

## **PREFACE**

## **INTRODUCTION**

- 1.1 Contemporary views of Education
- 1.2 The SOCRATES Programme
- 1.3 Promotion of ODL in SOCRATES Programme

## **TEACHERS' ROLE IN ODL PROJECTS**

- 2.1 Teachers in the new era
- 2.2 The process of Change
- 2.3 Teachers-Learners
- 2.4 A new role for the teacher
- 2.5 Teacher, student, author, designer: models for role-playing
- 2.6 The YouRA Model – Axes and roles

## **ODL AND SCHOOL CURRICULUM**

- 3.1 Reshaping the existing curriculum
- 3.2 Making space in the school curriculum for collaborative learning
- 3.3 Key points in the new approach

## **WEB BASED EDUCATIONAL SOFTWARE**

- 4.1 Student-centered design process
- 4.2 Designing web-based educational environments

## **ORGANISATORICAL AND TECHNICAL ASPECTS OF AN ODL PROJECT**

- 5.1 Managerial aspects
- 5.2 Technical aspects

## **THE YOURA PROJECT**

### 6.1 Project's Description

### 6.2 Aims and objectives

### 6.3 Organisational approach and structure

### 6.4 Pedagogical and Didactic approach

### 6.5 Introduction of the YouRA project to the school curriculum

### 6.6 The use of ICT in the framework of the YouRA project

### 6.7 Applying the project

#### 6.7.1 Teachers Training

#### 6.7.2 Implementation in the classroom

#### 6.7.3 Students' activities

##### 6.7.3.1 Construction of measuring devices

##### 6.7.3.2 Collection of data

##### 6.7.3.3 Data acquisition

##### 6.7.3.4 Communication – Discussion of the results

##### 6.7.3.5 Publication of the reports

## **EVALUATION AND MONITORING OF THE PROJECT**

### 7.1 Quantitative Evaluation

#### 7.1.1 Methodology

#### 7.1.2 Test Design

#### 7.1.3 Questionnaires

#### 7.1.4 Sample

#### 7.1.5 Statistical Methods

#### 7.1.6 Data Analysis

##### 7.1.6.1 General remarks

##### 7.1.6.2 Pre-test comparison of experimental and control group

7.1.6.3 Comparison between post and pre-test for both groups

7.2 Qualitative Evaluation - Achievements, elements of good practice

## **RECOMMENDATIONS FOR THE TEACHER IN AN ODL PROJECT**

8.1 Pedagogical recommendations

8.2 Social recommendations

8.3 Managerial recommendations

8.4 Technical recommendations

## **CONCLUSIONS**

## **GLOSSARY**

## **REFERENCES**

## **APPENDIX I: Evaluation Questionnaires**

## **APPENDIX II: p-values of the Questionnaires**

# Preface

*“This is no place to indulge in idle fancies, but it is no imaginary dream to picture the school of tomorrow as an entirely different institution from that of today because of the use of radio in teaching”. Statement contained in a 1927 application to the Federal Radio Commission by the State University of Iowa, seeking additional power for its radio station.*

*“Don’t be caught short. Start preparing immediately for the utilization of television as a medium of education. If properly used, television can be one of the most significant aids that has ever come within the reach of the educator. Television is here. It works...it is up to you to provide the guidance and assistance necessary for television to assume its proper place in the American system of education on all levels”. By these words television director Nathan M. Rudich warned educational broadcasters in 1948.*

*Moore 1997*

*“When the costs of communications come down next to nothing, as seems likely some time in the first decade of the next century, the death of distance will mean that any activity that relies on a screen or a telephone can be carried out anywhere in the world”.*

*The Economist journal, 1995*

Since the invention of writing there has been a continuous passing parade of new technologies, each one of which is claimed to "revolutionize learning" (Alexander 1995). These technologies are released in a flurry of excitement but sometimes end in disappointment when the practice by itself as well as evaluation studies fail to reveal the much-anticipated improvement in learning. Some of them prove to be nonexistent or without any long-term merit or real value (Hardin & Zierbath 1996). Alexander (1995) has an explanation for this phenomenon: many adopters of new technologies have as their

primary focus, the features of the new technologies. These features are then used to provide a learning experience that however proves to be the same or even of lower quality compared to that provided when using existing technologies. That is why a lot of surprise and disappointment prevails when the expected learning gains are not realized.

There are four different scenarios (Moore 1995) that describe the potential responses of teachers and educational organizations to the new opportunities offered by changing technologies:

*The Minimal Change Model.* The first scenario assumes no fundamental changes in the roles of teachers and in the organization of education; technology is used as an instructional aid in classrooms. Teachers may encourage the use of an on-line computer search for students engaged in a research project.

*The Marginal Change Model.* In this case, the pedagogy and the biggest part of the organization of education remains unchanged, but students in distant locations are added on to conventionally taught classes using audio-, video- or computer conferencing technologies. Teachers using this approach should be prepared to invest much time in designing a structure for the presentation of information and for the interactive sessions needed by students in order to learn it.

*Systemic Change.* In this scenario existing education systems change the fundamental organization of teaching. Teaching itself is re-organized into a technologically driven system.

*A Virtual System.* With the emergence of ISDN and multimedia communication to any place at any time, it is possible to imagine virtual universities and schools that are place-free, with little or no formal organization.

The YouRA (Young Researchers in Action) project, which will be described analytically as an example of good practice in this book acts between the Minimal Change Model and

the Marginal Change Model taking advantage of the new technologies' potential as an advanced instructional medium in the classroom. Extending collaboration out of the limited borders of a conventional classroom, reinforcing students' initiative and shifting towards a student-based instruction were the project's main goals. Technology was used as a supporting element of and not as the driving force behind, distance education project design. We may be far from establishing a viable fourth scenario – especially in primary, even secondary, education – but pedagogical research of new possibilities in education will enable us to be prepared for the new era. Or just improve – by little - the current state of the educational services the teachers offer to students. In any case the students will gain notable advantage from their familiarization with new technologies.

The YouRA project tried to create a style of its own that can be described as follows: this style involves the best of old and new: maintaining good teaching, maintaining the positive experience students have working collaboratively on projects to solve real-world problems, but adding new technologies and new pedagogies to accompany these old values.

This book is not trying to convince potential readers that the proposed way of implementing an ODL <sup>(\*)</sup> project in primary and secondary education is the only course to follow. ODL is a challenge, for those who develop a project and those who participate in it. It offers the potential to provide on going education to more people, but it requires detailed design of the implementation and very careful evaluation and monitoring of the adopted approach in order to achieve the best performance. The YouRA collaboration hopes that this book will be a helpful guide towards developing more advanced and

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(\*) The expression "Open and Distance Learning" does not anymore represent the dimension of education used by most institutions. It does not refer to the quality or/and the method, but mainly to the physical distance between the learner(s), educators and the educational institution. *Polymorphic education* is suggested (Lionarakis 1998) as a new term. If distance learning covers not only the means but also the principles of learning and teaching, then it can be distinguished and called *polymorphic education*. *Networked learning*, *distributed learning*, *technology enhanced learning* (Dillon and Granger 1998), *Internet based learning* (Tait 1997) are some of the labels currently being used for educational activities that broach the boundaries of the classroom. Despite the fact that the above terms are more suitable to describe our project, "ODL" is used in the book because of the catholic acceptance and universality of the term.

effective ODL projects. The suggestions presented here are based on research findings, evaluative information, and a careful analysis of both the context for the solution and the nature of the content and learning population. The book is not presented as the final word on the subject. It is the presentation of the outcomes of many years research on the implementation of ODL projects in primary and secondary education.

The book includes three parts. The first part (Chapters 2, 3, 4 and 5) presents the theoretical background needed for ODL's implementation, the new role of the teachers, the needed modifications to the current curriculum, the development process of web-based educational software in order to meet users' needs as well as the managerial and technical aspects. The second part (Chapters 6 and 7) presents the application of YouRA project in the participating schools as an example of good practice, the monitoring methodology of the project and the analysis of the quantitative and qualitative data. The third part (Chapter 8) presents the partnership's recommendations to teachers who are planning to apply an ODL project in their class.

# Introduction

*[We stand in the beginning of a great educational revolution, the most significant since the invention of typography. The strongest point of this revolution is the computer. Until the year 2000, the main teaching tool in every stage of education and every subject, will be interactive computer systems]*  
*Al. Bork, 1978, Speech in the American Physics Teachers Association*

## 1.1 Contemporary views of Education

Today, one year after 2000, Al. Bork's views (Bork, 1997) should be considered rather too optimistic, since computers are far from conquering the role he predicted in the contemporary school. Nevertheless it is certain that in a slow but steady pace computers have taken a place in the educational process and can be relied to improve it. The implication of computers in the educational process has been increasing daily with the use of personal computers in an increasing number of schools and the establishment of Information Technology laboratories (Solomon, 1996). Information Technology is now coming to support teaching, as a result of scientific research (Computer Based Instruction, CBI and Computer Aided Instruction, CAI).

Science teaching is considered invaluable in the educational process, since it advances learning, develops mental abilities and promotes knowledge of physical environment. Children have an early perception of the natural world, develop ideas, interpretations and correlations for physical phenomena. Students have a vague knowledge for these subjects and teachers must analyze students' ideas and develop a new level of understanding, that is based upon scientific knowledge.

Learning can be described as the procedure of acquiring, understanding and using information. Cognitive psychology looks at the learning process through a different point of view and studies the way people learn. Man is not a pathetic receiver of environmental stimuli, but has an active role. The need for supporting tools is obvious, not only in the first stage of the learning process, which is selecting and collecting stimuli, but in promoting the active participation of the students as well.

ODL has become a very interesting topic in the past few years. Whether it is called distance learning, directed learning, assisted learning, distance education, or some other name it describes the same procedure: It is the acquisition of educational or training information, including the instruction and experience, from the learners, although they are physically distant from the source of that information (Porter, 1997). ODL is an important way for educational institutions, from elementary schools to colleges and universities, to offer instruction to a new market of students. In the past years some potential learners faced difficulty fitting traditional courses into their schedules either because they lived too far from the site offering the instruction or the costs were prohibitive for them to take the courses they were interested in. ODL projects can be designed to meet any group of learners' needs. The technologies used in ODL, the structure of the course or a project and the methodology followed can be varied to meet a particular group's interests. It has to be noted that although the approaches for designing an ODL project are many, the success of the project depends on effective planning to meet a market need.

## **1.2 The SOCRATES Programme**

ODL projects can be expensive as they are based on online (computer based) information and tools. Any institution or organization which plans to develop an ODL project has to construct a detailed cost-plan which will include all the proposed activities. In many cases it is needed to find sources of funding beyond those the institution is able to provide. Grants offer several good possibilities for partial funding, promoting ODL in many ways. Organizations which provide grants may promote a specific type of project, may request use of a specific technology or development of advanced educational materials and tools by emphasizing research or applications of research. Grantors may also require collaboration among educational organizations or businesses from different countries or encourage individuals to develop innovative ideas. The YouRA project was developed under the framework of the European SOCRATES programme, [<http://europa.eu.int/en/comm/education/socrates.html>], ODL action, that requires the collaboration of institutions from at least 3 European countries. The SOCRATES program is based on articles 126 and 127 of the European Union convention. Article 126 specifies that EU “*contributes to the development of a high level education*” through a variety of actions that must be materialized with close cooperation among member states. One of these actions is the development of a “*European dimension*” in education, especially by

promoting teaching of foreign languages, encouraging students' and teachers' mobility, ensuring recognition of studies in other participating countries, developing cooperation in the area of distant learning, and intensifying exchange of information and experience regarding educational systems in all union dominion.

The specific goals of the SOCRATES programme, as mentioned in the decision decreeing the programme, are:

- development of the European dimension in studies of any level, so as to stabilize the spirit of European nationality, based on the cultural heritage of member states,
- promotion of quantitative and qualitative improvement of knowledge of European Union languages, especially of those which are less spread and taught, so as to improve understanding and solidarity among people constituting the European Union, as well as to promote the intercultural dimension of education,
- promotion of wide and intensive cooperation among foundations of member states, in any teaching level, so as to make use of their intellectual and pedagogical background,
- encouragement of teachers' mobility, so that studies acquire a European dimension and their skills are improving in quality,
- encouragement of students' mobility, by allowing them to materialize part of their studies in another member state, in order to establish the European dimension in education,
- encouragement of students' relations in European Union level, parallely promoting the European dimension in their education,
- encouragement of academic recognition of certificates, recognition of study periods and periods of acquirement of other qualifications, aiming to the development of a European open field of cooperation in the area of education,

- encouragement of ODL during the actions of this program,
- promotion of exchanging information and experiences, so that the variety and specialities of different educational systems in various member states may become sources of intellectual enrichment and mutual encouragement.

In order to materialize the above goals, SOCRATES programme provided help to the actions of seven sectors:

- Third level education (ERASMUS),
- School education (COMENIUS),
- Advancement of foreign languages learning (LINGUA),
- ICT and Open and distant learning (MIVERVA),
- Adult education,
- Exchange of information and experiences regarding educational systems and educational politics,
- Complementary measures.

Most of the SOCRATES programme actions provide help for some of the following sectors:

- creation and promotion of plans, networks, collaborations and cooperations among states,
- development of curricula, training and teaching material and other educational products,

- exchanges and mobility,
- interstate training courses for the educational staff,
- visits for facilitating preparation of plans or exchange of experiences,
- studies, analyses, printed guidelines and data collection activities,
- evaluation,
- dissemination of results.

### **1.3 Promotion of ODL in SOCRATES programme**

Promotion of ODL is about the use of new methods and techniques aiming to make learning more flexible in matters concerning space, time, selection of subject or teaching tools, so as to improve the quality of traditional teaching or/and distant access to educational systems.

The concept of promoting ODL has a double meaning in SOCRATES programme and concerns:

- introducing new ways of “open” learning through all the provided teaching mechanisms, mainly multimedia products and services, anywhere that a form of education can take place.
- providing services of “distant” learning.

The main goal of this action is the development of European co-operation in:

- Embodying new technologies and media in the educational process, which includes education of teachers and administrators.

- Promoting and providing ODL services.

This action is taking special measures to ensure that the educational community, in a wide point of view, will benefit from this work and that during the process of inventing and materializing educational software and multimedia, this educational community is going to play a full and definitive role.

While support for the use of new technologies and media in all the other actions of SOCRATES is mainly aiming to their implementation in a special structured framework, plans suggested in ODL have a clear multiplying effect and show an expected strong impact in conveying experience and the way of using new types of media and technology, under different circumstances and different levels of the educational process. Information and communication means are going to arise from these plans, as well as services which will encourage the educational community to apply innovative approaches in learning or/and model training systems, which may be utilized and spread all over Europe.

European level cooperation in the area of educational software and multimedia is still too incomplete, to contribute to noteworthy financial savings. This is why one of the main goals of the present action is to promote formation of services to support multimedia in many basic sectors, like education of teachers, and to enhance the politics of public and private sector, regarding development of educational multimedia, by providing initial support to the future self-sufficient plans.

The present SOCRATES action, especially designed for promoting ICT and ODL in the concept described above, includes measures that focus on the promotion of European cooperation in the following sectors:

- use of ODL methodology, including new types of media, information and communication technologies, for improving the quality of “conventional” education,
- use of distant education services, as a means to overcome obstacles of physical mobility and to have access to education.

The main priorities for fulfilling these targets, include:

- enhancement of cooperation among every organization and foundation that is part of these sectors in Europe, in any stage of education,
- wide spread of good practice and technological knowhow in Europe, based on both traditional and new approaches, and dissemination concepts.

Pursuing this goal, this action especially encourages the following:

- development of experimental model plans, which accurately evaluate the impact from educational use of new media and new information and communication technologies,
- development of innovative concepts, methodologies and approaches for the design of high quality educational software, as well as for the enhancement of teachers' participation in inventing educational multimedia and ODL services,
- enhancement of teachers', educators' and administrators' abilities, regarding the use of innovative methods and technics,
- promotion of systems for exchanging information and educational and training material amongst partners,
- accommodation for the recognition of qualifications acquired through ODL.



# Teachers' role in ODL projects

## 2.1 Teachers in the new era

There is little doubt that many of the assumptions, which teachers make about teaching practice are challenged when learning is removed from the conventional classroom. Clearly the application of ICT and ODL in the classroom brings teachers in a new era. Moreover, confidence both in oneself and one's professional capacity to control the classroom is related to teacher's ability to cope with the unforeseen either by being flexible or by minimizing what does not go according to plan. Technology in the classroom represents an area of anxiety. It can "go wrong" and this will render the lesson useless with possible attendant negative response of the students. So elementary technical competence is seen, therefore, as a necessity to maintain control and the students' confidence.

Freeman ([Lynch 1999](#)) points out "If the potential for information and communication technologies to bring better education and training to more people is to be realized, it is vital that teachers be on the side of change". And change is more than duplication of print onto the screen.

## 2.2 The Process of Change

The adoption of web-based education represents an example of Instructional Technology Diffusion as part of the standard Innovation Decision Process theory ([Rogers 1995 as cited in Hansen, Desphande & Murugesan 1999](#)). That is the adoption (or diffusion) of the use of a process that occurs over time and can be seen as having 5 phases, namely: Knowledge, Persuasion, Decision, Implementation and Confirmation. According to this theory, potential adopters of an innovation must:

- learn about the innovation
- be persuaded as to the merits of the innovation
- decide to adopt the innovation
- implement the innovation
- confirm (reaffirm or reject) the decision to adopt the innovation

A part of the above mentioned theory is the prediction that individuals who are predisposed to being innovative will adapt an innovation earlier than those who are less predisposed. On one extreme of the distribution are the “Innovators”. Innovators are the risk takers and pioneers who adapt to an innovation very early in the diffusion process. On the other extreme are the “Laggards” who resist adopting an innovation until rather late in the diffusion process, if ever. In general terms the diffusion process following an "S" curve as shown in figure 1.

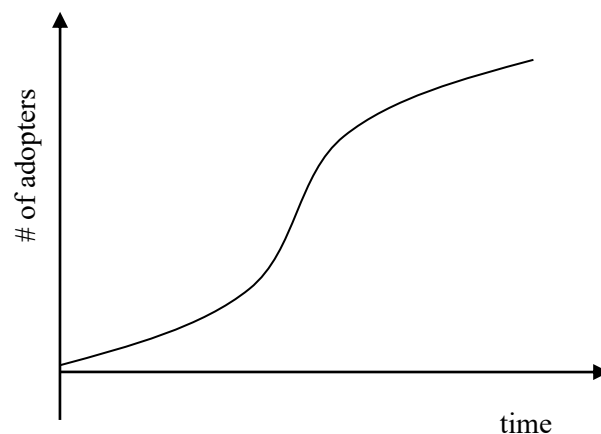


**Figure 1:** *The adoption of web-based education versus time.*

Talab and Newhouse (1993) have concluded that those teachers who believe in their own abilities to design their instruction by using new technologies, and who are willing and able to continue in their role as teaching partners, have successfully incorporated technology in their classrooms. These teachers:

- are committed to the concept of equality of education that network-based education provides
- see opportunities for professional advancement through learning new skills and networking
- seem revitalized by exceptional instructional design
- realize that the project will not work without their participation

Talab and Newhouse conclude that this success is based upon a match between the identified needs of the teachers and the resources, which are available to them, provided that teachers:

- are given time and accessible equipment
- are given assistance with equipment operation and troubleshooting
- take part in training and project planning, and they control the calibrating, classroom management and classroom activities
- influence the project through feedback
- see the need for technology integration in order to take part in the project

### **2.3 Teachers - Learners**

As the boundaries of teaching and learning dissolve educators become more like participant observers (Freeman 1996). Pea (Pea 1994 as cited in Sherry and Wilson 1998) goes one step further: teachers learn along with their students. As a result, teachers and students alike are transformed as learners by the process of communication.

The framework, which relates teachers to learners along three main axes – time, place and group size is shown in figure 2 (Norman 1995, Stanford 1996 as cited in Hedberg, Brown & Arrighi 1998).

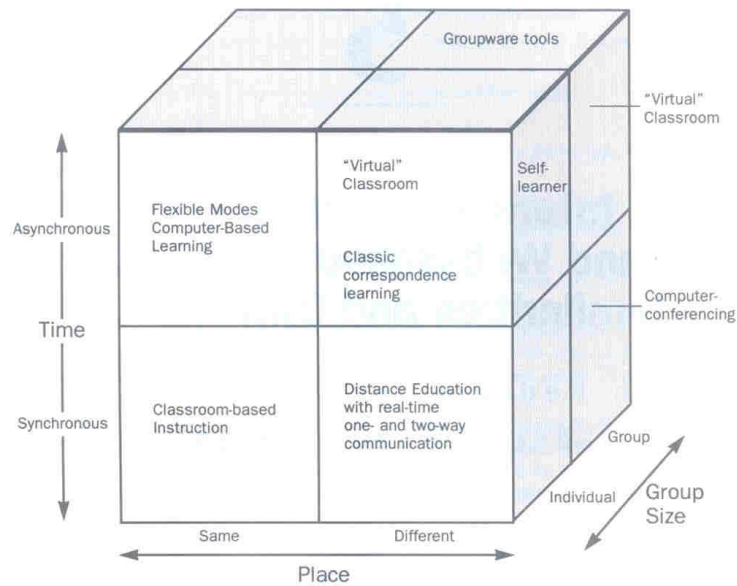


**Figure 2:** *The framework, which relates teachers to learners along three main axes – time, place and group size (Norman 1995, Stanford 1996 as cited in Hedberg, Brown & Arrighi 1998).*

At one side, we have the typical classroom, where the teacher and learner share the same place at the same time, and learners may work individually or in groups. At the other side, the teacher and learner are at different venues, communicate asynchronously, and learners may or may not congregate to share their experiences or collaborate with learning tasks. The ability for teachers and learners to find a position somewhere along that continuum has been largely facilitated by developments in information technology.

## 2.4 A new role for the teacher

Teachers are expected to be “in charge” in the classroom both as managers and as “the one who has all the answers”. Whether this control is achieved by teacher-centred or student-centred activities will depend on the teacher and school culture, but the teacher still has the responsibility for ensuring that children meet educational objectives (Cort, Brough & Stevenson 1995).

Furthermore, teachers must actively take on mentoring and counseling to ensure that learners are encouraged to pursue their learning in an appropriate and meaningful direction using approaches best suited to them as individuals.

The teacher shifted toward the role of facilitator of students' inquiry, guiding student work and offering individual help. The teacher's role in coaching, observing students, offering hints and reminders, providing feedback, scaffolding and fading, modeling, and so on, are powerful enhancements to any learning situation.

Dillon and Granger (1998) describe the new role of the educator in distance education:

*"I am not a teacher of "things", I am an "orchestrator" of ideas. My educational institution is not a physical plant with classrooms and trees, but a "hub" of resources no longer constrained by time and place. My students are no longer "my" students, but we are all students together".*

The student-centered orientation is emphasized by Pickering quoting Illich (Pickering 1995): "teaching is about authority, learning is about autonomy". There is a severe change to the students' role as well. According to Sherry and Wilson (1998) the process of student-centered instruction lends itself to an awakening within the students - a realization that the educator is not the sole authority or repository of answers, and that the answers to real problems aren't as simple as they might seem.

Distance collaborative learning will make a difference only if it incorporates methodologies and material that provide support for teachers who are learning to implement nontraditional activities in their classrooms. Lack of know-how, loss of control and loss of privacy are grounds for educators' reluctance to embrace distant learning projects.

## **2.5 Teacher, student, author, designer: models for role-playing**

According to Porritt (1997) the learning process models are networks of four roles connected by four processes. The roles are known as student, educator, author and

designer (identified as **s**, **t**, **a** and **d**). The student and the educator are users; the author and the designer are developers. The educator and the author are experts in the relevant subject while the designer produces learning materials to be used by the student based on author's contribution. It is possible for several people to perform one role and it is possible for one person to perform several roles.

The processes that connect the different roles are teaching, authoring, study and evaluation.

