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An affordable and efficient ICT in-service training scheme for the Science Teacher

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KEYWORDS: INTERNET, training, in-school training, Science teacher training.

After a Paper presented at the
International Conference "Computer Based Learning in Science (CBLIS 2003)", organized by the University of Cyprus in Nicosia-Cyprus, 5-10 July 2003 Proceedings Volume I pp 792-799.

An affordable and efficient in-service training scheme for the Science Teacher

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ABSTRACT

In this work a scheme for continuing in-school training of primary and secondary school Science teachers is presented. This system, using extensively the Internet and based on distance education methods, exhibits significant advantages compared with other forms of training. The proposed system may also be used as an on line help provider to the school personnel, a feature not possible under most of the current teacher training schemes; this feature is useful for schools in isolation or at hard to reach areas. This system has the advantage to be affordable to all the teachers, irrespectively of the location of their schools, and uses wisely time, resources and human capital.

It requires a good operational scheme, which may be developed, and an infrastructure, which is already present in the schools. It eliminates the teacher mobility due to personnel participation in short term training schemes. This characteristic is very important to the school operation. The operational scheme and the infrastructures required for the operation of the proposed scheme may also be used for the communication – cooperation within the framework of other school activities or participation to (competitive) programs, e.g. COMENIUS.

Science and Technology Literacy (STL) are important as:

- **Cultural asset of our society**

  Important to compulsory education

- **Base for understanding a Technology conscious society**

  Important to the society's welfare

- **Development of cognitive skills**

  Important to personal development

- **Right to Democracy according to UNESCO**

  Important to all the citizens

➔ **STL is a fundamental constituent**

of the Compulsory Education

(Primary and Lower Secondary school)

An effective Science and Technology Teaching:

- **should be focused on principles and methodology** rather
- **Should not be limited to factual knowledge**
  on specific data, techniques or themes
- **should incorporate the "scientific Inquiry"** in an inherent way
  (Planning of observations), data collection,
  data manipulation in order to locate patterns and relations,
  hypothesis forming and (experimental) testing,
  formation of models and induction
- **should not be taught in a narrative way**
  With the textbook as the only resource
- **should include 'modern advances'** known for more than 5 generations
  e.g. relativity, quantum mechanics, statistical physics, ……

For this last point:

- **a (qualitatively) different approach is required**
- **the Aristotelian one of classical physics is not appropriate.**

It is Necessary

the scientific knowledge

that the Science and Technology teacher possess

has to be transformed to teaching activities,

but teachers lack, in general, this skill.

As a consequence,

Science and Technology are considered as difficult subjects

although they are rather simpler and possess inherent advantages.

In modern, technologically advanced societies,

- **special measures are taken**

  for an effective Science teaching

- **an explicit objective**

  the generalised Science and Technology Literacy

STL in Compulsory education

must also be combined with the general School Objectives

i. e. personal development

Consequence:

Special Demands on the Science Teacher e.g.

- **a good knowledge of the basic principles,**
- **the skill to relate this knowledge to cases from the everyday life,**
- **the skill of using experimentation and scientific inquiry towards the development of creative thinking,**
- **the skill to contact teaching through the assignment of projects,**
- **etc**

However:

Science Teachers are not adequately Educated for example

Primary School Teacher,

- **Teacher for all the school subjects**
- **Initial training focused on psycho pedagogy**

Adequate understanding of Science is to be proven

Secondary School Teacher,

- **Teacher for a specific subject**
- **Initial training focused on the special subject**

Adequate psycho pedagogy is to be proven

Confusion to pupils because of the possible different approaches by different teachers

It seems appropriate and necessary a new planning:

- **Of the education and initial training of the Science and Technology teacher**
  in the compulsory, especially, education.
- **Of the continuous in-school training of S&T teacher**
  in order to maintain and improve their proficiency.
- **Of the teaching approaches,**
  a matter closely related to teacher's proficiency.

