A PROJECT FOR AFFORDABLE & EFFICIENT SCIENCE TEACHER IN-SERVICE TRAINING (AESTIT)

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Abstract

This paper concerns a training program on Science teaching taking place in the framework of a Socrates – Comenius(*)project funded by the European Union. The training program is based on the delivery of training modules about modern themes of Science, adapted to the learning needs of the school Science Teacher within the context of the school Curriculum. The training program based on the experience from traditional face-to-face seminars will be delivered with e-learning methods similar to the ones of distance education.

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Keywords

science teaching, training, teaching modules, secondary education.

INTRODUCTION

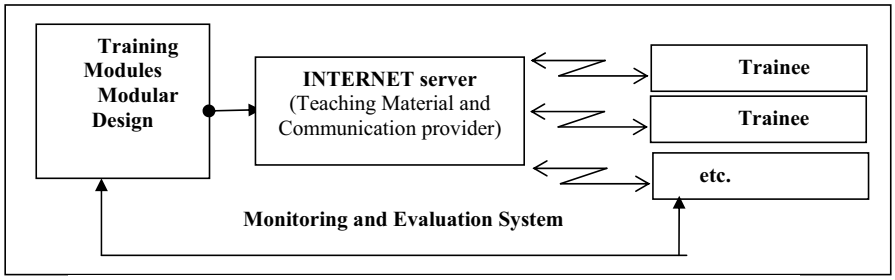
In all modern, technologically advanced societies, special measures are taken for an effective Science teaching[1] with the necessity for a generalised Science and Technology Literacy an explicit objective[2]. In order to be useful, this literacy must be focused on principles and methodology rather and not being limited to factual knowledge on specific data, techniques or themes. This implies that in order to be understandable and assimilated by the students, the scientific knowledge that the Science and Technology teachers possess has to be transformed appropriately to teaching activities but it seems that teachers lack, in general, this skill. As a consequence, Science and Technology are considered as difficult subjects (Halkia, 2001) although they are rather simpler[3]

1. See for example a synopsis for the case of England in Susan Barker and Pilar Reyes, 2001
2. See for example: a/for the USA the activities of the 'Institute for Science Education and Science Communication' related to the teaching of Science and Technology to students of a non Science related career, b/for England and Wales, 'Science: The National Curriculum for England', c/for a more general review, Karidas A and Koumaras P. 2001
3. As may be inferred from the fact that, in human history, they appear and advance earlier than other sciences.

and possess inherent advantages[4]. This constitutes a significant problem in most of the advanced countries. Another relevant matter is the existing outline of the Science and Technology subject matter and the way of teaching. In the majority of the cases the subject matter does not include advances like relativity or quantum physics that are known for more than 5 generations and require a (qualitatively) different approach than the Aristotelian one of classical physics (Kalkanis, 2001) The teaching is in general narrative (Smith and Neale, 1991) with the teaching book as the only resource (Athanassakis, 1992). This practice implies that scientific inquiry skills, an explicit common objective of the Science curriculum, are not developed. As a further consequence, a difficulty seems to exist to discriminate between data from observations and their interpretation.

AIM OF THE PROJECT

The aim of the project is the development of an affordable, sustainable and efficient in-service training scheme for the Science teachers. This scheme has two main axes: a. face-to-face training courses, and b. online training courses. The face-to-face courses focus on the learning of the recent theoretical paradigms on the Science teaching and the relevant supporting pedagogical principles. The e-learning system to be developped, will be used by Science teachers and specialised scientists in the area of Science Teaching.



Scheme 1. The structure of the e-learning system.

This e-learning system is based on the Scheme 1 (Michaelides, 2001).

