las diseñadas por el profesor, y aplicando lo que llamamos aprendizaje por descubrimiento. Propuesta C: Analizar en pequeño grupo determinadas experiencias y exposición posterior en gran grupo. Aplicación práctica en la vida real de la experiencia. Comentar la experiencia individualmente (prueba objetiva o examen) y exponerla ante el profesor utilizando videoproyector. Propuesta D: Utilizar el material como soporte para explicar conceptos abstractos. Visualizar los experimentos virtuales. Hacer los ejercicios que integra el material.

Las sesiones de observación dentro del aula advierten la aplicación metodológica B por lo que no hubo metodología basada en redes de personas como trabajo en colaboración, sino trabajo individual ante el ordenador tratando de favorecer el aprendizaje por descubrimiento.

6.3 Integración de SP2 con los recursos existentes.

En este punto es interesante detenerse en el cómo se integraron nuestros materiales con los recursos existentes. En particular se refiere a, por ejemplo, cómo se integraron los nuevos medios con otros habituales en el aula como pudiera ser libros de texto, otros materiales multimedia, con la charla del profesor u otros experimentos.

N/A

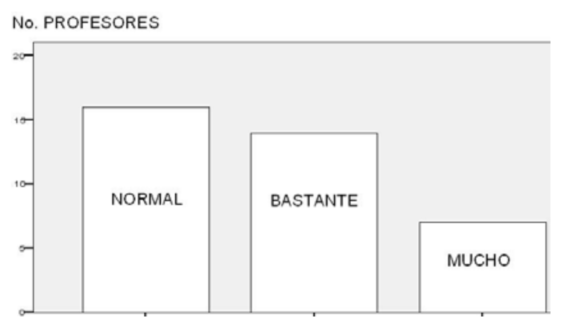
6.4 Dificultades del profesorado al integrar los medios en la enseñanza.

N/A

6.5 Sentimiento del profesorado y/o estudiantes ante los métodos de integración.

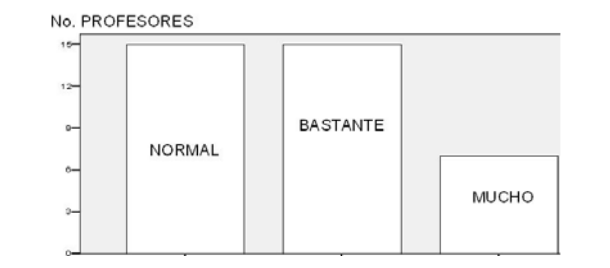
El sentimiento por la metodología aplicada ha sido objeto de estudio en el profesorado. Los ítems son: "muestra nuevos caminos en la enseñanza de la física" (tabla 6.3), "uso del ordenador de manera constructiva" (tabla 3.3), "inspiración para seguir dando clases y motivar a estudiantes" (tabla 6.4) y "exploración de forma apasionante" (tabla 6.5). Las respuestas de estos ítems (apartado 3.3) recomienda el trabajo en colaboración basado en redes y los seminarios como metodología de enseñanza-aprendizaje. El sentimiento en los estudiantes N/A.

Tabla 6.3: Muestra caminos diferentes en la enseñanza de la Física



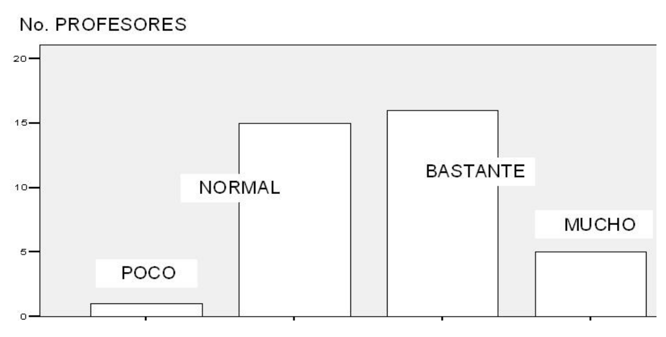
Conociendo los recursos SP2 el profesorado planteó cuatro posibilidades de integración curricular (A, B, C y D, punto 6.2).

Tabla 6.4: Le inspira para seguir dando clases y motivar a sus alumnos



El trabajo en colaboración por medio de redes de personas se advierte en C, el aprendizaje por descubrimiento favoreciendo la autonomía en B, una adaptación de la metodología de enseñanza tradicional en A y D. La propuesta C implica analizar en pequeños grupos, exponer en gran grupo, aplicar las experiencias en la vida real y exponer individualmente (prueba objetiva) ante el profesor utilizando videoproyector.

Tabla 6.5: Explorar de manera apasionante el fenómeno de la superconductividad



Atendiendo a los testimonios, el profesorado considera el CD-ROM útil para visualizar fenómenos habituales en libros de texto. En la pizarra resultan difíciles y pierden su aspecto dinámico. Permite apreciar la importancia de modelos como herramientas para dar explicaciones.

Se puede utilizar para explicar contenidos teóricos, para la realización de ejercicios prácticos y para observar experimentos que no se pueden realizar en laboratorio. El material es excelente para comprender y visualizar los fenómenos electromagnéticos sin necesidad de tener gran cantidad de materiales y es un recurso ágil, claro, fácil de manejar y muy interactivo.

6.6 Evidencias para las respuestas a las preguntas 6.1 a 6.5.

Registros efectuados utilizando cuestionarios **dirigidos al alumnado,** "Cuestionario de actitudes y conocimiento del medio informático" y "Cuestionario de evaluación de material multimedia didáctico (EVALALU)". Registros efectuados del cuestionario dirigido a profesores, cuestionario compuesto por 7

ítems con escala de valoración Likert. Los ítems tomaron como punto de partida los objetivos y tópicos internos al Proyecto. Documento base disponible en la dirección web: http://www.simplicatus.no/web.php?action=subpagelevel2_view_single&pk=42.

Sobre el CD general, la evaluación de expertos se registró con el cuestionario "Herramienta de evaluación de multimedia didáctico", disponible en inglés gracias a SC2, publicada por Píxel-Bit (18, 2002) y disponible en español en http://www.sav.us.es/pixelbit/articulos/n18/n18art/art187.htm.

7. Estudios de caso de clase

En los siguientes puntos se proporcionan dos estudios de caso que describen el uso real de los recursos SP2, es decir, el CD-ROM y del kit de manos de baja tecnología dentro de nuestro contexto. Cuando se ha podido, se incluye información sobre el número de estudiantes en clase, número de ordenadores y conexiones de red dentro de la sala de clase.

Tabla 7.1: Integración de contenidos de SUPERCOMET en asignaturas por curso

			ASIGNATURAS				
CURSO			TECNOLOGÍA	FÍSICA	QUÍMICA	INICIACIÓN PROFESIONAL ELECTRICIDAD-ELECTRÓNICA	CIENCIA, TECNOLOGÍA Y SOCIEDAD
E. S. O.	1º CICLO	1º	→ Integrar los módulos correspondientes a conducción eléctrica y fenómenos magnéticos de inducción → Visualización del fenómeno de la conducción eléctrica y otros conceptos difíciles de mostrar a los chavales	→ Magnetismo de corrientes e iones			
		2º					
	2º CICLO	3º	→ En la unidad didáctica de electricidad y electrónica (en lo correspondiente a los fundamentos teóricos del electromagnetismo y aplicaciones básicas)	→ En la unidad didáctica de electricidad y magnetismo → Conducción eléctrica es un módulo muy adecuado para introducir la idea de átomo, enlace metálico y movimiento de los electrones → Introducción a la superconductividad, para despertar interés		→ Inducción electromagnética → Conducción eléctrica → Superconducti-vidad	
		4º					

BACHILLER	1º	➔ Electromagnetismo	➔ Magnetismo de corrientes e imanes ➔ Magnetismo de bobinas y materiales ➔ Conducción eléctrica ➔ Introducción a superconductividad			➔ Visión relativa a los avances técnicos
	2º	➔ Electromagnetismo ➔ Inducción electromagnética	➔ Magnetismo de corrientes e imanes ➔ Magnetismo de bobinas y materiales ➔ Inducción electromagnética	➔ Inducción electromagnética ➔ Conducción eléctrica ➔ Introducción a superconductividad ➔ Historia superconductividad		

El conocimiento sobre el grado de experiencia del profesorado al usar TICS N/A.

Los dos estudios de caso son de naturaleza diferente, a saber, el seminario dirigido a formación de profesores y la enseñanza dirigida a alumnado dentro del aula. Ambos casos implican integración curricular de medios si bien, para diferenciarlas nos referimos a ellas como "Seminario de Formación de Profesores" e "Integración curricular de medios en el aula". Sobre la determinación de los medios utilizados en contexto de enseñanza se puede recurrir a los puntos 4.1 hasta 4.8.

7.1 Seminario de Formación de Profesores: Estudio de caso.

Una breve descripción (punto 2.2.), cómo se formó al profesorado para utilizar los materiales (punto 3 y 3.1), el estudio del seminario (punto 3.2), aspectos útiles (punto 3.3) e integración de medios (punto 6.1.1) se han descrito con anterioridad. El grado de experiencia del profesorado al usar TICS N/A.

Tras revisar el material multimedia en el seminario, reflexionar sobre la integración curricular y debatir en grupo, el profesorado considera oportunos integrar los contenidos en función de las asignaturas y cursos. Quedan recogidos en la tabla 7.1 que se encuentra en la página anterior.

7.2 Integración curricular de medios en el aula: Estudio de caso.

Una breve descripción (punto 2.2.2), modificaciones en los medios de enseñanza (punto 5) e integración curricular en la que participa el profesor que lleva a cabo esta experiencia (puntos 6, 6.1.2 y 7.1) han sido expuestos anteriormente. Atendiendo al proceso, se comienza introduciendo el concepto corriente eléctrica, utilizando un modelo de partículas portadoras de corriente como gases ideales.

Se comprueba la resistencia de cuatro elementos investigando la intensidad que pasa por la bombilla según el brillo (tabla 7. 1), se ofrece una visión microscópica de la corriente eléctrica partiendo del modelo atómico del litio y permite investigar cuantitativamente las relaciones entre intensidad y voltaje (tabla 7.2).

Tabla 7.1. Resistencia de cuatro elementos


Con la "Ley de Ohm" se propone la nomenclatura de "Regla de Ohm" que quizás se ajuste mejor a la realidad, se regresa a la visión microscópica del material y se visualiza un modelo microscópico. Se muestran líneas de campo eléctrico cuya intensidad se controla investigando relación con velocidad de arrastre de los electrones de conducción y número que atraviesan la sección. Se ilustra cómo depende la resistencia de un objeto con longitud, sección y resistividad. Con la Ley de Joule (tabla 7.3) se varía la resistencia sumergida en un líquido cuya temperatura medimos, constatando cómo si duplicamos la resistencia la temperatura se alcanza en la mitad de tiempo y si duplicamos la intensidad se calienta más rápido. Se concluye mostrando la electrolisis (tabla 7.4).

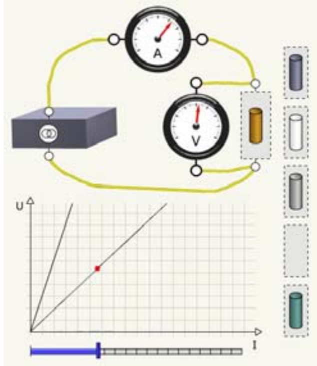
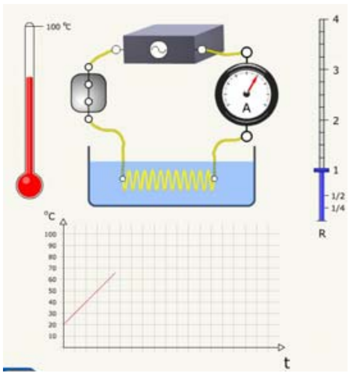
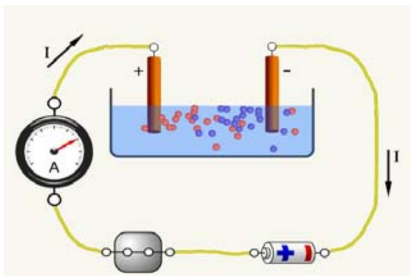
Tabla 7.2 . Relación corriente que circula y caída de tensión


Tabla 7.3. Ley de Joule	Tabla 7.4. Electrólisis
	

Del trabajo con materiales sólidos (electrones) se visualiza la conducción en un líquido en el que existen iones positivos y negativos contribuyendo a la corriente, que por convención, lleva el sentido de las cargas positivas.

8. Tests compartidos

El módulo objeto de estudio sobre la base de pretest y postest ha sido el módulo 3 denominado "Conducción eléctrica". Para ello puede recurrirse al punto 4.2 a 4.6 donde se exponen los resultados de aprendizaje obtenidos.

8.1 Balance de las respuestas a las preguntas cerradas.

Si has utilizado la forma estándar para los cuestionarios de los alumnos y del profesor, entonces proporciona un balance de las respuestas a las preguntas cerradas (necesitarás resumir éstos por separado y debes utilizar la evidencia dentro de otras partes de este informe). Las respuestas cerradas de las preguntas que deben ser divulgadas son:
• SC2_cuestionario-alumnos_20070423_HGM: Preguntas 1 - 22
• SC2_cuestionario_profesores_20070423_HGM: Preguntas 1 - 3
N/A

8.2 Informe de aspectos individuales de los módulos (pre y post test).

Si utilizas compartido el pre y el post - conocimiento prueba, entonces haz un informe sobre aspectos individuales para:
• SC2_electric_conduction_module_test_20070423_HGM
• SC2_electromagnetic_induction_module_test_20070423_HGM
• SC2_magnetism_module_test_20070423_HGM
• SC2_superconductivity_modules_test_long_20070423_HGM
• SC2_superconductivity_modules_test_short_20070423_HGM
N/A

9. Valoración final

Son dos las cuestiones que se responden en este apartado. De un lado, se plantea la cuestión de si son los recursos SP2, es decir, la guía y el seminario del profesor, el CD-ROM y los kit de manos una adición valiosa y útil a los recursos de la educación de la física disponibles en nuestro contexto. El planteamiento tiende a la emisión de juicios de valor como por ejemplo si contribuyen o no a la formación y/o al interés, tanto del profesorado como de los estudiantes que están aprendiendo. Se recuerda, nuevamente, que el kit de manos de alta tecnología N/A.

En un segundo momento se responde a de qué manera, si la hay, los recursos SP2 contribuyen a promover igualdad entre los hombres y las mujeres en nuestro contexto nacional. Para ello, desde Murcia, se redactó un informe del cual se extraen algunas aportaciones a continuación.

9.1 Validez y utilidad de los recursos SP2.

A continuación se expone la validez y utilidad del seminario de formación de profesores, la guía del profesor, el CD-ROM y los kit de baja y alta tecnología. Además se ofrecen recomendaciones con respecto a acciones futuras teniendo en cuenta los resultados obtenidos.

9.1.1 Sobre el Seminario de Formación de Profesores.

Más del 25% del profesorado no destaca el uso del ordenador bajo un planteamiento constructivo. Esto lleva a pensar que se necesita incidir más en metodologías favorecedoras de interactividad cognitiva. Resultando aconsejable el trabajo con entornos artificiales y herramientas de comunicación que favorezcan la conectividad como por ejemplo MOODLE, wikis, weblogs, buscadores, mensajería instantánea, chat, por citar algunas.

Más de un 35% indica que el seminario, normalmente, le permite conocer los recursos SP2. En este sentido, convendría incidir en propuestas innovadoras sobre el uso de medios en la enseñanza para aumentar el nivel de satisfacción.

Más del 40% del profesorado considera que se ha profundizado en el fenómeno de la superconductividad normalmente o poco, por lo que se advierte la importancia de atender al fenómeno de manera particular.

Interesa detenerse en la pasión por la exploración del fenómeno usando SP2 también. Más del 40 % de los profesores manifiestan una pasión normal o poca. Este dato contrasta con la inspiración a dar clase y a motivar, ya que cerca del 60% de los profesores reconocen estar bastante o muy motivados. Si explícitamente reconocen estar inspirados para dar clase y para motivar a los estudiantes, tal vez conviene enfocar el modo en que SC2 permite la exploración del fenómeno (validez y utilidad estética y pedagógica, nuevas metodologías de enseñanza y evaluación). De manera específica, el kit de manos de alta tecnología N/A con lo cual conviene replantearse el uso de este recurso.

El número de colegios participantes, teniendo en cuenta los profesores, que fueron formados en el seminario N/A. Conviene tener en cuenta este ítem para una evaluación del impacto. No se ha considerado número de profesores con experiencia docente, de los profesores aprendices, ni los conocimientos en Ciencias y TICs. Sería conveniente atender a ellos en un futuro.

9.1.2 Sobre la Guía del Profesor.

Debe considerarse que no se han establecido registro de aspectos específicos de la Guía del Profesor con lo cual no es posible determinar qué aspectos han resultado válidos y útiles de manera específica.

En este sentido, se ha hecho uso de la Guía (punto 3.3). Se recomienda una evaluación del medio impreso (imágenes, párrafos, colores, contenidos adaptado al contexto, situación del código visual y escrito) para una evaluación futura.

9.1.3 Sobre el CD-ROM y el KIT de manos de baja y alta tecnología.

Atendiendo a la interactividad de los recursos SP2 dentro del aula el avance del aprendizaje es de 23,4 puntos. Resulta de interés establecer comparaciones de esta medida con otros grupos sobre la aplicación de instrumentos similares para emitir juicios de valor concluyentes. En otras palabras, teniendo en cuenta el estudio realizado dentro de un aula con los recursos SP2, CD-ROM y KIT de baja tecnología, convendría ampliar el campo de aplicación SP2 a más de un grupo de estudiantes.

Debe considerarse que no se han establecido registro de aspectos específicos del kit de manos de baja tecnología. Con lo cual no es posible determinar qué aspectos han resultado válidos y útiles de manera específica.

9.2 Evidencias para la respuesta a la pregunta 9.1.

Dirigidos al alumnado: "Cuestionario de actitudes y conocimiento del medio informático", "Cuestionario de evaluación de material multimedia didáctico (EVALALU)". Para la evaluación del aprendizaje del módulo 3 se ha utilizado un cuestionario inicial y un cuestionario final. Para la observación en el aula se utilizó la adaptación del protocolo REGICOB.

Los procedimientos para la elaboración de las conclusiones son el análisis de contenido, las escalas (Diferencial semántico de Osgood y Escala de actitudes de Likert), matrices de datos, diagramas esquemáticos (mapas conceptuales y diagramas de flujos) y el análisis de este informe en los puntos 1 a 8.

9.3 Igualdad de Género dentro de los recursos SP2.

A continuación se aborda la manera en que los recursos SP2 dentro del contexto murciano han contribuido a la consideración del género (igualdad de género o *gender equality*) entendiendo por ello la igualdad entre hombres y mujeres. Las consideraciones se centran en el seminario de formación de profesores y que se han reflejado de igual modo dentro del CD-ROM. De manera interna al proyecto, la consideración del género se aprecia dentro del documento obtenido tras el *workshop* celebrado en Murcia en mayo de 2007.

Puesto que se han detectado necesidades sobre la consideración de género dentro de los recursos SP2, se ha abierto un punto (ver 9.3.2) ofreciendo recomendaciones en tres ámbitos: 1) las herramientas de evaluación en acciones futuras si las hubiera; 2) la metodología de enseñanza-aprendizaje a aplicar; 3) los contenidos de superconductividad dentro de los módulos SP2, ante la no consideración del indicador de género. Un ejemplo se encuentra en la tabla 9.1 y 9.2 contenido procedente del seminario de formación de profesores también introducido en el CD-ROM.

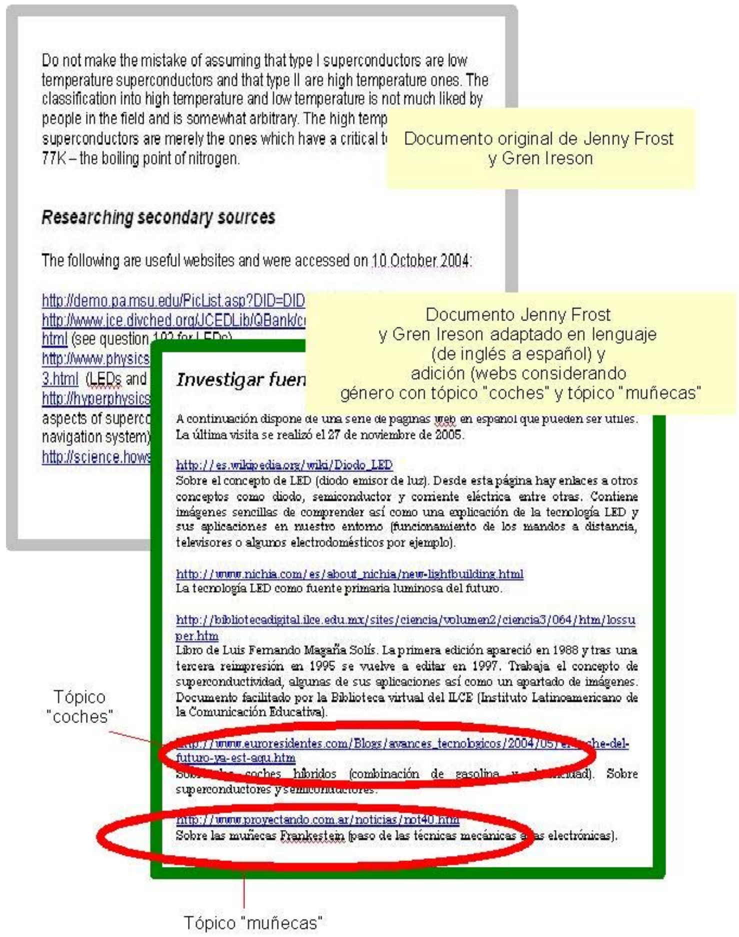
<table>
<tr><th>Tabla 9.1. Coach masculino: Premios Nobel</th><th>Tabla 9.2: Coach masculino: Teorías BCS</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

9.3.1 Manera en que los recursos SP2 contribuyen a la promoción de la igualdad entre hombres y mujeres.

En el **seminario de formación de profesores** se consideró la cuestión de género dentro del documento "Actividades prácticas de superconductividad y reflexión de tareas. Folleto de Instrucción" de Jenny Frost y Gren Ireson. Este documento fue traducido por el grupo de Murcia y adaptado considerando lengua (adaptación por medio de traducción) y direcciones web en español (adaptación por medio de adición). Dentro del apartado "Investigar fuentes secundarias" la adaptación considerando la cuestión de género consistió en introducir enlaces atractivos pensando en chicos y en chicas de la región. En la tabla 9.1 pueden advertirse los tópicos "coche" y "muñeca". La última visita a estas webs se realizó el 27 de noviembre de 2005.

Además se detectó la necesidad de considerar el código utilizado dentro de los contenidos (aspectos estéticos considerando el género e imágenes) si bien por limitaciones de tiempo no fue posible proceder a las adaptaciones pertinentes.

Tabla 9.1. Adaptación de contenidos considerando en GÉNERO



Posteriormente, en el **Workshop de Murcia**, celebrado del 16 al 19 de mayo de 2007 se ofrecieron pautas sobre evaluación y consideración de género dentro de los recursos SC2 atendiendo a las revisiones de los materiales.

9.3.2 Recomendaciones.

Considerando las **herramientas de evaluación** utilizadas: a) Necesidad de incorporar la variable género dentro de las evaluaciones: en el caso de Murcia (España) no se consideró dentro del seminario de formación de profesores; b) Población y muestra: se ha trabajado con una muestra de 11 estudiantes hombres. Convendría trabajar con estudiantes mujeres para favorecer una población y muestra representativa.

Sobre los **métodos de enseñanza – aprendizaje**: a) Incorporación de cuestiones socio-culturales. Para ello se precisa conocer al alumnado con el fin de personalizar el proceso de enseñanza y favorecer la enseñanza individualizada (enseñanza "hecha de encargo" o *customized*), por ejemplo utilizando frases comunes, clips de películas conocidos, sonidos cotidianos, imágenes. Para llevarlo a cabo puede ser de utilidad el cuestionario sociocultural de Miers y Amorós (2003-04, Universidad de Toronto), basado en los planteamientos antropológicos de Edward T. Hall (1959) tomando en consideración además a Hall (1966 y 1977), De Kerckhove (1995), Martínez (1995), Archer (1999), Martínez (1999), Darling- Hammond, (2001) y Guarro (2002). En la dimensión "Sexo/Aprendizaje" se registran temas que atienden al sexo masculino y temas específicamente para el sexo femenino.

Sobre los **contenidos de enseñanza de los módulos SP2**: a) Contenido fundamentado: es necesario disponer de un soporte bien fundamentado, teórica y prácticamente, para la introducción del indicador de género dentro del contenido dado. Actualmente los contenidos revisados no introducen el indicador de género. Un ejemplo de cómo trabajar este aspecto se desarrolla en el documento Action Point 14.08 SP2, de Prendes y Amorós; b) Consideración del código empleado: Identificación (comienzo de clases con preguntas para detectar relaciones con el género) y codificación audiovisual (estética y pedagógica), también ejemplificado en el documento Action Point 14.08 SP2, de Prendes y Amorós.

9.4 Evidencias para la respuesta a la pregunta 9.3.

Las evidencias se obtienen de: a) vagabundeo en la información ofrecida por SP2 tanto a modo de informes internos como de recursos; b) informes realizados dentro del grupo de Murcia como son las memos, los informes tras las evaluaciones y el diario del investigador; c) revisión de este informe final. A continuación se citan las fuentes revisadas:

a) Vagabundeo por los documentos SP2 (presentaciones visuales del seminario de formación de profesores, documentos de actividades con estudiantes enviados por SP2 y guía del profesor):

• Documento: SUPERCOMET_teacher_seminar_EN_2_superconductivity (slide 13, slide 27)
Autoría: Gren Ireson, Loughborough University. Traducción: Lucía Amorós Poveda

• Documento: SUPERCOMET_teacher_seminar_EN_5_description_handson_activities
Título: "Hands-on superconductivity activities and thinking tasks Instruction booklet"
Autoría: Jenny Frost y Gren Ireson. Traducción y adaptación: José Miguel Zamarro y Lucía Amorós

b) Informes internos, memos, diario del investigador:

• Documento: "Informe del seminario con el profesorado referente al proyecto Supercomet 2", de Luisa Ma. Fernández López.
• Documento: "MEMO: 18 a 20 de noviembre de 2005. ASUNTO: Adaptaciones en los documentos del seminario", de Lucía Amorós Poveda.
Action Point 14.08 SP2: Documento "Gender Equality and Evaluation Issues – Brackground", de Ma. Paz Prendes y Lucía Amorós.

c) Revisión de este informe final, desde el punto 1 al punto 8.