The training for the acquiring or developing practice skills,

- **apprenticeship teaching is more advantageous,**
- **the continuous informal in-school training is more appropriate.**

An effective In-school training should be:

- **Individualized to the needs of everyone of the trainees,**
- **Focused on very specific themes of the subject and its teaching,**
- **From the school's program (daily teaching) in order to easily link "theory" and "practice",**
- **Be on a large scale, in order to be affordable,**
- **Be incorporated into the daily teaching in order to avoid interferences on the school activities,**
- **Be affordable on their requirements on cost, human potential (trainers), operation, development, infrastructure,**

Must also meet adequately

the lack of experienced teacher trainers.

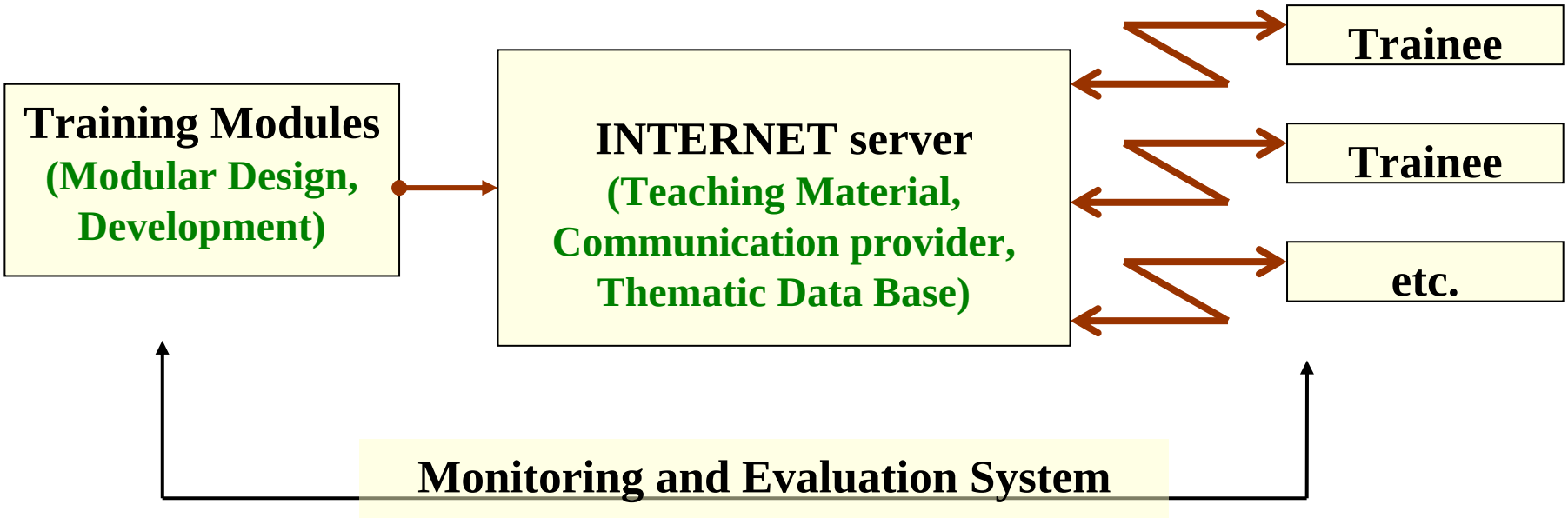
Assumptions:

- **Science and Technology Teacher works on his (her) own,**
- **Peer discussion is mostly absent,**
- **Assembling S&T teachers from different schools:**
  - ✓**interferes with the school operation,**
  - ✓**hinders the individualization of the training,**
  - ✓**requires training centre facilities,**
  - ✓**separates the training from the teaching,**
  - ✓**etc.**

➔A new scheme is on demand

INTERNET coupled with Open-Distance Education

An in-School Training Scheme for the Science and Technology Teacher



Notes:

- Trainees use the facilities of their schools
- The system may be developed in continuous stages,
- Every developed module may be used immediately,
- It may be implemented within a context of in-school training,
- It uses equipment and facilities already existing in schools.

Development of the training scheme proposed.