Some of the possible models are the following:

### **Educator Designer**

In this model the roles of educator, author and designer are all performed by the same person. It represents the one-man band approach common in the early development of learning technology where an enthusiastic educator adopts an authoring system and produces material primarily for use with his or her own students. This offers maximal communication, relevance, flexibility and staff utilization but minimal portability, quality assurance and economy of scale (see figure 3).

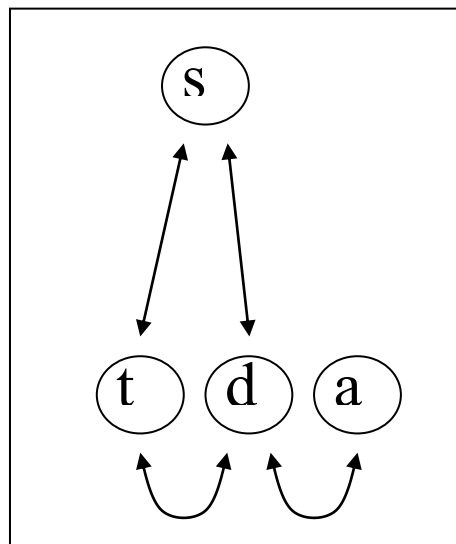


**Figure 3:** *The educator designer model represents the one-man band approach common in the early development of learning technology where an enthusiastic educator adopts an authoring system and produces material primarily for use with his or her own students.*

### **Author Designer**

The designer is an expert so he/she can be implicated in the authoring process alone. This enables the development to be rapid and responsive, but adds pressure to the evaluation process (see figure 4).

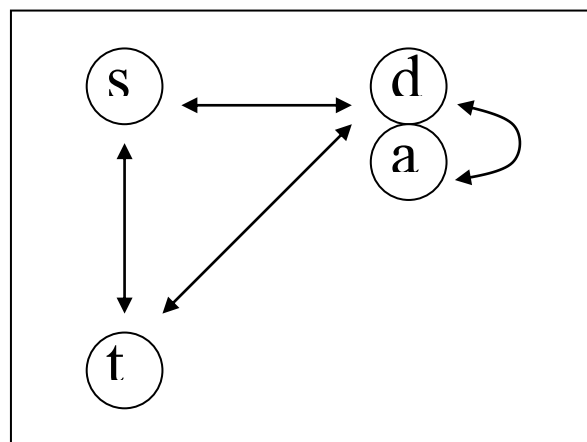


**Figure 4:** *The author designer model represents the best approach for fast development of the educational material.*

### **Educator Author**

This model represents the situation where individual educators write their own materials using a designer. This ensures that the materials are closely tailored to the course and that the educator's style is followed. It does not offer the economy of many educators using the material written by a separate author (see figure 5).

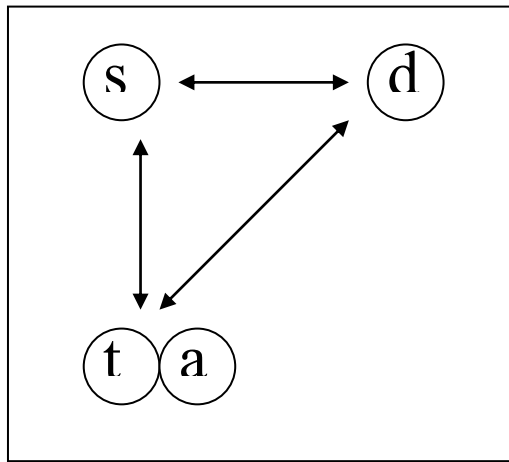


**Figure 5:** *The educator author model ensures that the materials are closely tailored to the course and that the educator's style is followed.*

### Open authoring

In this case the educator involved in teaching is distinct from the author. This has resource advantages because it enables a small team of researchers to generate materials for a large group of users, but the distancing effect could reduce the relevance and quality of application of the materials (see figure 6).

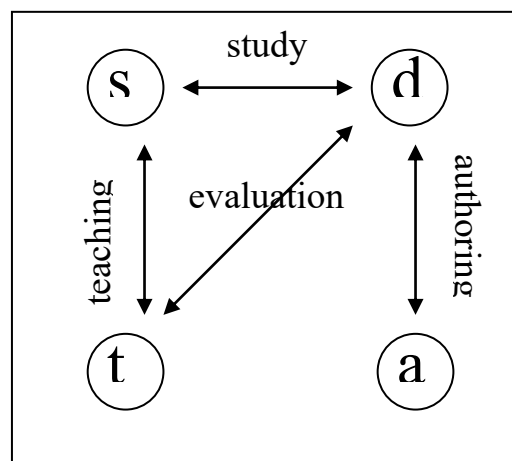


**Figure 6:** *The open authoring model has many resource advantages because it enables a small team of researchers to generate materials for a large group of users.*

## 2.6 The YouRA Model – Axes and roles

The collaborative model, which was adopted in the case of the YouRA project is described in figure 7. Groups of students, guided by educators collaborated mainly through a web-based educational software in order to study meteorological problems in order to come to commonly acceptable conclusions. Pedagogical departments (authoring) and field experts (software design) were also involved. The group of educators was the crucial link for the projects implementation. Their interaction with the students determined the success of the project.

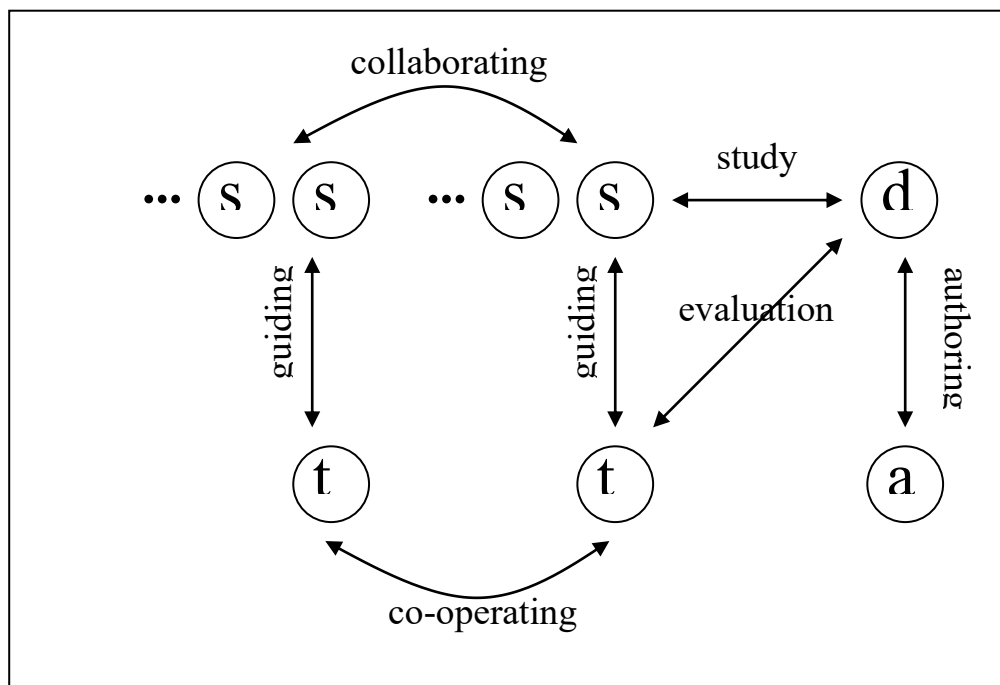


**Figure 7:** *The collaboration approach applied in the framework of the project's implementation in the classroom.*

The project's structure could also be described using a framework as indicated in figure 8, where the main axes (horizontal lines) of the project's framework are presented. This representation acknowledges the work of Reeves (1998):

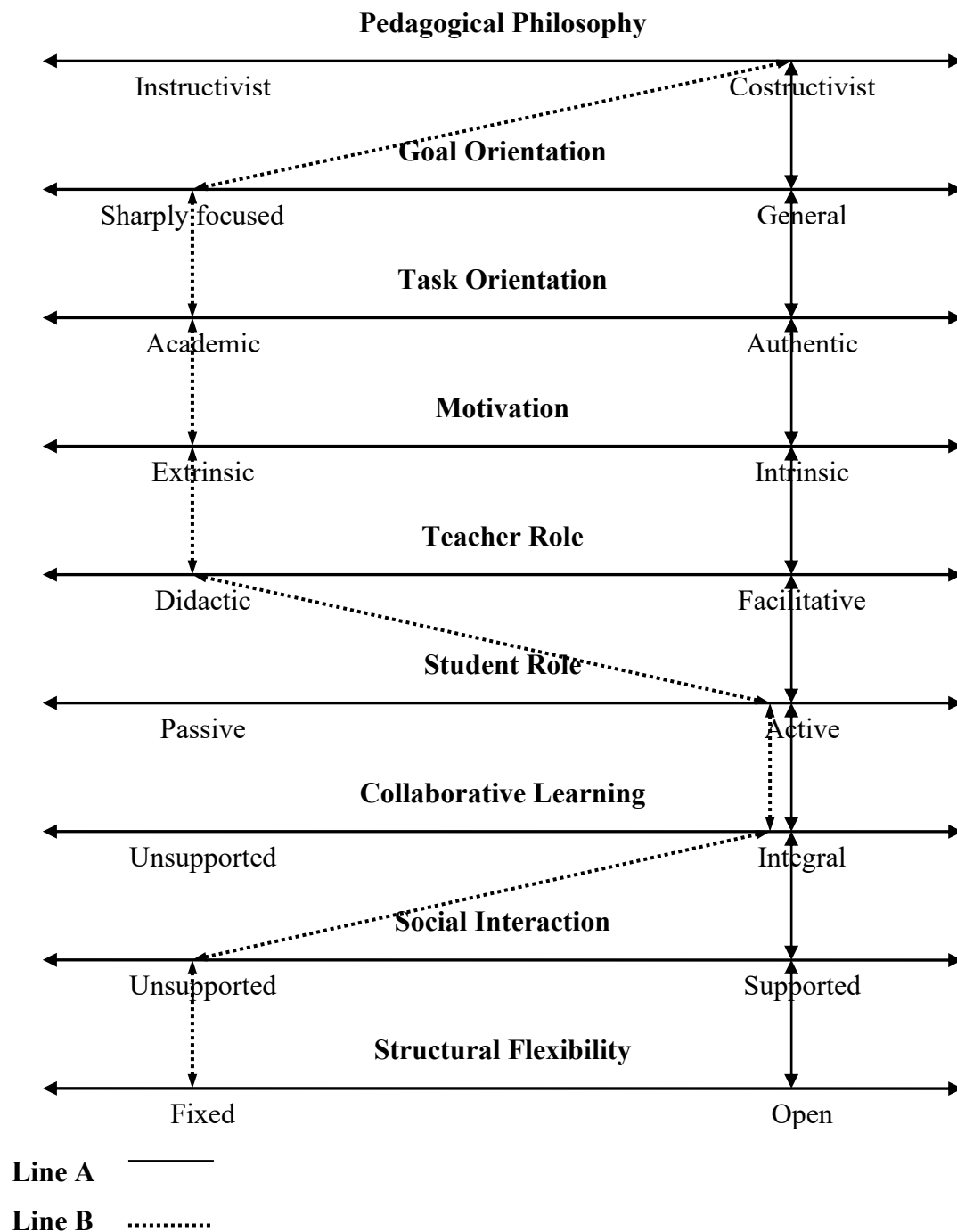


**Figure 8:** *Line A indicates the basic axes of the implementation of YouRA project. Line B refers to a hypothetical project implemented within a conventional classroom within the framework of the existing curriculum with the same general goals but without the use of the Web.*

Line A refers to the YouRA project as it was implemented while the line B refers to a hypothetical project implemented within a conventional classroom within the framework of the existing curriculum with the same general goals but without the use of the web. Both projects share the same pedagogical philosophy. Constructivism is their starting point. Great emphasis is put on learners, who are not viewed as passive recipients of instruction. It is paramount for constructivists that learning environments are as rich and diverse as possible. It is obvious that the need for rich learning environment is satisfied better in a web based project.

The conventional project would have to serve only sharply focused learning goals such as the use of measuring devices or the interpretation of a graphical representation of data. The YouRA project served -apart from the above mentioned- more general goals such as the promotion of social and international interactions among the participating students or the acquisition of technical skills concerning the use of new technologies from the citizens of tomorrow.

The YouRA project was designed to focus authentic tasks relevant to learners rather than academic ones. In a conventional project the students would have to take measurements in order to fill some workbooks and resolve some “scientific” problems. On the contrary a more authentic approach would involve real life situations like the (interpretation of) a daily weather report or study of international (or domestic) environmental problems in a worldwide collaboration.

The motivation to participate in an international project where groups of students collaborate (with a sense of a healthy competition) is more likely to be intrinsic. A conventional classroom project on the other hand many times provides extrinsic motives for participation where the source of motivation is outside the learning environment (i.e. getting higher grades).

While on the previous categories the boundaries cannot be strictly defined (elements from both ends of the axes could be found -more or less - in both projects) there is one area where there is a definite distinction. The role of the teacher in a web-based collaborative project could not be other than the role of the facilitator. The students need guidance in finding their way towards learning and not lectures in a teacher-centered environment.

Also the role of the student needs to be revised. Now the student is an active participant to the project where his ability to collaborate (or not) with his classmates (from a distance or not) defines the course of the project. Passive "knowledge" receivers of yesterday are asked to work together to accomplish shared goals. When a web-based project is structured to foster cooperative learning, learners can benefit both instructionally and socially.

The social interaction among the students plays a significant role in collaborative learning creating an attractive learning environment and providing a more intrinsic motivation to participation. While a conventional classroom prohibits social interaction - at least during the class hours -, social interaction is an invaluable element in a web based learning environment acting as a strong connecting element between "virtual" and "real" classmates.

A learning environment can be "fixed" or "open" with respect to time and place. While a conventional classroom lesson is strictly fixed in time (45-50 minutes) and place (school) the web is more suitable for asynchronous learning environments.

Videoconferences and Bulletin Boards extend the timetable and the physical boundaries of the classroom. It can also support autonomous learning allowing individual progress at one's own pace.

# ODL and school curriculum

## 3.1 Reshaping the existing curriculum

Technology has the potential to transform education, not by just providing students with an opportunity to learn the tools of the modern workplace, nor simply by automating aspects of the educational process. Its greater potential lies in the ability to change the organization of classes, from teacher-centered didactic instruction to student-centered collaborative inquiry. ODL should address concerns such as integration to the curriculum.

In a systematic study and analysis of classroom practices continuing over a century, Cuban ([Cuban, 1993 as cited in Relan & Gillani, 1998](#)) describes classroom instruction as a model stretching from a teacher-centered to student-centered approach. The author observes that in a teacher-centered approach:

- a. teacher talk exceeds student talk;
- b. instruction occurs frequently with the whole class; small group or individual instruction occurs less often;
- c. use of class time is largely determined by the teacher;
- d. teachers look upon the textbook to guide curricular and instructional decision making; and
- e. classroom furniture is arranged into rows of desks or chairs facing a chalkboard.

In a student-centered approach, on the other hand, “students exercise a substantial degree of responsibility for what is taught, how it is learned, and for movement within a classroom”. Thus, at this end of the spectrum of classroom practices:

- a. student talk is equal or greater than teacher talk
- b. most instruction occurs in small groups
- c. students help choose the content to be organized and learned

- d. teachers permit students to determine partially or completely the rules of behavior, classroom rewards and punishment
- e. varied instructional materials are used independently or in small groups determined by the group or the individual; and
- f. furniture is arranged so that students can work in groups or individually

The barriers impeding the development of distance education are not technological, nor even pedagogical. Plenty of technology is available, and teachers and pedagogists have a fair knowledge of how to use it. The major problems are associated with organizational change, change of faculty roles and change in administrative structures. For the teacher who attempts to provide distance teaching in spite of the absence of a reward system – the limitations of working with a conventional administration become apparent very quickly. For example, designing good-quality distance teaching material takes time, as well as teamwork in order to produce and deliver it. Therefore, it is impossible for a teacher to design a distance learning course for future presentation. Yet the administrative structures of the educational institutions seldom make provision for the release of the teacher for time (a year is recommended) to work with the graphic designers, instructional designers, evaluation specialists, video and audio specialists, and others to develop a program for later presentation. By requiring all teaching to be in the here-and-now, administrations set up an insurmountable barrier to the development of high quality distance education programs.

### **3.2 Making space in the school curriculum for collaborative learning**

Since technology is most commonly used in every day life to disseminate information, there is a tendency of educational institutions to equate presentation of information from a distance with distance education. A study from Sheard, Postema & Markham, 1999, concluded that students are enthusiastic about web resources but they find resources in paper form more useful than in electronic form; students are still dependent on paper for their learning. A good quality distance education project not only delivers high quality presentation of information, but also provides high quality personal experience for every individual student to interact with that information and with other students in such a way that the student can process

information into personal knowledge. There is no room in the curriculum for a teacher teaching from a distance to a conventional classroom. Students will get very quickly disappointed with the boring way of communicating information and they will find it very difficult to concentrate to the teacher's face, gestures and voice after 10 minutes (Moore 1998). The key word for having self-motivated students and forcing the curriculum for emptying the necessary space is collaborative learning. As an add-on service a web-based educational software that supports collaborative learning has a firm place even to the existing curriculum. A few "technical" and "land-planning" problems then remain to be solved: are there available computers in the classroom or the whole class should move to the classroom with the PC's?

When students interact with one another, with an educator, and with ideas, new information is acquired, interpreted, and made meaningful. Such interactions form the foundation of a community of students. If students feel they are part of a community, they are more apt to be motivated to seek solutions to their problems and to succeed (IDE 1998). The challenge for distance educators is to develop strategies and techniques for establishing and maintaining "learning communities" among learners separated by space and time.

Project work is clearly not just a teaching method but rather a curriculum design process (Morgan 1984) with two major dimensions: project intentions (academic topics versus real-world issues in a social and political context) and control (teacher-centered versus students-centered). These two dimensions are represented in figure 8.

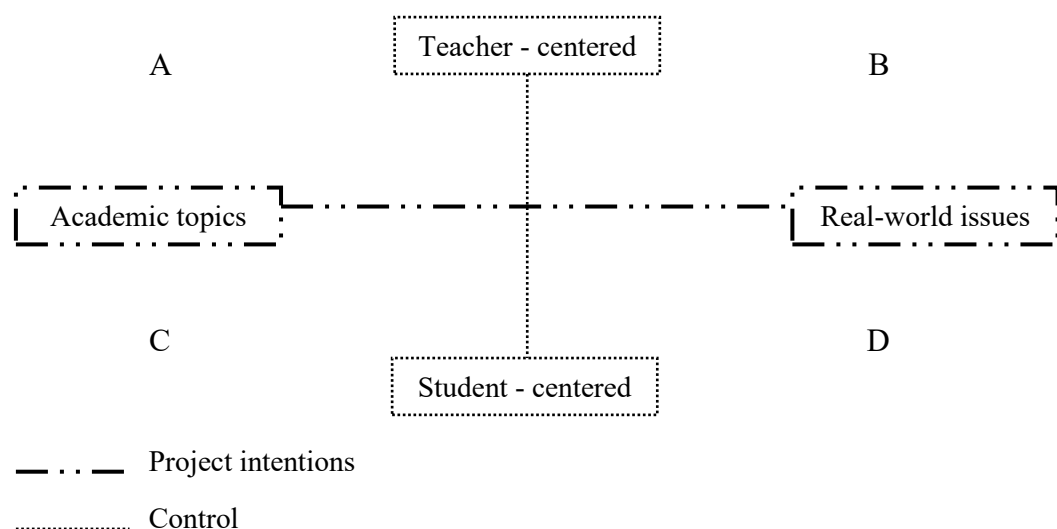


**Figure 8:** *The curriculum design is a process that develops across two dimensions, project intentions (academic topics versus real-world issues in a social and political context) and control (teacher-centered versus students-centered)*

Curriculum developers are free to move in the four different quadrants (A, B, C and D) of the above matrix. It is obvious that the proposed area is D (especially in Primary education), as it is likely to encourage students to adopt a more personal, intrinsic orientation for their learning.

### **3.3 Key points in the new approach**

Reshaping organizational practices and total transform of existing educational institutions of primary and secondary education in order to implement an ODL project is not possible neither proposed. There must be a long period of assimilation of the new technology by the teachers in order to change from ground the educational institution. By then the partial integration with the curriculum of the new educational tools are more than welcomed and absolutely feasible. That by all means should not lead to thoughtless insertion of ODL practices in primary and secondary but to carefully designed and well-planned distance learning projects. So, a more open, experiential, student-led, collaborative curriculum that defines the educational aims but leaves significant space for new educational practices is required.

Successful technological innovations must take into consideration the social and political climate of the school, and must also reinforce the authority of the teacher rather than undermine it (Sherry 1996). The curriculum should aim to provide a learning environment that contains opportunities for students to (Fowell, Levy and Riding 1996):

- engage in practical activity;
- reflect on this activity in order to reconcile and integrate it with their previous knowledge;

The efficacy of the reflection in allowing students to reconcile new experiences with existing knowledge is enhanced if the reflection is carried out socially; that is, if the students are allowed to articulate their interpretations of their experiences and share them with others, be they educators or fellow students.

To sustain the move toward a more liberal curriculum, online learning environments and the continual reassessment of the role of teaching and learning will be reliant upon (Carrucan & Lambert 1999):

- *An administration committed to the emerging curriculum.*
- *An ongoing budget plan to sustain the investment in related technology.*
- *The development of new specialized jobs and resources to assist staff in the development of online and interactive curriculum.*
- *Ongoing professional development programs to empower staff.*

Most teachers come to distance education with traditional teaching experience and find that the theoretical-based assumptions that worked successfully in face-to-face instruction do not translate well into technologically mediated instruction (Schieman, Taire & McLaren 1992 cited by Parker 1996).
- *School building and timetable reform changes to accommodate a changing curriculum.*
- *Speed and availability of access between disparate and remote locations.*

# Web-based Educational Software

*As the fable of the Emperor's new clothes aptly captures,  
children are often recognised for their audacious innocence.  
How can we tap into their way of thinking and seeing so as to help  
redress issues common to us all? In what way can young people  
be a contributing force in helping us shape the information society?  
Given that contributions from children cannot always be  
treated in traditional ways, how can this be done in way that is  
meaningful to both children and the adults involved?  
IST Coference, Helsinki, Finland, November 1999*

## 4.1 Student centered design process

There is no cause and effect relationship between cost of technology and quality of a distance education project. There is, however, a direct relationship between the quality of the project and the quality of the design process (Moore 1998).

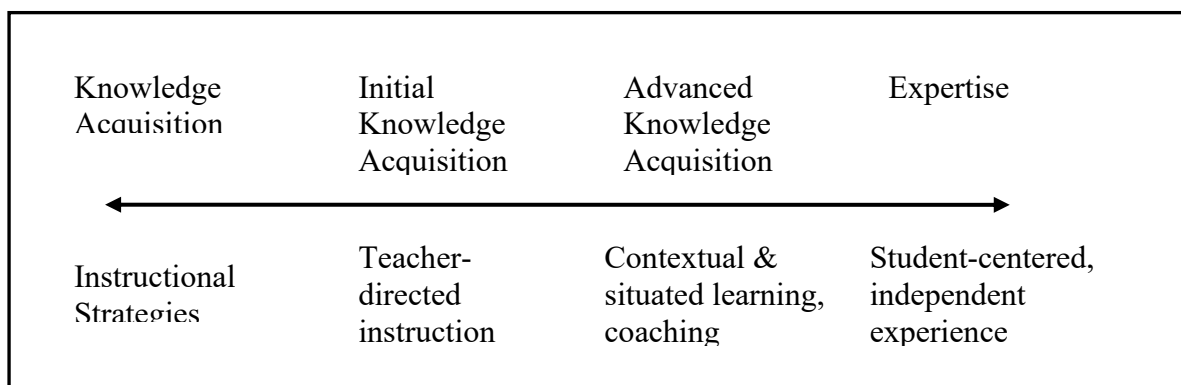
It is becoming increasingly important to ascertain the effectiveness of the technology in pedagogical terms. This reinforces the point that utilizing the web for instructional purposes does not imply one method of instruction. While at one level the medium is the Internet, at another level the medium is the pedagogy (Burnett 1999). Moreover, if the technology is implemented without a concurrent change in pedagogy, the use of the web - and the technology in general - will not guarantee learning any more than a campus library guarantees learning (Sherry and Wilson 1998). Up to now the involvement of the pedagogical community in the development of the innovative technology was relatively small. In most cases the educational experts are just criticising technological applications, usually negatively (e.g. video games, hand held computer games). Furthermore teachers and students are excluded from any contribution to this development. As far as it concerns educational applications, the technological innovation must be designed with educational targets and criteria.