10. Bibliografía

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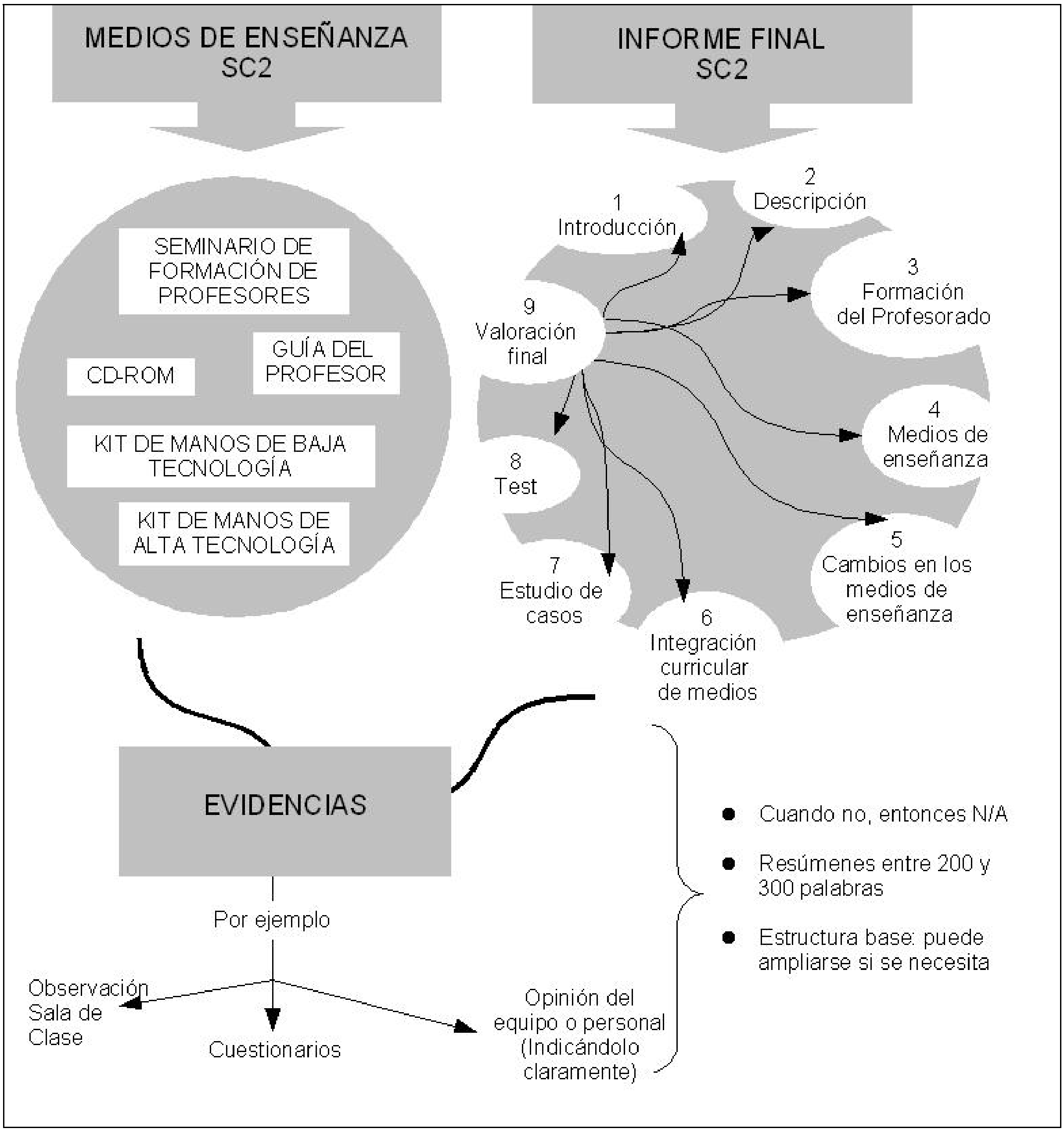
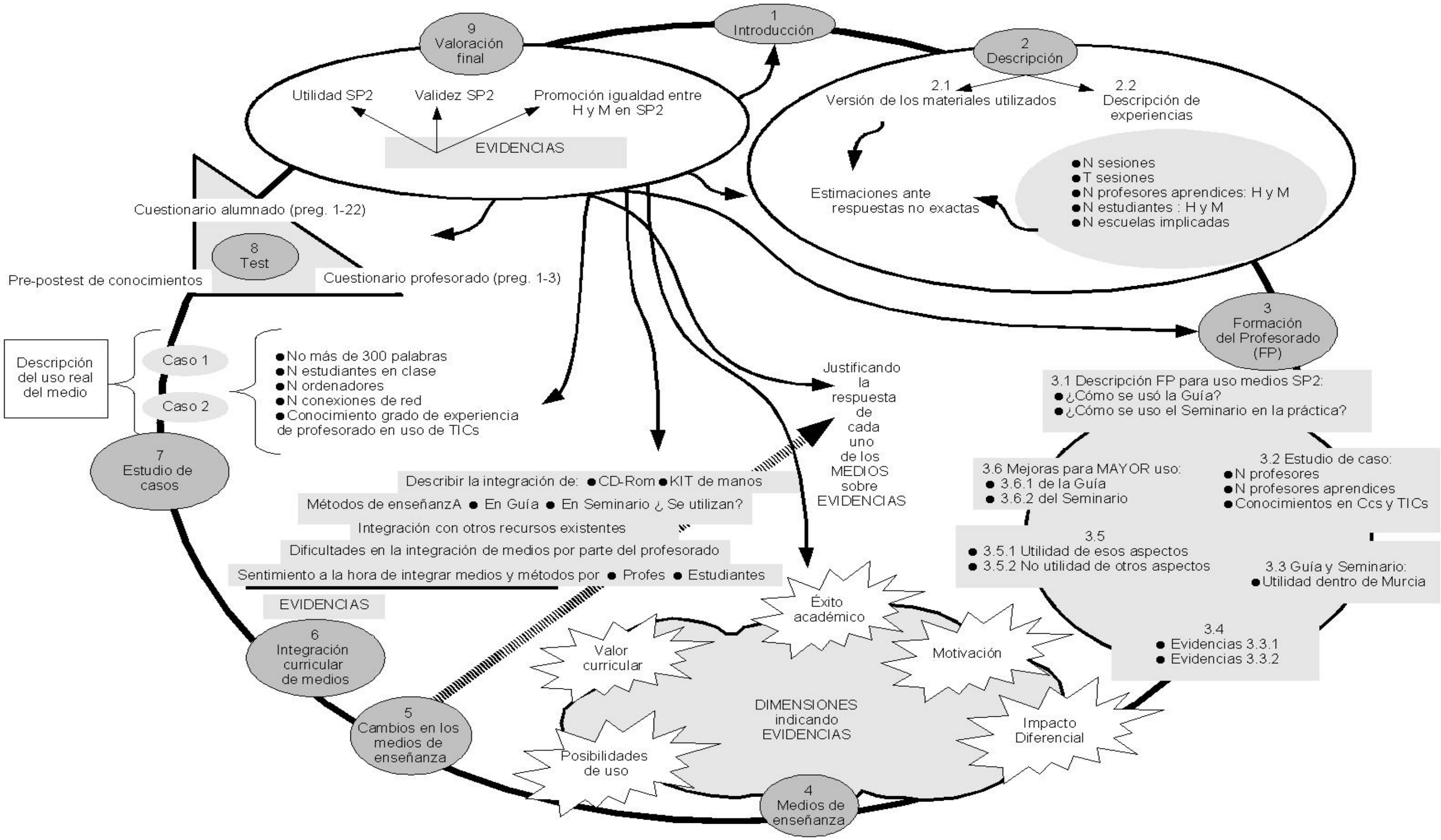
ANEXOS

ANEXO 1: Informe Final – Metaevaluación 1.


MEDIOS DE ENSEÑANZA SC2
INFORME FINAL SC2
SEMINARIO DE FORMACIÓN DE PROFESORES
CD-ROM
GUÍA DEL PROFESOR
KIT DE MANOS DE BAJA TECNOLOGÍA
KIT DE MANOS DE ALTA TECNOLOGÍA
1 Introducción
2 Descripción
3 Formación del Profesorado
4 Medios de enseñanza
5 Cambios en los medios de enseñanza
6 Integración curricular de medios
7 Estudio de casos
8 Test
9 Valoración final
EVIDENCIAS
Por ejemplo
Observación Sala de Clase
Cuestionarios
Opinión del equipo o personal (Indicándolo claramente)
Cuando no, entonces N/A
Resúmenes entre 200 y 300 palabras
Estructura base: puede ampliarse si se necesita

ANEXO 2: Informe Final – Metaevaluación 2.



PARTNER: **Loughborough University**

AUTHOR: **Gren Ireson** DATE: **yyyy-mm-dd**

REVIEWER: **<reviewer name>** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide

Teacher Seminar

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit

High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions
- Length of sessions

- Number of trainee teachers involved (please give numbers of male and female trainee teachers)
- Number of teachers involved (please give numbers of male and female teachers)
- Number of students involved (please give numbers of male and female students)
- Number of schools involved.

(You will not always be able to give exact answers to these questions, so please give your best estimate.)

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

Test Cohort

This can be considered in two parts:

a. the seminar and guide (CD and book) where presented via a one seminar to forty post-graduate trainee teachers. Of the forty 6 had a physics background, 16 a chemistry background and 18 a biology background.
b. The seminar was presented to eight in-service science teachers where 7 of the eight had a physics background.

Test Situation

a. The trainee teacher cohort where taken through the teacher guide, with examples demonstrated via an interactive whiteboard, before having the teacher seminar presented. This was done over a day from 9:00 am to 4:30 pm: February 2007
b. The in-service teacher cohort devoted the whole day to the teacher seminar and where given the guide to take away and work through: March 2007

Both of these session took place in the Science Education Laboratory at Loughborough University, UK and where presented by Dr Gren Ireson.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

Presenter Comments

Option (a) proved to be too much for one day and the trainee teachers observed the demonstrations rather than getting a hands-on approach. However they did participate in the seminar via the interactive whiteboard activities
Option (b) allowed time for participants to have a hands-on and minds-on session, working through magnetic breaking, magnetic levitation, flux pinning, cooling l.e.ds and transition temperature activities.

The numbers obviously dictate the activity if time is limited and the pedagogic knowledge base of the in-service teachers was much higher allowing the presenter to focus more on the subject knowledge.

Participant Feedback

Questionnaires where used to get immediate feedback with follow up feedback, via e-mail, requested. Once again the two cohorts can be considered separately.

a. Trainee teachers, immediate feedback

	Teacher Guide					**Seminar**				
1. strongly agree; 5. strongly disagree	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Improved my subject knowledge	38			2		38	2			
Improved my pedagogical knowledge	21	15	4			3	25	8	2	
Provided material I am likely to use in school	40					2	4	29		5
Provided material to enable me to continue my own learning	22	19	9					32	4	4

A number of comments regarding the visual way in which electricity and magnetism topics could be addressed were made, with a number (22) saying that their own understanding of basic electricity had been improved by the material on the CD.

Only those with a physics background really thought that they would use the practical activities from the seminar in their teaching. However almost all thought that some activities, e.g. magnetic braking would be used if they taught GCSE science or physics.

b. In-service teachers, immediate feedback

	Teacher Guide					**Seminar**				
1. strongly agree; 5. strongly disagree	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Improved my subject knowledge						8				
Improved my pedagogical knowledge							6	2		
Provided material I am likely to use in school						7	1			
Provided material to enable me to continue my own learning								8		

All teachers commented on the fact that they had not addressed superconductivity in their degree (or it had been long forgotten) and welcomed the fact that subject knowledge based INSET could be made available.

All commented that they would be likely to use materials from the seminar when teaching A-level, proving access to liquid nitrogen proved possible.

c. Trainee teachers, follow up feedback

During the 11 week school based practice 16 of the forty reported having used the materials in the classroom, with a further 11 commenting that they would have had they taught appropriate classes. 3 reported resistance from their placement school along the lines of “we don’t do it that way here”.
2 trainees reported that they had revisited the material to improve their own subject knowledge.

d. In-service teachers, follow up feedback

During the following term, of the eight teachers, all had used the material from the CD in their teaching, 3 had installed it on their school Intra-net and 2 had borrowed equipment from Loughborough University to measure transition temperature with A-level students.

One participant convenes a group of physics teachers from independent schools across the midlands and Dr Ireson was invited to present a shortened version of the seminar/CD to this group. All nine teachers at this meeting requested the teacher guide and expressed that they would use it with their teachers.

3.4 What is your evidence for your response to question 3.3?

3.5 Why are these aspects useful? Why are the other aspects not useful?

Conclusion

It would appear that a number of points can be drawn from the above:

1. a full day is needed for both the Seminar and Teacher Guide
2. Presenters need to focus the day(s) on the relative pedagogic and subject knowledge of the cohort
3. some schools need to be convinced that there are other ways of doing things
4. Those teaching A-level physics need easier access to materials and liquid nitrogen

It is hoped that the latter of these points can be addressed through the MOSEM project with ‘kits-for-loan’ being available.

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?
- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?
- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general					
4.2	CD-ROM Module 1 Magnetism					
4.3	CD-ROM Module 2 Electromagnetic induction					
4.4	CD-ROM Module 3 Electric conduction					
4.5	CD-ROM Module 4 Introduction to superconductivity					
4.6	CD-ROM Module 5 History of superconductivity					
4.7	Low-Tech hands on kit					

4.8	High-Tech hands on kit					

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: ‘Additional explanatory materials needed’, Teacher Seminar: ‘Further explanation of superconductivity needed’.)

		Suggested changes
5.1	CD-ROM - general	
5.2	CD-ROM Module 1 Magnetism	
5.3	CD-ROM Module 2 Electromagnetic induction	
5.4	CD-ROM Module 3 Electric conduction	
5.5	CD-ROM Module 4 Introduction to superconductivity	
5.6	CD-ROM Module 5 History of superconductivity	
5.7	Low-Tech hands on kit	
5.8	High-Tech hands on kit	

5.9 What is your evidence for your response to questions 5.1 to 5.8?

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

6.4 What difficulties do teachers find in integrating the materials into their teaching?

6.5 How do teachers and/or students feel about these different methods of integration?

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

9.2 What is your evidence for your response to question 9.1?

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

9.4 What is your evidence for your response to question 9.2?

PARTNER: **University of Udine - Italy**

AUTHOR: Rossana Viola DATE: 2007-10-**10**

REVIEWER: **<reviewer name>** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide

Teacher Seminar

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit

High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

7 ADDITIONAL DOCUMENTS

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

We used the 1st version of the materials.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions

- Length of sessions
- Number of trainee teachers involved (please give numbers of male and female trainee teachers)
- Number of teachers involved (please give numbers of male and female teachers)
- Number of students involved (please give numbers of male and female students)
- Number of schools involved.

(You will not always be able to give exact answers to these questions, so please give your best estimate.)

<u>The training seminars for teachers</u>

The teaching seminars have been done in 4 different manners, in 4 different sites (Udine, Bolzano, Matera and Catania), with tools and methods provided for in the Project. The total number of schools involved was 13, for a total of 51 trainee teachers (19 female, 32 male). There were 2 sessions in Udine and 1 in each other site. The length of sessions was 5 or 8 hours. All the details in Table 1.
Seminars included several themes of interest for teaching.
The goal of seminars was to show teachers a new way of teaching physics (with ICT too), to integrate use of supercomet into current teaching activities in the way that they will transmit motivation and enthusiasm to their students.
The treated contents are the follow:

- to acquire a good knowledge of Supercomet CD-Rom: trainee teachers were guided by training teachers in using the CD-Rom
- introduction to superconductivity: to examine closely and to analyze teachers' knowledge in superconductivity and in history of superconductivity
- pedagogical and didactical aspects in using the CD-Rom: some possible ways to use CD-Rom were suggested
- how the subject matter of superconductivity and the contents on the Supercomet CD-ROM can be used to deliver the curriculum.
- experiments on superconductivity

At the end of the seminar, trainee teachers would:

- Be familiar with the CD and teacher guide
- Have a sound understanding of superconductivity and its history, sufficient for them to feel confident to use superconductivity in their teaching
- Be able to safely perform a number of superconductivity-related demonstrations (such as levitating magnets above a superconducting disk)
- Be able to integrate superconductivity into their teaching, and the curriculum they have to deliver
- Be able to design learning activities using ICT and supercomet
- Start to establish a community of teachers using supercomet in – and maybe out – of their classrooms.

Minimum tasks for involved schools:

- To analyze materials
- To analyze the path
- To suggest for possible paths
- To experiment
- To communicate the results

List of the workshop with experimenting teachers carried out:

- 2 in Udine
- Bolzano
- Matera
- Catania-final meeting

The workshops have been done in 4 slightly different manners:
The timetables were the following:

1. UDINE, 20/6/2005 – 5 hours (Michelini, Corni: 13 attending teachers)
    - Introduction about the Supercomet project
    - The CD rom and the teacher guide
    - ICT and Physics education
    - The history of superconductivity
    - What is superconductivity
    - Superconducting materials
    - The BCS theory
    - How to introduce superconductivity in the didactic practice
    - Introduction to the experiments and the videos
    - Discussion with teachers and task assignment (produce didactical paths)

    UDINE, 2 February 2006 – 5 hours (Michelini, Corni: 15 attending teachers)
    - Illustration of the experiments
    - Execution of the experiments (in series)
    - Discussion with teachers and task assignment (produce experimental forms)

   After these meetings, group met one time each 2 months (5 hours each time) to discuss methods of work, problems, approaches, proposals for new paths for different types of schools and age of students.
2. BOLZANO, 24 February 2006 (Corni: 10 teachers attending)
    - Introduction about the Supercomet project
    - The CD rom and the teacher guide
    - ICT and Physics education
    - The history of superconductivity
    - What is superconductivity
    - Superconducting materials
    - The BCS theory
    - How to introduce superconductivity in the didactic practice
    - Videos demonstration with production of the list of the various phases of the videos
    - Illustration of the experiments
    - Execution of the experiments (in parallel)
    - Discussion with teachers and task assignment (experimentations)
3. MATERA, autumn 2005 (Michelini: 5 teachers and 120 student attending)
    - General seminar of 5 hours on the content of the projects, showing the MM-materials and virtual experiments of the cd-rom
4. Teachers involved formed with materials of the Project and that of the website www2.fisica.uniud.it .

   Catania, 8 hours (Michelini, 8 teachers and 140 student attending)

   Catania, May 2006 (Michelini, Immè: 8 teachers and 140 student attending)
    - Final meeting of students working in the project; distance cooperative discussion during the experimentation is carried out by the group of teachers of Drago distance cooperation

The follow table shows details about workshops:

Table 1. workshops with teachers:

Type	site	N of involved	Types of schools	N of trainee	female	male	N of sessions	Length of sessions

		schools	(***)	teachers				
1°	Udine	5	1 Lic. Scient. Tecnologico 1 Lic Scient PNI 1 Lic Scient 1 IPSIA 1 Ist Tec Indus Cst	13 (1st meeting) 15 (2nd meeting)	3 (1st meeting) 5 (2nd meeting)	10 (1st meeting) 10 (2nd meeting)	2	5 h (1st meeting) 5 h (2nd meeting)
2°	Bolzano	2	IPSIA, ITIP	10	4	6	1	8 h
3°	Matera	3	Lic Scient Tecnologico	5 *	3	2	1	5 h
4°	Catania	3	2 Lic Scient & 1 Liceo Classico (rete telematica Drago)	8 **	4	4	1	8 h

* There were 120 students attending too

** There were 140 students attending too

*** In Italy the scientific course of high school may be an ordinary course (Liceo Scientifico) or may have some specializations: Tecnologico (with particular attention to the technological and technical aspects of science topics), PNI (with additional hours of informatic science). Liceo Classico is an high school humanistic course. IPSIA is a professional school. ITIP and ITI Cst are technical courses that address students to industry.

Classroom trials

The Supercomet experimentation started in school year 2005/06 and continued in 2006/07. The total number of students involved in the experimentation was 348, with a total of 110 students from the ages 14-16 and 238 from the ages 17-18, from 22 classes in 12 schools in different seats (Udine, Gemona, Pordenone Bolzano, Ragusa, Vibo Valentia, Palermo). The total number of sessions was 71 for a total of 138 hours of lesson with students. Teachers involved were 14 (2 female, 12 male).
Table 2 presents an overview of the experimentation.

During the second year (s.y. 2005/06) and an extension period (2006/07) the Italian group conducted 3 typologies of experimentation (using the translation of supercomet materials, their adaptation to the curriculums of various types of Italian schools and the didactic proposals – included in the teachers' guide –):
A) research experimentation with setting up of didactic tools for analyzing didactic innovation produced during class activities and the efficiency of learning processes, with the relative tools of partial and global evaluation with respect to paths in teaching.
This was carried out in 2 contexts with 2 very different modalities:

A1) in the form of a training session for teachers in collaboration with an expert teacher and the *Research Unit in Physics Education of the University of Udine* (apprentice teacher Braida Michela, in collaboration with Teacher Buganza -expert teacher- of the Technological Scientific High School Malignani, Udine).

A2) in the form of didactic experimentation conducted by a researcher/teacher (Prof Giacobazzi of the ITI Fermi of Modena) following a protocol of analysis of didactic innovation perfected in the course of previous research (PRIN Ref M.L. Aiello Nicosia et al, Teaching Mechanical oscillations using and integrated curriculum, International Journal in Research on Science Education 19,8,1997). There are 6 monitoring worksheets relative to this research experimentation, illustrated in paragraph 4.

B) an activity of research-action directed by a network of schools organized online (Rete Drago) by a group of teachers who worked by correspondence both amongst themselves and with students, involving 2 Italian regions (Sicily and Calabria) which are areas in the south of the country with a strong need for innovation and the support required by this. The 3 levels of study: that of the students; the teachers who lead and follow these with blended modalities; the researchers, who in different environments carried out the task of analyzing the work of the students and the activity of the teachers. The project won an award in the field of national projects of support to scientific vocations (PLS – Physics). The prize-giving was held at a conference where 500 students participated and exhibited the experimentation Supercomet (around 60 students).

C) experimentation in Biennial (no.3) and Triennial (15) classes following the training course foreseen by the project, with meetings for comparison and discussion during the experimentation, between teachers who chose between 2 main strands: electrical properties and magnetic properties.

Table 2. School experimentations:

n	Seat	N of involved schools	Type of school	Students' age	No. classes	No. students	female	male	a.s.	No. sessions
1	Udine	1	Lic Scient Tecnologico	17-18	1	25	15	10	05/06	7
2	Udine	1	Lic Scient	14-16	2	33	18	15	05/06	5
3	Pordenone	1	Lic Scient PNI	17-18	2	34	15	19	05/06	7
4	Modena	1	ITIP	14-16	1	27	3	24	05/06	15
5 6 7	Ragusa &Vibo Valentia	3	2 Liceo Sci & 1 Liceo Classico (Rete telematica Drago)	17-18	3	24	10	14	05/06	10 (present)
8	Udine	1	Ist Tec Indus Cst	17-18	1	21	5	16	06/07	4
9	Gemona UD	1	IPSIA	14-16	4	50	0	50	05/06 e 06/07	4
10	Bolzano	1	Lic Scient	17-18	4	74	39	35	05/06 e 06/07	9
11	Bolzano	1	IPSIA	17-18	1	7	0	7	06/07	4
12	Palermo	1	Lic Scien Tecnologico	17-18	3	53	16	37	06/07	2 for each class

The prevailing strategies utilized in the experimentation are those proposed in the research experimentation (A1), where the stimulus-questions lead the student to reason about situations of the cycle Prevision-Experiment-Comparison (PEC). Even when the activity is conducted without worksheets the strategy is a conceptual exploration .

The teachers of the schools involved in the project followed different methodologies: some used only multimedia material, others carried out the 3 principle experiments and used multimedia materials, others again based their course only upon experiments. The project contributed to the didactic improvement not only from the point of view of content, but also in methods. We also carried out an experimentation with a virtual community of particularly interesting students. The approaches utilized were 4-5: A1) problematic – explorative, A2) multimedia, A3) applied, A4) experimental, A5) mixed.

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

The teaching seminars have been done in 4 different manners.
The 1st and 2nd type of training were of standard form, with tools and methods provided for in the Project . Trainee teachers involved had the same preliminary part, that was one day of formation.
We will describe the 1st type of training in the answer to the question 3.2 .
The teachers who followed the 2nd type training, after the first standard day of formation, with tools and methods provided for in the Project (see answer to question 2.2), did some of the experiments of a list (see Table 3) with the help in web by Prof Federico Corni.

Table 3. List of experiments for trainee teachers in training seminar:
1) the falling magnet
2) the jumping ring
3) the cold light (led in liquid nitrogen)
4) magnet levitation
5) magnet suspension

Teachers involved in the 3rd type of training benefited by the presentation of all the experiments that took place during a workshop of Master IDIFO (website www.idifo.fisica.uniud.it) in which the experiments of the list in Appendix 3 were presented and put at their disposal. On their own they analyzed and utilized (in their projects) materials, proposals of new paths, critical discussion by 1st group and put in a collaborative web-environment @ www2.fisica.uniud.it in the section “Sperimentazione Supercomet2”: in order to allow the circulation of the materials and to favour the communication between the university researchers and the testing schools and among the testing school themselves, a dedicated web-site was offered with the following features: memory space for document circulation (forms, didactical paths, student thesis, learning objects etc.), web-forum and chat tools for discussion and communication.

In the 4th type of training, teachers involved formed with materials of the project and that of website whit the co-ordination of teacher Concetto Gianino from Ragusa.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

The 1st and 2nd type of training were of standard form, with tools and methods provided for in the Project . Trainee teachers involved (28 trainee teachers in the 1st type, 10 in the 2nd one) had the same preliminary part, that was one day of formation. In the 1st type training other 2 meetings took place: a laboratory experimentation was prepared and each teacher did the experiments of a list (see Table 3). Than they met one time each 2 months (5 hours each time) to discuss methods of work, problems, approaches, proposals for new paths for different types of schools and age of students.

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?
- the structure of the guide itself because it is useful and functional to plan the paths

- the synthetic information in the guide about the modules of the CD-Rom
- the part about the applications of superconductive materials

3.4 What is your evidence for your response to question 3.3?
- the discussion with the trainee teachers after the workshop
- CD-Rom modules were a guide to plan classroom activities
- CD-Rom modules were used to plan new and innovative path too

3.5 Why are these aspects useful? Why are the other aspects not useful?
These aspects are useful because they are a tool for an individual new elaboration by the teachers and for an organization of ideas aimed to the classroom activities.
Sometimes the technical aspects are too much specific to be adopted in different contexts

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?
It would be useful :
- an introduction about the theoretic aspects of the physics of superconductivity
- examples of activities and lessons
- examples of student worksheets

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?
- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?
- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

All schools have one ore more informatics laboratories (ICT labs) and an adequate laboratory time to use it.

80% of students have a PC at home to examine closely the subjects.

In trials there were no problems in using project materials (in only one case CD-Rom didn't work with Linux)

About joining classroom activities and experiments, some more expert and competent teachers planned innovative paths (see paper T10.19_PaperSchools) while the majority of teachers used the paths and the materials of the project integrating it into their teaching.

The interactivity of the CD-Rom made very useful its using for students' learning and so for the achievement of learning goals. This aspect and the utilization of the experimental parts, with Low-Tech and High-Tech hands on kit, give us some general methodological information that clearly introduce an innovative value in the traditional school activity and bring to overcome the classic lesson methodology. CD-Rom modules were a guide to plan classroom activities and were used to plan new and innovative path too. For this reason the modules were in general integrated into a greater path, of 1-2 hours each. Using CD-ROM teachers employed less time in the process of teaching and more students succeeded in learning and understanding the contents. The part about the applications of superconductive materials is useful for learning because students are very interested in technological aspects, perhaps the technical aspects sometimes are too much specific to be adopted in different contexts. Surely students liked to work with the applets, even if they desired to perform the real experiments when it is possible. They liked very much all the types of experiment, low-tech and high-tech hands-on kits, because they could do them directly on their own and because, some of them, were spectacular and involved unusual phenomena.

Data analysis of the students results for each trial show that , comparing departure and final point for each student and for the hole class, there is a good profit, especially on the average and high bands, thanks to the different methodologies, approaches and tools used. Low ability pupils benefited of the project but, sometimes, the difficulties of the content joined with discontinuity in attending the lessons seems to weigh heavily on their results.

