THE COMPUTER CONFERENCE TO DISCUSS LABORATORY ACTIVITIES IN THE PRE-SERVICE SECONDARY SCHOOL TEACHERS TRAINING

Marisa Michelini, Pier Giuseppe Rossi, Lorenzo Santi, Alberto Stefanel, Research Unit in Physics Education, University of Udine, Italy

Teacher training for secondary schools in Italy requires a first degree in the subject contents and subsequently a biannual specialization school (SISS), during which themes regarding both teaching in general (common area), and teaching specific subjects (specific area) are dealt with. Very often a break occurs between the two areas and this influences the effectiveness of the courses themselves. The necessity for coordination between the two areas has arisen in the SISSs at a national level (Luzzato, 2002). Examples can be seen of experiences at the SISS Lazio, (Pontecorvo, 2002) and in Veneto (Michelon, 2002).

Such a link cannot be established only by integrating segments of the two areas in an organic curriculum, as the interaction between the two areas is also inside each area itself and in the single segments. For example, the didactics require a rethinking of the disciplines related with the didactic, from both the epistemological and theoretical points of view. At the same time, it is not possible to design general didactics without taking into account the specific epistemological factors for each individual subject: maps, languages, models, didactic intermediaries and methodologies must be established in line with the subjects (Rossi, 2002).

Therefore, the study path integrates a review of the subject knowledge, with the creation of relevant competences for didactic designing, and for constructing didactic intermediaries. The first objective is often in contrast with the fact that postgraduates, being already graduates in their individual subjects, believe they have mastered the subject and are unlikely to be disposed to go over the subject knowledge.

In the specific case of didactics for physics at the University of Udine, various experiments have been carried out (Michelini, 1998, 1999, 2000, 2001), some regarding the interaction between the two different areas (Michelini, 2002). Furthermore, for two years, in teaching learning on the net, a data communication environment has been experimented with to support laboratory activities and to verify that the use of tools on the net and in particular of web forums allows, thanks to speaking activities (Gergen, 2001), the sharing and negotiation of meanings among equals favouring circulation between the didactic aspects and the subject aspects, thus improving the training of the teachers.

Research questions
The problems on which the research is focussed are:

• Does sharing results and discussing on the net facilitate interaction between the didactic and subject aspects of the activities?

• Does the language for dialogues in the web forum (different from that used in reports) allow for problems and doubts to emerge and for dealing with them? In particular, in the context analysed, does it make the necessity of revising subject knowledge, emerge?

• Does the use of different tools (entering data and debate) and of different modes (individual and for dialogue) foster greater awareness?

• Does the double approach to the activities of postgraduates (as students and as future teachers) allow more awareness in training the reflective professional (Schön, 1993)?

Activities
A data communication environment has been used to support teaching in the Thermodynamics Laboratory (LTD).

In the LTD, postgraduates have carried out activities guided by worksheets on the thermal characteristics of material. The worksheets are structured with the sequence hypotesis-experiment-comparison (HEC) and were produced in the FFC project, national research, financed by the MIUR (Sperandeo, Sassi, 2003)
The laboratory activity lasted 20 hours and set 8 worksheets in which postgraduates had to insert forecasts regarding the problem situations proposed, subsequently carry out experiments using both poor materials and on-line probes and finally, compare the results with the forecasts.

The titles of the activities are:

EA1: Observing the objects placed on a table;
EA2: Heating water starting from home temperature;
EA3: Mixing liquids at different temperatures;
EB1: The cooling curve of various liquids;
EB2: The cooling curve of a liquid in different vessels;
EB3: Cooling of two different solids (data analysis of experiments);
MA2: Constructing a model
MA3: Using STELLA

The activities had the aim of making spontaneous ideas emerge regarding thermal phenomena, of proposing a model for temperature and heat and of suggesting didactic paths for constructing teaching modules.

At the end of the laboratory activities, the open distance activities started in a data communication network learning environment.

The data communication environment requires a personal access password to guarantee the confidentiality of the contributions and allows the monitoring of the activities.