During the development of the educational software students and teachers should come together with science researchers, psychologists, and technological and educational experts to contribute to the re-engineering of the school of tomorrow and test and evaluate the new ideas, concepts and technologies in real school environments. The web based tools, developed with the collaborative effort of academics, software developers, teachers and students, should serve as the connecting link between research and the users. The tools must be the result of scientific pedagogical research, applications of innovative technology and finally add-ons to the educational process that serve clear educational needs expressed by teachers.

A successful architecture for web-based collaborative learning environments must be extremely robust and open. It is very important that the architecture itself is closely wedded to one particular theory or approach to education, because we must expect that our theories evolve with the time and improve as we conduct research and as we observe the tools that we develop in use. In fact, an ideal architecture encourages the development of a variety of different instructional approaches.

The process of exploring the web is in itself an educational experience ([Hobbs & Taylor 1996](#)). There are, however, more structured ways that the web can be used in educational context.

According to Jonassen, Mayes & McAleese (1993) the choice of information organization for web materials depends on the nature of the intended learning outcomes ([as cited in Oliver, Herrington & Arshad 1996](#)). They provide a guide for the selection of instructional strategies against knowledge acquisition aims.



For higher levels of knowledge, for example, by developing an understanding of concepts and principles, learners can benefit from the freedom to browse and explore, to inquire and seek responses to their own questions rather than by following a pre-determined path of instruction.

## **4.2 Designing web-based educational environments**

Special attention should be paid to psychological issues related to “electronic” learning environments, such as the impact of the design of the learning environment on the learning process. There are a number of guidelines ([Oliver, Herrington & Arshad 1996](#)) suggested by experts in the field, which can function in such a way so as to minimize the amount of mental and cognitive activity associated with controlling the interface.

Designers suggest a variety of techniques to help users around information packages. These include ([Hedberg, Brown & Arrighi 1998](#)):

- use of color to identify the area or main path;
- the position of elements in screen to indicate their relationship to the underlying metaphor or the separation of positional navigation choices from the functional options
- simple use of contextual clues, regular use of a standard format of basic word style format to indicate links with other sources of information
- written directions which appear in separate areas or windows to facilitate understanding of the underlying information structure
- simplified mnemonics or preferably the use of pictures to provide standard and immediately comprehensible support for navigation or learning

Brooks (1993) suggests a need for simplicity and consistence in design. When screens change, the only thing that should change too should be the specific information to which the learner is being directed. Buttons and controlling features should remain in the same place and should be intuitive rather than clever in their design. Typographic clues, color changes and unnecessary graphics all have the potential to distract and should be used sparingly.

A growing number of research projects have started to investigate the use of animated agents in the software interface ([Andre et al, 1997](#)). For educational systems on the web, these animated agents are a promising option as they make presentations more lively and appealing, and even allow for emulation of styles known from personal human-human communication.

# Organisational and technical aspects of an ODL project

## 5.1 Managerial aspect

The answer to the question “Is distance teaching more work or less?” should be that it is neither. It should not be a question of having less work or more work than in conventional classrooms, but getting better quality out of the same effort as a result of that effort being more effectively organized and applied ([Moore 2000](#)).

Sherron (1998) has a different opinion: "The added workload, even with added resources, is probably the toughest issue in distance learning". Chizmar and Williams (1997) comment about on-line teaching "The overwhelming time demands of Internet instruction is a major obstacle; it is clear that the overall time commitment to this kind of teaching far exceeds that of teaching students in classrooms".

The e-Hermes project ([Apostolakis et al., 1999](#)) showed the necessity of a coordinator, which means a person that has no teaching responsibilities but only organizational ones. Moore ([Moore 1995](#)) described the main characteristics of a good coordinator. The first requirement of a site coordinator is the ability to communicate effectively with the educator, the students, and the community in which the project is implemented. While a coordinator can be invaluable in helping to design and teach the course and in numerous other ways, above all this person must be willing and able to communicate effectively when problems arising. The last thing the educator wants is the insecurity that results from not knowing what may be going on at a distant site; the educator must be absolutely confident that the coordinator will provide full information promptly, even when the news are not good. That was the case when a participant for example delayed the delivery of a contribution to the project's magazine. The coordinator was the one who straightened things up. The coordinator must also have the ability to communicate well with the local community. In the YouRA project contact was made with newspapers in order to promote nationwide the

project. The coordinator must have sufficient technical knowledge in order to recognize potential problems that may occur during the projects implementation so as to take appropriate preventive or remedial action. The coordinator should also have instructional competence. The educator wants a coordinator who is able to discuss the project during its design stage and give input based on specific perspectives and needs. In the YouRA project the coordinator was present and had an active participation throughout all stages of the project: design, implementation, evaluation and dissemination. That gave to the project the necessary consistency in pursuing its primary goals.

## 5.2 Technical aspect

Effective utilization of inadequate computer resources is often the key-point in an ODL project. In the YouRA project widespread media and communication standards were used, so that all media and most functionality were made accessible through software (web browsers) available in all platforms. This provided universal access from a uniform, familiar interface. But the ratio of resources for design and course preparation compared to course implementation is general higher in distance learning than in conventional training (Moore 1996).

The Web-based educational software uses *client-server* technology to enable users of “lightweight” platforms to have access to “heavyweight” functionality, namely a graphical interface on an adequately configured server machine.

According to Klingenstein (1998) as we sort through the technological issues in building effective widespread virtual learning environments, it is useful to categorize technologies into four groups:

- *Delivery systems* - technologies such as on campus and residential networking, Internet, video servers and so forth.
- *Middleware* - the "glue" pieces, such as authentication, authorization, customization, and localization, that transform raw delivery into viable service offerings.

- *Creatingware* - tools such as authoring tools, Java libraries, multimedia editing systems, etc, that allow authors and subject experts to develop electronic materials.
- *Administrative support* - the systems that track not only the students but also the online educational materials

Some of these areas, such as delivery systems, are further along than others, such as creationware, but all are still relatively immature.

# The YouRA project

## 6.1 Project's description

“Young Researchers in Action” project aimed to the development and application of a pedagogical framework suitable for ODL's implementation to pupils aged 10-13 and in parallel to the provision of in service training to teachers in the field of ODL.

The project was developed across two main parallel aspects:

- a) Development and application of a methodology, which helps to overcome the specific difficulties, related to the effort of implementation of ODL practices to young school students (such as lingual problems, familiarization with the use of ICT etc). The collaboration aimed to the development of user interfaces based on non-verbal communication, the introduction of students to the successful use of ICT and their introduction to scientific inquiry techniques. Through the YouRA approach pupils were gradually introduced to the idea that learning is the result of formulating questions, researching, investigating and finally sharing results.
- b) Provision of in service training to educators and students of pedagogical departments based a hands on experience of ODL application in school. Educators of the participating schools as well as students of the participating Universities were provided with both the theoretical knowledge necessary for application of modern ICT in transnational projects as well as a hands on experience of ODL implementation.

The innovation of the project lies in the idea that both above-mentioned aspects evolved in parallel. In-service trainees influenced the planning of the application in school and vise-versa, results from the application in school affected the planning of the in-service training.

## 6.2 Aims and objectives

The main goal of the project was the transfer of experience and good practice from the higher level of education to the upper primary school as well as the determination of the necessary degree of adoption. More specific the objectives of the YouRA project were:

- Provision of arguments in favor of ODL's application at the lower level of education.
- Development of a pedagogical framework suitable for ODL's application in the upper primary school. The degree of necessary adaptation as well as the pedagogical, technical and organisational parameters for a successful implementation were to be determined.
- Dissemination of arguments in favour of ODL's application to younger students through a hands on in-service teachers training.
- Improvement of quality and user-friendliness of ODL methods and products.
- Development of user interfaces that would allow for an effective students communication. Specific age-related problems, such as lingual ability restrictions, degree of ability to handle ICT etc. were confronted.
- Familiarisation of students with the use of ICT.
- Introduction of students to the principles of scientific methodology, with emphasis on the aspect of sharing data and communicating results with remotely located co-operating persons.
- Introduction of students to the idea of transnational co-operation. Promotion of the advantages the co-operation with remotely located students offers.
- Gradual introduction of students to the graphical representation techniques (from simple icons to more complex plots)
- Familiarisation of students with the idea of data acquisition and analyses (construction of simple measuring devices, data entry in special designed software forms, comparison with data from other locations etc)
- Transmission of the "active researcher" experience to the students. (based on the specific example of weather observation ).

Educators and students of pedagogical departments (potential deliverers of ODL) were directly addressed by **in-service training seminars** that were organised by the participating Universities. They were expected to act as multipliers who would disseminate the idea of ODL application in the upper primary/lower secondary school sector in the educators' society. Conventional dissemination policies may be addressing a wide public, the effectiveness though of their impact is questionable. Although many may hear a presentation in a conference or read a paper, very few will be motivated enough by a presentation or a paper to actually try out and apply in their class what they have heard or read. In contrast the seminars that were organised during the first year of the project may have addressed a smaller group, but definitely offered to those participating more convincing arguments in favor of ODL.

The project aimed to expand the field of ODL's application by developing a framework that would allow its introduction to classes of students aged 10-13. Developing a framework that would allow for the introduction of ODL practices to this level of education clearly opened new ways and prospects, since it introduced the idea of remote collaboration and transnational cooperation to even younger student groups.

The YouRA project enhanced the applicability of ODL in the target group addressed. A suitable software interface, the e-com, was developed by adopting a user-centred design in order to allow for a more effective application of ICT in everyday teaching. The interface was designed in a way that allowed for confrontation of specific, age related, difficulties such as lingual abilities related problems restricting communication, lack on experience on using ICT etc.

The aim of the project was to demonstrate the formation of a virtual open school society where students discussed, exchanged ideas and got familiarised with the use of new interactive ICT tools. Verbal and non-verbal communication forms as well as the e-com in general were tested during **the first cycle of school centred work (test run)** so that the appropriate level of communication for an effective implementation of ODL would be determined. Regular videoconferences, Bulletin Boards, drawing exchanges etc were tested and evaluated concerning their resonance to the specific target group. The e-com was improved and finalised after the test run, in order to be

used in the **second cycle of school - centred work (final run)**. The establishment of a steady and continuous communication among students from various countries at this early age was considered as an essential innovative parameter of this application. Introducing the idea of transnational cooperation to students at this early age is undoubtedly addressed the very essentials of the ODL action of the SOCRATES programme.

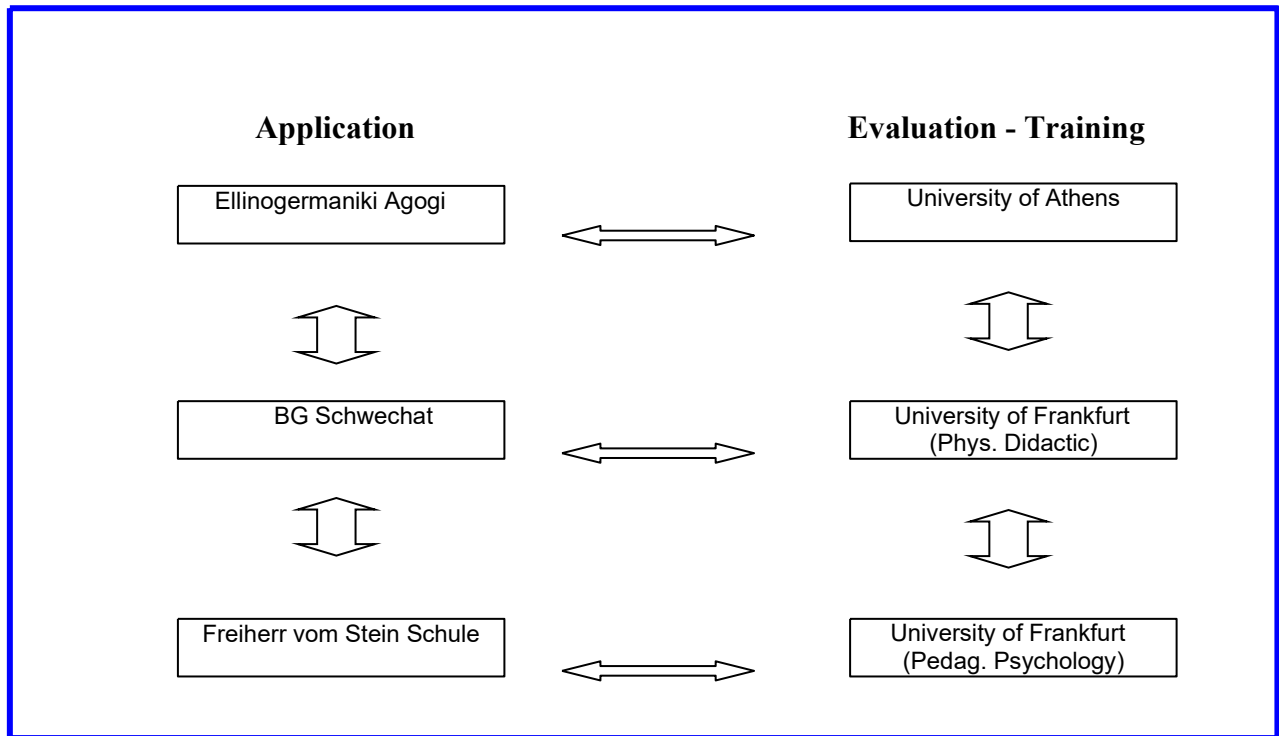
### **6.3 Organisational approach and structure**

Management can be thought of as four functions: planning, organising, motivating and controlling. In the YouRA project the following managerial aspects were considered, having in mind a primary school that runs an ODL project:

- Teachers training
- Incorporation of the project's activities to the curriculum
- Appointing, inducting teachers and monitoring their work
- Evaluation
- Managing financial aspects

Furthermore, emphasis was given in the adaptation of a user-centred design that allowed students and teachers the chance to offer their input in the development procedure of the innovative tools.

All above-mentioned functions were to a certain degree performed by all institutions, University Institutions and schools. The Universities undertook the design, research and evaluation, while the schools tested and implemented the research activities. The methodology adopted is presented schematically in the following diagram.



Nonetheless, co-operation was very intense, especially because of the complementary nature of the contributions of both schools and Universities.

The general organisational approach and structure was set in the two partners' meetings. The meetings of the project were organised in Athens and in Frankfurt during November 1999 and September 2000. During the meetings representatives from all the participating institutions had the chance to discuss in detail all the organisational aspects of the project and exchange ideas about theoretical and practical issues of projects' implementation.

During the test run the YouRA project was introduced in the classroom at the three participating schools. The activities undertaken during the project's test run were evaluated in order to allow for the partnership to perform the appropriate modifications and improvements to the didactical approach. According to the experience gained from the use of e-com during the test run, the final determination of the structure of the user-interface was made. At the final run ten more schools, selected according to socioeconomic and geographical criteria, participated, in order to have the project tested in a much wider scale.

The applied methodology ensured the active participation of all partner parties, as it proceeded in the following way: first a prototype version of the tool was developed according to the guidelines of the academics. Teachers were also involved in this stage providing significant input from their teaching experience. A test run (first cycle of school-centred work) was performed, in which the tool was tested and evaluated in real conditions. The final run (second cycle of school-centred work) followed the evaluation of the test run. The improvements and the appropriate modifications were made and the final version of the tool was used in the final run in the second year of the project. These cycles of school-centred work were not only meant for evaluation purposes (technological and pedagogical) but involve teachers and students in giving direction to the project and its technological and pedagogical results. The aim was to help both teachers and students reach beyond “clichés” to the areas in which they could make **the most valuable contributions**, and **potentially increase their role in the project**. To assure maximal usability of the new tool, optimal adaptation to the local environments and realistic evaluation of the pedagogical effects, the developed software add-on used a heavily **student-centre approach**.

#### **6.4 Pedagogical and didactic approach**

Open learning should be based on the «learning by doing» principle. Almost all learning happens best when coupled with experience, practice, trial-and-error and hands-on activity. The student's self-action must be the leading element in the teaching process. The learning environments are dependent upon the students traversing their own pathways, asking questions, finding analogies, experimenting and exploring their surroundings.

The main pedagogical and didactic approaches adopted in the YouRA project, which were results of the long research articles and experience of the partners, for the establishment of the project's effective learning environment were the following:

- **Enhancement of a constructionist approach in science teaching.**

Usually pre-designed experiments are used in science teaching. In the framework of the YouRA project students were able to use the instruments they constructed and perform them autonomously. In this way the procedure of scientific inquiry was fully simulated: experiment design, measurement, evaluation and comparison are the steps that allowed for a deeper understanding of the science concepts. The partnership believes that this approach acted as a qualitative upgrade to everyday teaching for several reasons:

**Motivation:** Students were more likely to feel a sense of personal investment in a scientific investigation, as they actively participate in the research procedure. Preliminary results on the teachers' observations reinforce this belief.

**Developing critical capacity:** Too often students accept the readings of scientific instruments without question. When students got involved in the proposed activities for example by measuring physical parameters, they should as a result develop a healthy scepticism about the readings and a more subtle understanding of the nature of the scientific information and knowledge.

**Making connections to underlying concepts:** In the measuring process students developed a deeper understanding of the scientific concepts underlying the investigation.

- **The development of new educational tools and learning environments.**

The partnership developed a user interface to be an adding on tool, a software educational tool that supports teachers and students in the new learning scheme. The main emphasis on the user interface was the improvement of the interaction between students and the universe of digital services.

- **The development of an interdisciplinary model in current educational practice.** It is held that interdisciplinarity is crucial towards enhancing the effectiveness of education, since it provides a unique way of strengthening

learning processes, such as discovering analogies, similarities etc., while providing application examples, which are inherently closer to real world problems. The main link missing usually in the learning process is that students do not learn sufficiently through experience but through a systemic model based approach, which is not (as it should be) based on culmination of learning efforts and not the initiation. A particularly disturbing phenomenon, that is common knowledge among educators, is that students fail to see the interconnections between closely linked phenomena or fail to understand the links of their knowledge to everyday applications. Therefore, in recent years, there is a **clear focus on interdisciplinary education**. This approach supports that educational experiences should be authentic and encourage students to **become active learners, discover and construct knowledge**. Authentic educational experiences are those that reflect real life, which is multifaceted rather than divided into neat subject-matter packages. Indeed, interdisciplinary instruction exploits the natural and logical connections that cut across content areas and is organized around questions, themes, problems, or projects rather than traditional subject-matter boundaries. Artificial barriers among subject areas are eliminated and students are given a broader context for solving real-life problems, which demands the development of analytical, interpretive and evaluative skills used in many subject-matter areas. This kind of learning is definitely of greater value to students. On the other hand, teachers are faced with a real challenge. Having been specialised in an academic discipline may cause frustration to them when it comes to creating interdisciplinary, cross-curricular activities. Such activities demand considerable knowledge in many areas, which they may lack. Collaboration with their colleagues may help them overcome this challenge, develop positive attitudes to interdisciplinary learning so as to gradually adopt it and make it part of their teaching practice.

- **Learning should be a collaborative experience:** It is widely held that increased students participation stimulates interest and enhances learning. The electronic tool was developed to facilitate the creation of a “virtual classroom”. In this new classroom students and teachers from European countries came into contact exchanging ideas and experiences. Every possible aspect of a conventional classroom was simulated. In a real classroom students’ collaboration and

interaction is one of the most essential characteristics of success of the didactical approach. This comparison forms the stimuli for a dialogue with virtual classmates through various communication channels the electronic tool platform offered (bulletin board, videoconference, electronic publication of project's magazine). During this dialogue questions or comments of one pupil were addressed and answered from a remotely located classmate or teacher. Through the use of the tools and their involvement in the above-mentioned projects, students from European countries started getting to know each other and thus cultural elements were transmitted. This goal of promoting transnational cooperation and the use of new technologies to overcome barriers to physical mobility was targeted with the use of the electronic tool.

- **Pedagogical and technological innovations have to be systematically evaluated.** Most electronic tools (software, CD-ROMs, Internet sites) used in education have never being concretely evaluated. The YouRA consortium stated right from the beginning that the evaluation of the pedagogical impact of the tools was a very important aspect. The didactic approach of the project was evaluated according to an academic valid scheme, based on well-defined methodologies. The aim is to develop a better theoretical framework on how different types of tools and learning environments support different types of thinking, reasoning and understanding. From this accurate evaluation scheme arguments in favour of the need for wider spread of new practices in everyday teaching arose.

### **6.5 Introduction of the YouRA project to the school curriculum**

Primary school teachers are, as a group, very sensitive to the student point of view and are somewhat freed from the demands of the content ([Rieder 1998](#)). Most primary school teachers are also faced with teaching a broad array of subjects, so the concept of integrating subjects in meaningful ways is familiar to them. In the YouRA project the subject of meteorological investigation was chosen because it helps the interdisciplinary approach and is beneficiary not only for the students but for the teachers too. There was a relatively close relation between the meteorological investigation and Science lessons (Physics, Chemistry), Informatics (Internet) and even foreign languages lessons (English, German). And of course there were a lot of

social and cultural effects of the project that a teacher could use to stimulate students in other lessons like Geography or even History. The social channel of communication could be used to support teaching in many ways. The students are the citizens of tomorrow. They should be prepared – among other things - to live in the so-called “global village”<sup>(\*)</sup>. So an interdisciplinary subject is easier to integrate in the curriculum than a “conventional” non-interdisciplinary one because the teacher will have much more time for the project's implementation during the school weekly program. The time factor is critical in an ODL project implemented within the framework of a conventional educational institution. *“We would like to have more time to take measurements, insert the data on the Web and make videoconferences”* stated Anna a 12 years old participant in YouRA.

Another reason for choosing the subject of meteorology was that it gave the opportunity to the students involved in the project to work with themes that are already included in their normal curriculum. This fact was very important in order to have an “experimental” and a “control” group of students for the statistical evaluation of the project (see Chapter 7). In this way the proposed approach to teaching is researched in order to determine whether it is possible to have students actively involved in a learning process without having to go through conventional teaching.

In the YouRA project total emphasis was given to *procedural knowledge* (rules, scientific and experimental procedure) to help with solving familiar scientific problems efficiently rather than *principles knowledge* (physics’ laws). With this fundamental guideline in mind the web software was not a “classic” instructional

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<sup>(\*)</sup>"Since Marshall McLuhan coined the term in the 1960's, few of us have truly understood what the term "global village" means... Yet today, growing thousands of [people] in dozens of countries around the world are living the reality of the global village in personal, hands-on, interactive ways. Through the medium of networking and telecommunications technologies these students are for the first time learning to think of themselves as global citizens, seeing the world, and their place in the world, in ways much different that their parents" (Rogers 1995).

software but an advanced tool to students' hands in order to help them to manipulate data and come more easily to conclusions.

The unavoidable quantitative orientation of the software (as it deals with data) should not be misleading. It's the qualitative approach that the YouRA collaboration set forth to achieve. Special care was given to the elfin factor: it involved the effort a student is willing to invest in pursuing an activity or in accessing a resource, in relation to the learner's current intrinsic interest in the topic (Duchastel & Spahn 1996). The elfin factor embodies a straightforward relationship: the more the effort needed to obtain the desired information, the more the topic must be of interest to the learner. If the required effort is great, only topics of very high interest will be pursued. On the other hand, if the required effort is minimal, then many topics become of interest. As the YouRA web educational software was addressed to students of primary school an effort was made in order the needed effort to access the data to be reduced, while at the same time the potential for interest grew for students.