1. **Locate training themes,**
2. **Development as Open Distance Education teaching modules,**
3. **Implementation through the INTERNET,**
4. **Monitoring and evaluation,**
5. **Enriching – adaptation and addition of more themes.**

4. Monitoring and evaluation

Includes a number of officials ("councillors")

- **For regular face to face guidance and feedback**
- **Education inspectors, councillors or experienced teachers.**

Features of the System (development):

- **Gradual development and Immediate operation,**
- **Multiple instances of every theme**
  to meet different teacher' background or different strategies
- **Continuous development**
  without interference to its operation
- **Upgrade without interference to system operation**
  addition of new modules - database built
- **Use of existing infrastructure**
  equipment, buildings, facilities of the schools
- **Share of operation costs**
  with the operation costs of the schools
- **Optimization of the experienced teacher trainers**
  involved only to the development – adaptation of the training modules
- **Easy feedback and adaptation**
  teachers using it may give their feedback "on-line"

Features of the System (delivery):

- **Use of existing infrastructure**
  equipment, buildings, facilities of the schools
- **Share of operation costs**
  with the operation costs of the schools
- **Integration with the operation of the school (apprenticeship)**
  teachers may use it in line with the "class of the day"
- **Immediate implementation of the training**
  teachers remain and conduct their classes
- **No interference on the operation of the school**
  replacement teachers are not necessary (informal training - unionism?)
- **Trainees may built their own training program**
  "menu selection" – self discipline is necessary
- **Teachers in rural areas have the same training opportunities**
  a significant advantage

Features of the System (spin-offs):

- **Involvement of the Universities**
  the scheme may be combined with under- and post- graduate studies
- **The infrastructure may be used as a communication system**
  between teachers in different schools or between teachers and administration
- **Integration with the operation of the school (apprenticeship)**
  teachers may use it in line with the “class of the day”

Feasibility factors of the system (prerequisites):

- **Management.**
- **Infrastructure (Communications, Support centres, Equipment).**
- **Trainees prerequisites**

  Computer Literacy, Self-discipline, Concentration, Practice, … .
- **Cost.**

- **Contents of the Training Modules**

Feasibility (Management) a crucial factor including:

- **Administration of the INTERNET server.**
  - **a service available continuously,**
  - **experience from other activities[1] valuable**
  - **competent personnel hiring is important**
- **Coordination of the team developing initially the training themes.**
  - **Experienced teacher – trainer to supply the basics,**
  - **Expert on Open – Distance education,**
  - **Expert on man – machine interface,**
  - **Computer specialist.**
- **Indexing system for the training themes.**
  - **Interrelations between related themes - Complete but Simple,**
  - **Individualized training patterns,**
  - **Guidance and Monitoring of the trainees progress[2],**
  - **Including trainees observations and patterns,**
  - **Adaptable[3].**

[1]i.e. web site developments, e-commerce, etc.
[2]an important point for the Financing of the scheme by education authorities.
[3]Care must be exercised in order to avoid issues of © conflicts.

Feasibility (Infrastructure):

- **Reliable communications (a prerequisite).**
  - **Inexpensive, reliable, fast[1] and continuously available[2],**
  - **based on LANs and Dial-up lines,**
  - **Technology available but lack of e-communication culture,**
  - **Balance between flexibility and (antivirus) security.**
- **Support centres.**
  - **Schools themselves,**
  - **For initial guidance and Feedback,**
  - **School inspectors and Councillors as local agents.**
- **Equipment.**
  - **Client equipment cost affordable and accessible (subsidized?),**
  - **School IT laboratory may be used,**
  - **Powerful, fast and reliable Server equipment,**
  - **Demand peaks in pace with school timetable.**

[1]special considerations on pictures' format, resolution and depth, animations, etc.

[2]see P. G. Michaelides, "4th Conference: A Test for Electronic Communication" Opening Speech to The University of Crete, 4th Conference on the Didactics of Mathematics and Informatics in Education, Rethymno, October 1-3, 1999, proceedings pp 14-19.