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	good	Useful aspects: Multimedia nature of materials, Modular organization, basic contents, flexible employment . Same aspect are to technical	With the use of the CD-ROM employs less time in the process of teaching and more students succeed in learning and to understand the contents. Some points must be improved and clafied	Surely the students like to work with the applets, even if they desire to perform the real experiments when it is possible	the impact is decidedly positive is to the different bands of ability and is for boys and girls
4.2	CD-ROM Module 1 Magnetism	Good but is important to complete the proposals on CD_ROM with low tech hands-on experiments	all the aspects are useful to condition that the signalled corrections are made	The use of the CD-ROM is complementary to the explorative activity using low tech experiments Media time: 2h	Surely the students like to work with the applets, even if they desire to perform the real experiments when it is	the impact is decidedly positive is to the different bands of ability and is for boys and girls

					possible	
4.3	CD-ROM Module 2 Electromagnetic induction	Good, Lab experiments must be integrated	all the aspects are useful to condition that the signalled corrections are made	E-M induction cannot be understood with explorative activities only. Very useful are the multimedia materials to focus the main electromagnetic behaviour of the systems Media time 2h	Surely the students like to work with the applets, even if they desire to perform the real experiments when it is possible	the impact is decidedly positive is to the different bands of ability and is for boys and girls
4.4	CD-ROM Module 3 Electric conduction	Good: experimental work is necessary before CD-Rom use	all the aspects are useful to condition that the signalled corrections are made	With the use of the CD-ROM employs less time in the process of teaching and more students succeed in learning and to understand the contents Media time 2h	Surely the students like to work with the applets, even if they desire to perform the real experiments when it is possible	the impact is decidedly positive is to the different bands of ability and is for boys and girls
4.5	CD-ROM Module 4 Introduction to superconductivity	Good	all the aspects are useful to condition that the signalled corrections are made	Project supports are fundamental due to the difficulties inside the topic Media time 2h	Surely the students like to work with the applets, even if they desire to perform the real experiments when it is possible	the impact is decidedly positive is to the different bands of ability and is for boys and girls
4.6	CD-ROM	Good	all the aspects are useful	With the use of the CD-ROM employs	Surely the students	the impact is

	Module 5 History of superconductivity		to condition that the signalled corrections are made	less time in the process of teaching and more students succeed in learning and to understand the contents Media time 2h	like to work with the applets, even if they desire to perform the real experiments when it is possible	decidedly positive is to the different bands of ability and is for boys and girls
4.7	Low-Tech hands on kit	Very important and useful	Motivating and clarifying	Great importance for learning	Great motivation value	Great impact
4.8	High-Tech hands on kit	Good, it is the need of more quantitative experiments	Very interesting for students	Useful to give evidence of the behaviours	Great motivation value	Grat impact

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

Teachers' interview

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

		Suggested changes
5.1	CD-ROM - general	- Introductive part about field lines - further explanation of Pohl experiment - further explanation of the differences between **F** and **B**
5.2	CD-ROM Module 1 Magnetism	- additional explanatory materials on superposition principle
5.3	CD-ROM Module 2 Electromagnetic induction	- to change the order of presentation of: types of materials, resistance, Ohm's Laws, resistivity - further explanation of Joule Law
5.4	CD-ROM Module 3 Electric conduction	- to introduce thermal effect on electrons
5.5	CD-ROM Module 4 Introduction to superconductivity	- further explanation of how Cooper's couples work - to improve animation on Cooper's couples
5.6	CD-ROM Module 5 History of superconductivity	N/A
5.7	Low-Tech hands on kit	N/A
5.8	High-Tech hands on kit	N/A

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Teachers' reports and interviews

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

In the majority of the cases the sessions with the students were though and organized to have a part of presentation, a part to use interactive modules of CD (in which students work on their own or in small groups), laboratory experiments (in small groups or demonstrated by teachers, It depended by the difficulties and available materials), a discussion with the students to clarify ideas and knots.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

the teaching methods suggested in the Teacher Guide and Seminar were completely adopted by some of the teachers who followed the training course of the 1st type. In general, the others oriented in a mixed use of suggested methodologies and of that they usually used with their students.

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

Classroom materials had a different role, depending by the type of school and the age of involved students. With 14-15 years old students these materials were the main support for the experimentation, while with 16-18 years old students they were the base, the starting point to build the concepts and the approach to the phenomenology to integrate, than, with text book and additional experiments. In other cases, where the contents of electromagnetism were already treated, the firsts modules of the CD-Rom were an useful tool to refresh and to synthesize that concepts to trait, then, the modules of superconductivity.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

No difficulties. When are already treated the topics of the preliminary part with respect to the superconductivity topics, its play the role of enforcing the concepts

6.5 How do teachers and/or students feel about these different methods of integration?

The different new approaches offered by the Supercomet material offers new opportunities to classroom work: teachers are oriented to find similar materials for other topics and students were really interested and motivated.

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

Teachers' reports + data analysis of the results

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

7.1 **the case of experimentation via internet: Rete Drago.**

Here we talk about the modality B) described briefly at 2.2 .

Drago Project is an online collaboration between 3 teachers (expert in using ICT) from 3 schools (see Table 1 and 2) with the supervision of Marisa Michelini of the Department of Physics of Udine. A virtual group Yahoo was created. 24 students enrolled in the group, all students of the final year of studies belonging to the community. All the involved students had a computer and network connection at home. The students were divided into 3 working groups, the activities of each sub-group were coordinated by 2 students coming from the 3 schools. Students received the CD-Rom at the beginning. The work environment was the group Yahoo® (in the modality closed group) and the students were subdivided into work groups. In addition all members of the group had access to:
- a database,
- a workplace where it was possible to insert link directories,
- a workplace where it was possible to save and share digital photographs,
- an agenda where it was possible to insert events and
- a place where it was possible to chat.

All students follow preliminary lessons in class, which aim to provide them the basic skills for working online. The students were asked to follow the didactic course previewed by each module, they were proposed a sequence of questions (compiled, previously, with the group expert Marisa Michelini), to verify the level of the subgroup and to stimulate greater attention to certain conceptual knots. The responses provided by the students were analyzed, corrected and inserted into the group. A group of students carried out class experiences, whose laboratory work was documented with video and photographs. The experimental results and the documentation produced were shared and discussed online with the other students.
List of carried out experiments (following the CD simulation):
1) Oersted's experiment,
2) Field lines of a rectilinear line of current,
3) Field lines produced by a broken and whole magnet,
4) Motion of an iron sphere in proximity to a magnetic field produced by a rectangular magnet,
5) Pohl's experiment,
6) qualitative analysis of Lenz-Faraday-Neumann's law,
7) the transformer,
8) production of a variable tension from a variable magnetic field (alternator),
9) analysis of the equilibrium between two ring magnets which are piled on a vertical axis,
10) analysis of the characteristic (V,I) of ohmic and not-ohmic materials.

7.2 **the case of IPSIA "Galilei" in Bolzano**

At IPSIA Galilei in Bolzano the experimentation involved 7 students in the school year 2006/07. Each student had the possibility to use a computer on his own at school. The teacher usually used ICT in his teaching. The subject of electricity was chosen and in fact the angle of attack was experimental and based on electric conduction and Ohm's laws. The field lines were used as reading instruments of **B** produced by lines, coils, solenoids and by the determination of the magnetic field of the earth. The path focused attention on the laws of induction and, above all, on the experimental analysis of certain applications: alternator, transformer, dynamo. The contents of superconductivity may be unraveled starting from the electromagnetic interactions of dynamic type and in conditions of equilibrium, used as a conceptual base for the recognition of phenomena of superconductivity, with particular regard to the difference between suspension and levitation in the interaction between magnets, currents, falling magnets and the dependence of these processes on temperature, parasite currents as recognition of the difference with the Meissner effect. The superconductive nature of phenomena is studied in a quantitative mode through the T-R relation, the characteristic fallen of R and the qualitative recognition between T and the Meisner effect. The course was organized over 4 sessions of a total of 4 hours and 40 minutes. Three hours and 30 minutes were dedicated to preliminary concepts. One hour and 10 minutes was dedicated to the specific part of superconductivity, and also foresees significant moments of experimental applications. The electromagnetic interactions and the Faraday-Newman-Lenz Law are the references for the comparison between classical induction and superconductive induction, the Meissner effect and the dependence upon temperature. Again, in qualitative terms, this dependence on temperature is useful to distinguish suspension and levitation. The dependence of resistivity upon temperature, introduced in ohmic classical phenomena, is the alternative modality of the superconductive behavior of electric nature in materials that present it.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

The value of the Supercomet Project is to join together theoretical aspects with epistemological aspects (the physics of '800 with the modern physics), with experimental aspects (and the suggested experiences in the simulations of the CD-Rom never are artificial and cunning), with technological aspect and, then, with technical aspects.

9.2 What is your evidence for your response to question 9.1?

Discussion with teachers

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

What is said in response to question 9.1 contribute to form persons who think and so who would have a role, a part in the world of institutions and of industry because also a worker is not a person who repeats always the same action but is a person who thinks and knows what is doing. In this sense the Supercomet materials contribute to promoting equality because there is no difference between the though of a woman and of a man.

9.4 What is your evidence for your response to question 9.2?

Discussion with teachers

Introduction to Superconductivity

School Year 2005/2006

Trainee teacher: Michela Braida

Class: V

Technological Scientific High School Malignani, Udine

Director: Marisa Michelini

Introduction

The phenomenon of superconductivity was noted in 1911 when Professor Onnes, who three years previously succeeded in producing liquid helium (T = 402 K = -269 °C) while studying the electric properties of metals at low temperatures in the course of his experiments. He observed that by cooling mercury at 4 K, rather than measuring a progressive and continuous fall in resistance as one would have expected, he measured a sudden drop, with a fall of four orders of magnitude in the interval of 0.0005 K. This signified the discovering of a new state of matter, the state of superconductivity.

Initially the critical temperatures of superconductors were extremely low, almost close to an absolute zero and thus difficult to reach, however in more recent times, Bednorz and Müller (1986) discovered that a particular ceramic material (an oxide of copper, lanthanum and barium) became a superconductor at relatively high temperatures (-243°C).

Currently, the superconductor characterized by the highest critical temperature is an oxide of barium, calcium, tellurium, mercury and copper that ceases to offer resistance when electrons reach -135°C.

To date we lack a theory able to interpret the physical mechanics behind the superconductivity of oxides.

In fact the theories that clearly interpreted the phenomenon of the “old” superconductivity occurring at low temperatures fails to explain the superconductivity of oxides, and this absence of a model leaves experimental research without the conceptual schema able to guide efforts in the preparation of new materials of superconductivity.

Thanks to the technological aspect of the phenomenon and its application, today’s efforts are directed toward the development of models able to utilize the phenomenon of superconductivity. The ability to transport current without significant loss of energy is in fact only one aspect of superconductivity. The particular magnetic properties of superconductors may instead find practical application in the so called phenomena of magnetic levitation, which would allow trains to move without friction on magnetized tracks. With microelectronics, the absence of electrical resistance opens the doors to new generations of fast transistors, which would enormously multiply the calculating potentiality of supercomputers that are utilized in many areas such as weather forecasting and other complex natural phenomena.

Superconductivity is an argument of current interest in such that we are beginning to perceive the necessity to insert it into school programs.

The purpose of this study is to introduce students to superconductivity and thus become a departure point for further studies related to the theories that explain superconductivity and stimulate students' interest in the various applications of superconductivity.

Target

The module is designed to be inserted in the study program of a fifth year class at the Technological Scientific High School Malignani, Udine ("Liceo Scientifico Teconologico Malignani").

Definition

We explore several electromagnetic phenomena starting with a clarification of the concept of magnetic induction field, field lines and flow. We experiment with electromagnetic induction, current generation and the role played by temperature in the various phenomena, through a series of simple proofs. We investigate through experimentation one of the most evident phenomena linked to superconductivity: the Meissner effect, or rather, how a superconductor brought below the critical temperature, in the presence of a magnetic field, expels the magnetic field from within. This effect explains how a magnet may be raised above the superconductor.

We distinguish superconductors of type I and type II for which we may reach critical temperature with the use of liquid azote, which is more economical and easily available than helium.

Approach

Our approach involves an exploration of phenomena and consists of a gradual study of the magnetic behavior of different systems. The objective is to produce an explanation for the phenomena observed and thus formulate hypotheses, transform these into equations or mathematic expressions, propose interpretative models and, finally, compare these with the results of the experiments and forecasts made, using the multimedia support from the project SUPERCOMET.

In this way the students learn to verbally express their own ideas and knowledge, to analyze and compare these with those of their peers, to test the validity or non-validity of their own affirmations and to introduce a “model” that is both qualitative and quantative.

Strategies

The didactic strategy utilized is the PEC cycle (prevision, experiment and comparison), or rather, the group of didactic strategies that induce the student to clarify his or her own ideas and express a reasoning strategy in order to train him or her to proceed according to processes requiring different types of ability.

The “*Prevision*” phase induces the student to express his or her own ideas, their own interpretative references (ideas using common sense and scientific concepts) and in doing this, to confront the link between expression in spoken language and descriptions in abstract language.

The phase “*Experiment or model*” helps the student to confront the problem of confusion between a physics reality and a model that may describe this.

In the “*Comparison*” phase an important role is played by reasoning strategies of the student, both in critical analysis of cases where the prevision and the results of the experiment or the model are not coherent with the prevision and therefore it is necessary to decide what must vary in the following the PEC cycle, and also in cases where the two produce the same result and it is necessary to generalize the interpretative model.

The PEC method, as well as highlighting possible cognitive conflicts and thus allowing the students to resolve these, also allows them to acquire the knowledge that different points of view exist, correct for various disciplines, and thus the capacity to opt for this method results in a more efficient resolution of the problem. Often the student relies upon an automatism to resolve problems and exercises and is not trained to reflect which path is the most advantageous in order to frame the problem.

When the student finds him or herself before a phenomenon, he or she analyzes it utilizing different models, both scientific or not, and often does not perceive incoherencies and contradictions; this requires the act of revision, reorganization and a re-conceptualization of his or her knowledge.

This strategy is fundamental for the process of building and integration of different interpretative models applied by students for the interpretation of a phenomenon.

Methodology

The first phase consists of giving the students an entry test where they must work individually in class. This has the objective of investigating the ideas and conceptions of the students with regard to the arguments that we will confront. A second phase consists of a series of activities and experiments, supplied by worksheets that the students must compile and that have the purpose of providing diverse points for reflection upon what they are doing and why. A third phase where the interpretative models provided by the students and emerging from the worksheets are analyzed, and thus we may formalize the correct interpretative models. A fourth phase where the students are given an exit or final text, which is the same as the initial entry test, in order to evaluate the progress in learning.

Tools

We will organize class lessons and a series of class activities with the multimedia support concerning superconductivity from the project SUPERCOMET; a series of experiments, some of which will be carried out by students; while the section requiring the use of liquid azote will be demonstrated and carried out by the teacher for safety reasons. All of the experiment information will supplied on worksheets.

Prerequisites

- familiarity with concepts relating to electricity and magnetism;
- knowledge of electrical characteristics of conductors, semi-conductors and insulators;

Conceptual knots

Superconductivity is currently an argument that is rarely dealt with in higher secondary school, either because only recently have studies been dedicated to the phenomenon, or because it is still an unresolved mystery. For this reason research into the teaching of physics has not yet investigated the learning difficulties linked to the argument and thus related literature provides little reference material. The following list was extrapolated from an article in the “Operation Physics American Institute of Physics”, which deals with the misconceptions of children in various fields of science.

- The particles in a solid do not move.
- Substances and their properties correspond to determined types of particles, however the formation of a substance with determined properties is not seen as a result of the reorganization of the particles.

Didactic objectives

- Distinguish different types of magnetic behavior of substances;
- Develop the capacity to build interpretations of phenomena by identifying the interpretative measures and the formal model;
- Develop the sense of prevision;

- Compare the behavior of superconductors with that of conductors;
- To know the field of application of superconductors;

Line of argument/Contents

- Investigation of the effects of the interaction of magnet with different materials. Worksheet 1

  By approaching a magnet with different materials, students identify and classify different typologies of behavior.

  Time necessary for activity: 1 hour.
- Experiments with floating magnets. Worksheet 2

  Time necessary for activity: 1 hour.
- Experiment with a magnet falling in a copper tube. Worksheet 4

  The motion of a magnet falling in a copper tube is not a free-falling motion because of the induced currents in circulation which are in opposition to the force generating them, according to Lenz's law. However if the tube is cut the fall of the magnet is slowed, even though the falling time is less than the falling time in a tube with no incision.

  Time necessary for activity: 1 hour.
- Experiment with Thompson's Ring. Worksheet 5

  If we lower the temperature, the leap of the ring is higher, which indicates a stronger magnetic field. The role played by temperature with this phenomenon.

  Time necessary for activity: 1 hour.
- Magnet which is raised over a superconductor. Worksheet 6

  Evidence of Meissner effect;

  Time necessary for activity: 1 hour.
- Panorama of events which brought about the discovery of superconductivity, superconductors I and II types, the abnormal behavior of variables in play;

  Time necessary for activity: 30 minutes.
- Application of superconductors

  Time necessary for activity: 30 minutes.
- Theories of Bardeen, Cooper and Schrieffer for superconductors of type I (low temperature).

  Time necessary for activity: 30 minutes
- Time necessary for entry test at beginning of course and for exit test at conclusion: 1 hour + 1 hour.

Experiments

- Magnetic interactions between different materials;
- Floating magnets;
- Magnets falling in a copper tube;
- Jumping ring;
- Levitation of a magnet over a superconductor

MONITORING OF THE EXPERIMENTATION

For an evaluation of the didactic intervention the teachers used the following protocol composed of 6 points, experimented and validated through previous research in teaching physics.

A. At the beginning of the experimentation the teacher writes up a report for the initial presentation to the class, developing the points indicated in WORKSHEET A.

B. The teacher then makes an initial evaluation of each student (students are identified with a code and name) compiling WORKSHEET B which concerns the evaluation of capacity, interest, application, socialization and scholastic performance. For each student we indicate a number from 1 to 5 with the following meaning:

1. well above average
2. slightly above average
3. average
4. slightly below average
5. well below average

The average does not refer to the specific class, but to the general situation, according to the teacher's judgement. The separation of the five categories must be thought out in such a way that the categories are, over a broad sample, distributed fairly equally. Therefore in a hypothetical class of an average 25 students, we expect to find around 5 in the first category, 5 in the second, and so on. However in a "good" class there will be a prevalence of the lower categories and vice versa for a "difficult" class.
The capacity may be different with "theory" work or laboratory activities; we attempt to give a response that takes this into account in a balanced way. Where there are obvious discrepancies, we note this in the relevant box, eventually assigning this with two distinct "marks". The student's interest must refer to physics in particular. Socialization also refers to active participation in regular class life.

C. Through the course of the experimentation, at the end of every class task, the teacher will write up a brief comment on "what happened" using WORKSHEET C (possibly straight after the task or at the end of the working day).

D. At the end of the experiment the teacher writes up a final paper, in an open format, attempting to produce a synthesis of what was written in the daily comments. WORKSHEET D suggests the grid.

E. The teacher makes a final evaluation of each student (utilising the codes indicated in WORKSHEET B), referring only to what was carried out in the course of the experiments. He or she completes WORKSHEET E where for each student we register effort and scholastic performance using the same criteria as indicated for the initial evaluation. This naturally refers to an average scholastic situation.

F. At the end of the experimentation it would be advisable if possible to proceed to an oral interview of each student (at least 3 with a low category profile and 3 with a medium-high profile, maintaining the identification codes assigned) and to a collective discussion in the presence of the teacher. The interviewed student may consult the material collected during the activities he or she has carried out, and before the interview he or she will asked to review (at home or, given sufficient time, in class) the whole work session. The interview should take place in an area different from the classroom.

WORKSHEET A

1) Possible experiments taking place (PNI, Brocca, assisted projects, mini experiments, max,ecc.)
   Possible previous experiments
2) Program effectively taken place before experimentation
3) Physics arguments treated before experimentation
4) Laboratory usage
   a. Frequency (percent of laboratory hours of the total) ....%
   b. Modality: in small groups ....% demonstration from teacher's desk ....%
5) Laboratory equipment
6) Usual operating modalities (percentages)
   a. Class lesson........% discussion(free or guided)…………....% laboratory........%
   b. Collective resolution of problems........% work in small class groups........%
   c. Work on calculator...........% oral interrogation..........% test......%
   d. Other test instruments. (specify)....................................%
   e. other (specify)...%
7) Use of calculator
   a. Frequency (percentage of calculator use) ....%
   b. Modality: small groups ....% demonstrations ....%
   c. Use of calculator:
   d. software simulation (specify)...................................%
   e. programming...........%
   f. electronic sheet..........%
   g. on-line measures...........%
   h. use of hypertexts /multimedia (specify).........%
   i. building hypertexts /multimedia.......%
   j. other (specify).............%
8) Global attitude of class
   a. effort..profit...
   b. interest in physics...............................interest in mathematics..........................
   c. degree of homogeneity..

WORKSHEET B

For each student

IDENTIFIER OF STUDENT
CAPACITY
INTEREST
EFFORT
SOCIALIZATION
SCHOLASTIC PERFORMANCE

WORKSHEET C

Date

Argument discussed

Type of work carried out (for each activity the time assigned in minutes, for those that require at least 10 minutes)

Presentation

Discussion

Laboratory experiences

Use of CD modules

Evaluation

Other

Possible homework

Possible problems arising

Interest and involvement shown by students

Degree of satisaction of teacher

WORKSHEET E

For each student

IDENTIFIER OF STUDENT	EFFORT	SCHOLASTIC PERFORMANCE

WORKSHEET D

Final report

At the end of the experimentation the teacher writes up a final paper, in an open format which attempts to synthesize what was written in the daily comments. We wish to highlight the following in particular:

1. an evaluation of the materials involved (worksheets, CD modules, short films, laboratory experiences,…)
   - 1.1 if these results were clear and easy to utilize
   - 1.2 in what measure these were effectively broadened
   - 1.3 if the time foreseen proved adequate
   - 1.4 if the conceptual difficulty proved appropriate for students
   - 1.5 if there were problems
2. if there were specific difficulties in using CD modules
3. if there were difficulties, in what way were they resolved
4. the possible link created with other specific themes found in physics or other disciplines, in particular mathematics;
5. the global attitude of the students with regard to the experimentation: if on average they were interested, willing, critical (with respect to normal attitudes outside of the experimentation), if they worked well together;
6. possible situations where the behavior of single students during the experimentation was visibly different (in a positive or negative manner) from usual;
7. a subjective and synthesized evaluation, independent from the ad hoc proof results, about how the experimentation could be useful both for a specific end (for example, an understanding of electromagnetic induction) or a general end (involvement, understanding of the use of models, development of positive attitudes with regard to the discipline....)
8. possible suggestions for revision (specific or general) for the material utilized

We advise you to conclude by saying in a few words if you believe the tasks carried out were useful or if the time spent could have been used more profitably in a more traditional manner.

WORKSHEET E

For each student

IDENTIFIER OF STUDENT	EFFORT	SCHOLASTIC PERFORMANCE

WORKSHEET F

Interview grid

1. What do you think you have learned through these experiments?

The list may be organized for

- concepts;

- laws and formulae;

- forms of representation:

capacity of the laboratory
capacity for software usage
in another manner according to what students are used to.

2. What aspects did you like most? Why?

3. What aspects did you like least? Why?

4. How do you think you learnt most: through discussion, through laboratory work, with a calculator, studying at home ... ?

5. Let’s review a part of the work carried out.

We select an area of discussion and check the degree of acquisition of specific points by asking precise questions.

The secondary school experimentation of SUPERCOMET in Italy

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Several Italian schools, from Sicily to the northern Italian regions, are involved in the experimentation of materials produced and validated by an international group of researchers within the "Leonardo da Vinci" phase 2 project, named SUPERCOMET 2 (SUPERConductivity Multimedia Educational Tool Phase 2). The materials developed within the SUPERCOMET project and translated into Italian are interactive animations, text, videos, hands-on materials for demonstrating and measuring phenomena related to superconductivity, electromagnetism and electrostatics, with an accompanying teacher guide and a teacher seminar. A report of the main experimentation will be presented, including the relevant contexts and the various approaches utilized.

1. The Supercomet Project

SUPERCOMET is a project within the program Leonardo da Vinci phase II of the European Union and is of what will be the final product of this project: a multimedia tool for teaching superconductivity addressed in particular to secondary school students.

The objective of the project in addition to producing the multimedia tool is to create an international community at an European level able to revitalize the teaching of physics in order to open new international collaborations.

Through a highly interactive application on CD which comprises animation, films of demonstrative experiments, and uses modern pedagogical methods such as collaborative learning and problem solving, the project aims to introduce superconductivity to European high school curriculums.

During the first year of the project the following were produced:
- a CD-ROM with didactic material
- a teacher's guide to clarify characteristics and roles of support material (texts, worksheets and computer presentations) and preview didactic courses.

During the second year of the project It was:
• translated the material into the languages of countries participating in the project;
• experimented the application in high school classes in various parts of Europe;
• tested the updating course and the teacher's guide with a group of reference teachers;

At the end of the first period of experimentation and dissemination various corrections were made and new material was integrated in order to produce a final version at the end of the project.
Further integrated proposals have been included with the revised material.

2. The Italian contribution to the project

In the first year Italy, represented by the University of Udine (led by Marisa Michelini) translated and adapted all material for the experimentation, and collaborated the definition of didactic proposals included in the teacher's guide. Adaptations were made to the curriculums of various types of Italian schools.

During the second year and an extension period the Italian group conducted 3 typologies of experimentation:
A) research experimentation with setting up of didactic tools for analyzing didactic innovation produced during class activities and the efficiency of learning processes, with the relative tools of partial and global evaluation with respect to paths in teaching.
This was carried out in 2 contexts with 2 very different modalities:

A1) in the form of a training session for teachers in collaboration with an expert teacher and the *Research Unit in Physics Education of the University of Udine* (apprentice teacher Braida Michela, in collaboration with Teacher Buganza -expert teacher- of the Technological Scientific High School Malignani, Udine).

A2) in the form of didactic experimentation conducted by a researcher/teacher (Prof Giacobazzi of the ITI Fermi of Modena) following a protocol of analysis of didactic innovation perfected in the course of previous research (PRIN Ref M.L. Aiello Nicosia et al, Teaching Mechanical oscillations using and integrated curriculum, International Journal in Research on Science Education 19,8,1997). There are 6 monitoring worksheets relative to this research experimentation, illustrated in paragraph 4.

B) an activity of research-action directed by a network of schools organized online (Rete Drago) by a group of teachers who worked by correspondence both amongst themselves and with students, involving 2 Italian regions (Sicily and Calabria) which are areas in the south of the country with a strong need for innovation and the support required by this. The 3 levels of study: that of the students; the teachers who lead and follow these with blended modalities; the researchers, who in different environments carried out the task of analyzing the work of the students and the activity of the teachers. The project won an award in the field of national projects of support to scientific vocations (PLS – Physics). The prize-giving was held at a conference where 500 students participated and exhibited the experimentation Supercomet (around 60 students).

C) experimentation in Biennial (no.3) and Triennial (15) classes following the training course foreseen by the project, with meetings for comparison and discussion during the experimentation, between teachers who chose between 2 main strands: electrical properties and magnetic properties.

The total number of students involved in the experimentation was 348, with a total of 110 students from the ages 14-16 and 238 from the ages 17-18, from 22 classes in 12 schools in 10 different seats.
Table 1 presents an overview of the experimentation.