## 6.6 The use of ICT in the framework of the YouRA project

The educational use of technology was clearly one of the most important aspects of the project. It has to be noted though that technology is not consider as a substitute of the conventional teaching but rather as an add-on that has to justify its introduction through the qualitative upgrade it offers to everyday school practice. The web-centered technology used in the YouRA project had three main aspects:

- **e-com**

Since in this age students do not easily use foreign languages, during **the development of the electronic tool special emphasis was given in the promotion of non-verbal forms of communication, which is based in the use of drawings, photographs and video.** In the electronic tool's data display, the step-to-step abstract thinking and the familiarisation of students in plotting data was endeavoured. Having access to data from all countries, students had the chance to discuss the results of their measurements and study the graphical representations that the electronic tool generated automatically in real time. Using all channels that new technologies offer

(e-mail, bulletin board, videoconference) they exchanged their observations with their virtual classmates and published electronically their results in the site of the project.

The code for supporting the recovery of the data from the database in order to be used from teachers and students was developed in ASP/HTML programming language with the use of VB scripts. Furthermore, a mathematical and analysis tool was implemented in order to support the presentation of the data and the comparison between the different sets of measurements. An SQL database was developed to store the collected data for future use. The development of the interface was based in Javascript and HTML, whereas advanced software tools (e.g. Macromedia Generator, Macromedia Flash) were used for the presentation of the graphical representations. The aim was the developed educational tool was to be a fast processing tool, free from complex procedures, giving students the opportunity to easily access the data on demand. The open architecture of the tool allowed for additions, modifications and improvements in their introduction to the real school environments as well as for future expansion. The e-com allowed for full freedom in the selection of the parameters plotted, the axis, the time window, etc.

In the development of the e-com a student-centred approach was adopted. D. Norman is calling this procedure as **human-centered product development** (Norman, 1998). What is it? “It is a **process** of product development that starts with users and their needs rather than with technology. It starts with a multidisciplinary team that includes representatives from marketing, technology, and user experience. The first task is to determine what the product should be. Although this seems obvious, it is the task most often ignored and most often done too quickly, poorly, and superficially. How does one define the product? Study prospective users: Watch them as they go about their daily lives. Understand what role the proposed product will play. Find activities that are as close as possible to the one the product is intended to support. The goal is to understand the users' true needs, what they care about. Then compile, refine, and analyze the observations to determine what the product might be, what role it would play, what actions it should perform. Go beyond the problem that is given to develop solutions that truly meet the customers' needs”.

The YouRA collaboration believes that this activity-based computing extends the basic assumptions of user-centered design and requirements engineering, because it allows considering the architecture that might be appropriate for a specific learning environment. The approach, which was adopted in the framework of the project, was to using scenario-based design methods as a means of defining suitable applications of technology. A series of **lesson-plans (scenarios)** were developed as the outcome of the teachers' training. These series of lessons were incorporated in the science curriculum of the participating schools during the two cycles of the school-centered work (test and final run).

To promote constructivism, the modelling theory and qualitative reasoning through the e-com, mostly diagrams were used as representational tools. The plots were selected since such tools are essential for competent modelling and problem solving. In a conventional classroom up to now there are two ways to approach diagrams:

- i. Students use already plotted diagrams. In this way they can easily discuss certain issues concerning variable correlations. Two are the main disadvantages of the use of already plotted diagrams. First, students do not really learn how to plot a diagram by simply using it; therefore they do not get to know several technical as well as scientific details (such as scaling, accuracy, fitting etc.), essential elements of plotting. Additionally, since they choose from a given list, they are not free to draw whatever diagram they would like, using any variable, at any time interval etc. In this way they are not free to express their own mental model of the phenomenon.
- ii. In the second approach, students actually draw by themselves the diagrams. In this way they can freely define the axis - variables, the scale etc., and so express their own model and understand all scientific details that lie beneath the technical difficulties. The main problem of this approach is that its implementation takes a lot of time, making it difficult to be used on a wide area of subjects in the science class, although it is expected to be much more effective than the first one.

The e-com went one step further providing students independence in choosing many combination of variables, the scale and additionally many combinations of data onto

comparative charts in real time. In this way it was actually the students who drew the diagram, not the computer, since they set all the parameters. This, by any means, does not imply that students must not draw diagrams by hand. Simply it was the only way to make them use diagrams for every phenomenon they study without losing a lot of time during the lesson or the science laboratory. The benefits of using these diagram-oriented tools were multiple. Students could see how a plot was altered when scale changes. They learned how to choose the diagram scale in order to study a detailed part of a diagram or to have a more general view. Using certain teaching strategies, students were stimulated to use these plots to articulate their own models, to make predictions grounded on them and to make explicit comparisons between their own diagrams and the accepted scientific models.

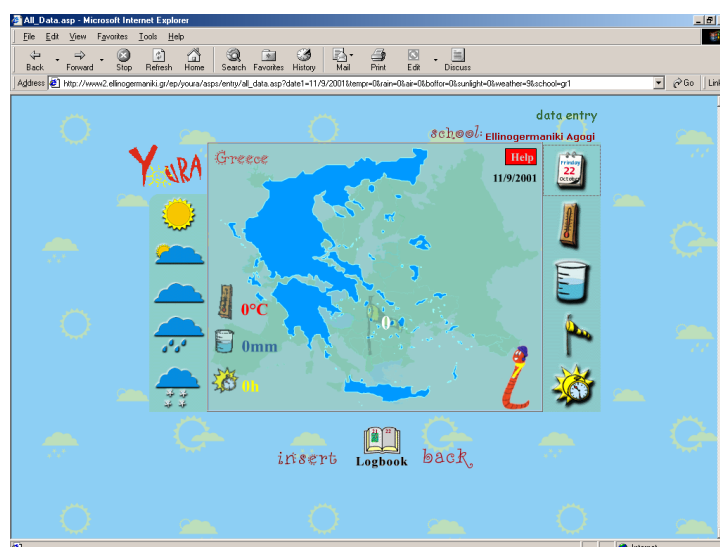


**Figure 9:** *The data submission form of the e-com.*

In the e-com life-like cartoon-style drawings were employed for presenting information (figure 9). Considering the students' age these characters were employed to:

- help the student to navigate through the projects' web site
- attract the student's attention

- convey additional emotional signals via facial expressions and body movements

In the framework of the YouRA the animated agents were mouse sensitive figures, namely four boys and girls who provided a short guide of the basic options of the web-based educational software that had a branching structure allowing for the user to choose one activity among the four possible options: Data input, make comparisons between different countries or parameters, and view the Meteorological Map of Europe (see figure 10).

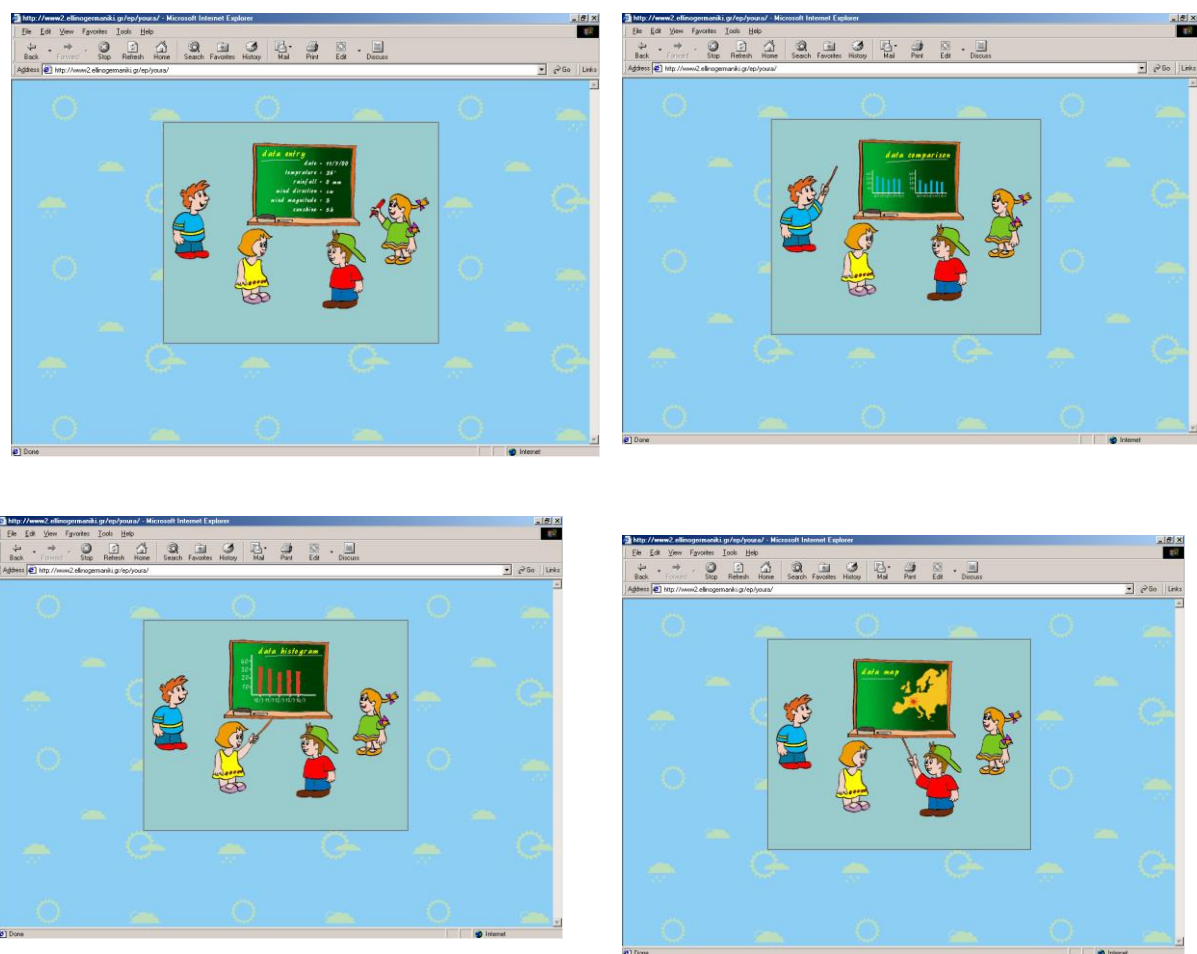


**Figure 10:** The user-interface of the e-com: Students had to click on one character presented in the picture in order to choose the activity they want to perform. Data input, make comparisons between different countries or parameters, and view the Meteorological Map of Europe.

A basic ever seen character throughout the web site was a cartoon-style human-like worm! This character came from a drawing contest about the project's mascot, for which all the students drew a different character (figure 11).

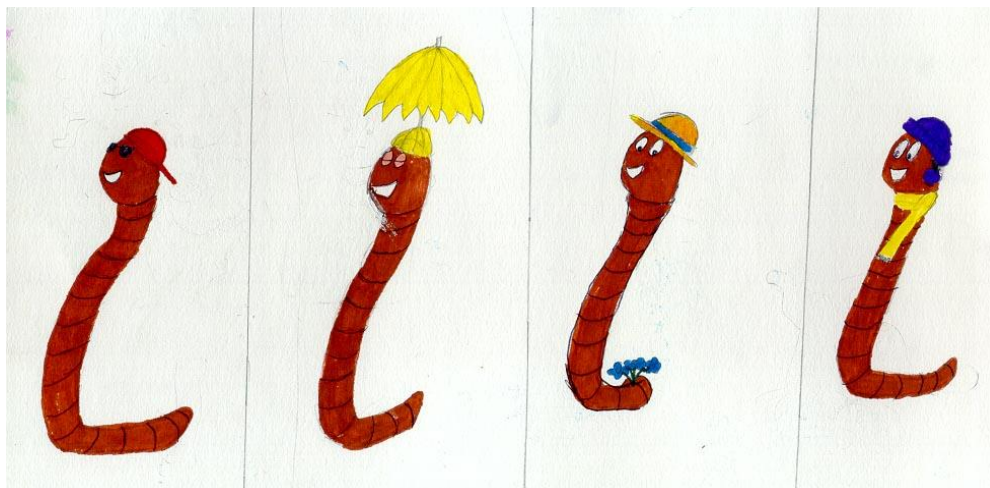


**Figure 11:** *The project's mascot, appearing in all screens of the e-com appeared dressed in various ways according to the temperature value with the help of Flash animation. The original winning drawing of the worm is presented in the picture. In this way students feel a personal investment and contribution to the development of the tool and its appearance.*

The worm appeared dressed in accordance with the weather (the selection parameter is the temperature), visualizing in this way the weather conditions.

Special consideration was given to the graphical interface that produced the graphical representations of the data giving the students the opportunity to compare their measurements in different geographical locations all over Europe and investigate the variation of the meteorological parameters during the year. Generally speaking the familiarization of the students of that age of with graphical representations and their meaning is in very low levels. The basic skills of interpreting a graph and acquiring important information from it are essential for the project's success but very rare in the ages of young students of primary school. That is why the graphical representations had to be presented in an easy-to-understand way to students. The abstraction of the graph itself makes it necessary to design a graphical environment

that uses daily analogies to visualize in a familiar-every day life way the graphical representation. According to Piaget students are entering the period of Abstract thinking in the age of about 12 years. Children tend to achieve abstract thinking at this age, but this means that while a significant number of children are able to think abstractly before the age of twelve, some may not achieve abstract thinking skills until after the age of 12. Of course the ages were not set in stone, and Piaget himself knew that these were just general guidelines. Indeed, in later research by Adler, in the 1970s, it was revealed that adolescents were not able to consistently use abstract thinking skills until after the age of 15.

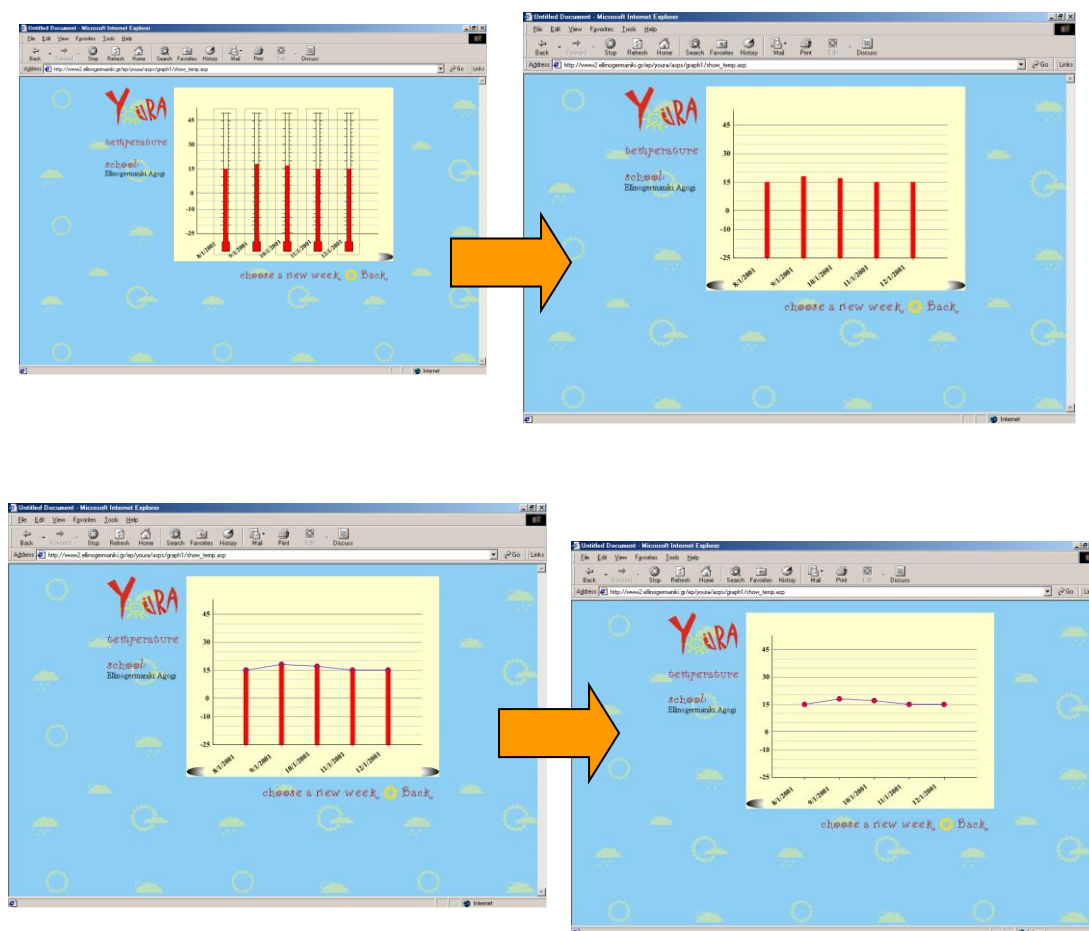


**Figure 12:** The e-com visualized the steps of the construction of a graphical representation. The case for the temperature distribution during one week is presented.

The students were familiarized with the reading of the thermometer so it was relatively easy for them to understand the variations of the temperature as the days went by. The web-based software gave the student the option to remove the thermometers from the graph leaving in their place only bars corresponding to the temperature reading of each day (figure 12).

Additionally the student could join the bar tops with lines transforming gradually in this way a familiar image of thermometers one next to the other to a complete mathematical graphical representation.

- **Videoconferences**

Generating and supporting dialogue within an ODL project, or using a conferencing system as a supplement to face-to-face teaching, is a serious challenge if the Web is to serve as an educational medium. A distance learning project where the learners have never met and their only means of contact with each other and the tutor is the conference system, must be the most challenging situation of all. Such a project provides a lot of opportunities for the beginning of discussions, exchange of knowledge and culture, and even for the creation of “friendships”. Students showed a great interest in videoconferences and during the life cycle of the project they became more familiarized with the procedure and created relationships with their virtual classmates.

- **Bulletin Boards**

Asynchronous computer mediated communication has reached a state of maturity. Synchronous ways of communication actually dominate the field, as they are more direct, fast and satisfactory for the participating parts. However the use of Bulletin Boards cannot be considered as dated, as they have a lot of advantages. Opportunities still exist for innovative ways to integrate conferencing and the web. The structure of a really useful Bulletin Board must be hierarchical containing important information essential for the following up and the contribution to a dialogue. There are three pieces of information that should be always available: *attribution* (who said what),

*sequence* (in what order) and *relationship* (to whom). This much seems common sense and most systems (but not all) have this information. Because an interchange in a web conference may well take place over a period of weeks it is important that this information is easily visualized and accessible to anyone interested in it. A learner returning to a conversation some days later, or catching up on new messages, needs this detail in order to respond and contribute to the discussion.

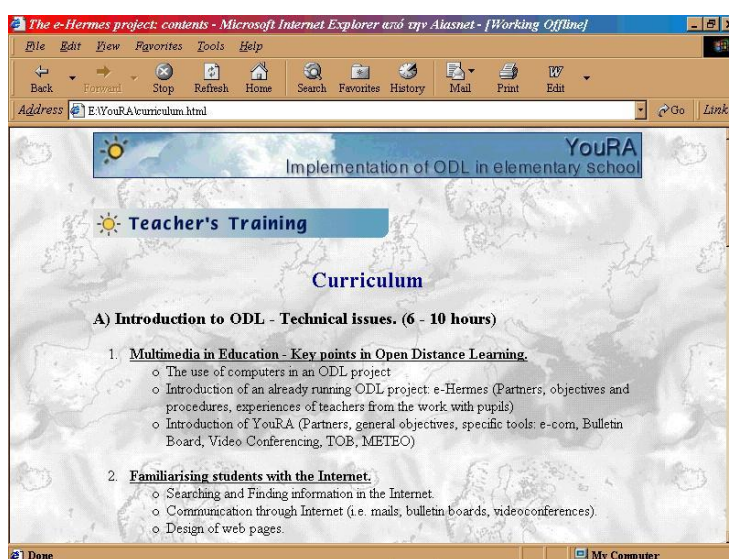
In the case of YouRA project an advanced Bulletin Board was developed in order to give the students the possibility to upload pictures and plots for discussion.

## 6.7 Applying the project

In this analytical description of the YouRA project we will make an effort to mark out the positive points of the project as well as to underline facts which need improvement, thus giving the educators a useful tool for the successful application of similar projects.

### 6.7.1 Teachers' Training

The participating University Departments of Athens and Frankfurt organized a cycle of courses and seminars on the subject of introducing Open Distance Learning in the Teaching Classroom for the last grades of Primary school (see figure 13).



