

# **DEVELOPMENT OF CHILDREN'S INVESTIGATIVE SKILLS THROUGH COLLABORATION AT A DISTANCE BETWEEN TWO ELEMENTARY SCHOOLS IN CYPRUS**

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## **ABSTRACT**

The introduction of new educational technologies in elementary schools constitutes a decisive factor for the preparation of tomorrow's citizens, who will be called upon to respond to the challenges of the newly emerging information society. During the school year 2001-2002, the Cyprus Ministry of Education and Culture, the University of Cyprus and the Bank of Cyprus implemented the first technology enhanced collaboration-at-a-distance program, called "ODYSSEUS", between two elementary schools of Cyprus. The program centred around a joint effort to prepare children for taking part in a science fair. The science fair is a non-formal learning environment that has been developed by the Learning in Physics Group as a context for developing investigative skills. Its is an organized educational activity that aims to engage students with science as a process of inquiry and to promote the development of science process skills as well as positive attitudes towards inquiry based learning. In the context of Odysseus, we have sought to implement teleconferencing and in particular to develop a methodology for tele-collaboration between the two elementary classrooms working on preparing science fairs in their respective schools. The participants were two grade 6 classes in different towns in Cyprus.

## **KEYWORDS**

synchronous distance learning, comprehensive teaching methodology

## **INTRODUCTION**

The introduction of new educational technologies in elementary schools constitutes a decisive factor for the preparation of tomorrow's citizens, who will be called upon to answer the challenges of the new emerging information society.

Information Society will be the new economic and social model in the beginning of 21st century (Anastasiades, 2000). One of the most important priorities of the developed countries throughout the world is to help their citizens come up to the needs of the new digital era (2001/C 292/02). As part of this endeavour, the role of our educational system is of utmost importance.

The preparation of tomorrow's citizens is incumbent on the elementary schools, which ought to include the new technological applications in the educational process. The integration of new technologies in the sensitive area of a school classroom is not an easy task (Papert, 1997). The use of computers and educational multimedia, the establishment of network infrastructures and the provision of videoconference systems ensure the technological aspect of this endeavour (Harley, 2001).

The technological tools and applications is the first step in the transition from the current, conventional educational system, to the new model of the virtual classroom (Norton, 2001) and the hybrid school environment (Rosbottom, 2001). At the same time, it is necessary to develop a pedagogic model, which

will constitute the necessary theoretical basis and will mark out the framework where the new educational technologies will be contained.

As part of this framework, the Ministry of Education and Culture of Cyprus and the Department of Computer Science of the University of Cyprus, with the sponsoring of the Bank of Cyprus, implement the first pilot program on distance learning via teleconferencing, called “ODYSSEUS”, in two elementary schools of Cyprus.

## **SCIENCE FAIR: AN INFORMAL LEARNING ENVIRONMENT FOR THE PHYSICAL SCIENCES**

The Science Fair approach is an organized learning activity in the physical sciences. The final outcome of this approach is an actual Science Fair that has the form of a school event. The Science fair approach works, as an informal learning endeavor that aims at learning beyond the boundaries of formal school curricula and resembles educational programs that take place in science museums.

During Science Fairs students exhibit their work to the audience. Their work that relates to specific science topics and it could be constructions, experiments and projects relevant to a topic of science, which they have investigated prior to the event.

The main educational goals pertinent to this approach are the development of thinking skills and of positive attitudes towards science while involving students in scientific processes of inquiry. Students learn how to design and execute experiments and they apply control of variables to the problem they investigate.

The Science Fair approach also promotes collaborative learning skills, creativity and epistemological efficiency. Students gain valuable experiences while positive attitudes towards science are promoted. Furthermore it provides a great chance for parents to participate in learning procedures. Experiences earned by students are another valuable outcome.

In order to organize a successful Science Fair, involved teachers need to get familiarized with two different procedures: a) a specific teaching approach aiming at students taking part in scientific processes; acquiring basic inquiry skills as design of experiment and control of variables and b) an organizational methodology that includes a particular sequence of activities that can be adjusted to the needs of the students.

The teacher usually proposes a list of topics. Students are encouraged to choose a topic that they find challenging and interesting. They are expected to organize an inquiry relevant to the topic they chose and to present the outcomes of their inquiry.

Moreover they are encouraged to organize an activity relevant to their inquiry topic in order to interact with the visitors to the Fair. Teachers need to guide and support students efforts throughout the whole procedure.