The tools are:

- **Bulletin board** on which general information on activities and notices may be placed;
- **Web forum** for discussing on the net;
- **Documents** for carrying out uploading of material;
- **Scricoll** for entering texts on the net and modifying them, also among various authors, whilst maintaining the line of the previous documents;
- **Worksheets** for entering comments on prepared forms, different for the various projects;
- **Who we are** in which individual members of the community may introduce themselves.

The net activity is divided into 3 phases.

The first phase (20 November - 7 January) consisted in carrying out a series of activities, all individual. Postgraduates had, first of all, to fill in on-line forms, giving brief judgements of the 9 activities done. For each activity, they had to enter the results: graphics, tables, worksheets. In addition, each postgraduate had to elaborate a detailed report on one of the activities. For this last activity SCRICOLL, a data communication tool which allows entering subsequent versions and modifications of an original text, was used.

On the form the following requests were formulated:

1 AGENDA: significant aspects of the activity; knowledge acquired; strategies; problem situations; ways of solving them; necessities to go into more detail; material and significant aspects for didactics.
2 How the activity carried out modified subject knowledge.
3 How the activity carried out influenced ways of perceiving a thematic path.
4 How the activity carried out modified your idea of teacher training.

In the second phase (8 January - 30 January) postgraduates debated, in web forums with scricoll, the material shared on the net and the problems arising in the activities.

The tasks set were:

The worksheets, at first produced by only one of you, are now discussed, commented, criticised if necessary. Specify the points on which one agrees, those on which one disagrees and those missing.

The discussion may develop on a general thread regarding the paths elaborated in the laboratory, their structure, and in specific threads on the individual paths.

In the third phase (31 January - 10 February) based on the suggestions and on the web forum, postgraduates reorganised the material produced individually.

Review the worksheets done in Scricoll, taking into account the discussion in the forum and the contributions of the other students.
ATTENTION: every modification must restart from the last Scricoll writing, so as not to lose the previous documents.
The interaction between the first phase (in which individual work is required) and the second (in which postgraduates interact) is an interesting model for e-learning. The individual phase allows theoretical rethinking, and reorganising the material. The privileged interlocutor is the teacher, even though operating on the net, the material is shared.
The interactive activities (debates in forums) start from the previous material. The modes for interacting and writing determine the privileged interlocutors to be the postgraduates themselves and this means that the negotiation of the meanings comes from the doubts and perplexities provoked by the activities.

Analysis of the results
There were 18 postgraduates involved in the activities, 9 in the first year and 9 in the second. Postgraduates have entered all the material required and it is possible to analyse on the net both the comments in the activities and the reports in scricoll.
With respect to the activities, postgraduates took part both as students and as future teachers: they analysed the material and examined the problems they encountered in carrying out the experiments, in formulating the forecasts, in interpreting the results; they also tried to imagine what problems students would have encountered in carrying out the activities, how they could be used and in which types of schools. This double point of view is particularly interesting in teacher training insomuch as it makes it possible to have two observation prospects. In this context, it is necessary to point out that some postgraduates lived through the activities also as a time for monitoring their own knowledge. The majority, however underlined that the performance of experimental activities by the teachers before doing them in class is fundamental for a good result of the experiments.

Tha analysis will now be carried out by comparing the contents and the observations from the forms in phase 1 and the debate in the forum.

1. Phase 1 forms

The forms in phase 1 are of two types: the first were produced on the individual activities of each student; at the end, each student completed a summarising worksheet.

The analysis of the final worksheet highlights the following points:

i. The importance of a constructive approach and of an active role by the students;

ii. The importance of referring to daily experience in scientific training;

iii. The importance of making the students’ spontaneous ideas emerge;

iv. The importance of the laboratory activities, in particular the effectiveness of experiments carried out using poor material;

v. The role of on-line temperature sensors which make it possible to construct graphs in real time and to facilitate a graphic representation of the process, making it become a model;

vi. The necessity for the teachers to possess a number of competences (not only be expert in the contents and didactics but also in technology and the intermediary didactics to use);

vii. The difficulty for a teacher in carrying out an active and laboratory activity as compared to a head-on lesson;

viii. The necessity of a final discussion which deals with the problems encountered, allowing students to clarify and connect the input generated in the activities.