Feasibility (Trainees prerequisites):

- **Computer Literacy.**
  - **Basic Skills of Computer usage,**
  - **INTERNET browsing and electronic communications,**
  - **Ensured(?) - by the ongoing Computer Literacy training programs,**
  - **Small scale initial training (also advice of a colleague),**
  - **Appropriate user Interface an advantage.**
- **Self-Discipline and Concentration (crucial).**
  - **Expected to exist (the trainees are already teachers),**
  - **Facilitated by monitoring the progress of the trainees,**
  - **Training modules in the form of projects appropriate.**
- **Practice.**
  - **Inherent in the proposed scheme[(1)],**
  - **May be combined with education (teaching) experimentation.**

[(1)]The trainees skill to adapt his (her) teaching to new challenges is required

Feasibility (Cost) compared to conventional training:

- **Zero cost for:**
  - **Buildings (schools are used),**
  - **Delivery (once a training module is developed),**
  - **Commuting (of the trainers and the trainees),**
  - **Replacement teachers (to replace those in conventional training),**
  - **Printing (the training and supportive material etc).**
- **Smaller or Comparable cost for:**
  - **Initial development of each of the training modules,**
  - **Trainers to deliver the program,**
  - **Adaptation and maintenance of the training modules,**
  - **Consumables and Equipment used in practice work (shared cost).**
- **Additional cost for[(1)].**
  - **Electronic (INTERNET) communication,**
  - **May be reduced (scale economies).**

[(1)]The total for this category is significantly lower than any of the avoided costs.

Contents of the Training Modules:

- **Objectives- Competence in Science and Technology teaching, i.e.[1]:**
  - Good understanding of the subject matter, professional knowledge and skills;
  - Proficiency to choose suitable teaching-learning strategies and resources;
  - Emphasis on developing students' comprehension and problem-solving skills;
  - Enthusiasm in promoting positive attitudes to science and technology in society.

Teaching Strategy:

- Project based training most appropriate (see above objectives),
- Compatible with Open – Distance education methods,
- Facilitates monitoring of the study progress of the trainees,
- May also serve as actual examples of school teaching,
- Facilitates socialization (on class – culture – skills - abilities)[2],
- May be combined with group work (a common aim in many curricula).

- **Format**
  - Modular – for flexibility and individualization to each trainee;
  - With cross reference links and a complete but simple to use indexing,
  - With study patterns to follow – to built.

[1] Unesco Project 2000+ (http://www.unesco.org/education/educprog/ste/projects/2000).
[2] The case of Greece with a lot of immigrants.

Contents of the Training Modules (continued):

- **Recommended Subject matter Outline:**
  - **Themes from the school curricula**
    (immediate incorporation - Polymorphic subjects[1],
  - **Similar themes focused on:**
    - ✓**teaching strategies,**
    - ✓**teaching patterns,**
    - ✓**subject matter,**
  - **Must include and discuss common misconceptions,**
  - **Including everyday observations from school environment[2],**
  - **Experimentation (see next) with simple (self-made?) equipment,**
  - **Including Modern (and recent) advances on:**
    - ✓**Quantum mechanics – relativity – statistical physics,**
    - ✓**Dispersed through different subjects or separately,**
    - ✓**Immediate feedback – reference source for the teacher-trainee.**

- **Scientific Inquiry an Integral part of the whole training process**

[1]**P. G. Michaelides, "Polymorphic Practice in Science", 1st PanHellenic Conference 'Didactics of Science and the Application of New Technologies in Education, University of Thessalonica, Thessalonica 29-31 May 1998, proceedings pp 399-405 (in Greek).**

[2]**P. G. Michaelides, "Everyday observations in relation to Natural Sciences" in Learning in Mathematics and Science and Educational Technology, Univ. of Cyprus July 2001, Vol.II pp. 281- 300**

Experimentation:

- **Distance education methods not suitable, in general**

- **However:**

  - **Equipment – school equipment, facilities and laboratories may be used**

  - **(minimum) psycho motive skills required from the trainee:**
    - ✓ **Trainees are already teaching → minimum skills exist**
    - ✓ **Introductory courses - face to face or through the use of multimedia,**

  - **On safety matters:**
    - ✓ **Primary education – simple experiments, no significant risks,**
    - ✓ **Secondary education – their education includes this issue,**