3. Preparation of the experimentation

For the training courses lasting 1-2 days the teachers made use of the Guide for teachers and the CD-Rom with 6 modules, whose translation in Italian was done by Federico Corni, Silvia Jona Pugliese, Marisa Michelini of the group from Udine. These took place at Bolzano (2); Udine (2), at the National Congress of the Association for Teaching Physics (Congresso Nazionale dell'Associazione per l'Insegnamento della Fisica - AIF); at Latina (1) and at Catania (1).
Six experiments were prepared (of which 4 are assembled with self-made materials and 2 with commercial materials)

1. Electrical and magnetic properties of different materials:
   Classification of various everyday objects (conductors, magnets, insulators, diamagnetic and paramagnetic material) in terms of their interaction with a magnet.
   Characteristics of magnetic attraction. Construction of field lines of a cylindrical magnet using a compass. Relations between field lines and the same field and significance of their density.
2. A falling magnet:
   We compare the falling of a small magnet and a piece of steel of the same dimensions.

3. A jumping ring:
Three rings of different materials (copper, aluminum and plastic), at room temperature or previously heated/cooled, are subject to a sudden variation in intensity of magnetic flow. The height of their jump is analyzed in terms of material and temperature.
4. Piled magnet rings:
Four magnet rings are piled onto a wooden bar, touching each other with the same polarity. We observe their behavior in terms of distance and reaction to an outside force.
5. Magnetic levitation:
We observed and discussed the characteristics of the levitation of a magnet on a superconductor.
6. Measure of the resistance of a superconductor in function of the temperature.
A length of superconductor material is cooled and its resistance is measured in function of the temperature and the time by means of a system of acquired data. We describe the graphs obtained and we compare with the previous experiment in levitation.

Table 1. Overview of the school experimentations

n	Seat	Type of school	Students' age	No. classes	No. students	a.s.	No. sessions	No. total hours
1	Udine	Lic Scient Tecnologico	17-18	1	25	05/06	7	14
2	Udine	Lic Scient	14-16	2	33	05/06	5	10
3	Pordenone	Lic Scient PNI	17-18	2	34	05/06	7	15
4	Modena	ITIP	14-16	1	27	05/06	15	12
5 6 7	Ragusa &Vibo Valentia	2 Liceo Sci & 1 Liceo Classico (Rete telematica)	17-18	3	24	05/06	10 (present)	20
8	Udine	Ist Tec Indus Cst	17-18	1	21	06/07	4	9
9	Gemona UD	IPSIA	14-16	4	50	05/06 e 06/07	4	21
10	Bolzano	Lic Scient	17-18	4	74	05/06 e 06/07	9	11
11	Bolzano	IPSIA	17-18	1	7	06/07	4	5
12	Palermo	Lic Scien Tecnologico	17-18	3	53	06/07	2 for each class	21

4. Instruments and methods
Two types of worksheet for the didactic activities and experimentations were developed:

- traditional detailed worksheets for the experimental activities: each experiment is seen as an auto-consistent module: the students are guided to identify the relevant physical quantities, to take measurements, analyze data and look for an explanation of phenomena observed using the experiment results.
- Sequence of stimulus-questions, realized in accordance with the strategy PEC Prevision-Experiment-Comparison (Martongelli 2000) and the approach inquiring physics (McDermott 2001): the entire course is organized as a sequence of activities based on PEC cycles with student worksheets.

Six worksheets were prepared, with the relative instructions for the teacher, for the monitoring of various phases of the experimentation, according to standards of evaluation of innovation perfected in previous research (Ajello 1998):

1. Class presentation (experimentation carried out or carried out previously, physics arguments familiar to the students, use of the laboratory, use of the computer, methods of teaching, attitude of the class)
2. Departure point for each student (ability, interests, attention, socializing, school performance)
3. Diary of various didactic activities carried out
4. Final report (text in free form containing: evaluation of materials, difficulties met with modules contained on the CD, interdisciplinary arguments, reactions of the students, evaluation of the experiment, suggestions)
5. Final personal student worksheet (attention, school performance during the experimentation)
6. Student interview grid (one interview per student group with the initial scholastic performance where they are asked what they believe they have learned, if they liked the activities, how they learned and, finally, they are asked to review a particular argument among those dealt with)

Following the training sessions for the experimentation, the group of teachers from Pordenone and Udine proposed two new courses that may be adapted both for the biennal and for the triennal of the secondary school, beginning with the Supercomet material (by Walter Manzon of the Scientific High School Grigoletti of Pordenone).

P1_Magnetic field. “Faraday’s way to the magnetic properties of the superconductor, or rather the course of field lines” may be unraveled like this:

- Analysis of the electric field lines due to a dipole and of the field lines in the case of a magnetic dipole (mapping and characterization in both cases)
- Analysis of the situations of suspension associated with field lines and situations of equilibrium (stable and not stable): we use the two experiences of ring-shaped magnets and not ring-shaped magnets.
- Slowing down of the magnet and the superconductor thanks to induced currents / analogy with the Fountain Effect
- Possibility to surround the superconductor with field lines: experience of magnetic levitation; introduction of the hypothesis of diamagnetism; possibility of correction of the position of instable equilibrium.

P2. Resistivity behavior. “ The master way of the properties of the superconductor, or the course of resistivity” follows these steps:

- Analysis of temperature dependence of resistivity, relation between resistivity and temperature with particular attention the below 0 degree Celsius temperatures.
- Falling of resistivity and different properties of conduction of superconductors
- Effects of superconduction
- Analysis of electrical circuits with elements of virtual superconductors

P3. An ulterior new course at the high school Liceo Scientifico Statale “G. Marinelli” – Udine – (Teachers: Vilma Capocchiani, Riccardo Sangoi) has as a main theme the “transformations of energy” for second classes of PNI course. These are put in the curriculum after the study of energy transformations and electric field. The proposal contains a new path in that it departs from the conservation of mechanical energy and its transformation into other forms and in particular into an electrical form; it looks at electric field and electrical conduction (module 4 of CD-Rom) and then analyzes the magnetic behavior of currents (Module 1 and 2), electromagnetic induction (Module 3), superconductivity (Module 5).

It is constituted by a combined use of laboratory experience, modules from the project Supercomet and interactive applets. It was favored group work for the laboratory experiences, some of which

were conducted in qualitative form, others quantitative, guided by the worksheets. After the experiences followed inter-group discussions with the aim of sharing conclusions.
All the materials @ www2.fisica.uniud.it
Select “Sperimentazione Supercomet 2”.

5. Strategies, approaches and methods

The prevailing strategies utilized in the experimentation are those proposed in the research experimentation (A1), where the stimulus-questions lead the student to reason about situations of the cycle Prevision-Experiment-Comparison (PEC) (Martongelli 2001, Michelini 2004). Even when the activity is conducted without worksheets the strategy is a conceptual exploration (McDermott 2992).
The teachers of the schools involved in the project followed different methodologies: some used only multimedia material, others carried out the 3 principle experiments and used multimedia materials, others again based their course only upon experiments. The teachers’ worksheets on the style of working are still being analyzed. The active role of the students with multimedia material was at a minimum of 30% and the same occurred with experiments. The project thus contributed to the didactic improvement not only from the point of view of content, but also in methods. We also carried out an experimentation with a virtual community of particularly interesting students: we would like to describe strategies and methods of this experience (paragraph 6). The approaches utilized were 4-5: A1) problematic – explorative, A2) multimedia, A3) applied, A4) experimental, A5) mixed.

CONTENT/APPROACHES	**problematic-explorative**	**experimental**
Semiconductors of I e II type	1	
Magnetic levitaion	3	4
Electric conduction		1
Ohm’s Law		1
Magnetic field of the earth		1
alternator, trsformator, dynamo		2
T-R relation	2	2
Field lines of a line, coil, solenoid	1	3
Piled magnet rings	3	1
Falling magnet	2	1
Magnetic interctions	2	1
Thompson’s ring	1	
Ampere’s and Pohl’s experiments		2
Lorentz’s Force		1
Magnetization of the matter		1
Electromagetic induction	1	1
Oersted’s experiment		1
Motion of a sphere in a magnetic field		1
(V,I) curve of ohmic and non-ohmic materials		1

Applied approach : 2

Multimedia approach	
Module 1	8
Module 2	8
Module 3	7
Module 4	7
Module 5	7

For 4 experimentations
(monitored with worksheets- see paragraph n 4) :

CONTENT/HOURS	CD modules Time dedicated (hours)	Presentation time (hours)	Discussion Time (hours)	Experiments Time (hours)
electrc conduction	2	2	1	4
magnetic phenomena - magnets	0.5	0.5		2
Ampere's and Oersted experiments	1.5		1	1
Phol's experiment	1		1.5	1
magnetic field of coils				2 h
magnetic field of a solenoid, magnetic properties of materials, magnetic field of the earth	2	1	0.5	4
electromagnetic induction	2	2	0.5	4
superconductivity	2			2
magnetic interactions				2
induced emfs				2
magnetic levitation				2
All the CD modules	7		2	
Faraday-Lenz Law (alternator, trasformator, dynamo)		2	1	4
piled magnetic rings	0.5	1.5	0.5	2
T-R relation		0.5	0.5	2
falling magnet			1	2
(V,I) curve of ohmic and non-ohmic materials			0.5	1
Motion of a sphere in a magnetic field			0.5	0.5
Magnetization of the matter		1	1	
Lorentz’s Force			0.5	1
Thompson’s ring			0.5	1
Ohm’s Law			0.5	1
Semiconductors of I e II type		1	0.5	

6. The case of experimentation via internet

The proposal of experimentation by Supercomet online has grown under “Project DRAGO and has been realized through an online collaboration between the teachers Concetto Gianino of the secondary school,“Q. Cataudella” of Scicli (RG), Carmelo Distefano of the secondary school “G. Carducci” of Comiso (RG) and Nicola Cutuli of the scientific high school “G.Berto” of Vibo Valentia, with the supervision of Marisa Michelini of the Department of Physics of Udine. In practice, a virtual group Yahoo® was created. Twenty-four students enrolled in the group, all students of the final year of studies belonging to the community: 8 students from the experimental scientific section of the PNI-Physics of the Institute “Q.Cataudella”, 11 from the scientific section of the institute “G. Carducci” from Comiso. The students were divided into three working groups, the activities of each sub-group were coordinated by two students coming from different schools. Considering that the interaction between actors occurred mostly online, each student was sent a SUPERCOMET CD-ROM which was a guide for each activity. The work environment was the group Yahoo® (in the modality closed group) and the students were subdivided into work groups. In addition all members of the group had access to: a database, a workplace where it was possible to insert link directories, a workplace where it was possible to save and share digital photographs, an agenda where it was possible to insert events and a place where it was possible to chat.
The activity of DRAGO developed, fundamentally, in the following four phases: 1[a] phase (October-November 2005): instruction of students in the principle function of the working environment to be

utilized. 2[a] phase (December): assigning homework to the students, formation of sub-groups and identifying the coordinating students, start of activities of virtual groups. 3[a]: phase (December-March): start of didactic courses on superconductivity preview by SUPERCOMET, analysis of difficulties and conceptual knots emerging, sharing and discussion online of arguments, carrying out of laboratory experiences and online discussion and sharing of results. 4[a]: phase (April-May): preparation of presentations for the concluding meeting.

In the first phase, all students participating in the project DRAGO follow preliminary lessons in class, which aim to provide them the basic skills for working online. In the second phase the students were asked to follow the didactic course previewed by the first module during the Christmas break. When school reopened, they were proposed a sequence of questions (compiled, previously, with the group expert Marisa Michelini), to verify the level of the subgroup and to stimulate greater attention to certain conceptual knots. The responses provided by the students were analyzed, corrected and inserted into the group. With the same procedure they dealt with the other modules. As well as the web activities only the students from Scicli carried out class experiences, whose laboratory work was documented with video and photographs. The experimental results and the documentation produced were shared and discussed online with the other students. In particular, the following experiments were carried out in the laboratory, following the CD simulation: 1) Oersted’s experiment, 2) Field lines of a rectilinear line of current, 3) Field lines produced by a broken and whole magnet, 4) Motion of an iron sphere in proximity to a magnetic field produced by a rectangular magnet, 5) Pohl’s experiment, 6) qualitative analysis of Lenz-Faraday-Neumann’s law, 8) the transformer, 9) production of a variable tension from a variable magnetic field (alternator), 10) analysis of the equilibrium between two ring magnets which are piled on a vertical axis, 11) analysis of the characteristic (V,I) of ohmic and not-ohmic materials.

The laboratory work was certainly an important complement to the SUPERCOMET course, as it allowed students to compare a virtual experiment, where the apparatus was prepared and reply according to the precise laws of a theoretical model, with a real model, where it is necessary to set up the apparatus and reproduce conditions responding to the problems posed. Each year the project DRAGO concludes with a final meeting in the month of May where students present their work. In the Final Meeting in 2006, students presented their work to 500 of their peers present, to the DRAGO community teachers, to the university lecturers present and to the project experts.

7. The courses

The particular characteristics of the courses merit a brief description.

The Research Experimentation A1 was inserted into the fifth year of the Technological Scientific High School “Liceo Scientifico Teconologico Malignani” di Udine. (5° classes of technical Lyceum – age 17 18).

The characteristics of the course are:

- introduce superconductivity, departing from the exploration of certain magnetic and electromagnetic phenomena (interaction between magnetic fields, electromagnetic induction, the generation of currents and the role played by temperature with various phenomena).
- investigate experimentally the Meissner effect,
- examination of superconductors of the type I and type II for which we may reach a critical temperature with the use of liquid nitrogen, more economical and easily found than helium.

The activities proposed started with the broadening of the students’ knowledge of magnetic and electromagnetic interactions, which then are linked to the phenomenon of superconduction, through phenomenological observations accompanied by advanced learning worksheets, making use of the multimedia tool of project SUPERCOMET. The didactic strategy utilized is the PEC cycle (prevision-experiment-comparison).

The research experimentation was carried out with monitoring instruments of the learning process:

- The entrance exam and final exam were the same in order to analyze learning variables

- Worksheets for a series of activities and experiments aimed to provide different ideas about the activities.
- interpretative models of the students which emerged from the worksheets were analyzed and discussed and shared interpretative models were formalized.

The entrance/exit test was comprised mostly of queries with brief replies and it attempts to investigate the main points of the argument, magnetic phenomenology, in terms of different classes of interactions of a magnet with objects of different materials; the birth of currents induced in a circuit and varying the flow; the dependence of resistance and resistivity of temperature in conductors and superconductors; dependence of superconductivity of critical temperature; reflection on reversibility or less; the phenomenon of transfer from one state to another; electric values inside a material superconductor; critical parameters that differentiate the different typologies of superconductors; applications.

Appendix A gives an outline of the contents.

At the state high school Liceo Scientifico Statale “M. Grigoletti”, Pordenone, Professor Walter Manzon conducted the experimentation with approach A2, exclusively utilizing multimedia tools, with 2 fifth year classes of PNI course and the experience of magnetic levitation was extended to all students of the high school.

At IPSIA Galilei (Odontotecnici + Elettronici) in Bolzano the experimentation involved 7 students in the school year 2006/07. The subject of electricity was chosen and in fact the angle of attack was experimental and based on electric conduction and Ohm’s laws. The field lines were used as reading instruments of B produced by lines, coils, solenoids and by the determination of the magnetic field of the earth. The path focused attention on the laws of induction and, above all, on the experimental analysis of certain applications: alternator, transformer, dynamo. The contents of superconductivity may be unraveled starting from the electromagnetic interactions of dynamic type and in conditions of equilibrium, used as a conceptual base for the recognition of phenomena of superconductivity, with particular regard to the difference between suspension and levitation in the interaction between magnets, currents, falling magnets and the dependence of these processes on temperature, parasite currents as recognition of the difference with the Meissner effect. The superconductive nature of phenomena is studied in a quantitative mode through the rapport between T-R, the characteristic fallen of R and the qualitative recognition between T and the Meisner effect. The course is organized over 4 sessions of a total of 4 hours and 40 minutes. Three hours and 30 minutes are dedicated to preliminary concepts. One hour and 10 minutes is dedicated to the specific part of superconductivity, and also foresees significant moments of experimental applications. The electromagnetic interactions and the F-N-Lenz law are the references for the comparison between classical induction and superconductive induction, the Meissner effect and the dependence upon temperature. Again, in qualitative terms, this dependence on temperature is useful to distinguish suspension and levitation. The dependence of resistivity upon temperature, introduced in ohmic classical phenomena, is the alternative modality of the superconductive behavior of electric nature in materials that present it.

Particular attention to the practical applications (Approach A3), but this time more specifically of superconductive materials, was also included in the course followed at the high school Istituto Tecnico Industriale “A. Malignani”, Udine, in the school year 2006/7 taught by Professor Cavallo. The fifth year class was composed of 21 students who, in the 400 minutes dedicated to presentation and 100min. dedicated to discussion, demonstrated a noticeable increase in involvement, interest and profit and a rare interest in particular for the practical applications of superconductive material, producing on their own a CD on this theme.

Also noteworthy for the value of their almost completely experimental approach (Approach A4) was the course conducted by Professor Fabio Ciralli who taught the experimentation in three fifth year classes of the high school Liceo Scientifico Tecnologico associated with ITIS Volta of Palermo, involving a total of 53 students. The hours dedicated to the project in the three classes were respectively 6, 6 and 9. Twelve students participated in afternoon laboratory activities at the

Department of Physics and Related Technology (DIFTER) at the University of Palermo. A seminary lesson was conducted to classes on superconductivity and its discovery, also with the assistance of module 4 (Introduction to Superconductivity) and 5 (History of Superconductivity) of the Project CD. Students also carried out a laboratory session of 3 hours at DIFTER in Palermo in the course of which experiments with superconductors were shown: 1. the measure of resistivity in function of the temperature of a superconductor; 2. the demonstration of the Meissner effect (magnetic levitation). Before carrying out these experiments students had studied the three simulated experiments on the project CD in module 4: 1. ring magnets piled one on top of the other, 2. magnet falls into a copper tube, 3. copper ring that jumps. A long and lively discussion followed. The critical moment occurred around the origin of the Meissner effect, which requires a further study with regard to this Project, above all concerning the interpretative bases of suspension and levitation between magnets. The activities shown on the multimedia CD concerned the modules 1,2,3 (in one class) and the modules 1,2 (in the other two classes). The final questionnaire and the interview following activities showed positive result for almost all students, a result that on the whole, is second only to that of the high school Liceo Scientifico Statate "E. TORRICELLI", Bolzano. Here, in the experimentation carried out, a total of 4 classes in the school years 2005/6 and 2006/7 involved 74 students of the fifth year of the scientific high school P.N.I. This course also followed an approach that was almost exclusively experimental (A4) and may be placed, within the annual program, after the arguments concerning electrostatics and electrodynamics. The regular program had already been oriented toward a heavy use of qualitative and quantitative laboratory work, carried out in mainly groups of three/four people or with the teacher. *In appendix B the course is shown, organized in 9 sessions.*

7. Conclusive considerations

Between the approaches, the most utilized was the experimental one (3 schools in an integral manner) and, next, a mixed typology which followed a combination of an experimental approach and a multimedia approach. We found we were dealing with situations of great significance, which involved the planning, development and utilization of new interactive applets, added to those proposed by the project (2 cases). In 2 cases we used an applied approach and the course P2 was developed with a view to applications of superconductive materials.

All courses made use of the multimedia tools of Supercomet Project (CD modules), 4 schools utilized the experiments perfected by the group from Udine and, finally, 4 schools also inserted other experiments in their courses, different from those mentioned: of particular value the sequence of 10 experiments proposed in the area of online experimentation (Project DRAGO): school no. 2 utilized the experiments to determine the Ohm's law, school no. 6 based the starting point upon experiments on the conservation and transformation of energy, school no.5 perfected a series of experiments on magnetic interactions for the study of the intensity of magnetic fields produced by magnets and currents, and the analysis of the magnetization of other materials.

Good results emerged from the monitoring of learning and from the students' progress tests.

There are some difficulties emerging concerning the theory and the formation of Cooper's couplet.

The characteristics of the CD-Rom most appreciated by the students were the clarity of the rapport cause-effect and experiment-theory and efficiency of the tri-dimensional representations. It was revealed that the mathematical treatment was judged not detailed enough, and perhaps inadequate for fifth year classes and more appropriate for a biennial (with particular reference to the modules treating classical electromagnetism).

APPENDIX A

Line/Content of experimentation A1

Worksheet 1- Introduction – Investigation of the effects of the interaction of a magnet with different materials

This is dedicated to the recognition of the main phenomenology of magnetic interaction, to its description through the magnetic field and to its representation through field lines. It presents the following steps:

Bring different materials close to a magnet, identify and classify the different typologies of behavior. Reflect on the cause of the phenomena observed. Understand if the behavior is reciprocal or if the magnet produces something. Observe if the attraction occurs when there is contact or if it is interaction at a distance. Represent the field lines using magnetic needles (little compasses) and try to interpret the significance. Repeat the experience with ferromagnetic bars and discuss the results. Reflect upon the significance of when field lines approach each other in some places and are distant in others and, as a consequence, say if the value of the magnetic field is same the whole length of the field.

Worksheet 2 – Experiment on the piled magnetic rings. This is dedicated to the study of forces of repulsion between trapped magnets:

Ring magnets are first piled on a wooden bar. The students are asked to preview, reflect, verify and represent the behavior of the magnets and the forces acting upon them.

Worksheet 4 – Experiment of a falling magnet in a copper tube.

This is dedicated to the recognition of induced current:

The motion of the falling magnet in a copper tube is not a motion of freefalling because of the induced emfs and current that opposes the change of magnetic flux in time that produced them, according with Lenz's Law.

It is requested

–To note the difference between falling times, inside the copper tube, of a magnet and of a cylinder of copper of the same dimensions.

- If the tube is cut the fall of the magnet is slowed even if the time of the fall is less than the case of a tube which is not cut.
- preview, first, this behavior, find proof for the experience, compare results with predictions, try to explain phenomena.

Worksheet 5 – Experiment with Thomson's jumping ring

This is dedicated to a reflection upon the role played by the temperature of the phenomenon: Decreasing the temperature (with the help of liquid nitrogen), the jump of the ring is higher, which indicates a stronger magnetic field.

Worksheet 6 - Levitation of the magnet.

This is dedicated to the content of superconductivity and leads us to observe Meissner's effect;

The following moments follow the described course:

- Panorama of events leading to the discovery of superconductivity, superconductivity of types I and II, anomalous behavior of variables in play;
- Applications of superconductivity
- Bardeen, Cooper and Schrieffer's theory for superconductors of the I type (low temperature)

<u>**APPENDIX B**</u>

The 9 sessions of the course at the **Liceo Scientifico Statale "E. TORRICELLI" – Bolzano were organized in this way:**

a) a *Preliminary part* for the building of prerequisites that unravel in 7 moments of variable duration (50 – 80 min) articulated in the following way:

1) Introduction to magnetism: hypotheses are formulated about the type of experiment (carried out in small groups) to conduct to be able to give an efficient representation of the phenomenology observed; representation of field lines; magnetism generated by current (lines and coils)

2) the experiments of Ampere and Pohl, carried out to highlight how currents can generate magnetic fields and these can react with the currents by means of force; changes in force generated and undergone by lines travelled by the current in relation to the disposition of the latter with respect to the magnetic field lines and the intensity of the current.

3) magnetic fields generated by coils and solenoids travelled by current (at the base of the experiment there is the application of the compass of the tangents) with the aim of proving the direct proportionality of the magnetic field generated by the bobbin with the intensity of the current and number of coils.

4) Lorentz' force: the results of the trajectories travelled by electrons in relation to the direction of velocity with respect to the magnetic field lines are analyzed to formulate hypotheses on the type of force at work.

5) *magnetization of materials, iron, dia, para-magnetism: behavior of nickel which above a certain temperature loses its magnetic properties, we also examine bobbins with and without an iron nucleus measuring quantitatively the forces of attraction on a sample of iron, and the difference in both cases.*

6)phenomena of electromagnetic induction and conservation of energy linked to the phenomena analyzed (flux variation provoked by a magnet that has been run inside a bobbin, Foucault's currents)

7) general summary on the conditions of metals; theory according to Drude's model, corrected with the principle of exclusion of Pauli and the quantum mechanics to overcome the contradictions in terms of specific heat; causes which led to resistance and possible intervention to diminish this.

8)interaction ofring-shaped magnets piled together, falling of a magnet and a piece of metal non-magnetized alternatively in a tube of copper and of aluminum, experiments where the interactions between magnetic fields and currents provoke unusual and unexpected reactions.

b) a section on the contents of superconductivity

9) cold light (led immersed in liquid nitrogen), levitation of a magnet produced by the currents induced in a superconductor cooled by liquid nitrogen, experiments related to the consequences of a sudden lowering of the intrinsic resistance of a conductor (superconductor) in the presence of a magnetic field. An explanation to the lowering of resistance of these materials.