The style used is formal. The first person is never used and the authors provide an objective and impersonal description.

The combination of the worksheets and the activities proposed has the intention of favouring a direct and active construction, by the students, of the models necessary for interpreting and foreseeing the physical phenomena considered.

Simple experiments with “poor” material are required and experiments with measuring using on-line sensors. The basic idea of this type of path is to make the student construct his/her knowing by him/herself, clashing with his/her pre-existing ideas, doing the proposed experiments personally, elaborating the data and obtaining autonomously the connections running through it.

The judgments regarding the activities are, on the whole “benevolent”.

As far as my opinions on teacher training are concerned, all this has been a confirmation of how important continual and constant preparation is, not only from the point of view of contents but also from the didactic point of view.

The activities carried out have brought me to reflect mainly on how useful activities of an experimental type can be for understanding the concepts of physics. The interlocutor (even if he/she does not intervene) is the teacher, i.e. the reports are written,
having the teacher as the main interlocutor, even though virtual. The fact that the texts may be read by the other postgraduates, does not influence the style or the structure of the material.

2. Debates in forums
Particularly interesting are the messages in the forum, i.e. the activities in the second phase. The interventions in the forum are 120, in number, and each message has been read, on average, 20 times. Bearing in mind that the discussion lasted 20 days (from 31 January to 18 February; only one student entered a message in April) it is possible to perceive immediately the intensity of the debate. The definition of a precise interval of time advantaged the significance of the debate. Furthermore, postgraduates entered, and therefore debated on only 12 sub-themes and this shows the prevalence of replies and of interaction. i.e. each theme has been dealt with from an average of 10 messages. From a rapid reading, there appears the willingness to participate in dialogues, to take into account the observations of others and to go more deeply into the problems which arose.
The distribution of the interventions by postgraduates, considering both date and theme, is homogeneous, as can be deduced from graph A and from graph B.
The style of the messages changes substantially compared to those in the forum. In this session, personal observations prevail, the considerations made on the didactic aspects, also on the base of one’s own scholastic experiences such as those had as trainees or as teachers; the problems emerging are encountered in the activities and in interpreting the data.
The main interlocutor, i.e. the receiver of the interventions are the other postgraduates; the interventions seem to answer questions such as: What would you do? How did you solve this problem? From the temporal analysis of the interventions, two periods can be highlighted: the first part of the debate is focussed on the difficulties the students may encounter, the second part on the difficulties encountered in the activities by postgraduates, personally.
In the first messages (31/1 - 6/2) the didactic instructions are debated, suggestions on the use of experiments in class, depending on the type of school in which the proposed activities could be carried out.
One of the postgraduates opens a thread with the following observation:
Rereading the texts produced in scricoll for the MA 2 worksheet: constructing a model, I realised that, among the significant aspects of the experience, and also among the didactic aspects, there are no comments on the fact that at the end of all the reasoning to understand the phenomena discussed, there is the request to produce a graph.
Interesting is the reference to the worksheets elaborated previously, which highlights the attention with which the interventions have been read, (such references are present in many messages)
Another initial intervention is the following:
In my opinion - a point which should be gone into more deeply in the activity (EB2) described in prof. Cozzarini’s scricoll - is the connection between this and the previous activity EB1, in which instead, the cooling of different liquids in the same vessel was observed. How can this fundamental aspect be further clarified with the students?
It appeare evident that the main interest is centered on the previous activity in scricoll and on the planning work for students. Also the first theme mentioned above, proposed by a student: thermal conductivity and thermal capacity, is dealt with only to identify more effective ways of teaching.
Only seven days after the beginning of the forum, in threads 7, 8 and subsequent ones, the difficulties postgraduates found in carrying out the activities emerged.
The conclusion obtained from the comparison between the two experiments is not clear to me. In my opinion, the values foreseen for the balancing temperature should have been the same (first message from thread 7)
In the practical carrying out of certain experiments, we ourselves encountered some difficulties and in certian cases we repeated the tests a number of times to obtain good results. (first message from thread 8)
Even now I can’t explain what this clash was due to. (a message from thread 7)
I personally still have doubts regarding the correctness of the answers given by me. (message from thread 2 on 12/2)
Many messages in these threads and in the subsequent ones start with “I too have had difficulties...”, which highlights both the problems encountered and the sharing of them. The problems are explained also because, being common, they can be expressed and not put down to the inexperience of the individual.