The focus of the project is on the promotion of the collaboration and cooperation between teachers, schools and institutions involved in the Science teaching and in Science Teaching education. The fundamental philosophy is that learning can be developed and enhanced through the sharing of knowledge and best field practice experience of diferent groups involved in such activities. A further objective is the establishment of a network of people including scientists, school-teachers and researchers to promote Science and Technology education. In this aspect membership consortium is intended to be open to any

4. For example their subjects of study are easily perceptible through the senses, an irrefutable advantage for most of the compulsory education students who, in a Piagetian context, have not as yet reached the formal logic stage.

colleague wishing to participate.

The main innovative points coming out from this training scheme are:

- It will be evolved gradually and put into operation from its early development stages with a continuous development that will not interfere with to its operation.
- Every theme will exist in more than one module addressing different teaching strategies, and (or) teachers' backgrounds.
- It is easily integrated to the daily school operation, which will be improved without the interferences due to replacements for the teachers on training.
- It will be operated within the existing infrastructure without the need for special resources in equipment, buildings, etc.
- It meets adequately the problem of the lack of experienced teacher trainers[5],
- It will be upgraded easily. Every new module may be added to the existing ones so that, gradually a database will built up. Teachers using it will add their experience a very significant characteristic for the adaptation of the training to different school contexts.
- There is no need for the trainees to suspend their work in order to attain training. Consequently the cost of replacement personnel and the interference to school operation due to the personnel mobility are minimised[6].
- The trainees will remain in their work places (in their schools) and, hopefully, will be able to implement directly their training into the teaching of the day,
- The trainees will manage their time more effectively. Also, every trainee may access the training themes database and build his (her) own training program from the existing modules, the links between these themes and the expertise of previous trainees[7],
- Requirements in buildings, equipment, operation costs[8], etc are minimised because the scheme uses the existing infrastructure of the schools and the training may be incorporated in the daily school operation,
- Because universities are involved in this scheme a synergy (and cross-fertilization) process is an added value[9].

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5. The few experienced teachers who are appropriate to be used as in-service trainers ("masters to train their apprentices"), in order to retain their expertise must not be absent from their professions, e.g. being elsewhere in order to train other teachers. With this scheme their expertise may be useful to a wider gro up without the need to suspend their work for extended periods.
6 . This could be proved an inconspicuous drawback in cases where teachers (and would be trainees) consider their training as part of their duties (consequently it has to be done in replacement of their work) and not as a means towards their personal development or towards improving their job skills. The fact that in-school training is mostly informal (no certification or other formal assessing mechanism is, in general, envisaged) may enhance this drawback.
7. This could also be proved an inconspicuous drawback if there is a lack of willingness and self-discipline.
8. Consumables, equipment etc are the same that are used for the daily school operation. As long as a training theme is developed there is no more any need for a multitude of trainers to deliver it (one or two are still necessary in order to maintain, adapt and enrich it).
9. Many tertiary education departments (e.g. departments of education) whose a substantial percentage of their graduates may become teachers in schools can incorporate the development and maintenance of training themes into their education and research activities. Apart from the benefits of the immediate links with educators in pre-tertiary education, they would have a supply of data, useful to their work and to their students.

- It treats teachers in isolated areas on a parity basis with the ones near the training centres.
- An added value also results from the use of the system in order to establish a fast communication system between the teachers in schools so that peer discussions may arise. The same system will also be used as a fast communication between every school and the (central) administration.
- Experimentation and relation of Science to everyday life will be a constituent of the approaches adopted.

This scheme presents a direct inherent advantage to the Science Teachers of primary and secondary schools, especially those in rural areas where modern equipment and counselling are sparse. Indirectly, through the improvement of their teachers, the pupils of the corresponding schools and the various groups involved in the activity will benefit. Groups that may be involved in this activity are Universities, schools, Institutions for Science Teaching, Science teachers and specialized Science trainers. It is expected that the different groups will collaborate in order to have a better achievement according to their aims and objectives with every group being able to benefit from the exchange of experience and knowledge in the field. This 'individualised benefit' is another advantage of the scheme.