Supercomet Workshop

Modelling of phenomena Related to Learning about Superconductivity

…the teaching-learning sequence…

Francesca Bradamante **Marisa Michelini**

Research Units in Physics Education of the University of Udine (Italy)

Supercomet project …

is based on simulation using **magnetic field lines**

to construct prerequisits to

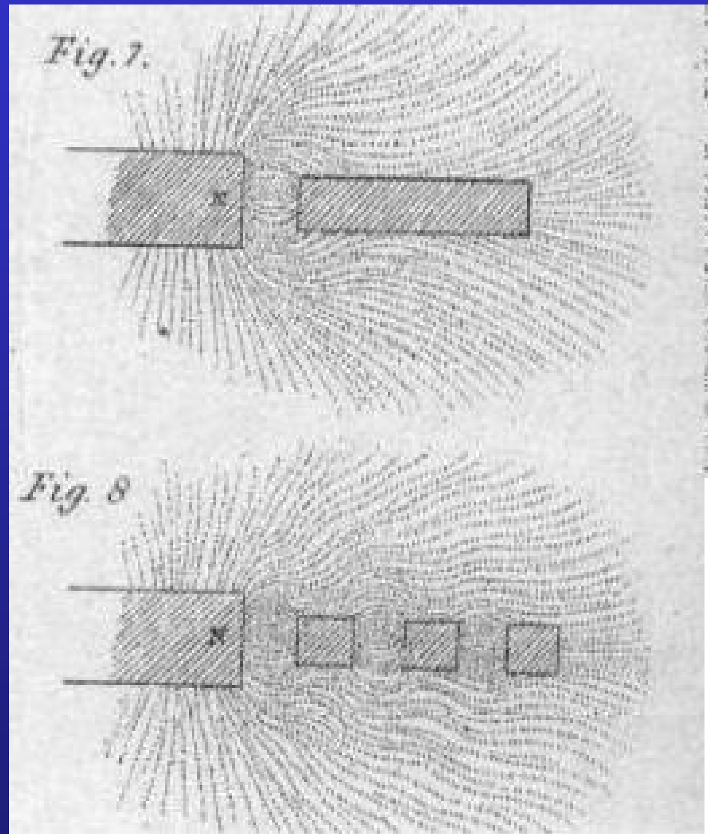
paramagnetism, diamagnetism, superconductivity

Historically Field lines …

Lines of force:

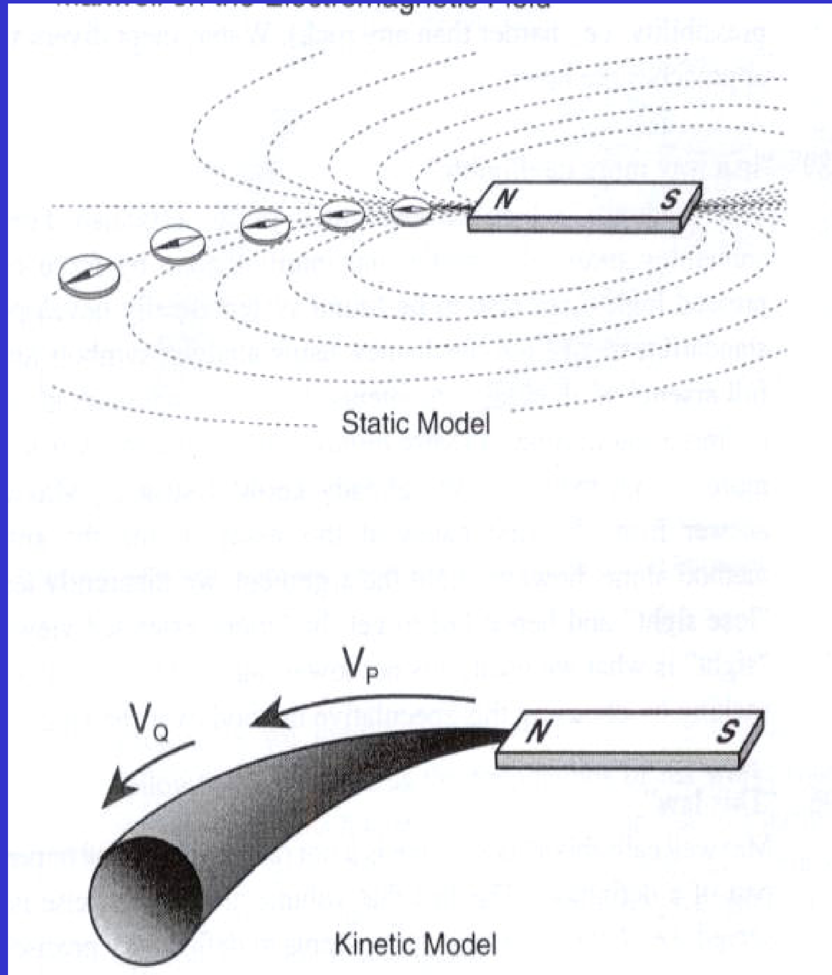
“.. to consider **magnetic power** as represented by lines of force”, “**the lines of forces**, well represent the “**nature”, “condition”, “direction”,** and **“amount”** of the **magnetic forces**”

Faraday

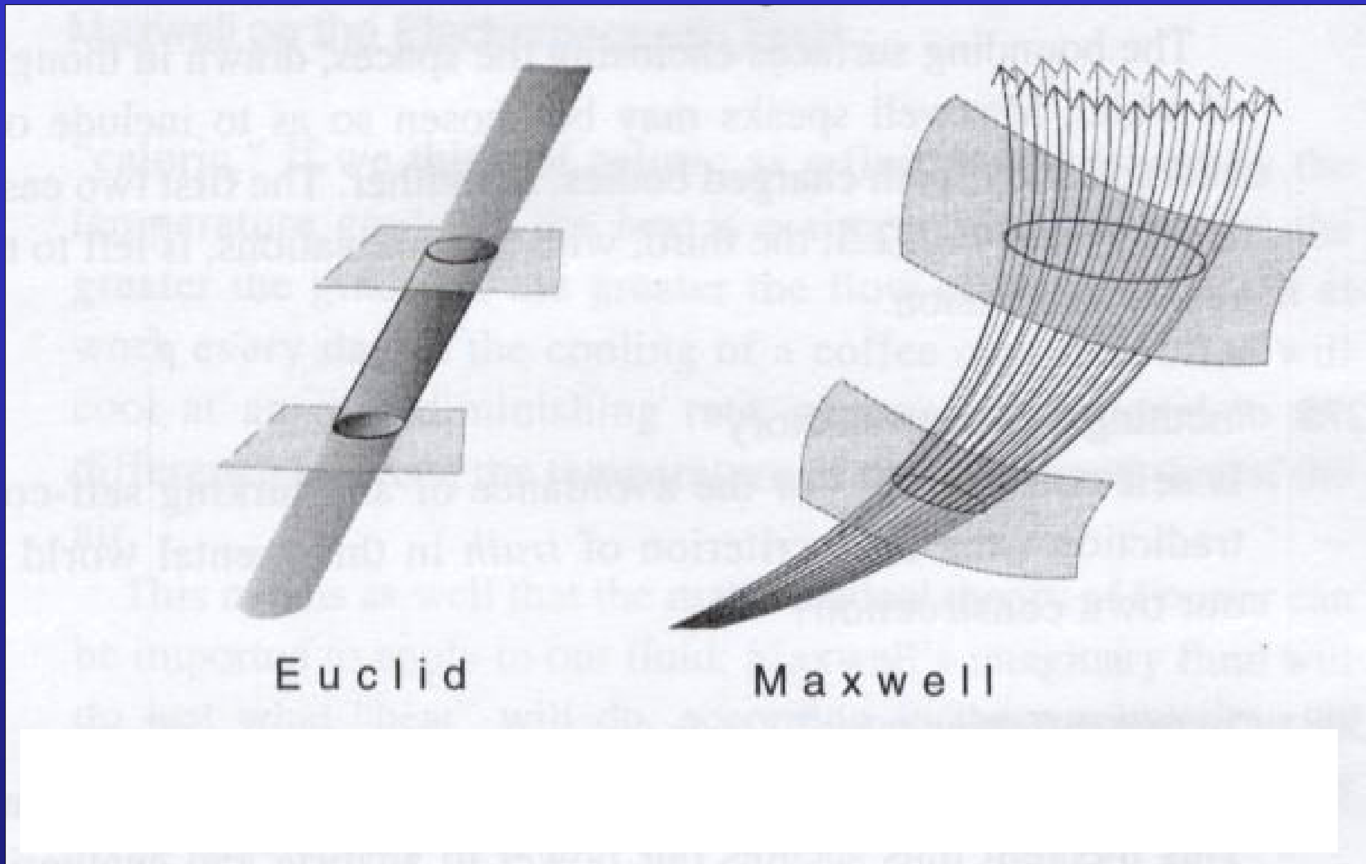


Field lines … and tubes of flux

"If we consider these curves not as mere lines but as **fines tubes of variable section** carrying an incompressible fluid, then since the velocity of the fluid is inversely as the section of the tube,… by regulating the section of the tube, … we might **represent the intensity of the force as well as the direction** by the motion of the fluid in these tubes.." Maxwell



Tubes of flux



Field lines are important for the conceptualization and formalization of field concept

1) Graphic models

- mental models and physics models have also graphic nature (*D. Hestenes*)

2) language and models

- relation between language and modelling *H. Fuchs*
- *Hesteness* “language does not refer directly to the world, but rather to mental models or components thereof”

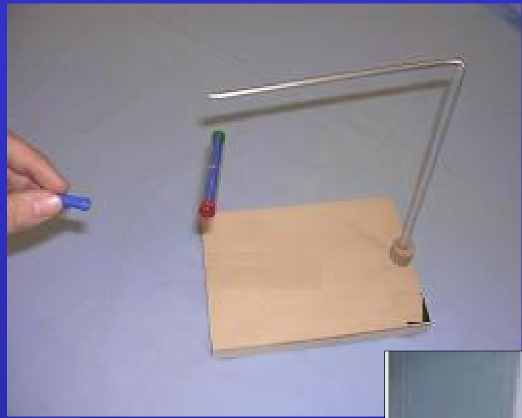
→ it’s important to distinguish between

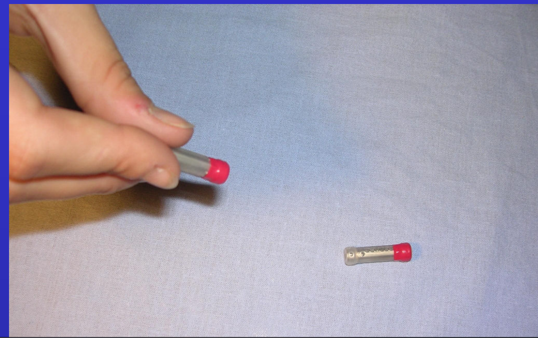
lines of field and lines of force

Teaching sequence on magnetic field:

1) Introduction to magnetic interaction

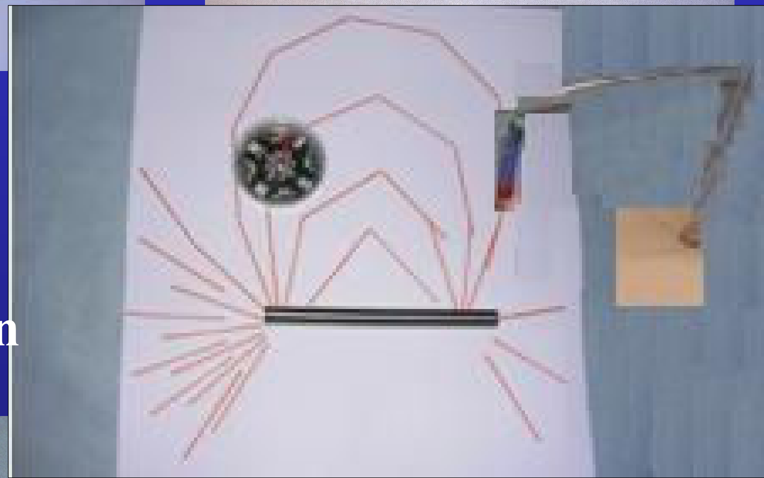
Identify:
attraction / rotation

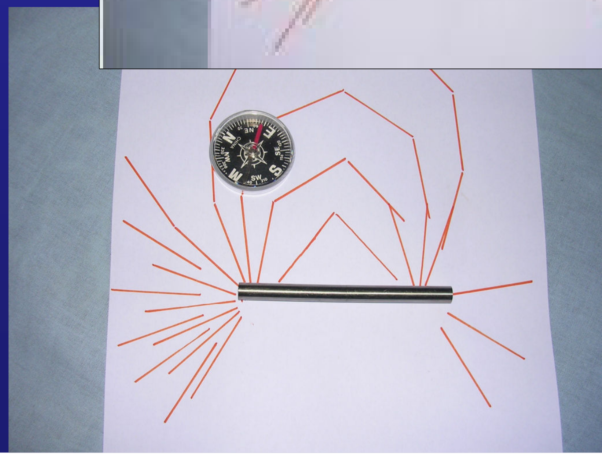




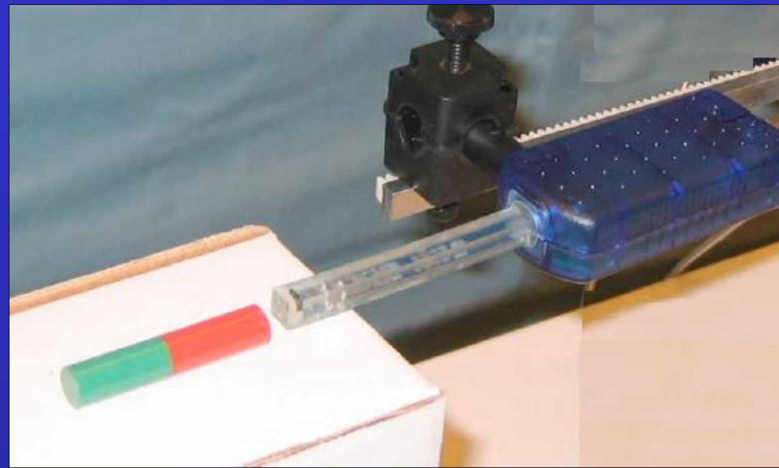
2) Constructing field lines

Lines of momentum / of orientation

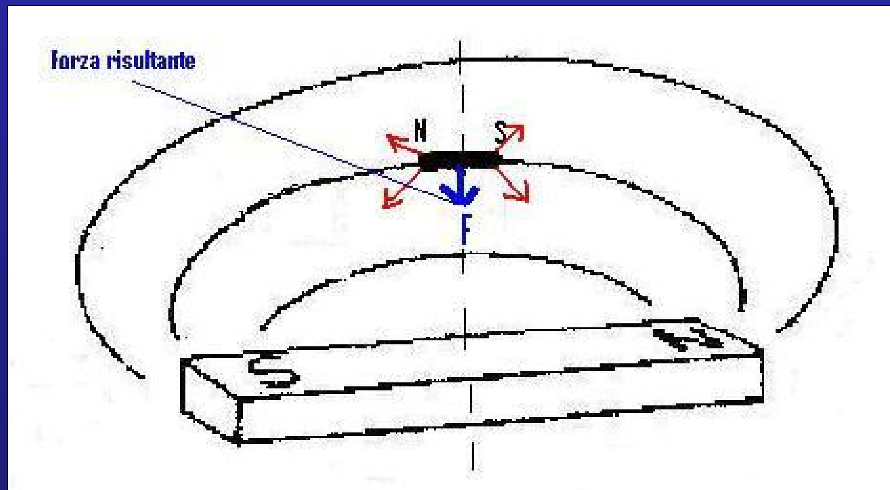




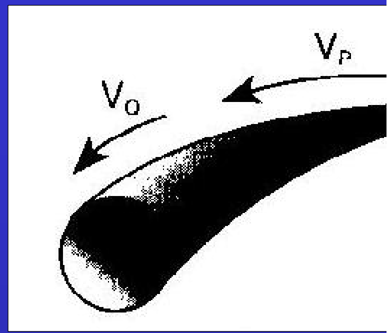
3) Measuring intensity of field vector

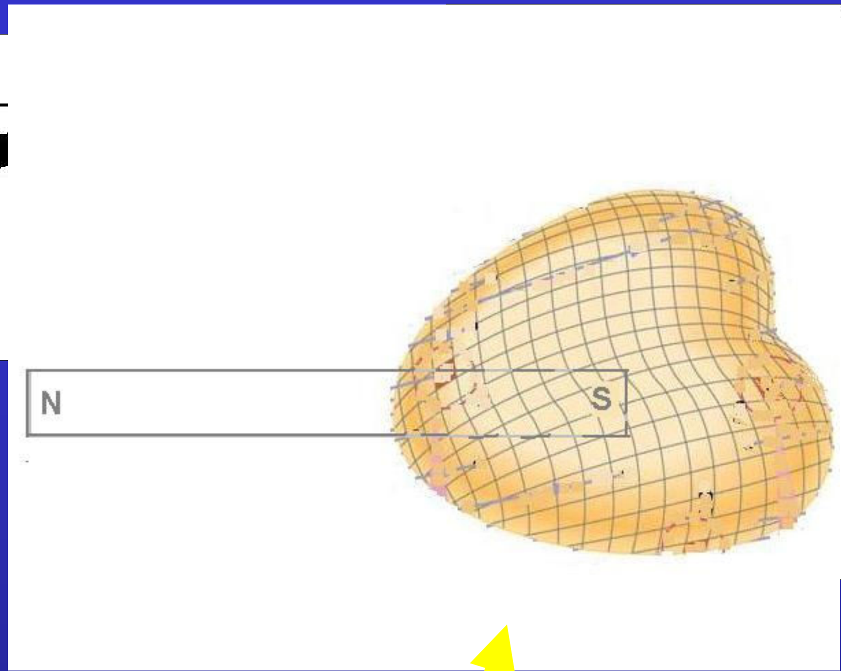


4) Differentiation between field and force vectors

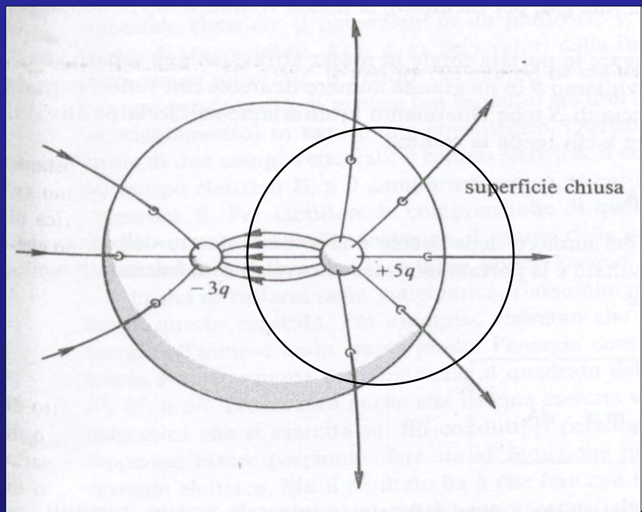


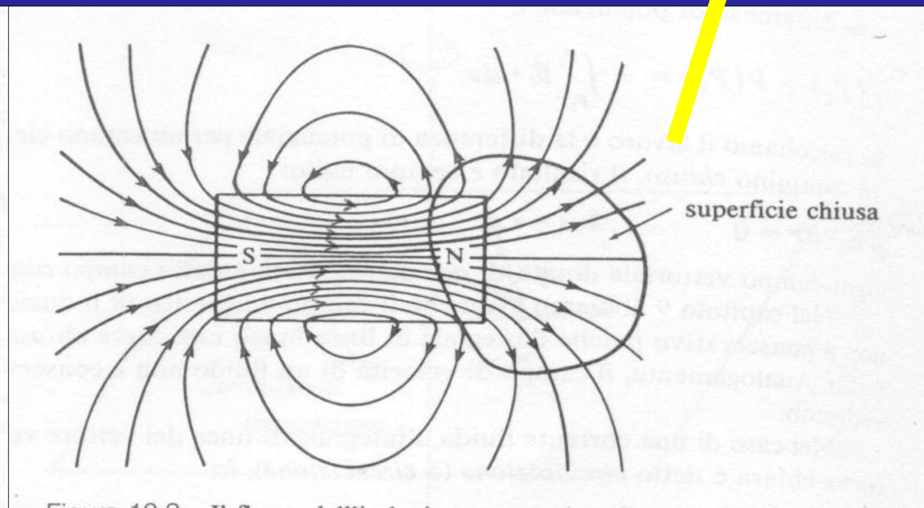
5) Tubes of flux

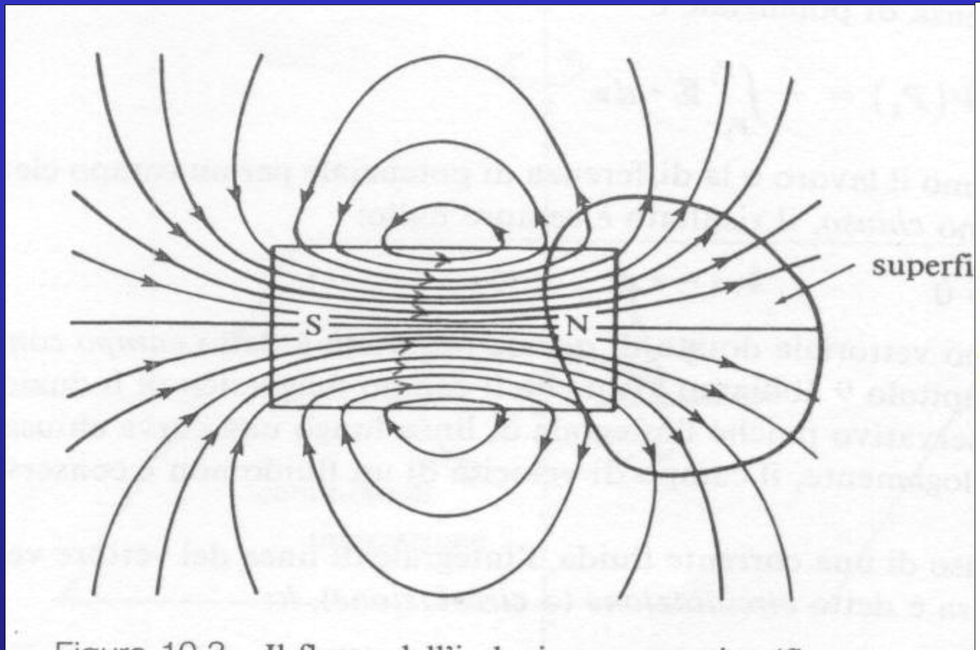




4) Gauss Theorem



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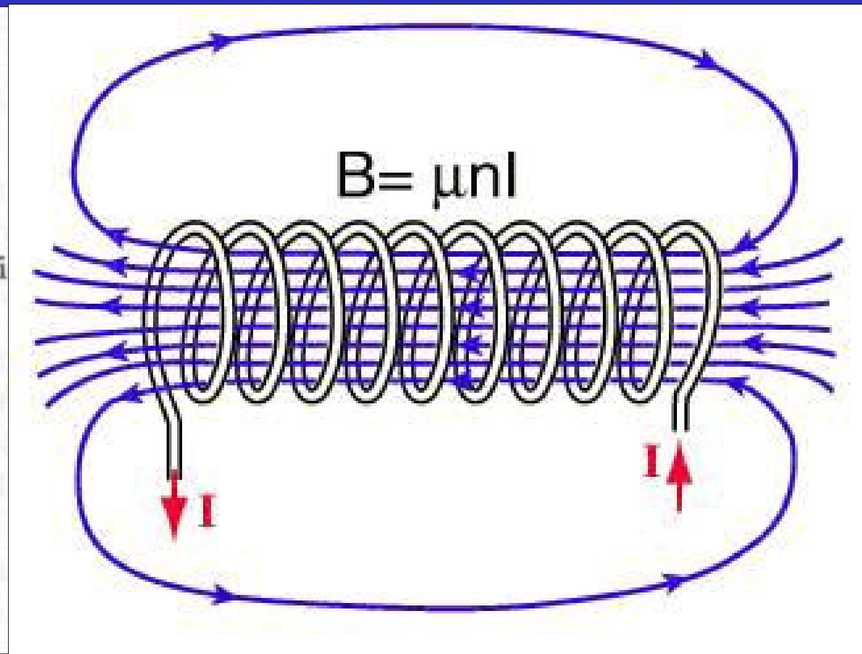
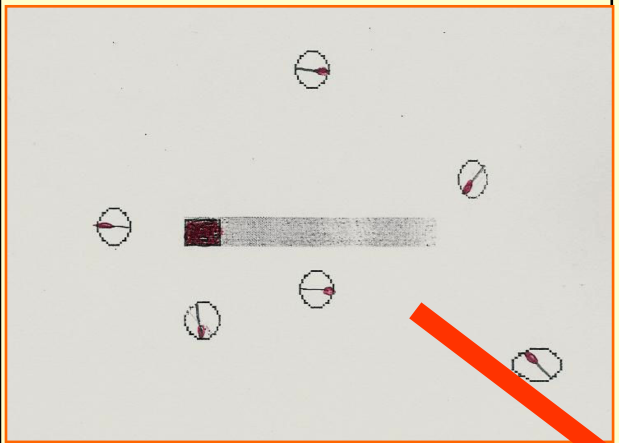
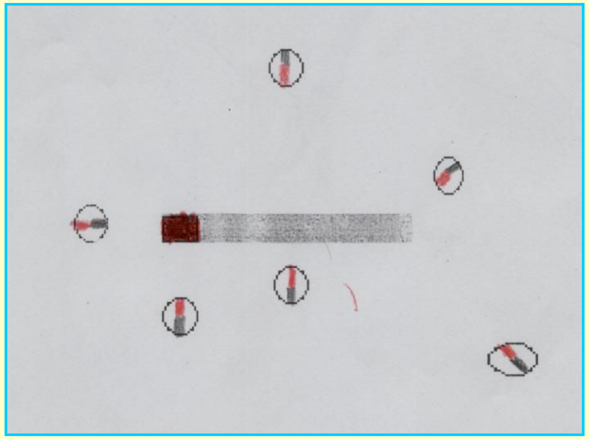
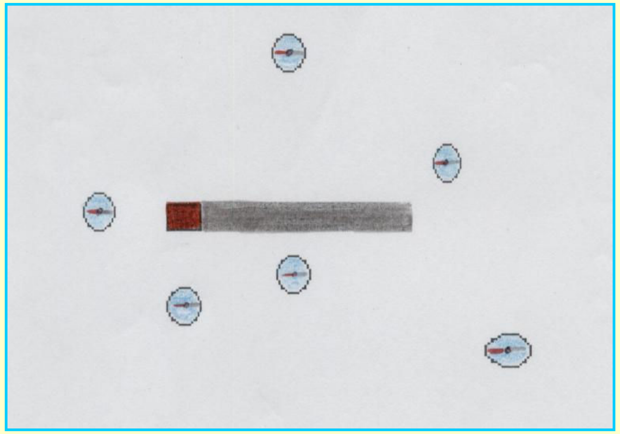
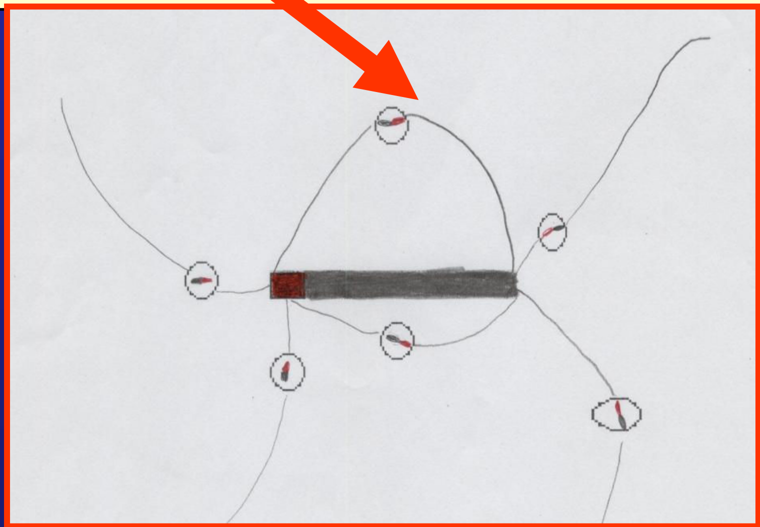

B= µnI
I
I

primary school

Diposition of compasses orientation around a magnet		
Correct disposition (9)	Obstacle of attraction (all needles towards the magnet 8)	All needles paralel to the magnet (3)
		



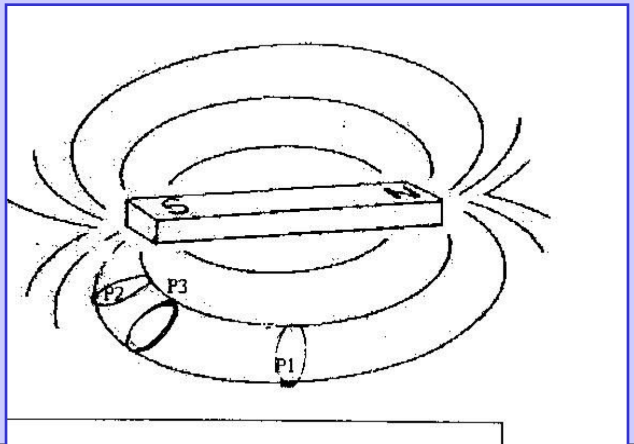
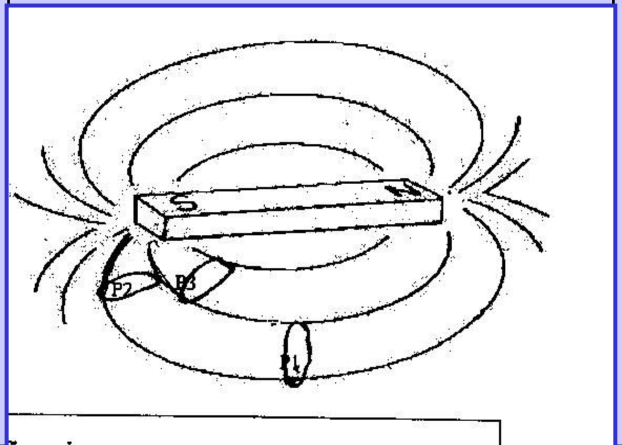
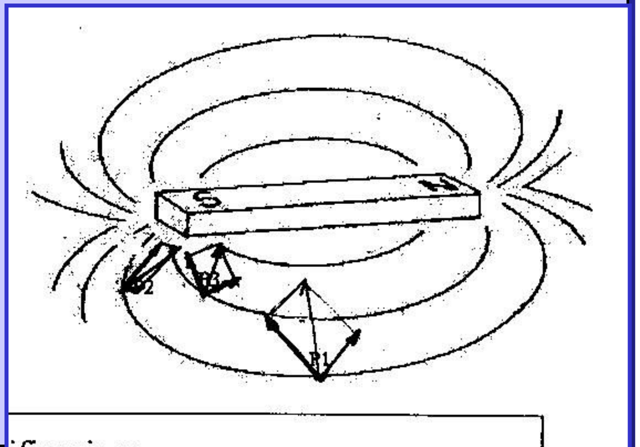
→children's capacity to **<u>remember and reproduce the configuration of field lines</u>**

which in some cases is explicitly evoked

Secondary school

Field lines → **visualising agents for the flux of the field** (flux tubes)

Tubes of flux → **conceptual references for the description of intensity of B**

Using tubes of flux to identify field intensity (9 students don't do any drawing)		
A (7): shows two (5) or three (2) surfaces all on the same tube of flux	B (2): shows 3 surfaces, but S3 appears on another tube of flux	C (1): indicates the components of forces of the two poles
		

The written explanations make reference to:

a) **the tubes of flux** (5/19):*"B(P1)=E1, B(P2)=E2 Since being E1S1=E2S2 and being S2<S1 results that it must be E1<E2. All of which explains the law of the tubes of flux"*

b) **to the number of entry and exit lines** (3/19): *"They belong to the same field line and all lines enter at BP2 , exit at BP1 , however the intensity at BP2 is greater because the area of the concentration of lines is smaller"*

c) **to the distance from the source** *(6/19)"P1 is further away with respect to the source, therefore its field is inferior with respect to that of the closer P1"*

d) **to the distance from the poles** *(5/19)"because it is further from pole S"*

SUPERCONDUCTIVITY – STIMULUS WORKSHEET FOR STUDENTS

Student worksheet 1 – Magnetic interactions

You have a magnet, a magnetic needle, a calamite, a piece of magnetite, an iron coin, a copper coin, an aluminum coin, an iron nail, steel staples, a plastic button, a shopping receipt, a table tennis ball, a toothpick, a small iron sphere.

