

# Teacher Guide and Seminar: experience in Physics Education



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## Abstract

Content of this paper is derived from experiences with materials of SUPERCOMET2 (SC2) that have served to training teachers as for education in class. This work has been organized for 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 (Spain). 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.

**Keywords:** Physics Education, Teaching & Learning Process, Secondary School.

## Resumen

El contenido de este artículo se deriva de las experiencias con los materiales del SUPERCOMET2 (SC2) que han servido para la formación de maestros así como para la educación en clase. Este trabajo ha sido organizado por 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 (España). Por un lado, la Guía del profesor es digital (pdf) e impresa. Por el otro, **el Seminario de Maestro** ha sido un recurso muy útil para la planificación de la formación docente. Se distribuye en formato digital, usando documentos con el procesador de textos y presentaciones visuales.

**Palabras clave:** Educación en Física, Proceso de Enseñanza y Aprendizaje, Escuela Secundaria.

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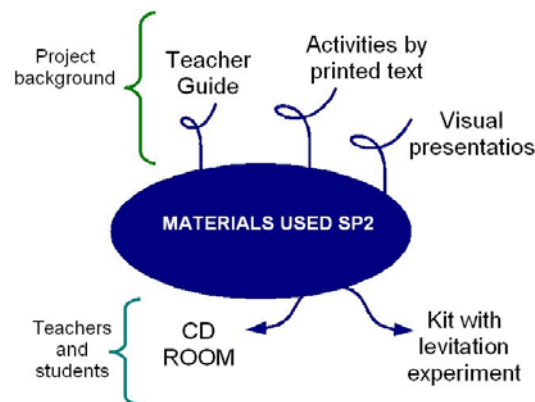
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## I. INTRODUCTION

SUPERCOMET 2 (the next SC2) is an European project started last November 2004. It was finished last November 2007. Financial support through the Leonardo da Vinci Programme (phase II) of the European Union amounts to 75% of the project's total budget. Approximately 540.000 euros.

According to the Physics On Stage conference at CERN, Geneva in November 2000, there is a crisis in Physics Education. Physics teaching needs revitalization. This view has been supported by numerous other conferences in the later years. Combining modern pedagogical methods (collaborative learning and student-centred problem solving) with computer animations and hands-on experiments in a blended approach, SC2 project aims to: a) connect the intriguing phenomenon of superconductivity; b) take this phenomenon and include it

inside curricula subjects of upper secondary schools in several countries.



**FIGURE 1.** Used materials. SUPERCOMET 2 in Murcia (Spain).

The accompanying teacher guide and teacher training seminar ensure that the project deliverables are successfully implemented. Processes to test these resources are the aim of this paper. One general point of view about material used in SC2 is in figure 1.

## II. EXPERIENCE

Teacher training of Obligatory Secondary Education and Bachillerato was thanks Seminar. It was coordinated by the Center of Teachers and Resources in Lorca (municipality of Murcia).

Seminar aims were in the line of help to overcome fears of teachers inside classroom when they decided use Information and Communication Technologies (ICT) in the classroom. Of one hand, integration of content with hypertext/hypermedia characteristics was made like hypertext favours exploration and autonomy as well. 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.

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 solve some of problems about Physics Education. 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” (figure 2).
- Using ICT in Physics Education: 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 was 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: when was necessary we offered 5 experiences (document offered from SC2).
- Common list of conclusions, working together.

### A. Case study

Training Teachers of Obligatory Secondary School and Bachillerato. Summons: Center of Teachers and Resources of Lorca (Murcia). Date: 23 of February of 2006. Assistance: 37 teachers.

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

Phase 2: Show superconductivity phenomenon using kit of hands of low technology (figure 2).



FIGURE 2. Superconductivity.

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

#### SUPERCOMET Teacher Seminar - Curriculum mapping activity

##### Objective of activity

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.

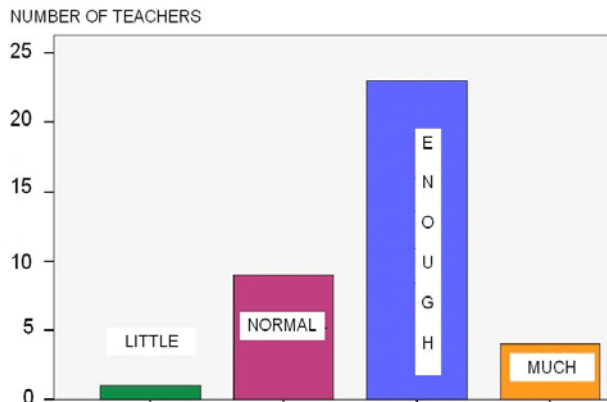
FIGURE 3. Curriculum mapping activity. File: SUPERCOMET\_teacher\_seminar\_EN\_3\_curriculum\_mapping.