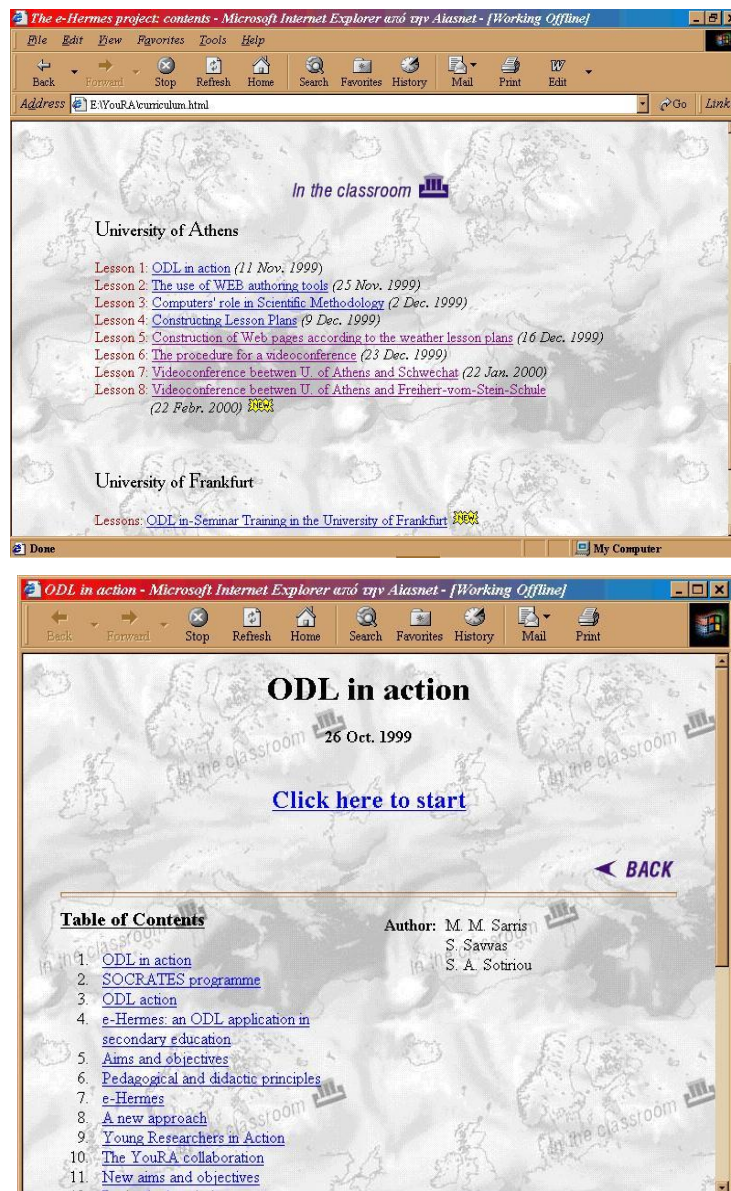


**Figure 13:** Distance - Learning Teacher training seminars

Emphasis was given to teachers designing lesson plans so they could apply the ODL. Simultaneously the participating University students were familiarized with the scientific methodology on the thematic subject the study of natural phenomena. When writing the lesson plans the teachers took into account the problems related to students age. The seminars themselves were organized in the form of ODL so that the teachers would become participant of this new ability. Thus they not only attended the seminars, which were organized by their University country but in parallel: a) they followed by distance the lessons of other Universities, b) they organized themselves in working teams with colleagues and fellow classmates from abroad. The material of

the lessons, the projects of working teachers, lesson plans for ODL which teachers suggested were published in a Bulletin Board carrying out a dialogue similar to the one which the students accomplished for the YouRA project. This dialogue was intensified with the help of videoconferences. In addition carrier of this dialogue was the bimonthly magazine of teacher trainers TOB (Teacher's ODL Bulletin). The structure of these seminars was as following:

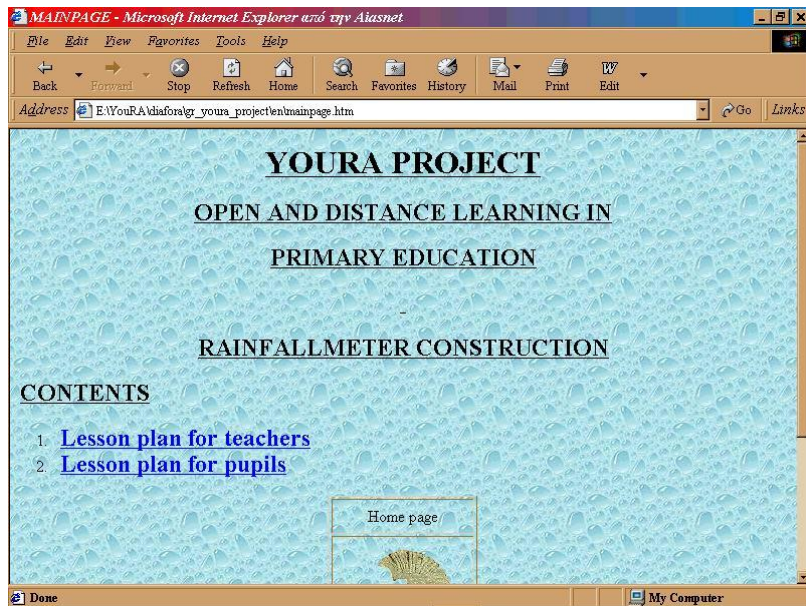
**A. Introduction to Open Distance Learning – Technical matters.**

Multimedia in education – Points of controversy in Open Distance Learning  
Familiarization with the web (searching, communicating, designing websites)

**B. Materializing Open Distance Learning**

Preparing lesson plans for use by Open Distance Learning and scientific methodology  
in the classroom. (figures 14 – 16)  
Designing Lesson Plans

**C. Evaluating an educational project.**



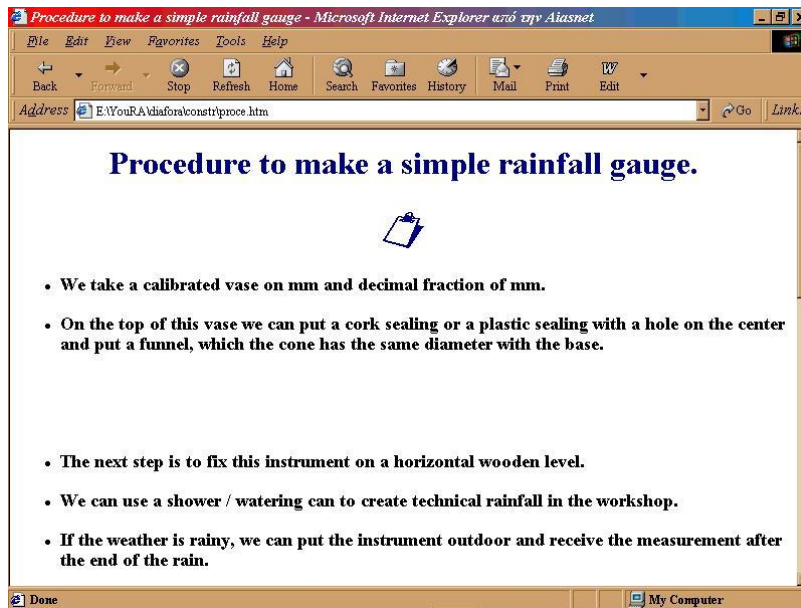
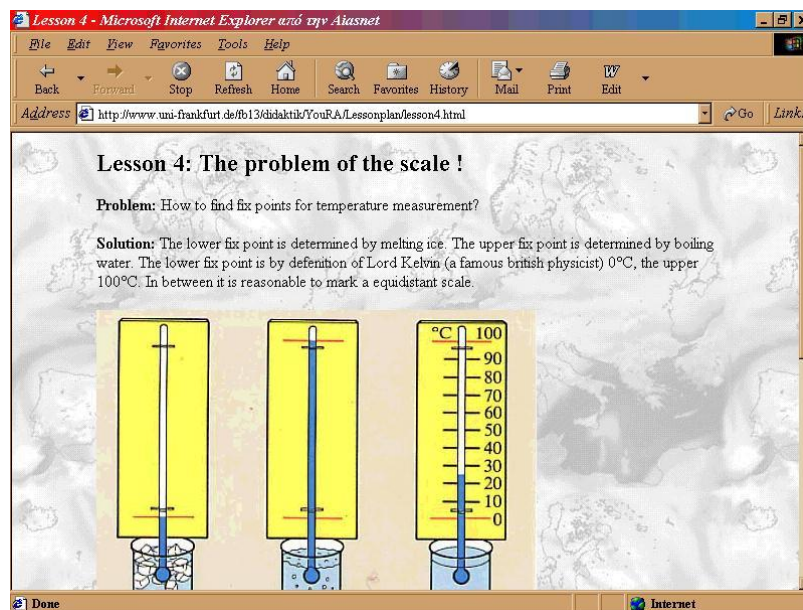


Figure 14: Lesson plan for designing a rain gauge.



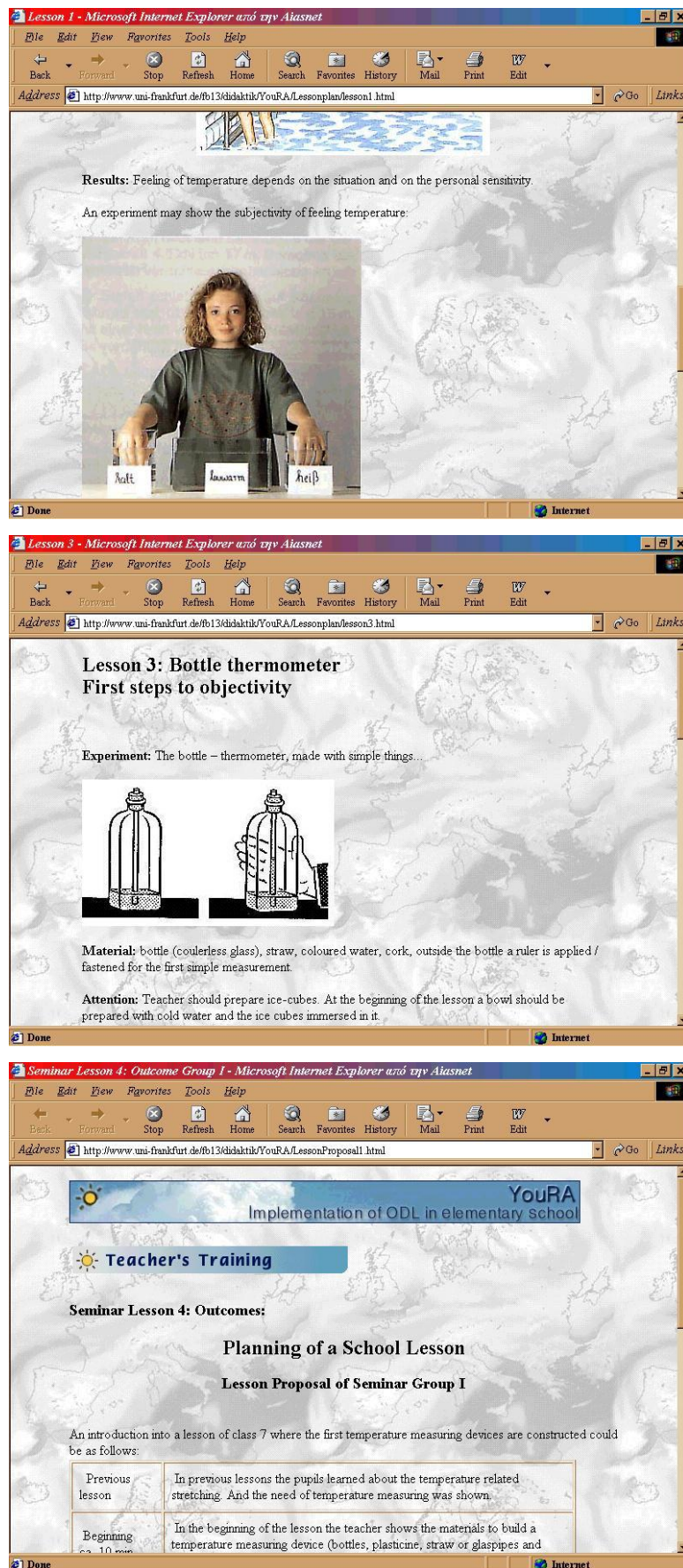


**Figure 15:** Lesson plan for designing a thermometer.

YouRA: lesson 4 curriculum - Microsoft Internet Explorer and the Aliasnet

Back Forward Stop Refresh Home Search Favorites History Mail Print

## Sunshine meter or heliograph

**A. Curriculum**

1. Weather in our life
2. Empirical and Scientific weather forecast
3. The Sun in human's life
4. Connection and distinction between sunlight and high temperature
5. Construction of a heliograph
6. Data acquisition - Measurements - e-com data entry

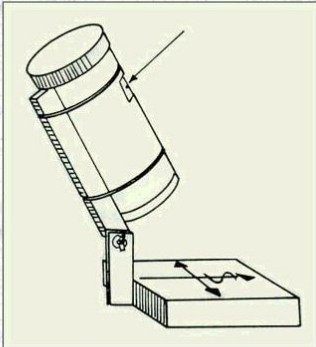
**B. Curriculum Summary**

1. *Weather in our life* (1 hour)  
A story with pictures only, of a German youngster in Greece during the month of April. As an example he leaves his country with cold and arrives to warm weather. He observes and follows every day activities of his Greek friends and recalls his own concerning the weather.
2. *Empirical and Scientific weather forecast* (1 hour)  
Clearness of the sky / cloudy weather, clear sky Shape and color of clouds Weather forecast and symbols (sun, clouds, rain, temperature) Meteorological services, meteorological satellites

proti1 - Microsoft Internet Explorer and the Aliasnet

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## "Heliograph"



[Items](#)

[Instructions](#)

[For teachers](#) [For pupils](#)

[BACK](#)

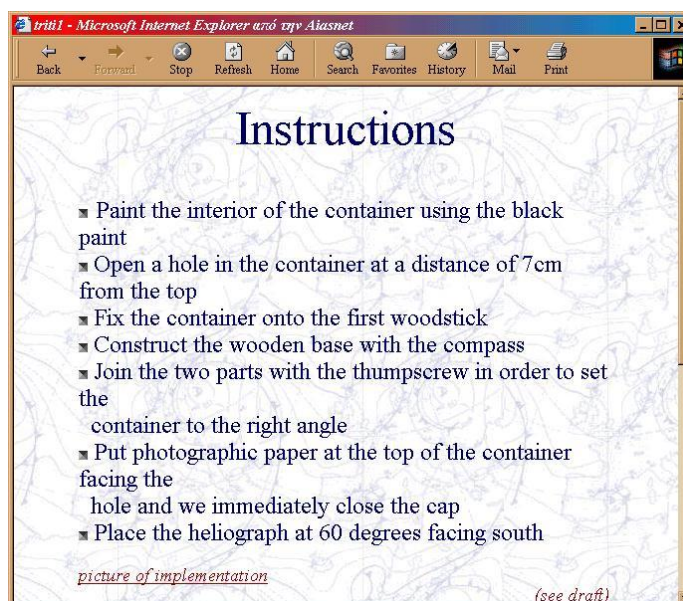


**Figure 16.** Lesson plan for designing a heliograph.

The results of the training were four lesson plans for the construction and use of:

- a. a rain gauge (figure 13)
- b. a thermometer (figure 14 )
- c. a wind gauge
- d. a heliograph (figure 15)

All lesson plans included the basic operational instructions of the devices. Every lesson plan was organized by different working team although the plan incorporated comments and notes by all teams.

### 6.7.2 Implementation in the classroom

Thematic chapters suitable for the YouRA project application were selected from normal curriculum of the participating schools. Observing weather phenomena, measuring meteorological physical quantities and registering these data were the students' starting point of communication and a basic element of ODL for the materialization of which the use of new technology was necessary.

Students' occupation with the design helped them get acquainted with the scientific methodology as it was proven from the evaluation results (see chapter 8). In order to

exchange measurements and experiences regarding the design as well as daily or personal events, students would communicate among themselves.

But for this communication to be feasible students had to be familiarized with ICT. The interdependence of all the above facts was what led the students to cultivate not only their cognitive skills but also their emotional and social area as well as cultivating practical skills, facts that proved the accomplishment of the projects aims.

Taking into account the content of the project, the involved teachers and students proposed four thematic units for applying the scientific methodology.

The thematic chapters were:

- Temperature – Thermometer
- Wind – weather vane - wind gauge
- Rainfall - rain gauge
- Sunshine - heliograph

Every thematic unit consisted of different student activities such as classroom discussions, experiments in a group, artwork with simple material etc. Lesson planning for each thematic unit, description of the constructions, necessary equipment and materials as well as detailed directions for the educators were found in the address:

<http://www.ellinogermaniki.gr/ep/YouRA/training.html>

### **1<sup>st</sup> Thematic unit**

#### **Temperature – Thermometer**

1. Reference to daily experiences of students regarding the temperature.
2. Subjective evaluation of the temperature by using our senses.
3. Spotting thermo sensitive sensors on the skin, manufacturing thermo-pens.
4. Manufacturing thermometers with simple material.
5. Calibrating of the improvised thermometer.

6. Comparison of measurements of an improvised thermometer to measurements of a conventional thermometer.

## **2<sup>nd</sup> Thematic unit**

### **Wind, weather vane, wind gauge**

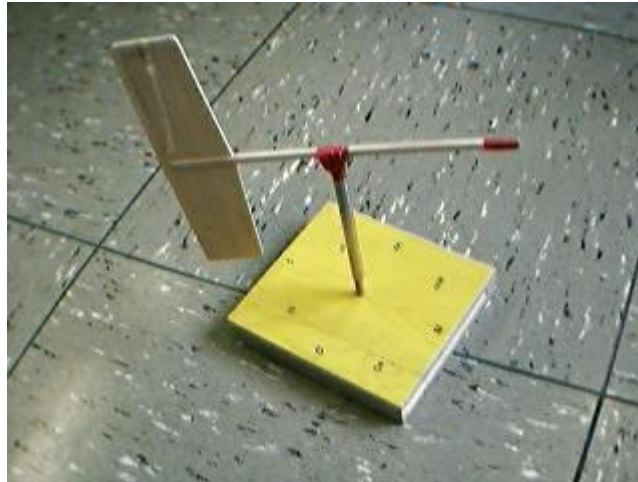


**Figure 17:** *The instrument for measuring the wind direction.*

1. Reference to daily experiences of students regarding the wind.
2. Consequences of the wind on the environment and human beings.
3. Manufacturing weather vane.
4. Manufacturing wind gauge.
5. Calibrating wind gauge.
6. Exploiting Aeolian energy.

## **3<sup>rd</sup> Thematic unit**

### **Rainfall – Rain gauge**

1. Rain in our life.
2. Experiential and technical prognosis of weather.
3. Factors, which determine the weather.
4. The water cycle.
5. Extreme weather phenomena.
6. Manufacturing rain gauge.



**Figure 18:** *The rainfall meter.*

#### **4<sup>th</sup> Thematic unit**

##### **Sunshine – Heliograph**

1. Weather in your life.
2. Sun, source of life for earth – exploiting solar energy.
3. Connection and dissociation between sunshine and high temperature.
4. Manufacturing a heliograph.
5. Positioning and calibrating of a heliograph.



**Figure 19:** *The heliograph.*

### 6.7.3 Students' activities

During the test run, students manufactured the improvised thermometer, which they calibrated and used in their measurements parallel to a conventional thermometer. During the final run of the project, the other instruments were designed also by the students namely the rain gauge, the weather vane, the wind gauge and the heliograph which were necessary for the measurements.



**Figure 20:** *Students' activities.*

#### 6.7.3.1 Construction of measuring devices

A central aspect of the YouRA project was the manufacturing and calibrating of measuring devices by the students themselves. Students made the measuring devices following the manufacturing directions, which were given to them without these directions being an impetus to student's creativity. Alternative student solutions and ideas were welcomed by all. Emphasis was given to students becoming active and gaining practical experience in making and calibrating simple tools; secondary importance was given to accuracy in measuring. It was obvious that with the improvised devices the greatest possible accuracy could not be obtained.

The teaching aims were maximizing student's interests, cultivating skills and developing a balance between theoretical and practical occupation.

In a few words the procedure was considered more important than the result.

### Manufacturing and calibrating of improvised thermometer

#### Tools – material

- glass transparent bottle
- tab with a hole
- plasticine
- water coloured with ink
- ruler
- bottle
- ice cubes
- water
- gas stove
- indelible marker

#### Construction

We fill up the coloured transparent bottle with coloured water and close it's opening with a tab. We open a hole through the tab and we pass a narrow tube. We close the opening where we've placed the tube with plasticine. We make sure the tube is in the coloured water without touching on the bottom of the bottle.

#### Calibration

We place the bottle with the tube in a larger pot with water and ice. When the level of coloured water stabilizes in the tube we mark the number 0 with an indelible marker. We place the bottle with the tube in a jar with water, which is boiling. We wait again until the level of the water is stabilized and we mark on the tube the number 100. Finally with the ruler we divide the distance from 0 to 100 on the tube in 20 equal parts each of which corresponds to 5 °C.

## Remarks

- If the students had not been taught the chapter on “HEAT” it was considered useful to discuss with them the phenomenon of dilation of liquids (when they heat) and contraction (when they cool down).
- It was very useful to refer to the way Celsius marked his thermometer; in the similar way students calibrated their improvised thermometer.
- An environmental thermometer was used for the measurements since the improvised thermometer had two disadvantages:
  - It was not reliable. The coloured water vaporized after time, since the tube and the bottle did not seal hermetically.
  - Water could be used for measuring temperatures below 0 °C, since this was its point of coagulation.

## Constructing a rain gauge

### Tools – material

- transparent cylinder pot with a 10 cm diameter
- plastic funnel of same diameter as the pot
- ruler
- adhesive tape



**Figure 21:** *Constructing the rainfall gauge.*

### Construction

We stick with adhesive tape a ruler in a transparent cylinder pot. In its opening we place a plastic funnel which should have the same diameter as the pot and should fit on it.

### Remarks

- The funnel should have the same diameter as the pot. In this case, the height of rainfall, which students read on the ruler, was the true one and they did not have to make adjustments.
- Teachers explained to students that the height of rainfall is measured in millimetres. Every millimetre of rainfall corresponds to litres of water per square meters of ground ( $1 \text{ /m}^2$ ).

### Constructing a wind vane

#### Tools – material

- a piece of wood (20 x 20 cm)
- a plastic pen container
- knitting needle 30 cm in length
- carton
- glue
- marker

### Construction

We mark on a piece of wood the four points of the horizon with a marker. In the center of a mental cycle we make a small hole in which we place a pen. We cut two arrows made of carton and we glue them placing between them the knitting needle. Finally, we place the needle with the arrow at the covering of the pen, which we have positioned in the hole of the wood.



**Figure 22:** *Constructing the wind vane.*

#### Remarks

- Teachers explained to their students that in order to determine the wind's direction they should place the weather vane in such a way that the four points of the horizon must coincide with those designed on the wood.
- Teachers informed their students that when one talks about the direction of the wind he/she is mentioning from which it comes (direction of wind's origin).

#### Construction of a wind gauge

##### Tools – material

- a piece of wood (30 x 15 cm)
- two small pieces of wood (20 x 30 cm)
- nails
- knitting needle
- carton
- glue
- indelible marker
- pins
- two corks



**Figure 23:** *Constructing the wind gauge.*

#### Construction

We make a small opening at the edges of the small pieces of wood so that the knitting needle can turn around. Following, we nail the small pieces of wood at the edges of the wood, which serves as a base. We pass through the holes the knitting needle. To fasten the needle we place a cork on every edge. We bend a piece of carton in half, we place it in such a way that the needle is between it and we glue the two sides. Finally we fasten with pins a small piece of carton on one of the small pieces of wood vertically on the large carton, which moves.

#### Calibration

We calibrate the wind gauge using a commercial one. The calibrating process is completed after some measurements by marking on the small carton which we have fasten with some pins small lines and marking next to each one the intensity of the wind in Beaufort.

## Construction of a heliograph

### Tool and material

- metallic cylinder pot with a tab (diameter 15 cm)
- small pieces of wood
- thumb screw
- screws
- nut tool
- a piece of wood (30 x 30 cm)
- photography paper (10,5 x 15 cm)
- a pointed objected
- goniometer
- black paint
- a compass
- black adhesive tape



**Figure 24:** *Constructing the heliograph.*

### Construction

We dye the interior of the metallic cylinder vase with black paint. With the pierce needle we open a very small hole 7 centimetres on the top of the vase. We fasten the vase with the wooden sticks and the screws on the piece of stick in such a way that we can alter the angle slope of the vase. We close the small hole with a black adhesive tape.

### Calibration

Calibrating the heliograph must take place on a shining day without any periods of shadowiness. We glue the photographic paper on the interior of the vase exactly across the small hole with adhesive tape and we close the cap right away. The small hole is also closed. We place the heliograph on the terrace and use the compass so that the small hole leads towards the North. The angle starting from the ground must be  $60^\circ$ . We arrange this angle with the goniometer. Following we take off the black adhesive tape from the hole of the vase and we leave the heliograph on the terrace without moving it for three hours. Finally we close the hole and transfer the heliograph in a dark room. We take off the photographic paper and count the length of the dark line, which is on it. We divide the length of the line with the hours that the heliograph was exposed to the sun and we have the correspondence between line lengths per hour of sunshine.



(a)



(b)

**Figure 25:** a) *Placement of the heliograph.* b) *The trajectory of the sun on the photosensitive paper.*

Remarks

- The photographic paper has a layer of nitric acid, which is sensitive to the light and becomes black when it comes in touch with light.
- If needed one could do more attempts at calibrating the heliograph so that the photographic paper could be positioned correctly.
- When there are shadowy days students measured the sections of black line, which in this case was interrupted, and they had to add up its length.

**6.7.3.2 Collection of data**

During the project's application the students had to measure the following physical quantities on a daily bases:

1. Temperature.
2. Height of rainfall.
3. Direction of wind.
4. Intensity of wind.
5. Duration of sunshine.

Temperature measurement

The students measured the external temperature placing the thermometer in a shadowy area on the school terrace. The measurements took place daily at 12 a.m. The thermometer remained continually at the point of measurement.



**Figure 26:** *Measuring temperature.*

### Measuring rainfall

The improvised rain gauge was placed in an open place on the school terrace. The students had to check every day if there was water in the rain gauge and had to “read” on the ruler the amount of rain in millimetres.



**Figure 27:** *Measuring the height of the rainfall.*

#### Determine the direction of the wind

In order to determine the wind's direction the students had to place the improvised weather vane in an open place on the school terrace. Initially, they used a compass in order to determine the points in the horizon. Later the students marked these points on the tiles on the school terrace so they wouldn't have to carry the compass with them. One had to mention the ease by which the students learned to evaluate the wind's direction without using the weather vane by simply observing the bending of the top of the trees, which were around the school.

#### Measuring the speed of the wind

The improvised wind gauge was placed by the students in an open place on the terrace for measuring and was kept in class. The wind gauge and weather vane were not permanently placed on the terrace because the constructions were not stable and perhaps they would not endure the different weather conditions without risking to be

destroyed. During the elaboration of the third thematic unit the students presented a correspondence of the speed of the wind with notes about nature, which were published in German and Greek in the fourth issue of the METEO magazine.