1. EXPLORATION OF THE PHENOMENOLOGY. Bring the different objects to one of the magnet poles one at a time, then change the pole and repeat the experiment. Identify different types of interaction between the magnet and different objects, observing what happens.

OBJECT	**TYPE OF INTERACTION**
Magnetic compass needle	
Calamite	
Piece of magnetite	
Iron coin	
Iron nail	
Copper coin	
Steel staple	
Aluminum coin	
Plastic button	
receipt	
Table tennis ball	
Small iron sphere	
toothpick	

2. What categories of behavior do you observe?

Illustrate.

A. ____

B. ____

C. ____

____

3. What determines the different types of behavior? (material, type of object, …)

____

4. When the interaction is attraction, which object attracts?

   Consider for example a magnet and some staples in the following situations

   A. Put the staples on the table and bring the magnet close
   B. Put the magnet on the table and bring the staples close

   Is it the magnet which attracts the staples or do the staples attract the magnet? (Explain)

   ____

   ____

5. Predict the interaction between a magnet and a ferromagnetic object. Explain.

____

6. Does the attraction between the magnet and the staples occur when there is contact or does it occur beforehand? Illustrate and explain.

____

7. Bring together two paper clips or two coins which were attracted by the magnet. Do they attract each other? ☐ Yes ☐ No
8. Predict what happens when you bring a magnet close

____

9. Proof. Describe what happens and give your explanation

____

Student worksheet 2 – Orientation lines and directions of departure

Place a sheet of transparent acetate under a magnet and trace its shape with a felt tipped pen. Arrange a group of compasses around a magnet. Draw with the felt tip the lines of orientation of the compass needles around the magnet with continuous lines to which each needle is a tangent. Remove the compasses.

10. In the space below reproduce the magnet and the distribution of the needles around the magnet with continuous lines to which each needle is a tangent.

11. Put another compass upon one of these lines. Where does its needle point?

    ____

12. Explain what these lines mean making reference to the way they were constructed.

    ____

13. Consider two of the lines of orientation.

    Do they maintain the same distance from each other? ☐ Yes ☐ No

    Do you think they would be the same on another plane, different from that of the table?

    ☐ Yes ☐ No

14. Illustrate in your own words how you represent orientation lines in the space around a magnet.

Remove the magnet. Distribute ferromagnetic needles uniformly on a sheet of acetate (iron filings or segments of steel wool for domestic use or similar tools). Place the magnet on the sheet of acetate in the same position as before. Observe how the steel filings arrange and orient themselves.

15. Is there any difference between the drawing of the lines produced based upon the arrangement of the compass needles and the distribution of the ferromagnetic needles?

    ☐ Yes ☐ No

    Discuss the similarities and differences. Formulate an explanation.

    Similarities ____

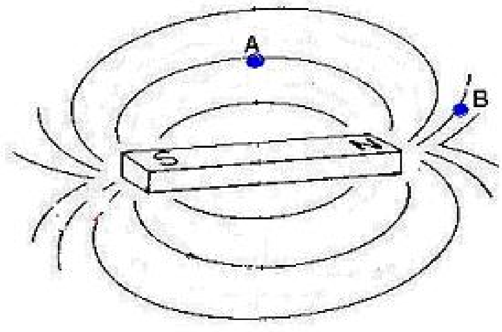
    Differences ____

    Explanation ____

16. Move the sheet of acetate with the magnet on top to various points on the table. Does the distribution of the segments of steel wool change? (respond and explain what you observe)

____

Let us consider the representation of lines of orientation of the compasses (field lines) of a magnet and let us place a steel ball at two points A and B as indicated in the figure below.



17. PREVISION. If we let the ball move,
    - what is the direction of departure of the ball placed at A?
      (draw the figure and explain your prevision in words)

    ___

    - and that of B?
    (draw the figure and explain your prevision in words)

    ___

    - in your opinion do the field lines coincide with the departure direction of the steel ball? (Explain your reply)

    ___

18. PROOF. Place a ferromagnetic ball on points A and B. How does it move?
    (Discuss results)

    ___

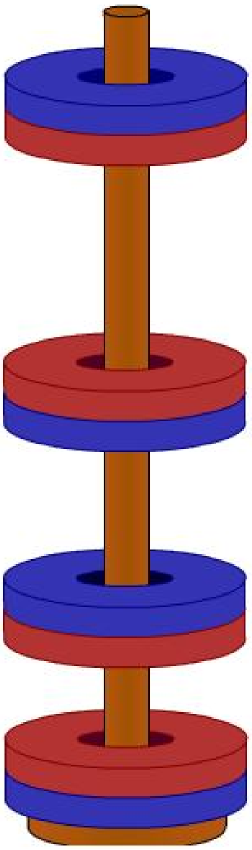
19. Do the directions of orientation and departure represent different aspects of the phenomena observed? (discuss the significance and explain your reply)

    ___

Suggested activity: measure of the magnetic Field along a field line. Look at worksheets for Experiments A1, A2, A3

Student worksheet 3 – Suspension of magnets

You have four identical cylindrical magnets with a hole in the centre arranged on a wooden axis. The magnets remain suspended one on top of the other.



1. Imagine that you apply a force directed downward upon the upper disc, for example by pushing with your hand. Which of the following proposals do think best describes the situation? Explain why.
   a. You expect to feel a "resistance" to the force that you are pushing downward.
   b. You think you will not be able to move the magnet from its position
   c. You think that the magnet will fall onto the one below.

____

____

2. Now push the upper disc downward with your hand. Describe what happens.

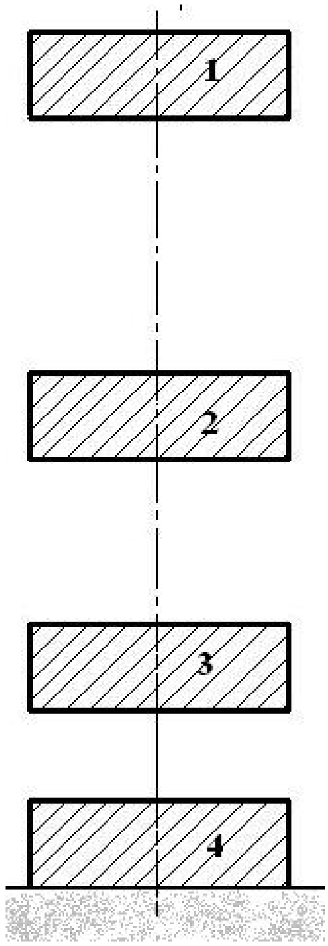
____

____

3. Compare your prevision with the proof. Discuss the results with regard to your expectations and give an explanation

In the figure below we have drawn up the four identical cylindrical magnets with holes in their centre in sections, arranged on a wooden axis.

4. What are the forces acting upon each disc? Show them on the figure below.



5. PREVISION. Suppose we place the magnets on top of each other with the same poles facing (as they are now without the wooden axis passing through the middle). How do you think the magnets will arrange themselves? Explain your response.

____

____

6. PROOF. Now place the same poles of the magnets facing each other without the wooden support.
   a. What happens?

   ____

   b. Give an explanation of what happens.

7. What are factors that come into play for which the cylindrical magnets on the wooden axis remain suspended?

Student worksheet 4 – Falling in a copper tube

You have a copper tube which is 114 cm with a diameter of 2,5 cm, a cylindrical magnet with dimensions such that it can pass through the tube, a steel cylinder of the same dimensions as the cylindrical magnet and a chronometer.
Hold the copper tube in a vertical position and use the chronometer to measure the time it takes for the cylindrical magnetic and the steel cylinder to pass through the tube.

1. Let the steel cylinder fall through the copper tube. How many seconds does it take for the steel cylinder to pass through the tube?

   ____

   ____

2. Let the cylindrical magnet fall through the copper tube. How many seconds does it take for the magnetic cylinder to pass through the tube?

   ____

   ____

3. Is there a difference between the time it takes for the steel cylinder to pass through the tube and the time it takes the magnet? How do you explain this difference?

   ____

   ____

You have a copper tube of the same dimensions as before where an incision of 0,2 cm has been made lengthways along the tube, such that the incision is as deep as the tube is wide. Hold the tube in a vertical position.

4. Suppose we let the steel cylinder fall in the copper tube. How long will it take to pass through the tube? _________________________

   explain your prediction____

   ____

5. Let it fall. How many seconds does it take for the cylinder to pass through the tube? _________________________

6. Do you notice any difference in the falling time of the same cylinder with respect to the tube without an incision? ☐ Yes ☐ No

   Explain what you are experimenting.

____

____

7. Suppose we let the cylindrical magnet fall through the copper tube. How long do you think it will take the magnetic cylinder to pass through the tube? ________________________
explain your prediction____

____

____

8. Let the cylindrical magnet fall through the copper tube. How many seconds does it take for the magnet to pass through the tube? _____________________
9. Do the two cylinders act in the same way when they fall in the incised tube and the tube with no incision? □ Yes □ No
10. How do you explain what you have experimented.

Student worksheet 5 – the jumping ring

You have a coil and on the top is a soft iron nucleus, a copper ring, a small chemist's furnace, a container with liquid nitrogen, white cardboard.

1. While the generator is off place the copper ring on the soft iron nucleus. What happens?

 ____

 ____

2. Leave the copper ring on the soft iron nucleus and turn on the generator. Describe what you see.

 ____

 ____

3. Leave the generator on. Do you notice anything?

 ☐ Yes ☐ No

4. Turn on and turn off the generator leaving the copper ring positioned on the soft iron nucleus. Describe what you observe.

 ____

 ____

5. When does the ring move from its initial position?

 ____

 ____

6. Explain the behavior of the copper ring when you turn on and turn off the generator

 ____

 ____

7. Place the white cardboard behind the coil with the soft iron core on the top, turn on and turn off the generator and mark the height reached by the ring on the cardboard.
8. h = ….
9. Heat the copper ring on the chemist's furnace for a few minutes and then put it on the soft iron nucleus. Turn on and turn off the generator.
 a. Describe what you observe.

 ____

 ____

 b. Does the ring jump more or less than the previous time when it was unheated?

____

____

10. Place the white cardboard behind the coil with the soft iron nucleus on the top, turn on and turn off the generator and mark the height reached by the ring on the cardboard.
h = ….
11. Suppose we immerse the copper ring in liquid nitrogen for some minutes in order to cool it and then position it on the soft iron nucleus. Predict whether the ring will jump:
    a. More or less than when it was at room temperature? Explain your response.

____

____

    b. More or less than when it was heated? Explain your response.

____

____

12. Position the white cardboard behind the coil with the soft iron nucleus on the top. Immerse the copper ring in liquid nitrogen for a few minutes and then position it on the soft iron nucleus and turn on and turn off the generator and mark on the cardboard the height reached by the ring. The ring jumps:
    a. More or less that when it was at room temperature?

____

____

    b. More or less than when it was heated?

____

____

13. Do you think that in some way the phenomenon is linked to the temperature of the ring. Explain your response.

____

____

14. our considerations

____

____

Student worksheet 6 - Superconductors

You have a cylindrical magnet, a small superconductor cylinder, a container with liquid azote and a compass.

1. Before pouring the liquid nitrogen on the superconductor place the compass on top of it. Where does the compass needle point?

___

___

___

2. Turn the superconductor and place the compass on top. Does the compass needle have the same orientation as in the previous case?

___

___

___

3. Place the magnet upon the superconductor. Remove the magnet and place the compass upon the superconductor. How is the compass needle oriented with respect to the two previous situations?

___

___

___

4. Does the compass needle orient itself according to a field that is not the earth field in the immediate vicinity of the superconductor? □ Yes □ No
5. How do you deduct this?

___

___

___

6. Pour the liquid nitrogen on the superconductor so that you cover the paste of the superconductor. Wait until some of the nitrogen evaporates and the paste of the superconductor re-emerges. Place the magnet upon the superconductor. Describe what you observe.

____

7. Place the magnet upon the paste of the superconductor, pour the liquid nitrogen on the superconductor and the magnet so that they are covered and wait until part of the nitrogen evaporates. Describe what you observe.

8. Compare the two previous situations. How do you explain the fact that the magnet remains suspended several millimeters above the superconductor?

9. Remove the magnet and the liquid nitrogen. Place the compass on the superconductor. How is the compass needle oriented?

10. Remove the compass, turn the superconductor and place the compass on top again. How is the compass needle oriented?

11. Is the compass is oriented according to a field that is not the earth field in the immediate vicinity of the superconductor?

    ☐ Yes ☐ No

    How do you explain this?

12. Our conclusions.

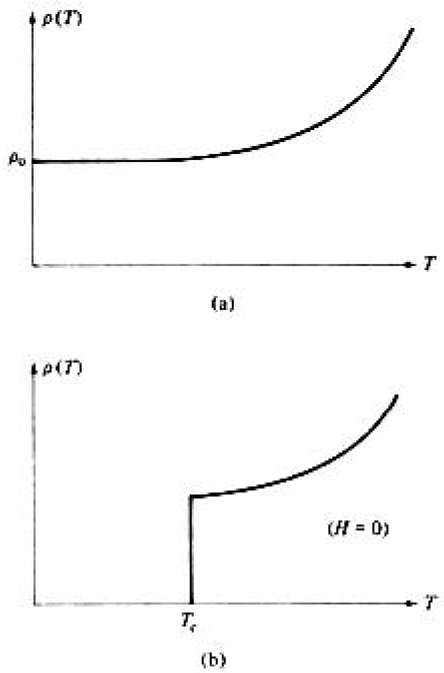
Entry/exit test

(prepared and given by Braida Michela at the end of the experimentation in Year IV ITIS Malignani – Udine)

1. Into how many classes may we subdivide the interactions of different types of materials with a magnet? How may they be differentiated?
2. In a closed circuit we generate an induced current whenever the flow of the magnetic induction vector connected to this varies, where the phenomenon lasts as long there is flow.
3. Is this affirmation always true? ☐ Yes ☐ No

   Explain your response.
4. In conductors and metals in general, resistance is linked to temperature. When temperature increases, resistance increases. How do we explain this?
5. By superconductivity we intend putting at zero the electrical resistivity, that certain materials show below a certain critical temperature of Tc.
6. In your opinion is the passage to the superconductor state a reversible or irreversible process? Explain your response.
7. Do the following behave in the same way?
   a. a normal magnetized conductor which is then made into a state of a "perfect conductor" (T < Tc)
   b. a superconductor immersed in a magnetic field and then brought below critical temperature

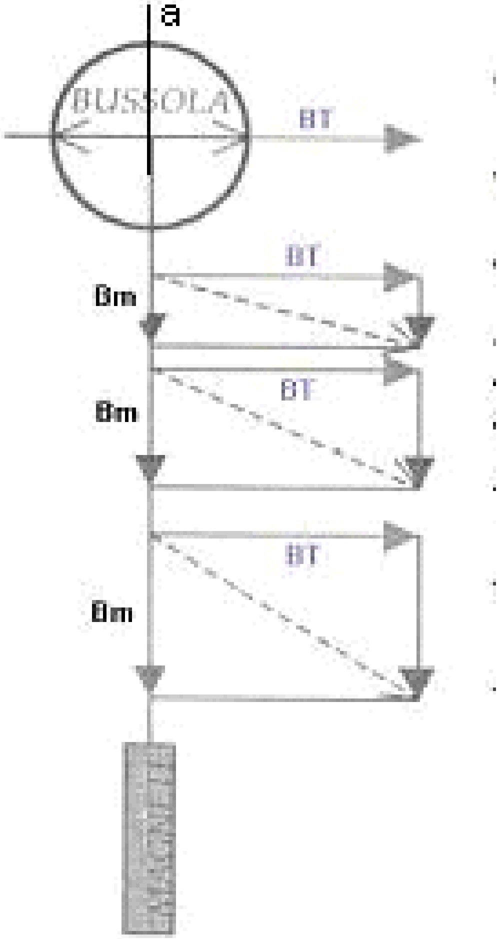
   (Consider that a superconductor below critical temperature, immersed in a magnetic field, becomes perfectly diamagnetic). Explain your response.
8. Why is it that inside a superconductor brought to below the critical temperature, the electrical field must be equal to zero?
9. Into how many and which typologies may we subdivide superconductors and what are their characteristics?
10. What are the critical parameters that distinguish a superconductor state from the normal state of a material, and condition its behavior?
11. In the figure below we see the graphs (a) and (b) of the trend of resistivity in function of temperature for conductors and superconductors.
    a. Which graph represents which type?
    b. What is the difference between the course of resistance in function of temperature in a superconductor and a normal conductor?



12. What are the environments where superconductors are utilized?
13. What are the difficulties linked to the realization of advanced technological components which utilize superconductors?

Worksheet Experiment A1
Measuring the magnetic field B with a compass
(compass tangent method)

(by Francesca Bradamante for Marisa Michelini)



Objective: dependence of distance from the magnetic field along the longitudinal axis of a cylindrical magnet.

Method: measure in units of the **earth's magnetic field (BT),** the magnetic field generated by a cylindrical magnet (**Bm**), based upon the deviation of a compass needle with respect to the direction of the magnetic earth field.

Materials: cylindrical magnet, compass, millimeter graph paper, pencil, ruler, adhesive tape.

Phases of experiment:

1. **Preliminary phase**: identify an area of the floor where BT is constant, using the compasses.
2. **Organization of system**:
   a) orient the graph paper so that the direction of BT corresponds with a line on the shorter side of the paper.
   b) place the magnet perpendicular to the direction of BT (along the line *a*)
3. **Measure**:
   a) arrange the compass initially at 35 cm from the magnet along the line a and mark the direction of the compass needle.
   b) Find the value of Bm in units of BT: choose an arbitrary unit of the vector of the earth's magnetic field BT (for example 2 cm) and identify the component Bm with respect to the direction taken from the compass at that point.
4. Gradually move the compass closer (at constant intervals of 2 cm) and identify Bm for each position.
5. Record the data on the table and analyze the dependence of the length of the vector Bm upon the distance: (d = distance between the compass and the closest magnet pole; Ln = logarithm)
6. Represent the data in a graph

d **(….)**	**Bm** (……..)	**Ln (d)**	**Ln (Bm)**

Worksheet Experiment A2
Measuring magnetic field B with Hall's sensor

(by Francesca Bradamante for Marisa Michelini)

Objective: dependence of distance from the magnetic field along the longitudinal axis of a cylindrical magnet

Method: direct measure of a magnetic field generated by a cylindrical magnet (Bm) with a magnetic field sensor.

Materials: cylindrical magnet, magnetic field sensor, millimeter graph paper, pencil, adhesive tape.

Phases of experiment

1. **Preliminary phase**: determine the direction of earth's magnetic field BT and orient the sheet of millimeter graph paper so that the direction BT corresponds with a line of the longer side of the paper.
2. **Organization of the system**: position the cylindrical magnet along the identified direction BT
3. **Measure:** at regular intervals (1 cm) move the sensor closer to the magnet and note the values of the magnetic field B measured
4. Record data on the table and determine, through the difference between B and BT, the magnetic field Bm produced by the magnet in each position of the compass.
5. Analyze the dependence of the length of the vector Bm upon the distance and represent it in a graph
   (d = distance between the compass and nearest magnet pole; Ln = logarithm)

d (…..)	**B** **(….)**	**Bm** (…….)	**Ln (d)**	**Ln (Bm)**

Worksheet Experiment A3
Measuring the magnetic field B with the oscillation of a compass

(a cura di Francesca Bradamante a Marisa Michelini)

Objective: the dependence of distance from the magnetic field along the longitudinal axis of a cylindrical magnet.
Method: measure of the period of oscillation of a compass needle placed along the longitudinal axis of the magnet.

Materials: cylindrical magnet, compass, millimeter graph paper, pencil, adhesive tape.
Phases of experiment

1) **Preliminary phase**: determine the direction of the magnetic earth field BT and orient the sheet of millimeter graph paper so that the direction of BT corresponds with a line on the longer side of the paper.
2) **Organization of the system**: position the cylindrical magnet along the identified direction of BT
3) **Measure:** at regular intervals (2 cm) move the compass closer to the magnet and measure the period of oscillation (measuring with a chronometer 5 or 10 oscillations and repeating each measure 3 times)
4) Given that the period T depends upon the magnetic field B according to the equation:

$$T = k\frac{1}{\sqrt{B}}$$

we use this to calculate (when k is a constant) the total magnetic field at the point where the compass is placed: $B = \frac{1}{T^2}$

5) Determine, for the difference between B and BT, the magnetic field Bm produced by the magnet in each position of the compass.
6) Record the data on the table and represent it in a graph

d = distance between the compass and the closest pole of a magnet; Ln = logarithm

d (…..)	**T** **(…….)**	**B** **(….)**	**Bm** (…….)	**Ln (d)**	**Ln (Bm)**

PARTNER: **<Daugavpils University>**

AUTHOR: **<Guntis Liberts>** DATE: **2007-10 -08**

REVIEWER: **<reviewer name>** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

- Teacher Guide
- Teacher Seminar
- CD-ROM
  - Module 1. Magnetism
  - Module 2. Electromagnetic induction
  - Module 3. Electric conduction
  - Module 4. Introduction to superconductivity
  - Module 5. History of superconductivity
- Low-Tech hands on kit
- High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials

We used SUPERCOMET Superconductivity Multimedia Educational Tool: **Teacher guide** / Editors Lorenzo Rossi, Vegard Engstrøm Authors Aileen Earle, Jenny Frost, Vegard Engstrøm, Mojca Cˇepicˇ , Gorazd Planinsˇ icˇ , Gren Ireson, Sara Ciapparelli/; **CD-ROM** /Editors: Vegard Engstrøm, Harvey Mellar; Authors: Jenny Frost, Mojca Cˇepicˇ , Gorazd Planinsˇ icˇ , Anton Ramsˇak, Sara Ciapparelli, Helge Røder, Knut Bodsberg, Carl-Axel Husberg, Jo Smiseth, Kristian

Fossheim, Vegard Engstrøm/; **Teacher seminar** /Editors: Vegard Engstrøm, Harvey Mellar, Aileen Earle Authors: Gren Ireson, Jenny Frost, Mojca Cˇepicˇ , Gorazd Planinsˇ icˇ , Anton Ramsˇak, Marisa Michelini, Anders Isnes. Edition 2004

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions - 30
- Length of sessions – 40 min
- Number of trainee teachers involved (please give numbers of male and female trainee teachers)
- There were 15 trainee teachers involved (6 male and 9 female trainee teachers in the trials
- Number of teachers involved (please give numbers of male and female teachers)
- There were 84 teachers involved (30 male and 54 female teachers in the trials)
- Number of students involved (please give numbers of male and female students)
- There were 320 students involved (145 male and 175 female students) in the trials
- Number of schools involved. 12 (85)
- You will not always be able to give exact answers to these questions, so please give your best estimate.)

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

The Teacher Guide and Seminar were used on Physics and Informatics teacher seminars (7). During these seminars trainee teachers (15) demonstrate Supercomet 2 materials Physics and informatics teachers of Daugavpils, Kraslava, Riga and Preili district were acquainted with possibilities of this program, and similarly and by instruction of the use. Besides teacher seminars dissemination of SUPERCOMET products were made at the session of the 9th Latvian Physical Society Conference 2005-09-16 (Presentation " Mechanism of superconductivity in the curriculum of secondary school")and at the session of International Conference "Past and present of natural sciences in Daugavpils University" 2006-02-02 (Presentation "The science contents integration for scientific and technological literacy")

Our opinion about teacher seminar is very limited due to absence of liquid nitrogen resources in Latvia, and particularly in Daugavpils, at the moment. Because HTsC and related superconductivity demonstrations needs cryogenic liquids we are looking forward to renovation of Latvian universities, including cryogenic infrastructure in the near future.Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

The physics teacher's competence of using ITC about three and more years ago was low. The situation is changing.

Now the new standard for science teaching in Latvian schools is worked out. Electronic teaching aids (presentations, animations interactive models and videofilms) are produced in the framework of ESF National Program Project "Working out of Education content and promoting teacher's qualification in science, mathematics anad technology" (Nr. 2005/0100/VPD1/ESF/PIAA/ 05/NP/3.2.2/0001/0181) (ES struktūrfondu nacionālās programmas projekta "Mācību satura izstrāde un skolotāju tālākizglītība dabaszinātņu, matemātikas un tehnoloģiju priekšmetos" (Līguma Nr. 2005/0100/VPD1/ESF/PIAA/ 05/NP/3.2.2/0001/0181) The workshops are organised for all science teachers to promote their ICT using competence in science teaching process. Teachers during practical lessons and post graduated

seminars assimilate experience to use sensors in physics investigations and to use computers for data acquisition, data processing and analyse.
Testing teacher seminars, Teacher guide trial and Testing computer application were organised and carried out on the basis of Secondary school N2 of Livani (~2.vidusskola) by Viktors Andreievs, -Riga State Gymnasium Number 1 by Physics teacher Tamara Brice and Daugavpils Centra gimnazija by Lolita Jonane
2005-09-20; 2005-09-28; 2005-10-02; 2005-10-07; 2005-10-15; 2005-10-22; 2005-11-05; 2005-11-12; 2005-11-25; 2005-12-06; 2005-12-12; 2005-12-15; 2005-12-17; 2006-01-08; 2006-01-12; 2006-01-22; 2006-02-03; 2006-02-26; 2006-03-08; 2006-03-12; 2006-03-22; 2006-04-03; 2006-04-06. 22.05.2006
Mrs T.Brice wrote: " I would like to thank you for the support in form of the highly qualitative teaching mean -the Supercomet CD. It has been highly appreciated by both teachers and students of the secondary-school forms at the Riga State Gymnasium Number 1 and other State (regional) schools.
I have presented the CD and the teachers' guide at teachers' seminars at the
Latvian Physics Association seminar in Daugavpils and at the State Gymnasium Conference in Valmiera where all the 15 State gymnasiums were represented. On both occasions, the teachers who had used the Supercomet Multimedia CD gave very positive feedback on it. They said it has helped to improve the scholars' knowledge of electromagnetism and related phenomenon, and has also lead to better results in the scholars' schoolwork.
As it was discussed in the mentioned seminars and experienced during classes that I have been teaching in person, it is also attractive to use the Supercomet CD during Physics classes due to the available animations that help the students in grasping the essence of electromagnetism laws and refresh the classes by bringing in a new way of teaching. The animations also relieve the teacher's work and make it more time-efficient as he/she does not have to draw so many schemes or graphs on the blackboard anymore -these are nicely presented in the CD. Of course, the visual material presented in the CD is more effective if supported with standard teaching methods and additional practical examples."