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 SC. 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, *i.e.* field strength, number of turns on a coil, relative movement.” We include possibilities with hardware too, according with characteristics of centers 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.

**B. Useful aspects in the national context**

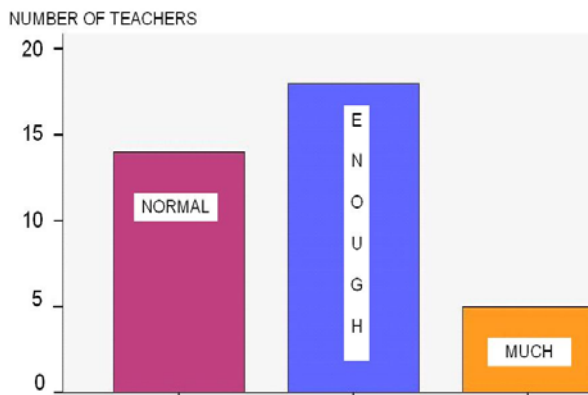
18,9% of teachers think that the seminar has shown many ways to do different Physics teaching. 37,8% consider that enough. Seminar offers a use of the quite constructive computer for the 62,2%. 10,8% consider that it has been very useful (figure 4) and a 24.3% that is normal.



**FIGURE 4:** Constructive use of computers, thanks Seminar and teacher Guide.

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.

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



**FIGURE 5:** Knowledge about media uses, thanks Seminar and Teacher Guide.

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%.

Attending [1] the interview [2] 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 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](http://www.simplicatus.no/web.php?action=subpagelevel2_view_single&pk=42)).

Likert scale measures attitudes and is the most popular model and intuitive [3]. 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. [4] 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 I).

**TABLE I.** Categories applied in a Likert scale.

1	2	3	4	5
Much	Enough	Normal	Fairly	Nothing

For the analysis of data has been used SPSS program [5] 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.

### C. Teacher Seminar like a method of teaching

February- 23<sup>rd</sup> of 2006, at 16.00 to 20.00, 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”. Aims was 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 showed superconductivity phenomenon.

It had a demonstrative representation of the superconductivity phenomenon using: liquid nitrogen, the kit, 1 container, 1 webcam, 1 notebook and 1 datashow. Part of the equipment takes shelter in figure 6. He interested teachers directly made the experiment with their hands.



FIGURE 6. Liquid nitrogen recorded by the webcam.

We have used a questionnaire to teacher’s interviews (about seminar, CD and kit). Items were about objectives and topics from SC2 (item 3.4 of the final 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 [6] and a learning test. Last one was facilitated by Doctor Erika Mechlova (Polland). On the general CD, evaluation of experts registered with the questionnaire “Tool of evaluation of multimedia didactic”, translated in English thanks to SC2 and published in Spanish in Pixel-Bit [7].

In Exposition Hall and Fair we resorted to indirect documentary sources as digital newspaper and webpages.

Moreover, we use the researcher diary and perform of internal activities.

We have products of own elaboration as propaganda, audio-visual presentation and photographs. Audio-visual presentation served to spread SC2 at the national and beyond the national context [8, 9, 10, 11, 12, 13].

For the Seminar questionnaire was used, internal perform as “Report of the seminar with teaching staff referring to SUPERCOMET2 project” and advertising propaganda to participate inside Teacher Seminar.

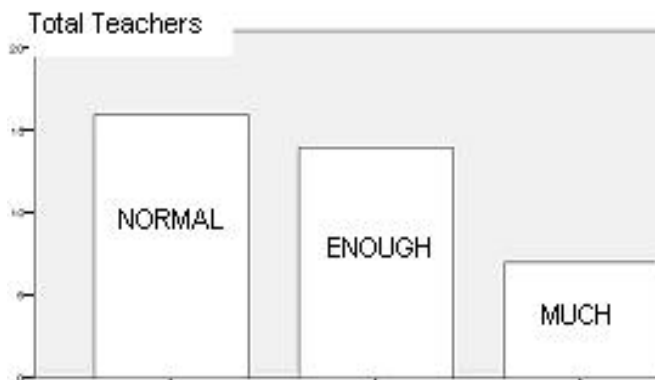
About the activity referring to integration of SC2 CD-ROM in the curriculum, it is possible to gather some reflections thank training teachers. Software seems very useful to visualize phenomena that come gathered in the text book. Also it is useful so that students appreciate importance of models like an explanation near to 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.

Taking care of the methods of education suggested in the guide and the teachers’ seminar, documents offered by SC2 were translated to Spanish (documents with text processor and displays on technical, pedagogical aspects and of Physics contents). In order to organize the seminary, we used a collaborative network of people.

Teachers proposed four methodologies (A, 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 datashow as complement to the theoretical explanation.
- Proposal B: Student is following 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).