The activity involves three phases. The first one consists on the development of training modules and it is carried out. The second phase consists of a traditional test delivery of the training modules developed and an (extensive) evaluation being under development. The last (3rd) phase will consist to the transformation of (some of) the training modules developed to distance education training material with a test delivery and its evaluation. It is expected to last 10-12 months. Phase 2 is necessary in order to obtain comparative evaluation results between the traditional face to face and the e-learning deliveries.

ENVISAGED OUTPUTS

Output will consist:

- Of training modules and material appropriate for traditional face to face in-service training,
- Of a web site to support such activities, with very simple navigation structure in order to be easy for any user to use it
- Of evaluations of these activities that may serve as guide to additional training module development,
- Actual training courses on Science teachers serving in the schools associated (linked) with the partners.

Format of training modules. Project based training is the most appropriate form to develop the skills required from the S&T teacher. It is also compatible with distance education methods and, also, may serve as a real example for the actual teaching of Science and Technology in schools[10]. Project based

10. Project based teaching facilitates the socialisation of students from different social classes, with different skills or abilities or from different cultures (as the cases with schools with immigrants) especially when it is combined with group work. Group work teaching is a common aim in many school curricula.

teaching is also appropriate for the development of problem-solving skills and creative thinking, in general. It seems as the natural choice for the training modules to be developed as it also facilitates the monitoring of the study progress of the trainees. In these modules, the scientific inquiry steps[11] should be incorporated. In order for these modules to be really valuable, they must include experimental activities. Distance education methods are not, in general, appropriate for teaching including experimental activities and, in general, for the development of psycho-motive skills. In this case, however, this is not a real problem because:

- On the issue of equipment and facilities needed, the school equipment and facilities (e.g. laboratories) may be used.
- The issue of the (minimum) psychomotive skills required from the trainee in order to conduct experiments may be met by optional general introductory courses with many audio visual explanations, a very inexpensive feature to produce, adapt and maintain with modern web communication techniques. As the trainees are already teachers, their physique should not show relevant defects.
- Issues of safety could possibly be a problem. However, for the elementary Science and Technology data are mostly collected from observations and, in most of the elementary school curricula, the necessary (small scale) experimentation do not exhibit problems of safety. The secondary education school teacher is by his (her) education trained to this issue.

Subject matter of training modules. The training modules' subject matter preferably:

- Will be chosen from the school curricula in order to become easily incorporated to the daily classes. In this way the benefits of immediate feedback of the training will be enhanced with a minimum to the school activities. From this view point, the use of "Polymorphic Practice"[12] is useful.
- Will be developed with a focus either on different teaching strategies, on different teaching patterns referring to differences in the organization of the school curriculum or on the subject matter itself. The inclusion of common misconceptions and of methods to spot and cope with them is necessary.
- Will use everyday observations (Michaelides, 2001) and experimentation with simple equipment from the students' environment to the maximum possible extent. This way the relation and consequences of Science and Technology to the everyday life becomes direct.
- Will include topics on modern (and recent) advances either dispersed into the modules with a related content or as separate modules. Apart from being used as reference sources to the teacher (trainee) they may also be used as experimentation towards their introduction to the school curriculum.

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11. (Planning of observations), data collection, data manipulation in order to locate patterns and relations, hypothesis forming and (experimental) testing, formation of models and induction.
12. Polymorphic practice (measurements, experiments...) in Science includes a common psychomotive activity (doing measurements, experimentation...) which consequently is morphed into different levels depending on the (previous) cognitive attainment and/or the mentality of the students.

EVALUATION

An evaluation of every one of the face-to-face test delivery training courses envisaged will be carried out through interviews with and questionnaires to the teachers involved. The results will be used for the evolution towards the e-learning type of training. An extensive evaluation of the test delivery is also envisaged. A specific evaluation task is envisaged. This will contain an internal assessment of the project by the members of the consortium and an external evaluation of the whole proceedings by a field expert – not a member of the consortium.

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