3.2 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

3.3 The materials of the Teacher Guide and Seminar are useful to reduce authoritarian teaching when subject teaching is replaced with subject studying. In these process information technologies can be helpful

3.4 What is your evidence for your response to question 3.3?

Trainee teachers are involved in creation of interactive teaching aids for science teaching in high schools as well in teacher training seminars

3.5 Why are these aspects useful? Why are the other aspects not useful?

These aspects correspond the requirements of the education development in Europe and in the world.

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

The Teacher Guide and Seminar materials are translated in Latvian

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?

- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?
- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	There are many high- schools where science classrooms equipped with computers in Latvia and teachers are learning to use IT in teaching process	The CD –ROM themes are included in the Latvian high-school's physics curriculum	. CD-ROM can be used as an exciting resource to teach many physics concepts. The large number of interactive animations of physical processes makes learning process more attractive	Virtual labs can provide pupils with access to a number of experiments that would otherwise be impossible for them to experience in a normal classroom, for reasons of safety, or because the effects are too fast, slow or small.	Students interest was high
4.2	CD-ROM Module 1 Magnetism	The module has to be used for acquisition clarify general conceptions and basic laws of magnetism	The theme magnetism is included in the Latvian high-school's physics curriculum	Very demonstrative and effective is simulation of Oersted's un Amper's experiments	Students were interested in different kinds of magnets and they usage	Students interest was high
4.3	CD-ROM Module 2 Electromagnetic induction	The module has to be used for acquisition clarify general conceptions and basic laws of electromagnetic induction	The theme Electromagnetic induction is included in the Latvian high-school's physics curriculum	Animations help students to better understand and learn electromagnetic induction	Students were curious about different electromagnetic phenomena	Students interest was high
4.4	CD-ROM Module 3 Electric	The module has to be used for acquisition clarify general conceptions	The theme Electric conduction is included in the	Animations and models help students to better	Students were interested in models of electric	Students interest was high

	conduction	and basic laws of electric conduction	Latvian high-school's physics curriculum	understand and learn electric conduction.	conductivity	
4.5	CD-ROM Module 4 Introduction to superconductivity	The module has to be used as a context in which to teach conceptions and basic laws of electric conduction	The theme Superconductivity is not included in the Latvian high-school's physics curriculum	The theme Superconductivity is not included in the Latvian high-school's physics curriculum .	Students are getting up-to-date information about modern technology	Students interest was very high
4.6	CD-ROM Module 5 History of superconductivity	The module has to be used as additional material	The theme Superconductivity is not included in the Latvian high-school's physics curriculum	N/A	Students interest about History of superconductivity was not high	Interest about History of superconductivity was not high
4.7	Low-Tech hands on kit	N/A				
4.8	High-Tech hands on kit	N/A				

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

Practical work with CD_ROM and materials in Secondary school N2 of Livani, Daugavpils centra Gimnazija, Riga State Gymnasium Number 1

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

5.1	CD-ROM - general	At the beginning of each modulus could be practical examples (technical or everyday life), w3hich needs additional motivation for learning electromagnetism and superconductivity .
5.2	CD-ROM Module 1 Magnetism	Change colours of magnetic poles: S- red, N – green Explanation of Earth magnetism
5.3	CD-ROM Module 2 Electromagnetic induction	Practical application in technique and technology – short video or pictures (generators, transformer, electromotor)
5.4	CD-ROM Module 3 Electric conduction	Resistors with colour codes and interactive tasks for virtual creating electric circuits with fixed summary resistance
5.5	CD-ROM Module 4 Introduction to superconductivity	N/A
5.6	CD-ROM Module 5 History of superconductivity	The size of pictures can be bigger.
5.7	Low-Tech hands on kit	N/A
5.8	High-Tech hands on kit	N/A

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Practical work in Secondary school N2 of Livani, Daugavpils centra Gimnazija, Riga State Gymnasium Number 1

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

CD were used in the classroom lessons for frontal demonstration as well for individual study and virtual laboratory experiments

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

Yes, the teaching methods suggested in the Teacher Guide and Seminar are very useful on lectures, practical demonstrations, as well for homework

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

CD-ROM and other materials were used in different ways: animations to visualize and analyze experiments, to look for explanation of phenomena in textbooks and in virtual labs to compare electric conduction of different materials.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

Difficulties are connected with deficit of time. Studying needs more time than conventional learning.

6.5 How do teachers and/or students feel about these different methods of integration?

Teachers and students feel good

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

Practical work with CD_ROM and materials in Secondary school N2 of Livani, Daugavpils centra Gimnazija, Riga State Gymnasium Number 1

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

CD are very helpful in organizing efficient and interesting classes even though the technical support is limited (although it is somewhat better than average in the State schools). Also the summaries of the sections are helpful in controlling and planning the work at classes.
What students like the most about the Supercomet CD is the clear and comprehensive style in which the information is presented, and the real-life related examples
They also show much more enthusiasm and interest in the laboratory works and experiments as they are curious to see whether it really happens like in the presented material. The Ohm's law laboratory work, for instance, can be directly compared to one of the animations presented under the Electric Conduction section in the CD, and students enjoy doing so.
As the Supercomet CD has proven itself very useful at the best schools of Latvia and has received such positive feedback, we would welcome any additional educational materials you could suggest or provide. Once again, thanks for the support until now and we hope to continue and expand our cooperation.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

N/A

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

N/A

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

The SUPERCOMET materials as a whole is valuable and useful addition to the physics education resources available in Latvia for students' learning and teacher training

9.2 What is your evidence for your response to question 9.1?

Trainee teacher's personal experience and results of students knowledge

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?
To work with animations, virtual demonstrations, CD-ROMs can easily both men and women

9.4 What is your evidence for your response to question 9.2?

There are more women physics teachers than men in Latvian schools

This concludes the NATIONAL EVALUATION REPORT from P26 University of Daugavpils

Rector of the University of Daugavpils
Prof. Arvīds Barševskis
Partner contact person
Prof. Guntis Liberts

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PARTNER: AMSTEL Institute, Universiteit van Amsterdam, P28

AUTHOR: **Peter Uylings** DATE: **2007-10-26**

REVIEWER: **<reviewer name>** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide

Teacher Seminar NA

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit NA

High-Tech hands on kit NA

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

CD-ROM version 2007-01-20 played over the school network.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

On the Dutch testing school Bonhoeffercollege, Castricum, 4 sessions of 50 minutes were held this year's course (2007-2008), in addition to the same number in last year's course (2006-2007). Two teachers, one male and one female were involved. The first one (and writer of this report) functioned as trainee as well. Basically, all 8 sessions were held in two classes: one higher per-vocational with 18 boys and 2 girls and one pre-university class with 20 boys and 4 girls.

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

No seminar was given, but instead personal training was used in combination with the teacher guide and the .ppt of the teacher seminar. As no experimental demonstrations were given (yet), main issue was general theory and use of the application.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT). NA

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

In the Dutch national context, details and real knowledge of superconductivity, except for the phenomenon per se, are relatively unknown. As a result, the qualitative overview of superconductivity itself and its applications is very welcome. In addition, physics teachers immediately like to learn more in a quantitative direction: what equations may be used? What is BCS theory and its relation to quantum mechanics? At the same time also: how do I set up and give a classroom demonstration in a safe way? The teacher seminar material provides answers to this.

3.4 What is your evidence for your response to question 3.3?

The enthusiasm of the trained teacher. All of the physics section members wanted to know more of SC. I gave 3 lectures for science (mostly physics) teachers on conferences in the Netherlands, and I see the same response: SC is something we don't know much about, let's learn more: what gan you give to me?

3.4 Why are these aspects useful? Why are the other aspects not useful?

Most useful are the description of SC phenomena, how to set up experiments, and the explanation of the current status of the basic theory. Useful because obviously this is the kind of practical information teachers want: how can SC2 help them to do their job (well). Other information of more general, didactical, pedagocical kind, as well as information of how to use the computer application, are considered less useful because teachers feel that they do alright without it.

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

In view of the above: more emphasis on what teachers do not know but need to teach well and interestingly on SC.

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?
- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?
- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	good	good	Repetition purposes: students are already familiar with the subject.	Yes, not very differtial but limited in time (20 min)	None in general
4.2	CD-ROM Module 1 Magnetism	Good	Good	Nice for short survey and added understanding	See above	See above
4.3	CD-ROM Module 2 Electromagnetic induction	good	good	Very well as training for understanding and for solving qualitative problems	Medium (gets boaring after some time)	NA
4.4	CD-ROM Module 3 Electric conduction	limited	no	Outside curriculum	low	Only for high ability students
4.5	CD-ROM	Average, only one	poor	good	sufficient	Only for high ability

	Module 4 Introduction to superconductivity	class, 3 sessions.				and pre-university students
4.6	CD-ROM Module 5 History of superconductivity	See above	poor	good	See above	See above
4.7	Low-Tech hands on kit	NA				
4.8	High-Tech hands on kit	NA				

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

		Suggested changes
5.1	CD-ROM - general	More activating with animations. If possible, a way to store results like answers, short calculations, quiz choices.
5.2	CD-ROM Module 1 Magnetism	See above
5.3	CD-ROM Module 2 Electromagnetic induction	See above
5.4	CD-ROM Module 3 Electric conduction	May be reduced, or less emphasized like in an appendix
5.5	CD-ROM Module 4 Introduction to superconductivity	Somewhat more quantitative and little bit more formulae. Animations like expelling magnetic field lines, as explicit and illustrative as possible.
5.6	CD-ROM Module 5 History of superconductivity	See above
5.7	Low-Tech hands on kit	NA
5.8	High-Tech hands on kit	NA

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Classroom observations and teacher discussions.

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

The application should preferably be used in connection with actual i.e. hands-on experiments and/or demonstration.
Each country will no doubt have their own approach to be used as prerequisite before using the application. I don't think that use of the application will change this approach drastically. Instead, the application serves as a welcome visual tool to be added and implemented in the treatment of the subject. To my mind, and this is again confirmed by the tests in the final high school forms this year – course 2007-2008- , the computer application works best for repetition purposes, halfway and at the end of the subject of (electro)magnetism and induction. Alternated with central introduction and explanation by the teacher, followed by class discussions, the application is a powerful tool not only to resume the general lines and to test one's own level of expertise in the subject, but also to check the finer details of especially induction problems with their usual a priori 50% chance of answering them correctly.
Having written this, it should be said that most of my pupils have difficulty working longer than say one half hour on end with the computer application: again, change of lesson form is the key word. It may help if the outcome of the pupils were a little bit more productive at times.
Hands-on kits were not used.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

Yes, but only because they don't deviate much from the current methods. Teachers are not inclined to change their approach drastically for one project.

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

Key words here are change, variation. In the Dutch curriculum, there are no text books or multimedia materials on SC outside the SC2 material. So, change means teacher talk, demonstration (not carried out yet), and introducing SC in schoolexam problems.

6.3 What difficulties do teachers find in integrating the materials into their teaching?

Lack of time and knowledge. Experimentally, lack of material ans liquid nitrogen, in addition to some fear for the dangers of the unknown.

6.5 How do teachers and/or students feel about these different methods of integration?

They like to do it, if they are given the opportunity.

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

Classroom observations and extensive discussions with colleagues and fellow teachers.

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

On the Dutch testing school Bonhoeffercollege, Castricum, 4 sessions of 50 minutes were held this year's course (2007-2008), in addition to the same number in last year's course (2006-2007). Two teachers, one male and one female were involved. The first one (and writer of this report) functioned as trainee as well. Basically, all 8 sessions were held in two classes: one higher per-vocational with 18 boys and 2 girls and one pre-university class with 20 boys and 4 girls.

The sessions were give in the computer classroom, as a variation on the class teaching of electromagnetism. After say half an hour at the most, a teacher talk and explanation of specific details were necessary to keep attention.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

NA: will arrive november.

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

NA

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

Yes!

9.2 What is your evidence for your response to question 9.1?

There is much interest for the subject of SC in general with the students. Of course, it makes a kind of change with the teaching of the traditional curriculum.

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

Hard to find out, there is hardly statistics in my classes between boys and girls. On the other hand, there is also no difference in interest and attitude of apporach to the subject so that may be good (though girls tend to be more interested in medical applications, while boys like more technical ones).

9.4 What is your evidence for your response to question 9.2?

Classroom observations.

PARTNER: **Katedralskolen, Trondheim, Norway**

AUTHOR: **Helge Ræder** DATE: **2007-10-02**

REVIEWER: **Vegard Engstrøm** DATE: **2007-10-12**

NATIONAL EVALUATION REPORT: NORWAY VERSION: **B**

1 Introduction

The contents of this report covers the trials of the SUPERCOMET materials carried out by the partner school in Norway. It is a national summary; but as only one single school carried out testing that has been reported, due to the withdrawal of the subcontractor in charge of the national testing in Norway, it can also be seen as an individual report from the partner school (P29 Katedralskolen, Trondheim, Norway).

The Reviewer has added some information about the attempt to organize teacher training in Norway. Except from point 3, all the answers relate to the testing at only one school.

The SUPERCOMET materials examined in these trials include only the Computer Application:

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

2 Description of trials

2.1 The January 2007 version of the computer applicaton was used in the trials.

2.2 January 2007 version of the computer application was installed in all the computers in the computer room. Due to renovation of the physics compartment we are without physics classroom for 3 months. The teacher had to book the computer room at the start of the school year (20. of august 2007) to be able to do the test on the 26. of September 2007. The test lasted from 08.15 till 11.25 with short pauses.

- Number of sessions was 1
- Length of sessions about 3 hours
- Number of teachers involved was 1 male
- Number of students involved 24; 12 male and 12 female
- Number of schools was 1.

3 Teaching the teachers

3.1 One short session for teachers was held during the National Conference for Science Teaching in October 2006. It was mainly a presentation of the computer application using a projector, and explaining about the possibility for participating in the trials. A simple demonstration of levitation using liquid nitrogen was also performed.

About 20 teachers from the Oslo area participated. Two of them signed up for further trials. However, the subcontractor in charge of the trials failed to follow up this initiative, and no teacher training has therefore been carried out in Norway.

4 Classroom materials

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	Good Possibilities				
4.2	CD-ROM Module 1 Magnetism	Good Possibilities	Relevant	Time needed At least 1 hour	High	No gender difference
4.3	CD-ROM Module 2 Electromagnetic induction	Good Possibilities	Relevant	Time needed At least 1 hour	Medium	No gender difference
4.4	CD-ROM Module 3 Electric conduction	Good Possibilities	Relevant	Time needed At least 45 minutes	High	No gender difference
4.5	CD-ROM Module 4 Introduction to superconductivity	Good Possibilities	Weakly relevant	Time needed At least 30 minutes	High	No gender difference
4.6	CD-ROM Module 5 History of superconductivity	Good Possibilities	Weakly relevant	Time needed At least 30 minutes	High	No gender difference

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

No response from the teacher on this one.

5 Changes in classroom materials

		Suggested changes
5.1	CD-ROM - general	Better explanations are needed. Text should be refined. Differences in explanations between various language versions should be avoided.

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Answers in pupils questionnaire, question 28

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

CD-ROM and other software frequently used whenever the computer room is available.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

N/A

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

The publishing company (Cappelen) editing the new physics textbook has produced their own webpages to be used with the textbook. See comment in 6.1

6.4 What difficulties do teachers find in integrating the materials into their teaching?

Difficulties in integrating the materials into the teaching are of an organizational kind not pedagogical ones.

6.5 How do teachers and/or students feel about these different methods of integration?

Teacher and students are positive to different ways of integration.

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

N/A

7 Classroom case studies

7.1 We made one test with the computer application version January 2007. Number of students in the class was 29. 5 students were absent on the day of the test (26 September 2007), so that the number of students in the test was 24, 12 girls and 12 boys. Number of computers 29. Teacher average experienced in using ICT.

8 Shared tests

8.1 The closed question responses are attached to this report:

- SC2_testing_report_NO_questionnaire_pupils_20071002_HR.doc
- SC2_testing_report_NO_questionnaire_teachers_20071002_HR.doc

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- Pre-test gave next to nothing concerning pupils knowledge.
- Post-test gave some signs of learning.
- 2 ADDITIONAL PAPERS

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

Answer: Yes I think so

9.2 What is your evidence for your response to question 9.1?

Answer: Evidence is the contents of the answers to the post-test.

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

Answer from teacher: No comment

Comment from reviewer: According to the teacher's response to point 4, there was no observed gender difference. This could be attributed to the fact that Norwegian pupils are so used to ICT tools in the learning situation that there are no gender differences when using such materials, and thus the SUPERCOMET materials would also not be able to contribute much. On the other hand, it can be said that the materials also did not create any differences, at least none that were observable.

On the gripping hand, however, these trials were obviously too short and too small to give any solid conclusions on this or other deeper aspects.

Finally, it should be remarked that the state of the SUPERCOMET materials as they have been developed and completed by the end of the project is much advanced to the state they were in as of January 2007, which was the version tested here.

9.4 What is your evidence for your response to question 9.2?

Answer. See 9.3

Questionnaire (Pupils)

Pupil code number:

In order to help us improve the SUPERCOMET materials, please answer the following questions.

1.	Male/Female: 12/12 Total: 24 students					
2.	Age: (years old) 17 (average) 6 students of age 16, 2 students of age 18					
		Strongly disagree	Disagree	Agree somewhat	Strongly Agree	Don't know
3.	I find the subject of physics interesting			11	13	
4.	I find the subject of superconductivity interesting		3	14	5	2
5.	The SUPERCOMET materials are interesting		4	16	4	
6.	The SUPERCOMET materials stimulate my imagination		5	14	4	1
7.	The SUPERCOMET materials are easy to use	1	6	8	9	
8.	The SUPERCOMET materials are attractive		4	15	5	
9.	The SUPERCOMET materials helped me to learn	1	5	10	7	1
10.	The SUPERCOMET materials offer meaningful experiences	1	4	13	3	3
11.	The quantity of text appearing in the SUPERCOMET materials is about right	1	5	11	4	3
12.	The text in the SUPERCOMET materials is easy to read and understand	3	6	12	2	1
13.	The quantity of images appearing in the SUPERCOMET materials is about right		1	16	5	2
14.	The images in the SUPERCOMET materials are clear and understandable	1	1	16	5	1
15.	The images in the SUPERCOMET materials explain the topic well		3	15	6	
16.	The page design in the SUPERCOMET materials is good		1	14	8	1
17.	The movement in the animations in the SUPERCOMET materials and the speed of the screen changes are good		2	7	15	
18.	The animations in the SUPERCOMET materials helped me to understand		2	13	9	
19.	I found surprising things in the SUPERCOMET materials	1	6	13	4	
20.	The SUPERCOMET materials promoted class discussions.	4	12	2		6

21.	The SUPERCOMET materials changed my attitude about some things		5	13	1	5
22.	The experiments performed in the superconductivity course were interesting		2	16	4	2
23.	Which parts of the superconductivity course using the SUPERCOMET materials did you particularly like and find easy to use?					
24.	Do you think that you have learned through using the SUPERCOMET materials? Please give reasons for your answer.					
25.	List two things that you thought were good about the SUPERCOMET materials A B					
26.	List two things that you thought were not good about the SUPERCOMET materials A B					
27.	Would you recommend the SUPERCOMET materials for the other pupils? Give reasons for your answer.					
28.	What should be changed/improved about the SUPERCOMET materials?					
29.	In order to use the SUPERCOMET materials do you think you needed previous knowledge in using computers? Please give reasons for your answer.					

	In order to use the SUPERCOMET materials do you think you needed previous knowledge in science? Please state what areas you needed knowledge in Please give reasons for your answer.
30.	Do you have any other comments about the SUPERCOMET materials:

Thank you for your answers

Questionnaire (Teachers)

Teacher code number: P 29

1. Male					
	Not at all useful	A little bit useful	Quite useful	Extremely useful	Don't know
2. To what extent you consider the following parts of the materials useful for your teaching?			x		
Subject information (Superconductivity)			x		
Experiments			x		
Learning program					
Comment:					
	Not al all attractive	A little bit attractive	Quite attractive	Very attractive	Don't know
3. In your opinion, how attractive and interesting are the materials for your pupils?				x	
Subject information (Superconductivity)				x	
Experiments				x	
Learning program			x		
Comment:					

4. How might the materials be improved?

5. How would you use the materials in your classroom? (e.g. as preparation or as revision, for class work or for homework, display to the whole class using a data projector, or in a computer room where each pupil has access to a computer, as a replacement for the text book, or as an extra as well as the text book etc))

6. Problems:

- Did you notice any ‘bugs’ in the software Bug reports? (Please give a list of any bugs noticed)
- Did you notice any mistakes in the physics content? (Please give a list of any errors noticed)
- Were there any significant difficulties in using the materials?

PARTNER: **<NCU Torun, Poland>**

AUTHOR: **<Anna Kamińska (Słupsk) school test>** DATE: **2007-10-01**
AUTHOR: **Andrzej Karbowski (Torun) teaching teachers** DATE: **2007-10-01**

REVIEWER: **< Grzegorz Karwasz>** DATE: **2007-10-30**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide		YES
Teacher Seminar		YES
CD-ROM		
Module 1.	Magnetism	YES
Module 2.	Electromagnetic induction	YES
Module 3.	Electric conduction	YES
Module 4.	Introduction to superconductivity	YES
Module 5.	History of superconductivity	YES
Low-Tech hands on kit		YES
High-Tech hands on kit		YES (partially)

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

We used in the trials Polish version of Supercomet 2 CD-ROM, Module 1, 2, 3, 4, and 5.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions - 20
- Length of sessions – 45 or 90 min
- Number of trainee teachers involved (please give numbers of male and female trainee teachers)

110, 70 female, 40 male

- Number of teachers involved (please give numbers of male and female teachers)

5 in Sopot, 12 in Slupsk, 8 in Torun in total 19 female, 7 male

- Number of students involved (please give numbers of male and female students)

320, 155 male, 165 female

- Number of schools involved.

14 schools. In 4 schools in Słupsk and 3 in Toruń the whole SC2 material was used and tested under our supervision or with our participation. In the remaining schools we gave the material to experienced teachers there and explained how to use it. We got a post-use feedback from those teachers.

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

Teachers have been given with printed copies of the translated material (separate sheets), and all schools with one copy of the English book. Teaching teachers was base on Saturday/ Sunday classes, in 6 hours modules. The first module was about the magnetism in general, the second on the superconductivity (we skipped the electrical conductivity, as rather well covered with the textbooks available on the Polish market).

In teaching magnetism we insisted on the exact scenario of introducing the magnetic field concepts, the magnetic field created by the electrical current and the electromagnetic induction. We started from:

1) describing contents (usually known by teachers, but now not in all curricula)

2) showing experiments, mainly those given in the SC book and CD

3) then showing simulations

Teachers appreciated much all three segments.

In teaching superconductivity all experiments with HT superconductors as well as with LN_2 were a novelty for teachers. They would appreciate much such experiments in their own schools.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

Teacher seminars were performed both in Słupsk and Torun, within post-graduate teaching. Modeules on superconductivity and magnetism were introduced as 12 hours into 120 hours subject in didactics of Physics. Teachers were already graduated in Physics (60%) or mathematics (the rest). Their knowledge on ICT was good, however their ability on using multimedia was only fair and their knowledge how to integrate multimedia (and experiments) with the lesson was only *residual*. Out of the group of 32 teachers (65% women) only 15% used experiments on electricity and magnetism before.

Using the university equipments we repeated (and extended) all experiments described in SC2 material, flowing the teaching path suggested there. Majority of teachers declared after the seminar that "now they could use experiments". However, very few schools are equipped to make experiments. The existing enterprises in Poland produce very little equipment on magnetic induction; nothing is available on superconductivity.

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

The most important point is presentation the whole sector of magnetism in a uniform way. Currently in Poland the variety of curricula and textbooks make difficult teaching magnetism – in many cases it is completely optional. Therefore we presented the SC material as a reference way of teaching magnetism, in particular we insisted on the necessity of the experiments as described in the teachers guide.

3.4 What is your evidence for your response to question 3.3?

The SC2 programme was presented in several national meetings for teachers, not only on the twoe regions interested (Słupsk and Torun). This includes the national congress of the Polish Physical Soceity in Warsaw in September 2005. In all case teachers form different places asked SC material; some groups, like Wrocław, joined the programme.

3.5 Why are these aspects useful? Why are the other aspects not useful?

Teaching on magnetism and magnetic induction is the most useful aspect. Teaching on superconductivity is interesting but teachers have no material to repeat experiments in schools.

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

The space for Physics is very little in the secondary school. To be realistic, the most useful material is that on the induction. In this view, the modules on the electrical conductivity and some aspects of superconductivity (the difference between the first and second type of sc) could be skipped.

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?

Simple material and experiments proved to be more practical for classroom use – the access to internet and computers is limited, se we were able to use CD only in some case studies. Sometimes students have better access to internet at home, so we put some material from CD-Rom on our web-site. We have evidence of high up-load index.

- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?

We used the SC2 contents as example in national meeting on Physics. Some of the existing textbooks made string cuts on the magnetism teaching, so the remaining materials is strange and/or unclear and/or misleading. Therefore, the experience with **SC2 material was very, very useful** in the whole **national** context. We have evidence for this as other academic groups in Poland joined spontaneously our activity.

- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?

We have introduced elements from CD-Rom and experiments on superconductivity to the academic cv of future teachers. We obtained more profound understanding of the problems, as proved by cross-check exams. Learning is somewhat faster, but this is not the essential improvement. Significant improvement is that some students (usually women) never tried experiments with electricity before our Sc2 module.

- Motivation - Do students like working with materials?

Yes, they like very much, in some case we have to stop playing with the experiments. As showed by the tests, they tend to spend too much time playing, and I have no time for explanations.

- What do they like? What do they not like?

They very like the nice simulations and films; another category are simple experiments with magnets. They have no enough motivation to follow experiments on induction as indicated in the scenario.

- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general	high	high	High	High	High
4.2	CD-ROM Module 1 Magnetism	high	high	average	average	average
4.3	CD-ROM Module 2 Electromagnetic induction	high	high	High	High	High
4.4	CD-ROM Module 3 Electric conduction	low	low	Low	Low	Low
4.5	CD-ROM Module 4 Introduction to superconductivity	high	high	High	High	High
4.6	CD-ROM	high	average	average	Average	average

	Module 5 History of superconductivity					
4.7	Low-Tech hands on kit	low	low	average	Average	average
4.8	High-Tech hands on kit	average	average	High	Average	average

We do not see much difference between boys and girls.

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

		Suggested changes
5.1	CD-ROM - general	More films with experiments, at different level of difficulty
5.2	CD-ROM Module 1 Magnetism	I would like to see more films with low-tech experiments.
5.3	CD-ROM Module 2 Electromagnetic induction	I would like to see more films with low-tech experiments.
5.4	CD-ROM Module 3 Electric conduction	I need more information about electrolysis.
5.5	CD-ROM Module 4 Introduction to superconductivity	I would like to see more films with high-tech experiments and more careful explanation what is Meissner effect and so on.
5.6	CD-ROM Module 5 History of superconductivity	More photos of the high temperature superconductors and their applications.
5.7	Low-Tech hands on kit	More explanations should be given and practical hints
5.8	High-Tech hands on kit	We have problems in getting material for experiments in classroom

5.9 What is your evidence for your response to questions 5.1 to 5.8?

Although for us the multimedia material was very useful, in some cases apart from animations I would like to see some real films. Pupils would also like to see some practical machines working with electricity. Superconductivity is very interesting, but I have practically very little time to explain it. Better students get some information from internet.