<http://www.ellinogermaniki.gr/ep/YouRA/outcomes.html>

The students developed criteria to estimate the speed of the wind. In order to verify their evaluations, they used their improvised wind gauge. The students were very pleased when they found out that their evaluation coincided or was very close to their measurements.

### Measuring the duration of the sunshine

In order to measure sunshine duration, students placed the improvised heliograph on the school terrace at nine o'clock in the morning and would take it back in class at 1 o'clock p.m. The measuring time was common for all schools, which helped in making a comparison of sunshine in different areas.

### Remarks

- In order to collect data, students worked in groups of five, which had been determined at the beginning of the project. The groups were composed in such a way that there was no possibility of alienating students due to sex or academic performance.
- If a problem arose during the project, which could not be solved in another way, they transferred students from one group to the other. This phenomenon was rare. Groups were altered every week for the measuring process.
- Teachers encouraged students to work independently cultivating their self-confidence.
- Students worked independently in teams took full responsibility for measuring without the teachers' interference.
- Through working in teams students developed cooperation and cooperative learning.

- The role of educators in this phase was helpful. The teachers offered guidance or assistance only when the students themselves asked for it.
- Initially there were difficulties because some students faced difficulty in reading the thermometer or reading the height of rainfall on the rain gauge. An example: At first reading the thermometer, some students marked 20,5°C while the temperature was 25°C. They had difficulty in understanding the distribution of the scale; that it progressed by 1°C and not by 0,1°C as they thought. Something similar happened with the rain gauge. Students marked 1.8 mm while the correct value was 18 mm. In this case, there was the tendency to make a mistake when measuring in centimetres while they did not make a mistake when measuring the height of the rainfall as they knew the height of the rainfall was measured in millimetres. Their fellow classmates without teacher's interference made corrections.

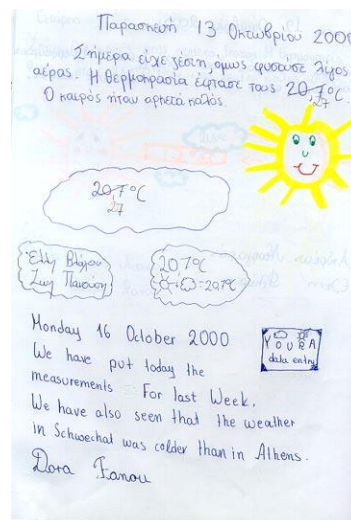


**Figure 28:** *Students kept logbook for their measurements and observations.*

- In every team there was a definite distribution of activities, which would change with the students' initiative; thus monotony was avoided and all students participated in all measurements.
- Working in groups cultivated teamwork without having a negative influence on each student's individual expression. On the contrary, working in teams acted as an initiative to assign to each student a suitable role to play as well as spotting and promoting the special capabilities and skills of each student.

- When students work in a team, the teacher must have the ability to keep the balance in each group and discourage some students from stigmatising others and making them feel inferior.

#### **6.7.3.3 Data acquisition**

Students marked their measurements daily in a logbook. Students submitted the collected data to the e-com every week.

The groups of students who were responsible for the measurements, the registration of data and data input alternated once a week. All the students who took part in the project had the chance to participate to all activities, which were mentioned beforehand; namely they measured, registered in the logbook and submitted the data to the e-tool. The data input took place in the computer lab.



**Figure 29:** *Data submission to the e-com.*

#### **Remarks**

- In order to submit the data in the e-com, students had to become familiar with some operations of the PC. Students gained useful skills not only in the school environment but also in the wider social environment, skills useful for their lives.

#### **6.7.3.4 Communication – Discussion of the results**

The presentation of the data on the e-com acted as a stimuli of discussion between the students. Two ways of communication were used in order to facilitate students communication:

### Communication through the students' Bulletin Board

More than 100 contributions were sent to the Bulletin Board during the 3-month test run and more than 200 contributions during the 6-month final run (see Chapter 7). It has to be noted that a conventional Bulletin Board was used during the test run, while an advanced Bulletin Board (allowing students to upload pictures and plots) was implemented during the final run. The number of messages with subject relative to the project's activities was increased significantly during the project's life cycle and reached the 80% of the total number of contributions to the Bulletin Board. The partnership believes that the effective participation of the students to the discussion on the construction of the measuring devices and the data analysis was one of the major achievements of the project.

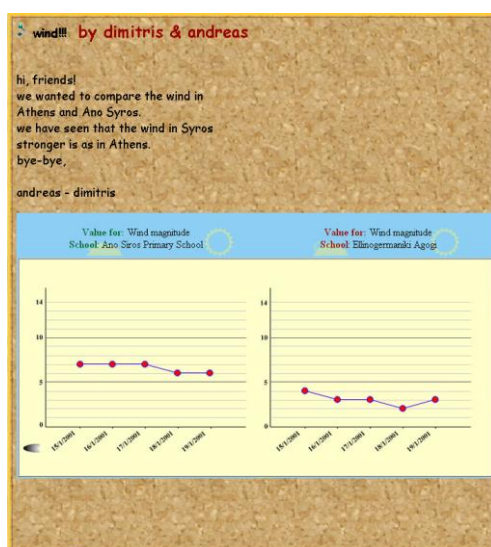


**Figure 30:** Discussion on the results through the Bulletin Board which was used in the final run. The students were able to upload pictures and plots in order to explain to their classmates their opinion – statements. This is the message of two Greek students comparing the data between two partner schools in Greece.

## Communication through Videoconferencing

Students in many occasions had the chance to discuss their activities through videoconferencing. This way of communication presents in general terms many difficulties (mostly technical) but clearly is the best way of communication as it is direct. Students have shown great enthusiasm and interest. During the procedure questions were being formed by the students and their classmates and they had the chance to get an answer immediately. The most interesting topics for discussion were the construction of the devices and the measurement of the duration of the sunshine where the most important differences appeared during the project's run. A great effort was made from the participating teachers in order students to get familiarized with the Netmeeting software, which was used for the videoconferences. Students during the last stages of the project's application were able to send pictures and plots through the internet.

Each partner school participated at least 10 videoconferences.

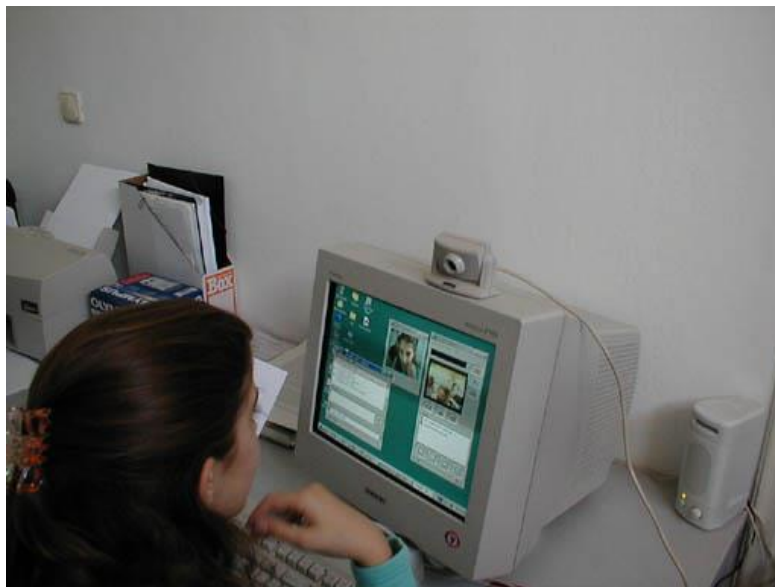


**Figure 31:** *Discussion on the results through Videoconferencing. The students were able to send pictures and plots using the Netmeeting software package.*

### 6.7.3.5 Publication of the reports

Publication of the reports was the final stage of the application of the scientific methodology. Each report included all the appropriate parts: statement of the problem, statement of the purpose of the research, statement of hypothesis, detailed description of methodology, detailed description of the construction of the measuring devices, presentation of the results, proposals for future topics and research, presentation of bibliography and publication in conventional and electronic format (figure 32). In total 4 issues of the students magazine (METEO) were published during the project's run. The magazine was aiming in acting as a means of acquaintance for the students of a virtual classroom and then to be used as a means of expressing and registering the results, conclusions, notifications relevant to the data acquisition. METEO was also operating as a means of exchanging students' views and beliefs on everyday topics.

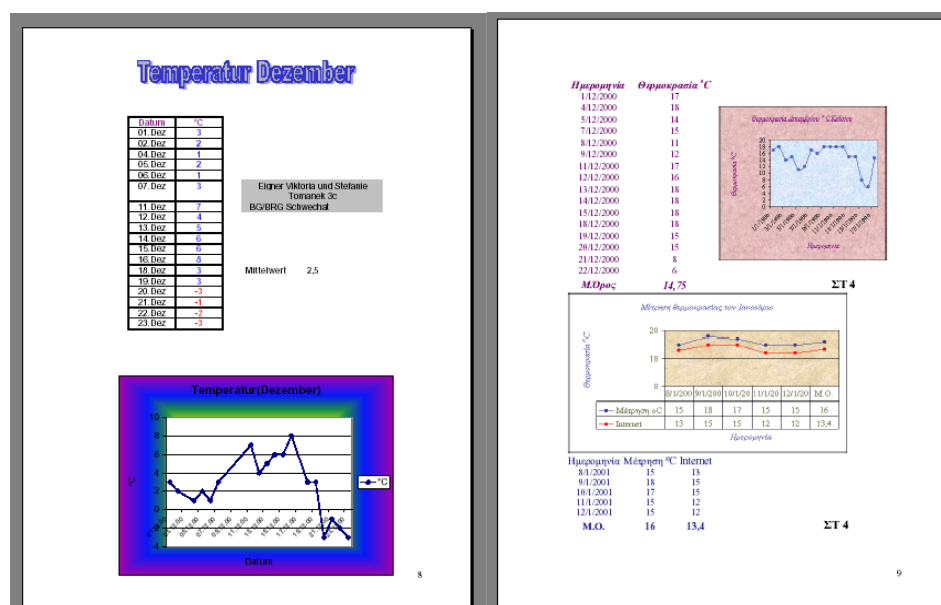


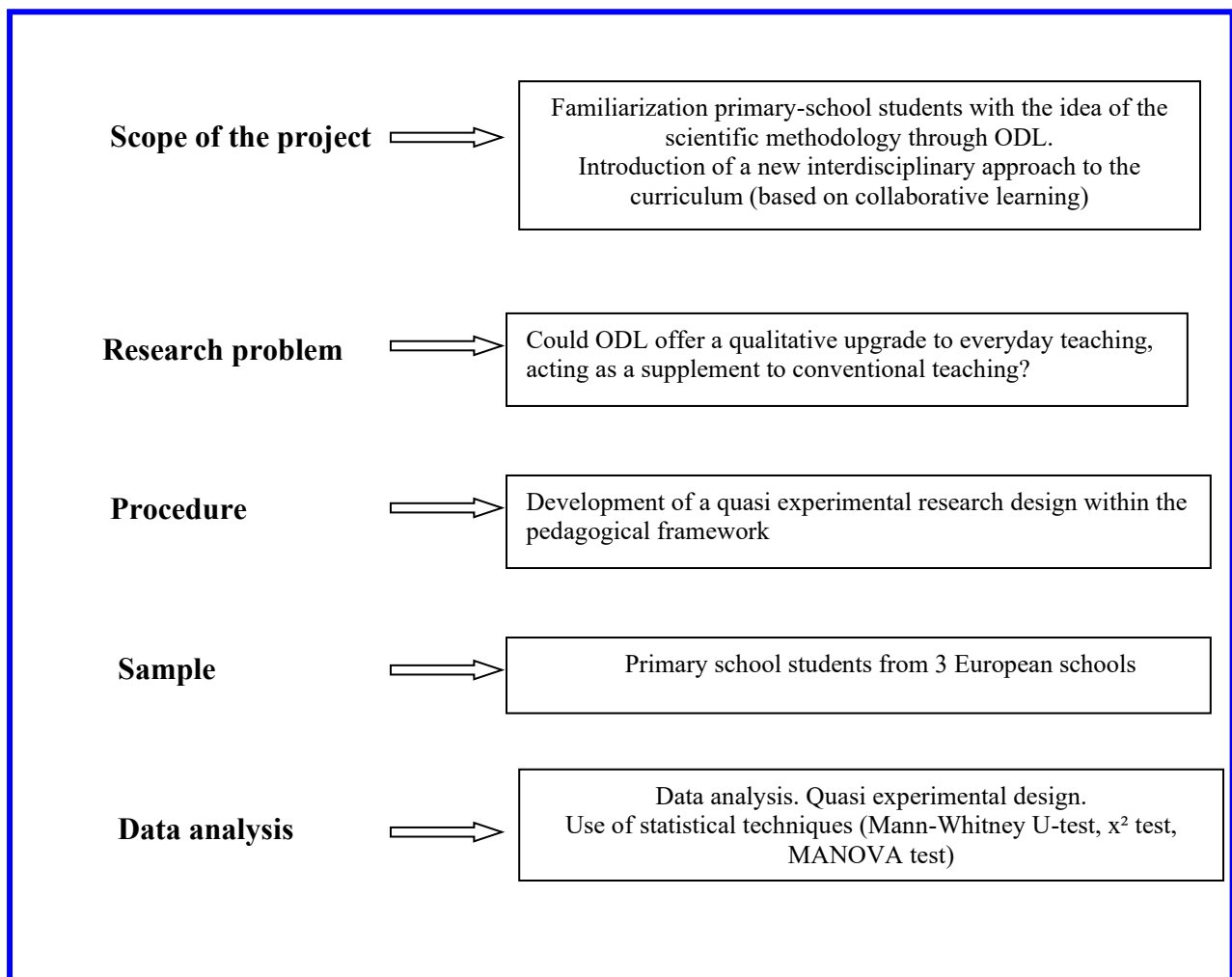
**Figure 32:** Presentation of the data analysis in the METEO magazine. In total 4 issues were published during the project's implementation in the classroom. The reports were published in conventional and electronic format.

# Evaluation and monitoring of the project

## 7.1 Quantitative Evaluation

### 7.1.1 Methodology

The task of the evaluation of the YouRA project was a matter of great importance since only a few ODL projects in the field of primary education have been systematically evaluated so far. The research process adapted is presented schematically in the following graph. It includes the problem statement, the exploratory question (hypothesis), the description of procedure followed, the sample, the measurements, the tests and the methodologies used during the data analysis.



### ***The research process in the YouRA project***

Quantitative results of the project were obtained by numerical methods. Different statistical tests were carried out in order to access the development of understanding, knowledge and attitude towards the use of new tools as communication channels. Comparisons between the students' groups from the three countries (Germany, Austria and Greece) were also performed.

The main purpose was to present the methodology that one has to follow in order to get really valuable data and set the guidelines for similar future applications and present first results.

#### **7.1.2 Test design**

The evaluation was performed through the use of a questionnaire, that was applied at the beginning of the test run and at the end of the final run following a quasi experimental design with control and experimental groups. A two-group design with repeated measurements had been selected. The data from a control group in each country were included in the analysis in order to rule out effects of normal development and ageing, which would be interpreted as project outcome misleading the conclusions. Special care was given to the fact that both experimental and control group studied the same curricula in the framework of their school lessons. The results that were obtained after the implementation of the project can be summarized in three different categories: a) *No effect*: In this case there was no change in the behaviour and the attitude of both the experimental and the control group. b) *Main effect*: Both the experimental and the control group changed their behaviour and their attitude at the same degree and towards the same direction after the implementation of the project. c) *Interaction effect*: The interaction effect means that the experimental group improved its behaviour and attitude whereas in the control group no changes were detected.

What was expected after the implementation of the project was an interaction effect between the experimental and the control group. The interaction effect is presented in figure 33 as an example. The scale on the vertical axis represents the number of the correct answers given on average by the control and the experimental group. At the pre-test both the experimental and the control group gave four correct answers on average. At the post-test the experimental group improved and gave six correct answers on average, whereas the control group remain stable and gave four correct answers on average. The red colour represents the pre-test values while the green the post-test ones.

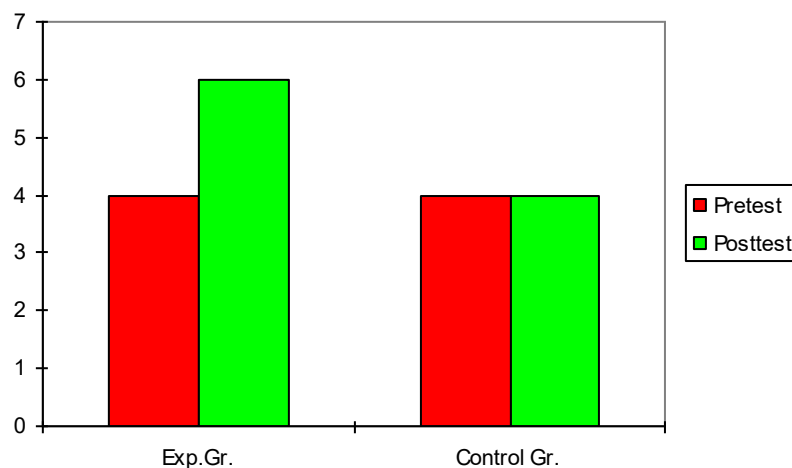


**Figure 33:** *An example of interaction effect between the control and the experimental group for an hypothetical question: The experimental group is expected to improve its behaviour towards the theme of this hypothetical question, whereas the control group is expected to remain stable. This will prove that the positive changes will be due to the implementation of the project.*

### 7.1.3 Questionnaires

The logic behind the construction of the questionnaires is to find the areas where changes in pupils' attitude or behavior are expected. The questionnaires used are presented in Appendix I. The questions were related to:

- the students' social attitudes towards foreign pupils (questions 1-2),

- the students' attitude towards collaborative learning (questions 3-4),
- the students' performance in working with a scientific methodology (questions 5-8),
- the students' performance in working with graphical representations (questions 9-11),

The questionnaire was written in English and translated to the students' mother tongue by their teacher. In Germany a university student was filling out the questionnaires together with the pupils whereas in the other countries the pupils filled out the questionnaires themselves with the presence of a teacher, who explained possible remaining problems.

#### **7.1.4 Sample**

In each country (Austria, Greece and Germany) two groups of students participated in the evaluation:

- The experimental group, who was participating to the project,
- The control group, who did not participate in the project and served as reference group. It is important to mention that the control group also dealt with the same physical phenomena within the framework of their school curricula

This quasi experimental research approach was used in order to rule out different kinds of effects. Into the analysis were taking only the students who belonged to the same group in the pre-test and in the post-test. Over all 142 pupils filled out questionnaires, 85 girls and 57 boys. In the experimental group participated 78 pupils and in the control group participated 64 pupils. The age of the pupils ranged from 9 to 14 years.

| <u>AGES</u>  | <u>PUPILS</u> |
|--------------|---------------|
| 9 years old  | 1             |
| 10 years old | 27            |
| 11 years old | 31            |
| 12 years old | 56            |
| 13 years old | 25            |
| 14 years old | 2             |

### 7.1.5 Statistical Methods

Univariate analyses were performed with conservative non-parametric tests. For ordinal data the Mann-Whitney U-test was applied and for nominal data the  $\chi^2$ -test. Group comparisons on a nominal scale were also performed on the values between the pre-test and the post-test.

A short description of the applied tests is presented below:

#### *Mann-Whitney-U-Test*

The U-Test of Mann-Whitney is used to compare the values of one variable in two independent samples with regard to their central tendency, respectively if they stem from the same or different populations. This procedure requires data with - at least - an underlying ordinal scale without specific distribution. The basic idea is to transform the data into their ranks by arranging them from the smallest to the highest value and by giving every single datum the rank that corresponds to its position in the new row. A mathematical comparison of the sums of ranks of each sample completes the test.

#### *$\chi^2$ Test*

The  $\chi^2$  test involves grouping the observed data into classes with theoretical (expected) frequencies and comparing the observed frequencies with the theoretical ones. As only frequencies are needed for such a procedure, data with an underlying nominal scale can be analysed.

#### *Kruskal-Wallis-H-Test*

The Kruskal-Wallis-H-Test is used to compare one variable in more than two independent samples of data with at least underlying ordinal scale. No requirement is made about the data's distribution.

## 7.1.6 Data Analysis

### 7.1.6.1 General Remarks

The first important condition, on which the present analysis is based on, is the equivalence between the experimental and the control group before the project's implementation. The two samples have to be selected from the same population. For each statistical analysis, there is given a value " $p$ " that expresses the probability for the fact that control group and experimental group are equal or different.  $p$  is the probability that the two groups do not differ. The different values of  $p$  have the following meaning:

|                           |                                           |
|---------------------------|-------------------------------------------|
| If $0.1 < p$              | no significance, the groups do not differ |
| if $0.05 < p < 0.1$ (*)   | statistical tendency                      |
| if $0.01 < p < 0.05$ (**) | statistical significance                  |
| if $p < 0.01$ (***)       | high statistical significance             |

It has to be mentioned that due to the pilot character of this study no Alpha-corrections (Hays, 1973) have been taken into consideration. For the more statistical tendencies were also reported.

### 7.1.6.2 Pre test comparison of Experimental Group and Control Group

The members of the experimental and the control group had to be selected out of the same population. This parameter is very important as the validity of the conclusions of the present analysis is depended on the equivalence of the two groups before the project's implementation. For comparison of the experimental group with the control group the nonparametric Mann-Whitney-U-test and  $\chi^2$ -test were applied to the answers of the pre-test. The results of these tests are the probabilities  $p$  that the compared groups are coming from the same population. That means, the greater value of  $p$ , the greater the probability that the groups do not differ in respect with the considered question.

Statistical analyses showed that in most questions no significant difference in the answers between the experimental groups and the control groups was observed. However, there were some questions where differences between the groups were obtained with high significance.

#### **7.1.6.3 Comparison between the Post-test and the Pre-test for both groups**

A detailed analysis of pre-test and post-test in view of changes during the project presented very interesting and useful results showing that the project has met its aims to a satisfactory level. In the following section some selected items are described in order to give some hints about changes in attitude, in learning and the impact of the usage of new tools on the students learning. In order to avoid taking into account changes, which are not depended on the project's implementation, all results are checked by using the control group as a reference.

As it was described in the previous paragraph, the differences between pre- and post-test were statistically evaluated with the use of non-standardized residuals of the MANOVA test for pre- to post-test; these residuals allow for an evaluation of changes that are independent of the initial values in the pre-test, which is a very important parameter in the data analysis. Comparisons between the experimental and the control group were calculated with Mann-Whitney's U-Test. In the following the changes between the pre- and the post-test are presented for the selected questions.

The most interesting questions are discussed in the following.

#### **The students' social attitudes towards foreign students**

From the quantitative results it comes out that there was no detectable effect concerning the enforcement of the social attitude of the students towards foreign students.

It is however very important to notice that the number of messages that students exchanged increased as time passed by. Moreover students' participation to the Bulletin Board was sufficient (see Chapter 6). This fact shows a positive change to

students behaviour towards ICT but also towards collaboration with foreign students. It seems though that this change didn't concern their permanent attitude towards their social behaviour towards foreign students.

It is a fact that in ODL the social parameter is a weak component, even after the implementation of significant number of videoconferencing events between the students of the participating schools. It seems that more radical changes have to take place – the communication has to have a more central role in the project's development – in order to enforce the social parameter in ODL projects.

### **The students' attitude towards collaborative learning and teamwork.**

The promotion of the teamwork and of the collaborative learning was one of the main aims of the project. Based on qualitative results (number of contributions to the Bulletin Boards, number of articles published etc.) it is clear that the YouRA project has meet this aim.

It is however a fact that the analysis of the quantitative data doesn't support any progress in students' positive attitude towards collaborative learning or teamwork. It has to be noted though that students in all schools have experienced collaborative learning before in the framework of the normal classes of science. Especially the teamwork is being promoted in the laboratory work, so students of both experimental and control group were familiarized with it. This fact is represented to the very high percentage (>80%) appeared in the pre-test for the two groups for the questions concerning the students will to work in teams. On average the increase was about the same in both groups in this category of questions. In some cases though, especially in activities which were promoted during the project's implementation the students of the experimental group have shown an even better attitude towards collaborative learning and teamwork (figures 34, 35).