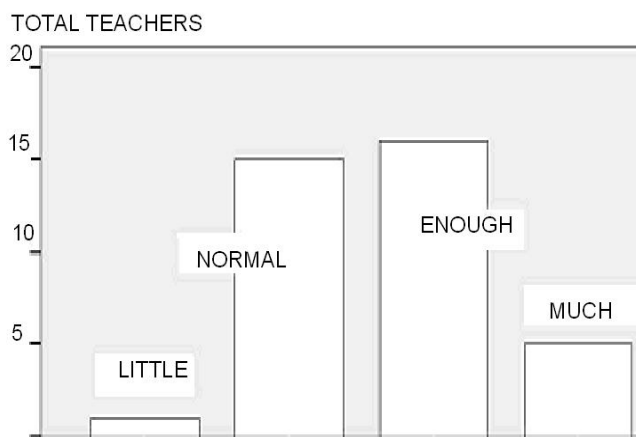
Feeling about methodology has been researched asking teachers. Items are: “it shows new ways in the physics teaching” (figure 7), “use of computer as a constructive way”, “inspiration to continue teaching and to motivate his/her students” and “exploration of exciting form” (figure 8).



**FIGURE 7.** Methodology in SC2. Show new ways in the Physics Teaching.

Answers of these items recommend the networks collaboration work and seminar as teaching-learning methodology as well.

When teachers knew SC2 we offered these four possibilities of curriculum integration (A, B, C and D). The collaboration network with people is noticed in C (learning by discovery) favouring autonomy in B, an adaptation of the methodology of traditional education in A and D.



**FIGURE 8.** Exploration of superconductivity phenomenon with passion.

Proposal C implies to analyse 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 a dashboard.

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.

Evidences for these responses are:

- Conducted registries using questionnaires directed to the pupils, "Questionnaire of attitudes and knowledge about computer" and "Questionnaire to evaluate multimedia didactic material (EVALALU)"[6].
- Conducted registries of the questionnaire directed to teachers, questionnaire made up of 7 items with Likert scale test. These items was made over internal aims and topics of SC2 project. Backgrounds are available in [14].
- About the CD, the evaluation of experts was registered with the questionnaire "Evaluation tool to educational multimedia" [6].

### III. RESULTS

Attending teaching 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.

### IV. CONCLUSIONS AND FUTURE CONSIDERATIONS

Evidences of next future considerations have been studied from: a) Wandering around the information offered by SC2 as in internal reports as in the resources; b) Reports of process from Murcia team, as reports after assessments and researcher diary; and c) Revision of final report. Below, you can find the files of these resources:

- 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\_SUPERCOMET\_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\_hands-on\_activities.
- Title: “Hands-on superconductivity activities and thinking tasks. Instruction booklet” by Jenny Frost and Gren Ireson.

Take time to analyze the results about the item “To explore superconductivity in a passionate way” using SC2 resources is very interesting. In that question more than 40% shows a normal or low score. This data collides with the fact that up to 60% of teachers confess to be enough or very motivated. If they claim to be inspired for lecturing and to motivate students, it could be convenient to focus the way SC2 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, there are not question/answer about 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/her knowledge in Science and ICTs. It would be convenient to attend them in the future.

Attending 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. To future actions in assessment will be good an evaluation about printed media (aesthetic and content).

The evidence for our response 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)” [6]. The strategies to elaborate the conclusions have been the content analysis, the scales (Semantic differential of Osgood and the Scale of attitudes of Likert), data matrices, schematic diagrams (concept maps, flux diagrams) and the analysis of the final report.

SC2 - Spain understand *gender equality* (GE) as equality between women and men [15, 16, 17]. Arguments are focused around Teachers Seminar. In SP2 gender arguments can be appreciated in action point 14.08 [18].

As needs about gender considerations within SC2 resources has been detected offering suggestions about: a) Tested and assessment tool; and b) teaching-learning methodology to be applied.

Teachers Seminar GE - topic was considered within the document “Hands-on superconductivity activities and thinking task” (from 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. Last visit to these sites was performed on 27<sup>th</sup> 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 GE.

About test and assessment tools:

- a) Need of incorporating gender variable in our test and assessment: Murcia did not consider them inside Teacher Seminar.
- b) Population and sample in the line 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, future considerations are in the way of incorporate social-cultural aspects. We must meet students to personalize learning process and to promote a customized learning. For instance, could be good use common phrases, popular films clips, familiar sounds, images. It could be useful the socio cultural questionnaire by Mindy Myers and Amorós [6] based on the anthropologic statements [19, 20, 21], cross-cultural considerations [22, 23, 24] and education [25, 26, 27, 28]. At the level “Sex/Learning” there is issues with attention in gender.

About content of teaching in SC2 modules, future considerations are:

- a) EG content: considering backgrounds about Physics history about woman role in Sciences.
- b) Considering used code: to begin lectures asking questions to detect relations with gender and audiovisual code thinking in aesthetics and pedagogic. Some on these aspects was treated in Action Point 14.08.

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