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

I have only one multimedia computer in my class so I show its contents with the projector. Experiments on induction I show from my table, experiments with magnets, like hanging magnets, the magnetic table etc I give to pupils. The experiment with superconductor – we have seen it at the Slupsk Academy during the exhibition there.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

Yes, they are very good.

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

I have little time for Physics, so I decided to use some animations from CD-Rom as integration with the textbook which is recommended in our school and with the experiments I have in lab. I can not show the whole CD.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

The frameworks for Physics have been recently much restricted in Poland – from 8 hours in 4 years secondary school down to 3 hours. Therefore, the main difficulty is the necessity of eliminating some material in order to teach magnetism and SC.

6.5 How do teachers and/or students feel about these different methods of integration?

The integration of the textbook, classroom experiments and software simulations is very appealing both to teachers and students. The difficulty is: 1) lack of laboratory equipment 2) lack of multimedia projectors.

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

We received very positive comments from students, and also teachers showed their interest.

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

The material on electromagnetic induction was tested in two schools in Słupsk, two classes in the first one and three in the second one. We tested both the understanding as well as the durability of knowledge.

Students prepared the material from the textbook before the lesson. The material explained when the electric current is generated (moving magnets, changing current) together with giving directions of the current. Then, in the traditional class the material was repeated by the teacher in the school using schemes from the textbook; the teacher showed the experiments from her table. In the SC2 class the material from the textbook was not repeated and the teachers used directly the SC2 CD-Rom, to explain the directions of the current etc. Then, in the experiments students first tried to guess the direction of the current (the teacher asked for voting, if they were not decided clearly) and then two pupils made the experiment instead of the teacher. This method proved more efficient, especially whe we asked in the test practical issues, like how the electricity generator worked etc.

The low-tech kit was interesting for students, they played with pleasure, but if we did not use some explanatory material in the form of multimedia (from SC2 or from internet) pupils' knowledge was *not* better than from the traditional teaching.

Unfortunately, internet connection is available only for the teacher and it is pretty slow; computers are available only in the special lab, so I can not use it always in Physics. Other my colleagues prefer not to use ITC in explaining magnetism.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

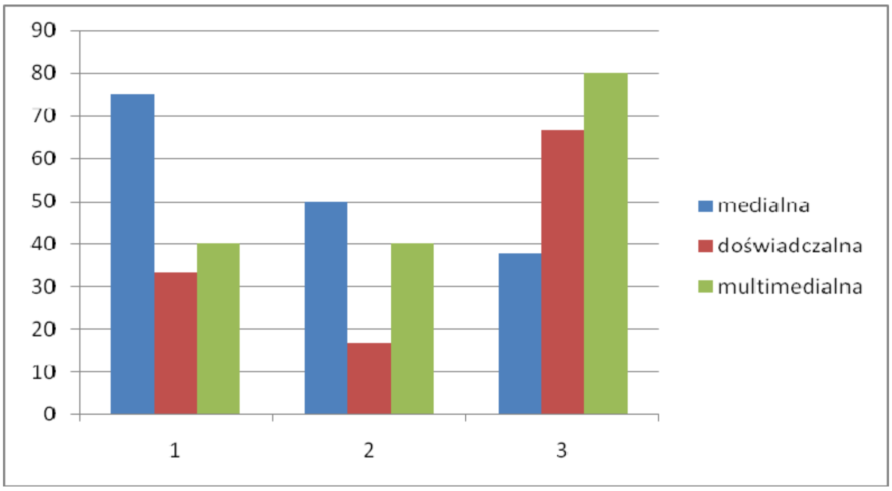
8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

Due to the lack of extended magnetism modules in the cv, we used our own tests, based on elements that can be found in textbooks in use in Poland.

SC2_electric_conduction_module_test_20070423_HGM

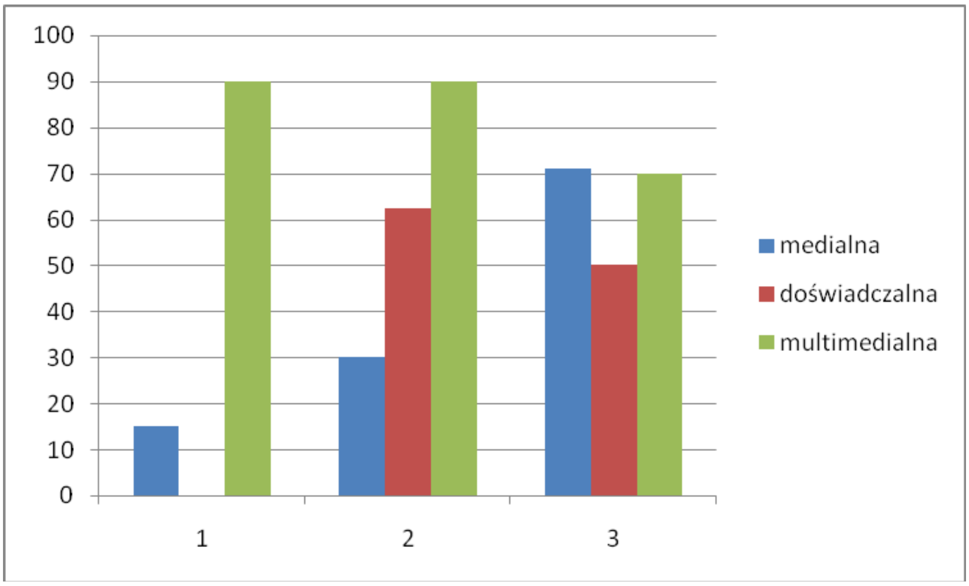
These are results of tests for two groups (Secondary School in Słupsk) on **electric conduction module (% of correct answers)**

The blue is only description, red is little description and some experiment, green is the lesson following SC2 teacher guide and CD-Rom (experiments + multimedia)

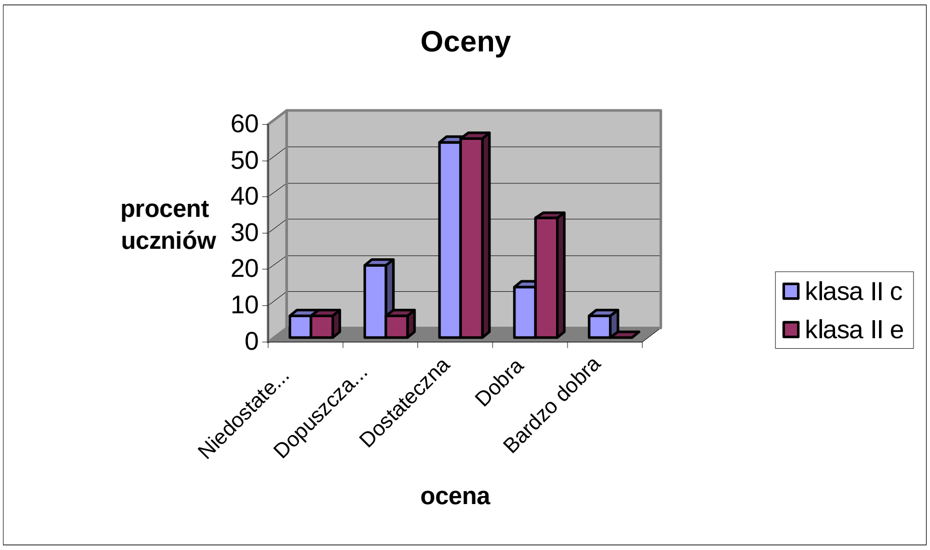


grupa I

grupa II



- **SC2_electromagnetic_induction_module_test_20070423_HGM**



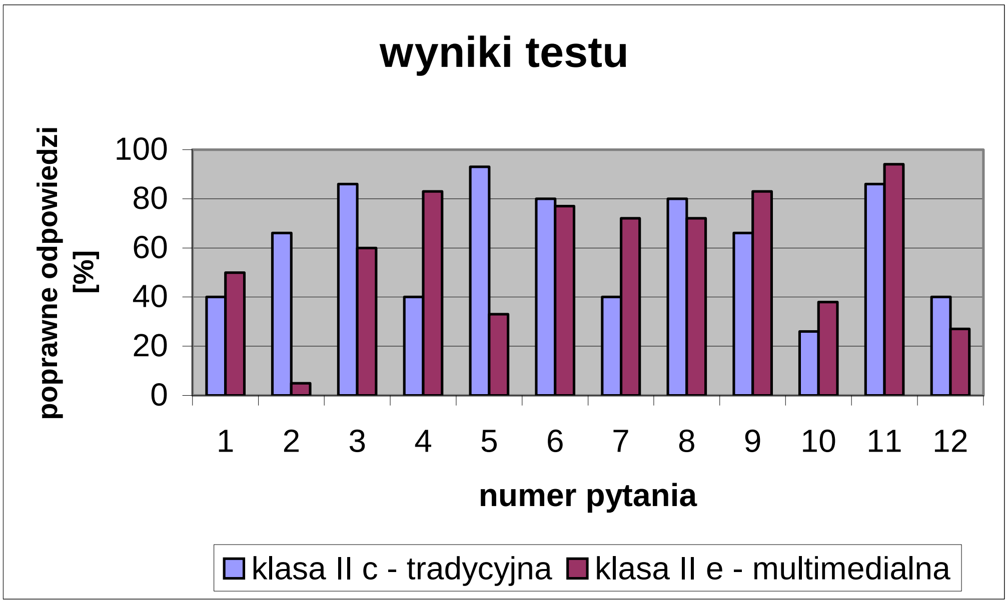
Rysunek 1 Procentowy wykres kolumnowy wyników testu

From left to rigth: insufficient (2/6), acceptable (3/6), sufficient (4/6), good (5/6), very good (6/6)

Class IIc is the traditional method (without multimedia from SC2), IIe – is with the material from SC2.

As far as the traditional method gives some more very good results, the multimedia method from SC2 is muchj more efficient in obtaining "good" knowledge and gives less "acceptable". i.e. poor knowledge.

- **SC2_magnetism_module_test_20070423_HGM**



Rys. Procentowy wykres kolumnowy poprawnych odpowiedzi

The test on magnetism was done in two classes, in which for the same amount of time (45 minutes) were dedicated to teaching on magnetic materials. In the traditional class students had more time to play with different materials and magnets, in the multimedia class we only showed material, handed them to students and used explanations from the CD-Rom. The traditional (i.e. experimental) class proved to performed better in some questions, like no3. "What we use to improve the performance of electromagnets" and No5. "Is alluminium magnetic"

- SC2_superconductivity_modules_test_long_20070423_HGM

We have not performed tests on superconductivity as it is not in the school programmes, so comparison was meaningless.

- SC2_superconductivity_modules_test_short_20070423_HGM

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

The main advantage of SC material is a deepened knowledge on the sector which is currently treated in a non-homogenous way in different schools. Teachers appreciate the easy and systematic way in which magnetism is explained and also innovative aspects of the superconductivity (although they do not understand some aspects, like pinning, unless we show them in real experiments).

9.2 What is your evidence for your response to question 9.1?

The SC2 has extended in Poland by free-diffusion much beyond the local regions. We get e-mails and calls asking us about the SC2 material and how to use it (we put it on internet and we control downloads, which are several hundreds every month).

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

The contribution of the SC material to promoting equality between men and women was significant. The technical issues treated with the SC material were treated as rather risky for teachers non experienced in lab procedures. Working with experiments encouraged women to deal with the technical and/high tech issues.

9.4 What is your evidence for your response to question 9.3?

Several she-teachers in Słupsk and Torun introduced permanently superconductivity and magnetism experiments to their classrooms. We have evidence for this as they ask us LN_2 and superconductors samples; they also buy he material on magnetism from collaborating with us enterprises (what we know in exchange, as these enterprises ask us about technical features of the equipment they sell, etc.)

PARTNER: **Faculdade de Ciências e Tecnologia da UNL**

AUTHOR: **Vitor Duarte Teodoro** DATE: **2007-10-31**

REVIEWER: **<reviewer name>** DATE: **yyyy-mm-dd**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

- Teacher Guide
- Teacher Seminar
- CD-ROM
  - Module 1. Magnetism
  - Module 2. Electromagnetic induction
  - Module 3. Electric conduction
  - Module 4. Introduction to superconductivity
  - Module 5. History of superconductivity
- Low-Tech hands on kit
- High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

Not sure which version. The translation was done early 2006 and revised by a physics college professor with training at doctoral level in superconductivity.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions
- Length of sessions
- Number of trainee teachers involved (please give numbers of male and female trainee teachers)
- Number of teachers involved (please give numbers of male and female teachers)
- Number of students involved (please give numbers of male and female students)
- Number of schools involved.

(You will not always be able to give exact answers to these questions, so please give your best estimate.)

The translation was done by Sandra Sousa, a secondary school teacher involved in a master degree course at FCTUNL, as part of her work.

The translation was then analysed by Vitor Duarte Teodoro, a college professor of physics education and information technologies in science to check for consistency.

Finally, the translation was revised by Gregoire Bonfait, a college physics professor with training at doctoral level in superconductivity. He made a list of comments, both on the content/text of the application and on the animations. The following list is a synthesis of his comments, focusing the module on superconductivity (the comments were sent in due time to the project coordinator):

CD- ROM SUPERCOMET:
Module 5: Introduction to superconductivity

Detected Errors:

Slide 7:
The schema isn't comprehensible and wrong because it shows the magnets connected to each other with the same pole (that way they will repel each other).

Slide 9:
The graphic has the axis mistaken. It should change the axis each other to be the right way to have some resistance at 0 degrees.

Slide 25:
The SC type II description has errors: the resistivity doesn't change from 0 to normal resistivity between Bc1 and Bc2. At first approximation is that normal state of the SC type II is zero. The resistivity of those SC is "complicated".
This graph should represent the magnetic field B in the SC. The field B changes from 0 to Bext (external magnetic field) (next slide), but the Meissner effect has not yet been explained…

Slide 31:
The text says:
"Because the electrons in a pair usually move in opposite directions, the overall kinetic energy of each pair is small."
It's wrong, because $Ek(tot)=1/2\ mv12+1/2\ mv22\neq 0$.

Slide 33:
The text says:
"The group is called "high temperature superconductors", including almost all of the type II superconductors…"
It's wrong, because there are many type II superconductors that aren't "high temperature" ones…

Slide 35:
The text says:
"Click and drag the Niobium magnet…"
It's wrong, because it is an alloy of Neodymium, Iron and Boron (NdFe14B), instead of Niobium.

Slide 41:
The text says:
"As the temperature is lowered, the energy gap increases…"
It's wrong.

TEACHER GUIDE SUPERCOMET:

Page 39 and 40

The text suggest the use of the Niobium material, it should be an alloy of Neodymium.

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

The current Portuguese version is not completed (the final computer application had problems), so it was not yet used in teacher training.
But it is easy to admit that it can be used in teacher training and directly with students. The theme superconductivity is not explicitly part of the physics curriculum but most of the topics are taught in 11th grade and some also in 12th grade physics.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

All parts of the guide are useful and not only in in-service teacher training. They can also be used in pre-service teacher education.

3.4 What is your evidence for your response to question 3.3?

The topics covered by the guide and the multimedia approach to the topics, usually with useful animations.

3.5 Why are these aspects useful? Why are the other aspects not useful?

Answered above.

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

We have added to the guide a table that relates the topics with the Portuguese curriculum.

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?
- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?
- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls

<table>
<tr><th></th><th></th><th>Possibilities of use</th><th>Curricular value</th><th>Academic achievement</th><th>Motivation</th><th>Differential impact</th></tr>
<tr><td>4.1</td><td>CD-ROM - general</td><td rowspan="6">Good, all schools have computer labs that teachers can used and most teachers have enough computer literacy to use it</td><td>Good</td><td rowspan="6">Not sure about the final results as measured by tests and exams but most probably the modules can help students learn the topics more meaningfully, particularly those topics that rely on visualisation</td><td rowspan="6">High to very high level, if combined with the hand-on kits</td><td rowspan="6">Most probably it can have a differential impact on low ability students, supporting motivation and making learning more concrete and interactive.</td></tr>
<tr><td>4.2</td><td>CD-ROM
Module 1
Magnetism</td><td>Very useful, explicitly in the curriculum</td></tr>
<tr><td>4.3</td><td>CD-ROM
Module 2
Electromagnetic induction</td><td>Very useful, explicitly in the curriculum</td></tr>
<tr><td>4.4</td><td>CD-ROM
Module 3
Electric conduction</td><td>Very useful, explicitly in the curriculum</td></tr>
<tr><td>4.5</td><td>CD-ROM
Module 4
Introduction to superconductivity</td><td rowspan="2">Useful but not explicitly in the curricula</td></tr>
<tr><td>4.6</td><td>CD-ROM
Module 5
History of</td></tr>
</table>

	superconductivity					
4.7	Low-Tech hands on kit	Good	Very good	This kit and the experiments are absolutely essential for learning the topics	High motivation doesn't depend exclusively on the use of the kit but it can give a good contribution	
4.8	High-Tech hands on kit	Not sure	Not sure	Not sure	Not sure	

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

The analysis of the materials, discussions during the translation and professional experience.

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: 'Additional explanatory materials needed', Teacher Seminar: 'Further explanation of superconductivity needed'.)

		Suggested changes
5.1	CD-ROM - general	Some slides could be divided in order to have less text on each. All relevant keyword should be highlighted. One or more pages could be added with concept maps, with links to slides. Overall navigation could be improved, probably with a tab area, like the one used in Acrobat documents.
5.2	CD-ROM Module 1 Magnetism	
5.3	CD-ROM Module 2 Electromagnetic induction	
5.4	CD-ROM Module 3 Electric conduction	
5.5	CD-ROM Module 4 Introduction to superconductivity	
5.6	CD-ROM Module 5 History of superconductivity	
5.7	Low-Tech hands on kit	A collection of video could be added to facilitate visualization when a computer projector is used.
5.8	High-Tech hands on kit	

5.9 What is your evidence for your response to questions 5.1 to 5.8?

The analysis of the materials, discussions during the translation and professional experience.

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

Not applicable.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

Not applicable.

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

Not applicable.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

Not applicable.

6.5 How do teachers and/or students feel about these different methods of integration?

Not applicable.

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

Not applicable.

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

Not applicable.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

The closed question responses that should be reported are:

- SC2_pupil_questionnaire_20070423_HGM: Questions 1 – 22
- SC2_teacher_questionnaire_20070423_HGM: Questions 1- 3

Not applicable.

8.2 If you use the shared pre- and post-knowledge tests then please report on individual scores as appropriate for:

- SC2_electric_conduction_module_test_20070423_HGM
- SC2_electromagnetic_induction_module_test_20070423_HGM
- SC2_magnetism_module_test_20070423_HGM
- SC2_superconductivity_modules_test_long_20070423_HGM
- SC2_superconductivity_modules_test_short_20070423_HGM

Not applicable.

9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

Yes.

9.2 What is your evidence for your response to question 9.1?

The analysis of the materials, discussions during the translation and professional experience.

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

The topics are essentially independent from genre issues. Some problems could arise from the use of information technologies, but these are less and less common since most youngsters of both genres are familiar with computers.

9.4 What is your evidence for your response to question 9.3?

The analysis of the materials, discussions during the translation and professional experience.

PARTNER: **Timsoft, Romania**

AUTHOR: **Carmen Holotescu** DATE: **2007-10-31**

REVIEWER: **Gabriela Grosseck** DATE: **2007-11-04**

NATIONAL EVALUATION REPORT VERSION: **A**

1 Introduction

The contents of this report should be derived from the trials of the SUPERCOMET materials (in both teacher training and in classroom teaching) that your organisation and the partner schools in your country have carried out. This should be a national summary; please do not send individual reports from each partner school.

This is separate from the expert review that you and others have already carried out of the materials, and which you have already reported.

The SUPERCOMET materials examined in these trials include:

Teacher Guide

Teacher Seminar

CD-ROM

Module 1. Magnetism

Module 2. Electromagnetic induction

Module 3. Electric conduction

Module 4. Introduction to superconductivity

Module 5. History of superconductivity

Low-Tech hands on kit

High-Tech hands on kit

Your organisation may not have carried out trials of all materials. Please simply enter N/A (not applicable) in any parts of the report that you have no data for.

You are asked to provide evidence for your answers – these should be brief summaries of data from the trials and should not normally exceed 200-300 words per answer (this template simply gives a structure for the report you will need to expand the boxes for your replies as appropriate for your answers). It will sometimes be sufficient to state what the sources of this evidence are (e.g. classroom observation, questionnaires, teacher interviews). If the source of evidence is simply personal opinion, or the shared opinion of the project team in your organisation then you need to state this clearly.

2 Description of trials

2.1 Please state which version of the materials you used in the trials.

The materials in Romanian version produced in 2006 were used.

2.2 Please give a brief description of any trials carried out. This should include both trials in the training of teachers and classroom trials. As appropriate, please indicate in your descriptions:

- Number of sessions

- For each school a trial in the training of teachers was organised. Each school organised 2 or 3 classroom trails, with the students in X and XI grades.
- Length of sessions
  - The duration was 2 or 3 hours
- Number of trainee teachers involved (please give numbers of male and female trainee teachers)
  - 18 teachers: 5 male teachers, 12 female teachers
- Number of teachers involved (please give numbers of male and female teachers)
  - 24 teachers: 7 male teachers, 17 female teachers
- Number of students involved (please give numbers of male and female students)
  - 130 students: 72 male students, 58 female students
- Number of schools involved – all the four partners schools were involved:
  - Liceul Electrotimis Timisoara
  - Liceul Industrial A Vlaicu Arad
  - Colegiul Tehnic Arad
  - Colegiul Tehnic Transilvania Deva

(You will not always be able to give exact answers to these questions, so please give your best estimate.)

3 Teaching the teachers

3.1 Describe how you trained teachers to use the SUPERCOMET materials – include in this description an account of how the Teacher Guide and Seminar are used in practice in your national context.

The f2f meetings with the teachers in all the 4 schools were organized in spring 2006, when the Teacher Seminar was organized.

At that moment the Physible space was set up; there were created accounts for the teachers.

For all the duration of the project the communication was realized using the Physible platform, e-mail, and phone calls.

The teachers took part online in a training related to how to integrate Web2.0 technologies in their didactic activities.

3.2 Provide one case study of a teacher seminar (no more than 300 words). (Please indicate in the case study the number of teachers/trainee teachers and what you know about their backgrounds in science and ICT).

During the Teacher Seminar, the Teacher Guide was presented together with the Multimedia CD. The application was tested, and the teachers shared their opinion about how they can integrate the materials in the curriculum.

All the teachers involved in the program have a background in Physics, some also in Chemistry. Almost all of them have a formal training in ICT.

3.3 What aspects of the Teacher Guide and Seminar (if any) are useful in your national context?

All the parts were consider useful by the teachers. The national curriculum contains Electricity and Magnetism, and the Superconductivity could be part of optional curriculum.

3.4 What is your evidence for your response to question 3.3?

3.5 Why are these aspects useful? Why are the other aspects not useful?

3.6 How might the Teacher Guide and Seminar be improved so as to be of greater use in your national context?

4 Classroom materials

Assess the classroom materials (i.e. each of the modules 1-5 of the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit) in terms of:

- Possibilities of use – to what extent can these classroom materials be effectively deployed within your national context (this question refers to practical deployment issues, i.e. access to computers, laboratory time etc)?
  - All the schools are very well equipped with laboratories with computers.
- Curricular value – to what extent are these classroom materials of value within, and offer content relevant to, the curriculum being taught in your country? What aspects of the CD-ROM are useful in your national context? Why are these aspects useful? Why are the other aspects not useful?
  - As specified above, the national curriculum contains Electricity and Magnetism, and the Superconductivity could be part of optional curriculum
- Academic achievement - to what extent do these classroom materials contribute to the achievement of learning goals within that context? How long, on average, does it take to complete each module? Do students learn from the materials? Which aspects of the materials are useful for learning? Is there improved learning overall, improved learning of specific aspects, quicker learning?
  - The general opinion was positive on the materials. The students were interested about the possibility of using the materials at home, for self study too.
  - During the sessions in the classrooms they were encouraged to work in groups.
- Motivation - Do students like working with materials? What do they like? What do they not like?
- Differential impacts on specific groups of students - two areas of particular interest are: a) high/average/low ability pupils b) boys/girls.
  - The boys and girls expressed the same interest on the materials.

		Possibilities of use	Curricular value	Academic achievement	Motivation	Differential impact
4.1	CD-ROM - general					
4.2	CD-ROM Module 1 Magnetism					
4.3	CD-ROM Module 2 Electromagnetic					

	induction					
4.4	CD-ROM Module 3 Electric conduction					
4.5	CD-ROM Module 4 Introduction to superconductivity					
4.6	CD-ROM Module 5 History of superconductivity					
4.7	Low-Tech hands on kit					
4.8	High-Tech hands on kit					

4.9 What is your evidence for your responses to questions 4.1 to 4.8?

5 Changes in classroom materials

Briefly indicate which aspects of the classroom materials (i.e. each of the modules 1-5 of the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) should be changed or added to so as to be of greater use in your national context.

(Do not give detailed feedback on changes needed, give just broad general feedback e.g. Module 1: ‘Additional explanatory materials needed’, Teacher Seminar: ‘Further explanation of superconductivity needed’.)

		Suggested changes
5.1	CD-ROM - general	
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5.7	Low-Tech hands on kit	
5.8	High-Tech hands on kit	

5.9 What is your evidence for your response to questions 5.1 to 5.8?

6 Use in the classroom

6.1 How are the classroom materials used in practice? (Briefly describe the use of classroom materials - i.e. the CD- ROM, Low Tech hands-on kit, and High Tech hands-on kit - in your national context).

During the classroom sessions only the CD-ROMS were used.

6.2 Do the teaching methods suggested in the Teacher Guide and Seminar actually work in practice in your national context?

6.3 How are the classroom materials integrated with other aspects of the teaching of these topics (e.g. other text books, multimedia materials, teacher talk, experiments etc)?

All the high schools in Romania are equipped with AeL – educational software packages with simulations and presentations for almost all the curriculum. The teachers and students appreciate that the materials of the SUPERCOMET2 project as a valuable and useful addition to the AeL.

6.4 What difficulties do teachers find in integrating the materials into their teaching?

The teachers reported some difficulties in integrating the materials because of the overload of the compulsory lessons.

6.5 How do teachers and/or students feel about these different methods of integration?

6.6 What is your evidence for your responses to questions 6.1 to 6.5?

7 Classroom case studies

7.1 & 7.2 Provide two case studies describing actual use of the classroom materials (i.e. the CD-ROM, Low Tech hands-on kit, and High Tech hands-on kit) in your national context (no more than 300 words for each). Please include information on number of students in the class, number of computers and network connections inside the classroom, and any knowledge you have about how experienced the teachers are in using ICT.

8 Shared tests

8.1 If you have used the standard forms for pupil and teacher questionnaires then please provide a separate summary spreadsheet giving the answers to the closed questions, but not the pupils' answers to open questions (you will need to summarise these separately and should use the evidence within other parts of this report).

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9 Overall added value

9.1 Are the SUPERCOMET materials as a whole (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) a valuable and useful addition to the physics education resources available in your national context (for example by contributing to teacher training or to students' learning or interest)?

9.2 What is your evidence for your response to question 9.1?

9.3 In what ways (if any) do the SUPERCOMET materials (i.e. the Teacher Guide and Seminar, the CD-ROM, Low-Tech hands on kit, and High-Tech hands on kit) contribute to promoting equality between men and women in your national context?

9.4 What is your evidence for your response to question 9.2?