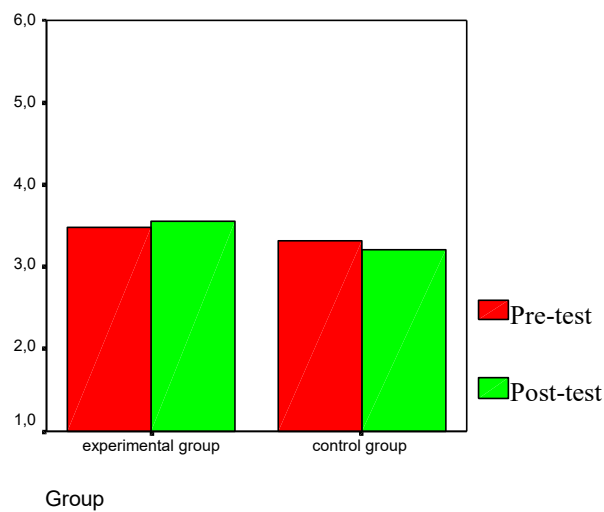


**Figure 34:** “Would you prefer to write a report alone or with other students?”. The students of the experimental group have shown a better attitude towards team work. The effect is more clear for the Greek students (see figure 35).

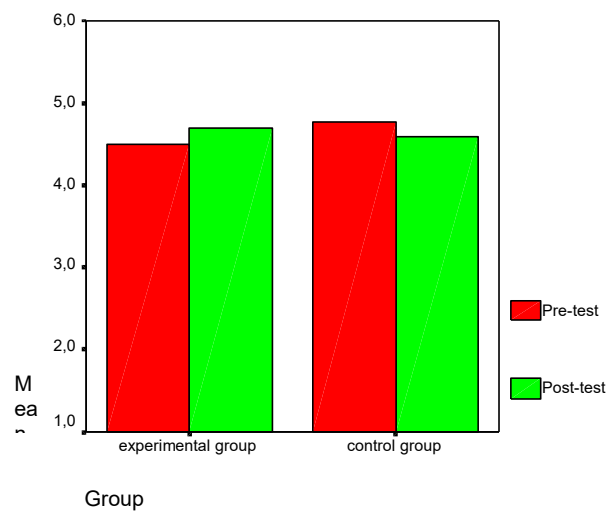


**Figure 35:** “Would you prefer to discuss the results of your research alone or with other students?”. The Greek students of the experimental group have shown a better attitude towards team work after the project’s implementation.

However this change in pupils’ attitude was not crucial enough to support any conclusions for a positive change in pupils’ attitude towards this direction.

## The students' abilities and performance in working with a scientific methodology

One of the main aims of YouRA project was the familiarization of the students with the scientific methodology. According to the quantitative results of the evaluation the experimental group has showed a better performance after the project's implementation in respect with the control group. The understanding of the scientific methodology and the ability of the students to research and experiment is of great importance, especially for the ages that the project addressed to. The student was given the steps for performing an experiment (e.g. prove that sun gives life to the plants) and he/she had to put them in the correct order according to the scientific methodology. In figures 36 and 37 the results of questions 6.2 and 6.3 are presented for both groups.

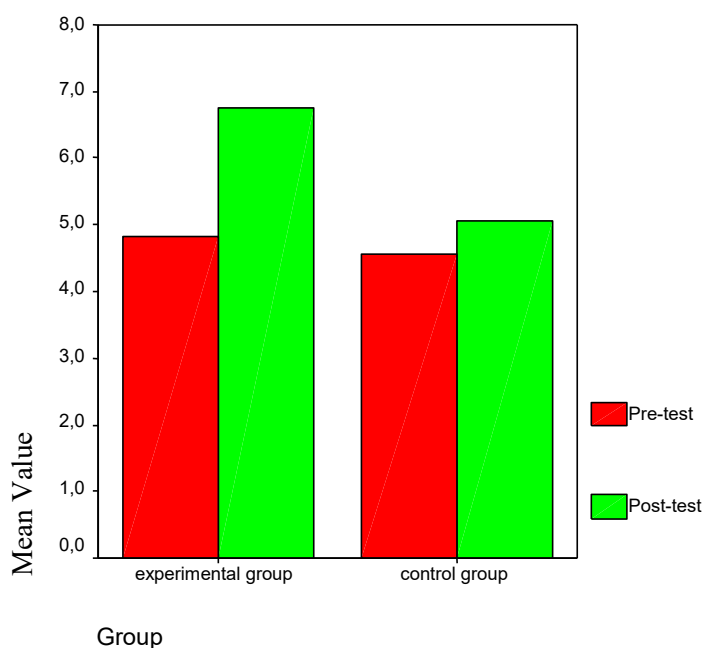


**Figure 36:** *“Identify the correct order to the subject: Sun gives life to plants”. The students of the experimental group gave more correct answers after the project's implementation. The effect is more clear for the girls rather than the boys.*

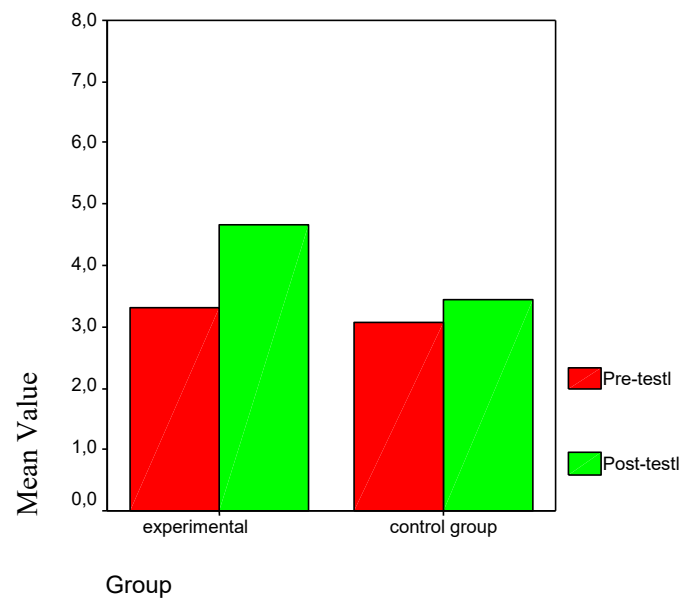


**Figure 37:** “Identify the correct order to the subject: Boiling water”. The students of the experimental group gave more correct answers after the project’s implementation.

Additionally the experimental group presented familiarization with the use of measuring devices (figures 38, 39, 40, 41, 42)

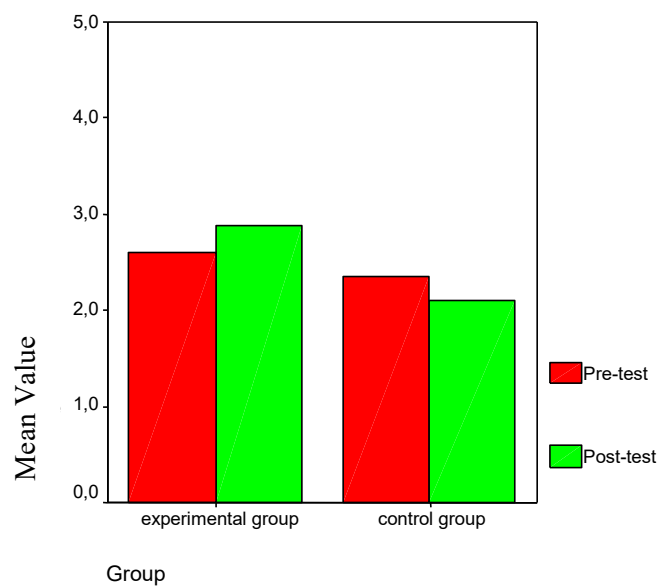


**Figure 38:** “What instruments you need for an experiment in the laboratory showing the water cycle?”. The students of the experimental group gave more correct answers after the project’s implementation. The effect was more clear for the boys in this question.

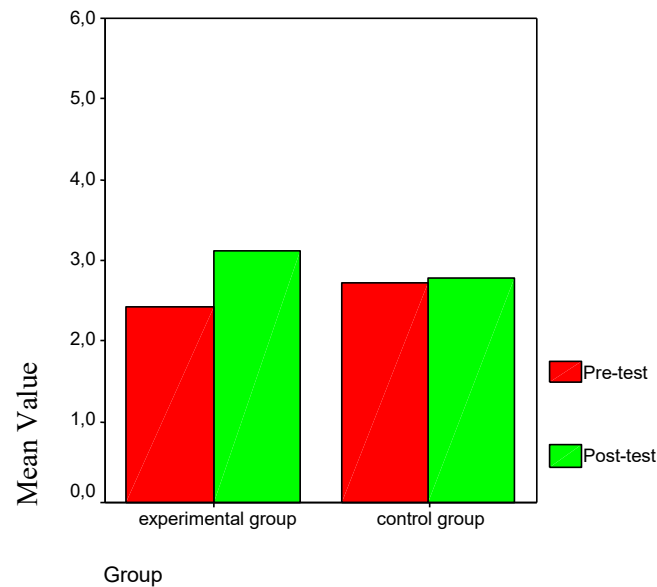


**Figure 39:** “What instruments you need for an experiment in the laboratory to compare which is more aerodynamic: a steel spoon or a glass?”. The students of the experimental group gave more correct answers after the project’s implementation.

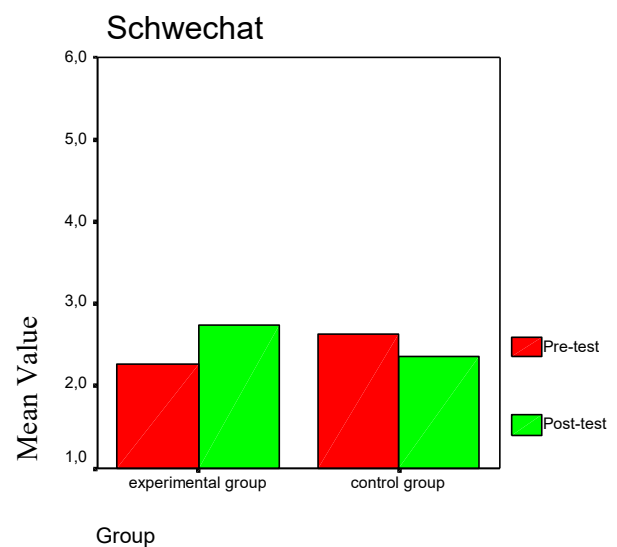
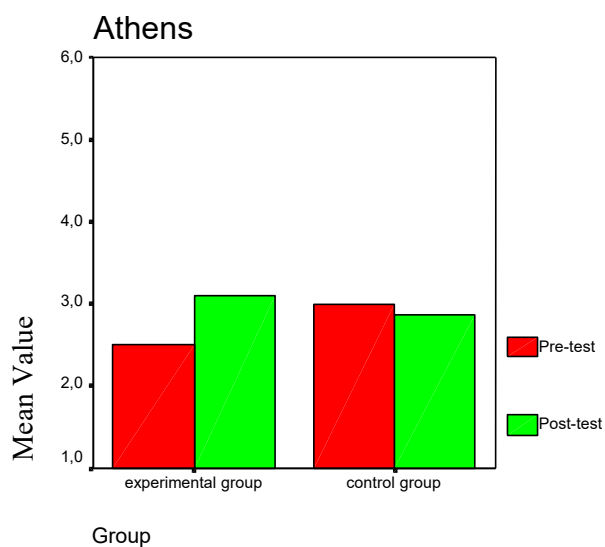


**Figure 40:** “What instruments you need for an experiment in the laboratory to compare which is more aerodynamic: a steel spoon or a glass?”. The effect is more clear for the Austrian (from Schwechat) and the Greek (from Athens) students in this question. Students who belonged to the experimental group in Austria and in Greece improved.

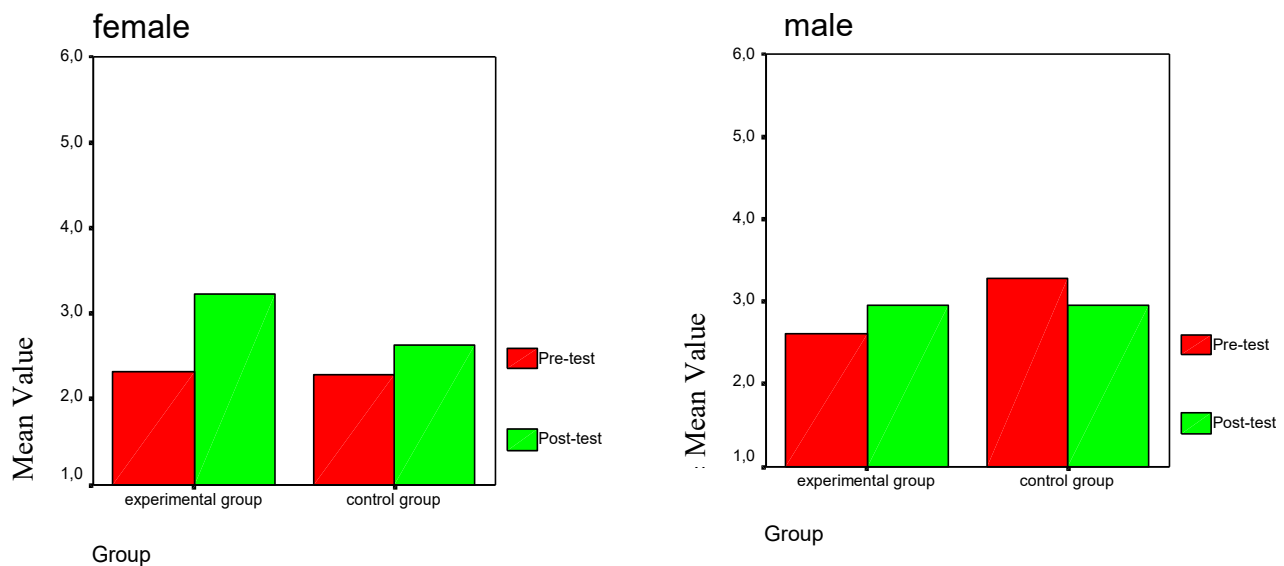


**Figure 41:** “What instruments you need for an experiment in the laboratory to compare which is more aerodynamic: a steel spoon or a glass?”. Both boys and girls improved but it is important to mention that girls’ attitude improved more than the boys .

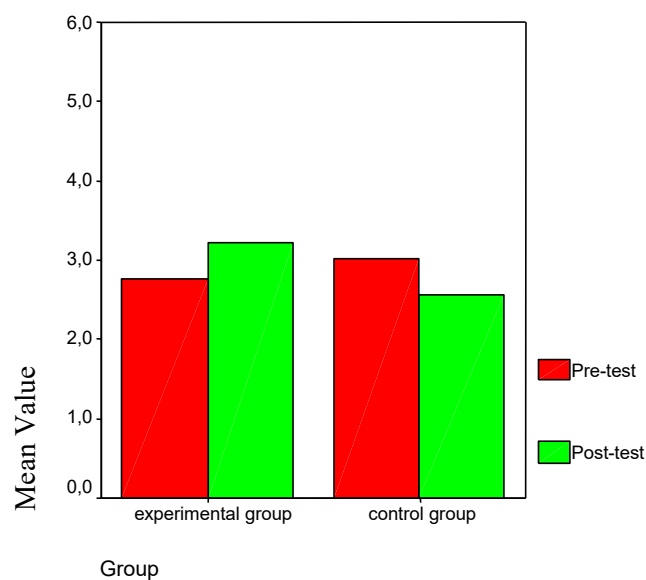


**Figure 42:** *“What instruments you need for an experiment in the laboratory to find what materials are better conductors of heat: a steel spoon or a glass?”. The students of the experimental group gave more correct answers after the project’s implementation.*

### **The students’ performance in working with graphical representations**

The students seem to have acquired another useful skill: the interpretation of graphical representations. This result validates the usefulness of the e-com that was produced and used in the project (see figure 43). It seems that the software offered a successful introduction to the world of diagrams for the students of primary education. The students’ performance improved a lot during the implementation of the project. The results that came out from the data analysis were very satisfying and proved that ODL can help a lot towards this direction. It would be very interesting to test the strength of this skill some months after the project’s end.

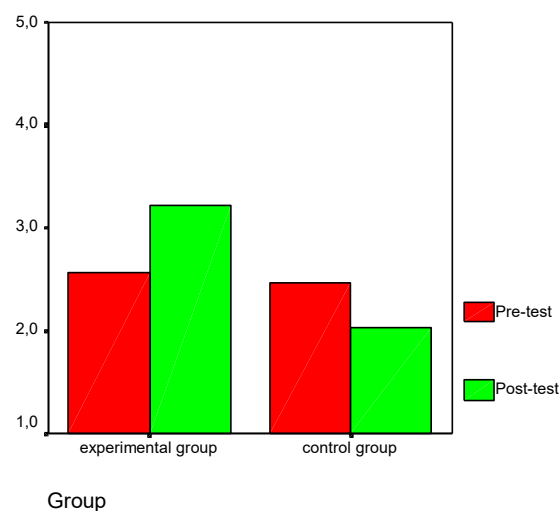


**Figure 43:** *“Which is the correct graph?”. The students of the experimental group gave more correct answers after the project’s implementation.*

## **7.2 Qualitative Evaluation - Achievements, elements of good practice**

The YouRA project was based on the formation of a virtual open school society where students and teachers discussed, exchanged ideas and got familiarised with the use of new interactive ICT tools. Both verbal and non-verbal communication forms were tested. Regular videoconferences, Bulletin Boards, drawing exchanges were used to enhance communication.

In the following the main achievements of the project were described. Furthermore some examples of good practice were presented in each case.

### **Successful implementation of on-line teachers' training seminars**

In the framework of YouRA project students of Pedagogical Departments (teachers to be) had the opportunity to co-operate on field with active educators and participate in the planning and implementation of ODL courses for students at the upper primary level of school education. In this way they gained valuable experience not only by being part of an active educational process but also by realising the possibilities and - at the same time- the limitations of ICT application in the classroom. The project offered teachers an effective in-service training that familiarised them with the use of modern ICT and allowed for the incorporation of ODL elements in the teaching practice. The in-service training ran in parallel with the University students training. Each teacher was the nucleus of a working group of University students. These teacher/students groups acted as learning/teaching teams. Teachers and students attended the seminars organised by the Universities and exercised in practice the content of the seminars by organising and delivering ODL courses to the students at school. On the other hand those teacher/students groups provided to the University seminars feedback from the schools. The high level of interest of the students and teachers that participated at the training seminars was proved by the active participation to the videoconferences as well as by the large amount of contributions to the Bulletin Boards (figures 44, 45)



**Figure 44:** The MS Net-meeting software was used for the videoconferences between the participating Universities and schools. Two moments of two videoconferences are presented above. In the first picture the Austrian teachers are presenting the calibration of their anemometer to the Greek students and teachers. In the second the Greek students are presenting their simple rainfall meter to the German teachers and students.

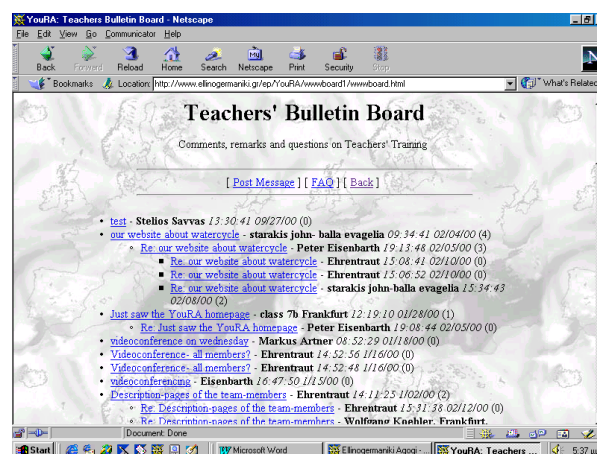


**Figure 45:** *The teachers' Bulletin Board. Seminar material, contributions of the trainees, questions and answers were constantly fed to the project's web site so that a transnational dialogue was stimulated.*

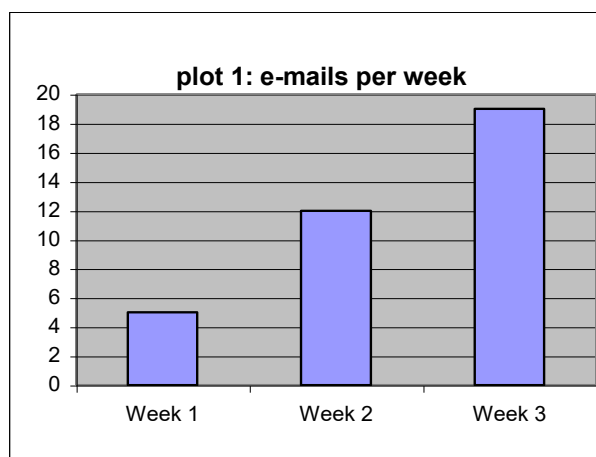


**Figure 46:** *The increase of the number of contributions to the Bulletin Board proves the increase of students and teachers interest during the training.*

The seminars were organised according to an ODL scheme. Students and teachers were able to attend not only the seminars organised by the local University but also the ones organised by the other (remotely located) University and schools through videoconference. It has to be noted that **more than 300 contributions** were sent to the Bulletin Boards by students and teachers.

### **Development of lesson plans allowing for the introduction of ODL in the primary school**

The outcomes of the teachers' training seminars were the introductory lessons for the students (lesson plans and worksheets) that the participants of the seminars, under the supervision of the University staff, had produced. The lesson plans can be found at <http://www.ellinogermaniki.gr/ep/YouRA/training.html>. During the project's Final Run these introductory lessons guided students in the construction of the selected devices (thermometers, speed-wind meters, rain-fall meters and heliographs). The lessons included:

- introduction of general weather issues and meteorological phenomena (figure 47)

- description of the devices used by meteorologists to measure the weather parameters (figure 47)
- instructions for the construction and the calibration of simple measuring devices
- instructions for the data gathering with the use of the simple devices
- instructions for the data analysis with the use of e-com

For every activity a lesson plan addressed to the teacher was also available. It included the didactical objectives, the methodology, the procedure and the estimated duration of every activity in the classroom. The high quality of the produced material has proven the interest the students and teachers involved in the training procedure showed through out the project's run. **More than 120 web pages were developed by the three groups of teachers and students.**

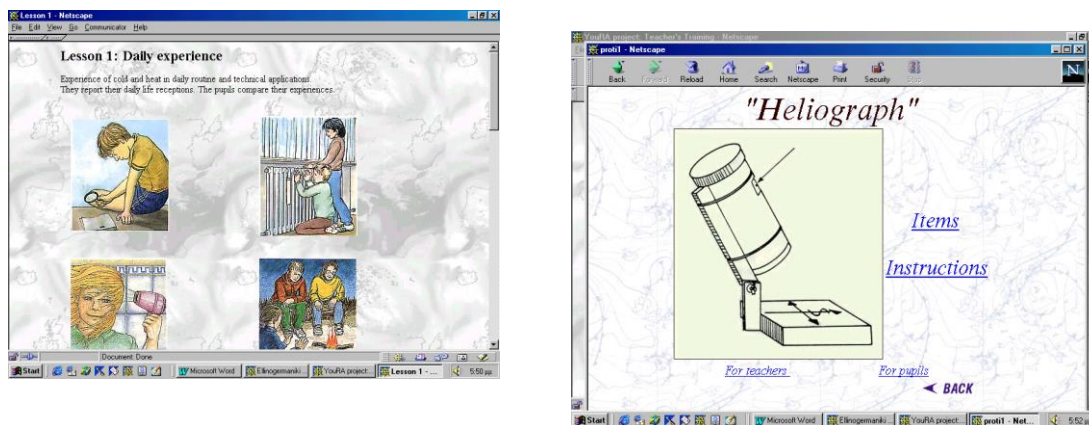


**Figure 47:** *Sample web pages from the lesson plans for the temperature measurements (Developed by the German group of teachers and students) and for the heliograph (developed by the Greek group of teachers and students). More than 120 web pages were developed by the three groups of teachers and students.*

### **Development of a state of the art learning environment**

The e-com was originally designed according to the guidelines given from the University experts. According to the recommendations given by the students and teachers, adjustments were made after the experience of the test run. It was of major

importance to ensure that the e-com would be attractive to the ages targeted by the project (Figure 48). The use of cutting edge technology in the construction of e-com was not a priority. The main task was to use existing technology in the best way in order to produce a pedagogically suitable and attractive user interface.