The necessity to go into the theory more deeply is underlined and a request for the teachers’ interventions emerges.

For this worksheet, I have tried to look for the confirmation of my forecasts in certain manuals, but it is still not clear to me what type of expression is required to express any dependence of the constant of the exponent on the conductivity and on the specific heat of the two solids.

I remember the observation Alessandra mentions, after your observations I started thinking and I looked in the book of the Karlsruhe School, recommended to us by D’Anna.

I hope that in the final part of the course, these themes will be gone into more deeply...

The explanation of one’s own difficulties becomes a starting point for rethinking the didactics and for affirming the positive role (heuristic) of mistakes and their role in didactics.

From the subject point of view, there are various ways of seeing the concept of heat. Some messages repropose the concept of heat as a transiting substance, whilst for others, the approach in the worksheets is not only acquired but in the forum these postgraduates take on the role of guiding and suggesting to widen one’s knowledge to other postgraduates.

Conclusions

The data obtained from this research has still to be examined more deeply. In particular, and of primary interest for our research, it is necessary to compare the initial reports and those produced after the debate on the net. It will be interesting to analyze how the observation of the other postgraduates have contributed to improving the productions.

The material shows an interaction between the subject and didactic observations. The considerations regarding didactics (what to deal with and how to deal with it) are connected with a rethinking of theoretical aspects (in this case the concept of heat and entropy), favoured in particular by the second phase of the forum. The conflict with previous knowledge is explained only in the comparison among equals, whilst in the reports the problems encountered are not mentioned. The language used in dialogues in the web forum has allowed difficulties encountered to be revealed and explained, and the request for different modes for describing the activities (with reports and with a debate) has made it possible to carry out a differential analysis of the activities. The use of different tools (entering data and debates) and of different modes (individual and in dialogues) has therefore favoured the awareness of the necessity to revise subject knowledge.

It has been useful to combine: laboratory activities and putting them on the net, individual work and collective debates, entering material and discussing in forums, having the teacher as a virtual interlocutor for certain activities and, for others, one’s own equals.

Such combinations and the comparisons which they provoked have allowed criss-cross landscapes (Wittgenstein, 1953) and modification of the teaching profession in the direction of reflective professionals. (Schón, 1993)

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DISTANCE INSTRUCTING OF IN-SERVICE TEACHERS IN COMPUTER-BASED MEASUREMENTS

Karla Holá, Václav Koubek, Miroslav Šedivý, Soňa Bendíková, Vincent Cigánik, Marián Daničovitch, Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava, Slovakia

Introduction

Innovation of skills and knowledge is an important issue for anyone’s development and life in general. If it concerns teachers, it is of a crucial necessity to stay up-to-date and topical, since teachers do have a great impact on knowledge and skills of other people. Physics as a vital natural science has been undergoing a permanent evolution. Similarly also tasks and methods of didactics of physics have been changing in the modern society. However, the most dynamic development, which struck ordinary people, has been registered in the field of information technologies. Consequently this extraordinary development has remarkably influenced also teaching methods and opened new learning possibilities.

Institutional introduction

It was the very work with information technologies which became a new item in teacher training courses of pre-graduate students at the Department of Physics Education in recent years as a result of the accomplishment of the international project TEMPUS AC_JEP 13101-98 „Innovation of teacher training in physics and maths“ at which the Department took part [1]. By now, the usage of multimedia tools like dynamical models, video clips, computer-aided laboratories and Internet sources has already been well established in pre-graduate teacher training. At present, we have approached the phase of dissemination of these tools among in-service teachers in order to provide them with methods and materials, enabling them to motivate their pupils and increase students’ activity.

So far the computer-assisted education has only rarely been used in primary and secondary education especially out of two reasons. First because of bad equipment and accessibility of computers for the purposes of physics education, second for the low computer literacy of school-
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