The e-com was providing students independence in choosing many combinations of variables, the scale and additionally many combinations of data onto comparative charts. In this way they were actually the students who drew the diagram, not the computer, since they set all the parameters. Additionally they drew it quickly, as they did not use any pen but the tool executed their instructions. This, by any means, does not imply that students should not draw diagrams by hand. Simply it was the only way to make them use diagrams for every phenomenon they studied without losing a lot of time during the lesson or the science laboratory. The benefits of using these diagram-oriented tool were multiple. Using certain teaching strategies, the students interest was stimulated and they used these plots to articulate their own models, to make predictions grounded on them and to make explicit comparisons between their own diagrams (Figure 49) and the accepted scientific models.

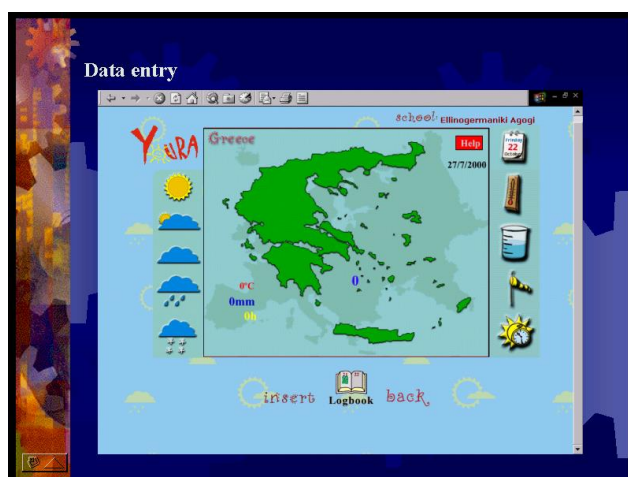


**Figure 48:** *The data entry form of the e-com for Greece. The e-com was based on pictures, symbols and animations (using Flash Micromedia software) so that even students with limited knowledge of foreign languages could easily use it.*

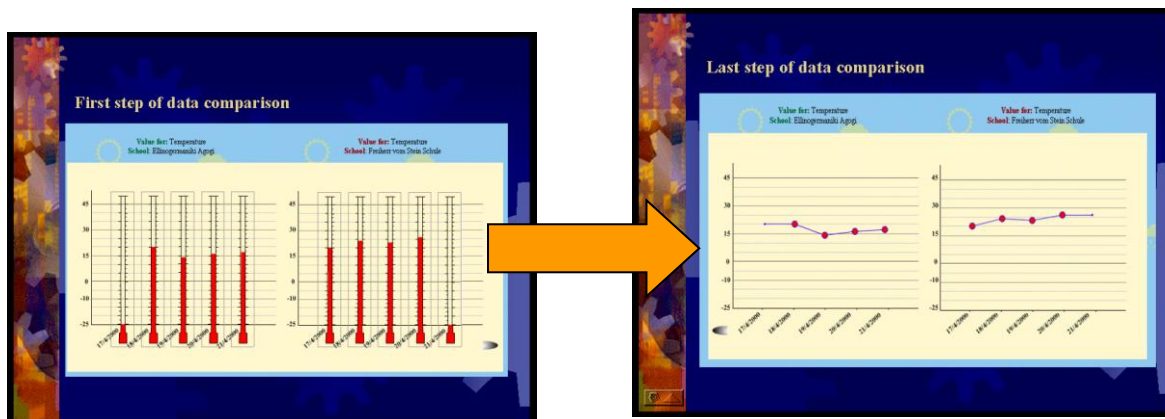


**Figure 49:** *The e-com was providing students independence in choosing many combinations of variables, the scale and additionally many combinations of data onto comparative charts. In this way it was actually the students who drew the diagram, not the computer, since they set all the parameters. Additionally they drew it quickly, as they did not use any pen but the tool executed their instructions.*

### **Smooth introduction of the project in the classroom and successful incorporation within the curriculum**

During the test and the final run the project was introduced in the classroom. Students constructed simplified low cost measuring devices and used this apparatus for measurements, compared these measurements with others taken with more sophisticated equipment and entered the measurements to the e-com. Students participating in the project, benefit from the qualitative upgrading the introduction of ODL is offering to the “conventional” teaching. They had the opportunity to use the web as an interactive communication medium and co-operate with virtual classmates remotely located and by this expand their learning experiences (figure 50). In the same time they were introduced to the methodology of scientific inquiry. They were actively engaged in the construction and use of low cost measuring apparatus and actively experience weather observation and graphical representation of weather parameters. The partnership succeeded in incorporating the elements of the YouRA project in various disciplines of the curriculum of the participating countries.

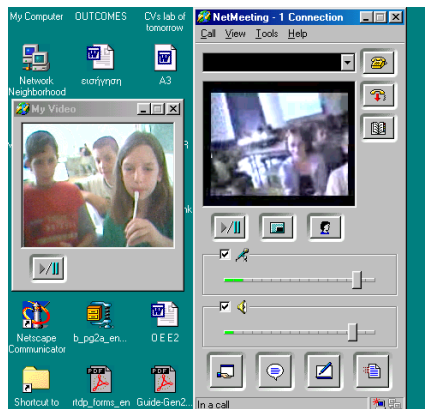


**Figure 50:** *Moments from the videoconference between the Greek and the Austrian students.*

Students compared the weather situation in the area they lived, with the ones of their virtual classmates. This comparison formed the stimuli for a dialogue with the virtual classmates through the various communication channels bulletin board, video conferencing. **More than 100 contributions** were sent to the Bulletin Board during the 3-month test run and **more than 200 contributions** during the 6-month final run.

# **Recommendations for the Teacher in an ODL project**

The main aim of this book is to help teachers to improve their class performance and upgrade the quality of their teaching. There has been a long series of recommendations and guidelines presented by many authors. Here some very important remarks emerging from many years of research and implementation of ODL projects in education are presented. These recommendations could be categorized into four areas, presented below. Cases from the implementation of the YouRA project are given as example.

## **8.1 Pedagogical recommendations**

*Have Clear Objectives.*

Participants should be convinced that their online-offline interactions is time well spend. It is better to take more time (progressing conservatively) and do less - than to try to do too much too quickly.

#### *Maintain as Much Flexibility as You Can.*

Rather than presenting an elaborate project agenda at the outset and a complex process for students to fulfill, it is better to follow the flow of the conversation, while guiding it toward the subject. It is a very demanding task to follow a preset project's timetable in parallel with the school's activities. Unexpected positive contributions may occur, like when a student participating in YouRA project suggested that we should put a ping-pong ball in the rainfall-meter's top hole in order to prevent water's evaporation by the time we check the rainfall-meter. It took some time to discuss the proposal with all participants to the project. That does not mean to leave everything in chance. But the primary goal is the project's success and not keeping the timetable.

#### *Encourage Participation.*

The use of various learning options can stimulate learner participation and interaction. Small group discussion, debates, hands-on experiments, constructions, taking measurements daily, writing articles for the magazine, exchanging messages through the Bulletin Boards, social interaction though videoconferences were some of the activities used in the framework of the YouRA project to encourage participation. In general publication of students' work provides them with motivation. It encourages student authors to produce work of high quality and gives them the satisfaction of knowing their work is read and appreciated by others (Downing 1997). Collaborative and project-based learning may have a negative implication. The newly gained freedom and autonomy can create problems for some students. These students are not able to cope with taking this responsibility for learning and prefer to be "taught" (Morgan 1984). Some students may back off from asking questions from a fear of wasting other's time or from the difficulty in knowing an opportune moment to interject (Hearnshaw 1997). There is an occasional tendency to hide behind group anonymity. So the teacher should give emphasis, especially in the initial stages of the project, in student's support and "learning how to learn".

#### *Don't Expect Too Much.*

There will be times when a videoconference will have nothing to offer (if it works at all) to the participants or when the students won't come to the conclusion you expected they will. Using new technologies to help students collaborate and learn is just another means in the teacher's hands. It is not the answer to every educational need. So be as modest as you were for any conventional way of teaching you used up to now.

*Promote as Many Distance Conversations as well as those in the Classroom.*

The essence of the project was to help students to collaborate with (besides their classmates) students in distant geographical locations ("virtual" classmates) in order to study common problems and come to generally accepted conclusions. We could have set up a similar project within a single school, dividing students in small groups. But we would have lost the qualitative add-on of international collaboration that offered to the students a very strong motive for participation to the project. Social interactions between and among learners enrich the learning community and should be encouraged and supported in the instructional design and the delivery of educational programs.

*Make the Material Relevant.*

Develop questions and activities for learners that relate to the students' experiences. The Weather Forecast on TV proved to be a very good starting point to discuss students' measurements and comparisons. All students have watched a weather forecast and there were things that they already knew (practical and empirical concept of temperature) and things that the project helped them to clarify and understand (scientific methodology).

*Require Contributions.*

To sustain a viable Bulletin Board or magazine, contributions from as many participants as possible had to be made. In the framework of the YouRA project many times students were reluctant to actively participate, preferring a passive observer's attitude. The teachers had then to ask from them to take some form of action, such as to write an article for the magazine, submit a message to the Bulletin Board, or compare their measurements using the web-based software etc. In general, the

contributory publishing process encourages students to take a more active role in the learning process (Downing 1997).

#### *Present Conflicting Opinions.*

Educators can draw attention to opposite perspectives, different directions, or conflicting opinions that could lead to debates and peer critiques. This was a key point for the project's success as the main goal of the Web educational software that produced comparative graphical representations of the students' measurements was to provoke discussions among the virtual classmates, simulating in this way "scientific" debates that produced "scientific" conclusions.

## **8.2 Social Recommendations**

#### *Guard Against Fear in Your On-line (or Off-line) Sessions*

Fear of public ridicule often stifles participation in a project (of any kind). Be gentle accepting students' comments and deal with exceptions off the list.

#### *Watch the Use of Humor or Sarcasm.*

Privacy issues for students in a virtual learning environment are an order of magnitude greater than those for students in a more traditional learning environment (Ferencz & Goldsmith 1998). It may be wise not to use (or let others use totally uncontrolled) humor or sarcasm due to different cultural and ethnic backgrounds that are likely to participate in an ODL project. Using text-based communications, it is especially difficult to construe intent and tone from on-screen text, unless you know the other participants very well. Administrators who handle arbitration of computer abuse incidents have long recognized that more harm is done through ignorance than intention. Mutual apologies would have to be made and so for the YouRA project it was decided to use two Bulletin Boards: one for purely social interaction and one for the "scientific" part of the project. In addition the Bulletin Boards were password protected so as to prevent someone over the Internet from sending messages to students.

### *Use Introductions*

The facilitator should encourage the participants to introduce themselves, to help build the sense of community. We spend the first issue of the METEO (students magazine) and the first few videoconferences getting students to know to each other using apart from a short note about their interests and a photo.

### *Praise and Model the Discussant Behavior You Seek.*

Reinforcing and modeling good discussant behaviors, such as by saying “Very Good” to students who respond effectively on-line or offline, can be helpful to encourage courtesy and interaction.

## **8.3 Managerial Recommendations**

### *Informality.*

Depending upon the instructional objectives of the course, the educator may decide that informality should be encouraged. One way to stress the informality in a Bulletin Board for example is to let students know that perfect grammar and typing are much less important than making their meaning clear. That, of course, is not always desirable. The educators didn’t pay too much attention to grammar mistakes that students did when trying to communicate in a foreign language but students were encouraged them to be as precise as possible when they were using scientific terminology. A “mm” is different from “m” when one refers to the height of the rainfall. Also, the extent of grammar mistakes tolerance depends upon the medium of communication. The time pressure in composing a message in a Bulletin Board does not exists in the editing of an article for the project’s magazine.

### *Distribute a List of Participants.*

Distribute, or make available to all, a list of participants so that private messages can be addressed to individuals and not to the list. It is inevitable that private message exchange will take place to make the necessary arrangements for whatever occurs.

### *Be Clear.*

Succinctly state the expectations for students within the project. The students were informed in detail from the beginning of the Test-Run about the project. Their

participation to the project was crystal clear right from the start, had no dark points or hidden future obligations for them.

#### *Don't Overload.*

It is obviously important for all participants to be able to keep up with the project's activities. Students from different countries participating in a project means different timetables, different educational obligations and different pace in general. Everybody should have the chance to follow the project. In the YouRA project emphasis was given to procedural knowledge and not to factual knowledge. Students were provided with an opportunity to practice classical (perhaps rather idealized) scientific methodology. Pure scientific knowledge is accumulated over the following school years.

#### *Preparation Time.*

Educators find that planning, developing and distributing course materials needs a substantially greater lead-time for preparation than may be anticipated at first. Probably the most common cause of failure is impatience on the part of management as well as educators to get into implementation phase of the project - to see the students at work - before a proper foundation of materials and strategies has been laid (Moore 1996). In YouRA the preparation and design of the project lasted 13 months (including a 3 month Test Run) while the final run of the project lasted 6 months.

### **8.4 Technical recommendations**

#### *Use Technical Support.*

One can not start talking about a modern ODL project without using the advantages that the modern technology has to offer. It is obvious that having a team of professionals to back up technically the project is close to the ideal. But the experience from the implementation of the YouRA project is that for a quality project it is adequate to have an all around technician per distant location (who will provide the necessary feel of security especially concerning the last minute problems). If the software needed for the project is available on the market (with the advantages and the limitations this means) the team for the technical support could be only that one all-around technician. If the software is meant to support an educational innovation

then a professional team of software experts is the one for you (as the one that developed the software for the e-Hermes and YouRA projects).

#### *Provide Technical Feedback.*

Provide swift feedback, especially to technical problems. In YouRA project there was technical support available (a “help desk”) within each participating institution. There were no severe technical problems encountered and every other minor problem was dealt successfully with swiftness.

#### *Provide Time to Technology Users.*

New users of technology need support as they learn to use new software features. Adequate time should be provided to them in order to make them to feel comfortable with the technology before their active involvement in the project. In the YouRA project special emphasis was given to the design of the web-based educational software in order to ensure the maximum user-friendliness for the students of primary school.

## Conclusions

There is an increasing tendency to integrate new technologies and especially the Internet with everyday teaching practices. Technology has widened the horizons of distance learning and promised a much-anticipated improvement in learning. But there are some critical factors – as the YouRA project clearly showed - that are going to play a decisive role in the extend of the positive use of the new technologies:

- **Pedagogical backup of the implementation of new technologies in distance learning.** The adopters of new technologies should not have as their primary focus, the features of the new technologies but the pedagogy that will support their use in a fruitful way. The humble goal of improving - even by little - the current state of the educational services we (the

teachers) offer to our students using new technologies is, in fact, a significant breakthrough (especially having in mind that the educational system –in its basics set of rules - has practically remained unchanged for decades). There are numerous (and there have been in the past) research project in the field of distance learning and new technologies in education in general. But they are all implemented in a relatively small scale, including some students, a school or even some collaborating schools. We haven't been able yet to implement large-scale programs that will take full advantage of the new technologies in the field of distance learning. And that is because we haven't decided to make the necessary changes to the structure of the traditional school and the pedagogy we use that survived through decades.

- **Teachers training.** The teacher/educator should be prepared to cope with two major changes:
  - There is an unavoidable shift in his role in the classroom. Mentoring and counseling students, guiding their work and providing individual help to encourage them pursue their learning are the key features for the “new” teacher. A “new” teacher that many times will have to learn along with his students and he or she must be prepared –and willing- to handle over a significant part of his authority.
  - There is an urgent need for elementary technical competence for the teachers in order to maintain control and the pupils' confidence. Technology in the classroom represents an area of anxiety but on the other hand it has much to offer. Teachers should be trained in the use of new technologies – the carrying vehicle for enhanced distance education. Each and every one of them should be able to decide for ones self the extent of the introduction of new technologies in the classroom (either a conventional or a “virtual” one).
- **Reshaping curriculum.** Major problems in implementing ODL projects on a large scale are associated with organizational change, change of

faculty roles and change in administrative structures in the school. Thus, we need:

- An administration committed to the emerging curriculum.
- An ongoing budget plan to sustain the investment in related technology.
- The development of new specialized jobs and resources to assist staff in the development of online and interactive curriculum.
- Ongoing professional development programmes to empower staff.
- School building and timetable reform changes to accommodate a changing curriculum.
- Speed and availability of access between disparate and remote locations.

Furthermore, we need a curriculum that leaves significant space for new educational practices. A student-centred approach that delivers high quality presentation of information, but also provides high quality personal experience for every individual student to interact with that information and with other students in such a way that the student can process information into personal knowledge.

**Evaluation of pedagogical research.** It is time to systematically evaluate ODL projects concerning the extent that they finally meet their initial educational aims. The feedback about what succeeded and what failed is valuable in order to draw the general guidelines for large-scale implementation of educational programs. We should decide about the pedagogical value of the new technologies supporting distance learning based on real facts about their present abilities and constraints and not on their future potential.

# GLOSSARY

**abstract** A summary of a study that describes its most important aspects, including major results and conclusions.

**audio-visual** A term used to describe instructional materials or systems which use both sound and vision.

**case study** an in-depth examination of real-life or simulated situation carried out in order to illustrate particular characteristics.

**computer-assisted learning** Also referred to as computer-based instruction, learning using specially prepared instructional materials on a computer.

**computer based instruction** an instructional technique which utilizes a computer.

**Conventional education** education process where teachers and students are present in the same place and at the same time.

**co-operative learning** a learning situation in which students work together in small groups and receive rewards or recognition based on their group's performance

**curriculum** a term, which compasses all the learning that goes on in a school or other environment and expresses the aims, assumptions and values of the learning environment and of the educational system that supports it.

**curriculum development** a task of supervision directed toward designing or redesigning the guide lines for instruction. Includes specifications indicating what is to be taught, by whom, when, where and in what sequence.

**data** general term for raw research material or information.

**Didactic material** collective term for all material used for teaching purposes.

**Distance education** education conducted through no face to face contact between teacher and student.

**Distance learning** learning carried out by a student who is separated from the institution or person organizing the instruction.

**Distance teaching** A method of instruction in which the teacher and students perform their roles in different geographical locations and the content of the study is transmitted through technological means.

**Education** Organized and sustained instruction designed to communicate a combination of knowledge, skills and understanding valuable for all the activities of life (UNESCO)

**Electronic mail (e-mail)** a general term for systems that enable letters, memoranda, etc. to be sent from one to another solely by electronic means.

**experiment** a research study in which one or more independent variables are systematically varied by the researcher to determine the effects of this variation.

**experimental group** the group in a research study that receives the treatment (or method) of special interest in the study.

**experimental research** research in which at least one independent variable is manipulated, other relevant variables are controlled, and the effect on one or more dependent variables is observed.

**experimental variable** the variable that is manipulated (systematically altered) in an intervention study by the researcher.

**follow-up study** a study conducted to determine the characteristics of a group after some period of time.

**histogram** a graphic representation, consisting of rectangles, of the scores in a distribution; the height of each rectangle indicates the frequency of each score, or group of scores.

**hypothesis** a tentative, testable assertion regarding the occurrence of certain behaviors, phenomena, or events; a prediction of study outcomes.

**independent variable** a variable that affects (or is presumed to affect) the dependent variable under study and is included in the research design so that its effect can

be determined; sometimes called the “experimental” or “treatment” variable.

**information technology** the technology involved in the creation, storage, selection, transformation and distribution of information of all kinds.

**nonparametric technique** a test of statistical significance appropriate when the data represent an ordinal or nominal scale, or when assumptions required for parametric tests cannot be met.

**ODL (Open distance learning)** the acquisition of educational or training information, including the instruction and experience, from the learners, although they are physically distant from the source of that information.

**one-group pre-test-post-test design** a weak experimental design involving one group that is pre-tested, exposed to a treatment, and posttested.

**parametric technique** a test of significance appropriate when the data represent an interval or ratio scale of measurement and other specific assumptions have been met.

**pilot study** a small-scale study administered before conducting an actual study its purpose is to reveal defects in the research plan.

**population** the group to which the researcher would like the results of a study to be generalizable; it includes all individuals with certain specified characteristics.

**Post-test-only control group design** an experimental design involving at least two randomly formed groups; one group receives a treatment, and both groups are post-tested.

**prediction** the estimation of scores on one variable from information about one or more other variables.

**Pre test-post test control group design** an experimental design that involves at least two groups; both groups are pre-tested, one group receives a treatment, and both groups are post-tested (e.g. YouRA test design). For effective control of extraneous variables, the groups should be randomly formed.

**probability** the relative frequency with which a particular event occurs among all events of interest.

**problem statement** a statement that indicates the specific purpose of the research, the variables of interest to the researcher, and any specific relationship between those variables that is to be, or was, investigated; includes description of background and rationale (justification) for the study.

**procedures** a detailed description by the re-searcher of what was (or will be) done in carrying out a study.

**purpose (of a study)** a specific statement by a researcher of what he or she intends to ac-complish.

**qualitative research/study** research in which the investigator attempts to study natu-rally occurring phenomena in all their com-plexity.

**random sample** a sample selected in such a way that every member of the popu-lation has an equal chance of being selected.

**regressed gain score** a score indicating amount of change that is determined by the correlation between scores on a post-test and a pre-test (and/or other scores). It provides more stable information than a simple post-test-pre-test difference.

**regression line** the line of best fit for a set of scores plotted on coordinate axes (on a scatterplot).

**regression threat** the possibility that results are due to a tendency for groups, selected on the basis of extreme scores, to regress toward a more average score on subsequent measurements, regardless of the experimental treatment.

**reliability coefficient** an index of the consistency of scores on the same instrument. There are several methods of computing a

**research** the formal, systematic application of scholarship, disciplined inquiry, and most often the scientific method to the study of problems.

**Research / test design** the overall plan for collecting data in order to answer the research question. Also the specific

data analysis techniques or methods that the researcher intends to use.

**research hypothesis** a prediction of study outcomes. Often a statement of the expected relationship between two or more variables.

**research proposal** a detailed description of a proposed study designed to investigate a given problem.

**research report** a description of how a study was conducted, including results and conclusions.

**results (of a study)** a statement that explains what is shown by analysis of the data collected; includes tables and graphs when appropriate.

**sample** The group on which information is obtained.

**sampling** the process of selecting a number of individuals (a sample) from a population, preferably in such a way that the individuals are representative of the larger group from which they were selected.

**scatterplot** the plot of points determined by the cross-tabulation of scores on coordinate axes; used to represent and illustrate the relationship between two quantitative variables.

**scientific method** a way of knowing that is characterized by the public nature of its procedures and conclusions and by rigorous testing of conclusions.

**standard deviation (SD)** the most stable measure of variability; it takes into account each and every score in a distribution.

**statistically significant** the conclusion that results are unlikely to have occurred due to sampling error or “chance”; an observed correlation or difference probably exists in the population.

**survey study / research** an attempt to obtain data from members of a population (or a sample) to determine the current status of that population with respect to one or more variables.

**target population / group** the population to which the researcher, ideally, would like to generalize results.

**test of significance** a statistical test used to determine whether or not the obtained results for a sample are likely to represent the population.

**validity** the degree to which correct inferences can be made based on results from an instrument (e.g. a questionnaire); depends not only on the instrument itself, but also on the instrumentation process and the characteristics of the group studied.

**variable** a characteristic that can assume any one of several values, for example, cognitive ability, height, aptitude, teaching method.

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