The innovative aspect of our work lies in the fact that the Science Fair approach was for the first time implemented while employing a specific distance learning methodology called “ODYSSEAS”.

## **DEVELOPMENT OF CHILDREN’S INVESTIGATIVE SKILLS THROUGH COLLABORATION AT A DISTANCE**

### **Objective of the program**

ODYSSEUS program is the pivot of a collective endeavour, with the participation of the Ministry of Education of Cyprus and the Department of Computer Science, University of Cyprus. The students and

teachers of the two elementary schools that participated in the program were the main component parts of an open learning environment

The main objective of our project was the establishment of a hybrid- learning environment between the students and the teachers of the two schools, through the use of synchronous communication tools. The added value of teleconferencing in the preparation of a science fair emerges from the increased access to new forms of communication and to metacognitive reflection procedures as well as from the capability to cross reference the experimental measurements by distributing them across students at two different sites.

In this paper we will address three main issues: a) the development of a comprehensive teaching methodology, that will be useful as a prototype model for the introduction of distance learning synchronous communication courses at the primary education level, b) the development of an evaluation methodology with regard to the learning effectiveness and social implications of the activity as realized by the students of the two elementary schools which participated in the project c) the presentation and discussion of the learning outcomes from this particular activity.

### **Targets of the program**

The main target of this pilot endeavour is to familiarize students with a step-by-step hybrid-learning environment. By “hybrid” we mean a learning environment where an optimal combination of the new educational technologies and traditional pedagogic methodologies is attempted (Anastasiades, 2002). The methodology applied will enable the students be active components of an interactive learning strategy plan.

### **The technological background of the two schools in the program**

The two elementary schools, chosen to participate in this program, were Elenion Elementary School in Nicosia and 9<sup>th</sup> Elementary School in Paphos. One 5<sup>th</sup> grade class with 24 children from Elenion co-operated with a sixth grade class with 30 children from the 9<sup>th</sup> Elementary School.

The children in both of these classes were acquainted with teleconference, through a different educational program, named “OIKADE – Electronic Journeys to mother country” . OIKADE is an ambitious program aiming to bring closer Greek students from various places in the world, through the most advanced use of telecommunication and information technology.( [www.oikade.gr](http://www.oikade.gr)).

The technological equipment from “OIKADE” was used in the new program. Specifically, this equipment included three ISDN lines, one internet connection line, a TV, a teleconference camera, a VCR, one Personal Computer and a telephone for each participating schools. Technical support was provided by technicians who were in deal with the Bank of Cyprus in order to offer their services to the program whenever it was necessary.

## **METHODOLOGY**

In the last thirty years various discussions have been taken place and many theories have been developed related to the pedagogical model of distance-learning, which is considered substantially different from the traditional model of teaching. For instance, we refer to the methodology of independent studies (Wedmeyer, 1977), the idea of autonomous learning (Moore, 1972, 1994) and the theory of interactive learning (Holmberg, 1989). Although the importance of these concepts cannot be denied, a comparative analysis reveals their inadequacy to be considered a fully integrated pedagogical model (Keegan, 1993).

In recent years, distance learning becomes more decentralized and more student centered and often is being offered in conjunction with traditional academic studies. Furthermore the traditional education utilizes in an ascending mode new educational technologies. As a result, traditional education and distance learning converge with the pass of time ( Picciano, 2001, pp. 67, Keegan, 1996). We have to

mention that the medium is not the message, and that the substance or content is most important in learning (Clark, 1983). In line with this trend, it can be inferred that there is a need for a pedagogical model supporting this convergence.

The adoption of Clark's suggestion reveals a special view of the concept of hybridic educational setting. The transition from the dominant model of the traditional classroom to the new hybridic educational setting is not as simple as it might seem, because there seem to be a lot of new factors, which may possibly encumber the process of enrichment and change of the existing conditions (Anastasiades, 2002).

The phases of effectuation are build in a great extend to the acceptance of the model of American Distance Education Consortium (ADEC, 1996).

### **Designing**

The levels of implementation of the designing of the program can be distinguished chronologically into the following:

- Part A: Preparation period – actions design.
- Part B: Implementation of actions.
- Part C: Designing of an informative prospectus.
- Part D: Development of audiovisual material.
- Part E: Webpage design.

In this suggestion we will refer as analytically as we can to part A

#### *Part A: Preparation period – actions design*

A1: Development of the team: The project team constitutes of the following sub teams:

Project design and implementation team: This team has to propose the teaching methodology, the project time management and deliver the acts.

Exploratory team: According to the agreement that was signed by the implementation parties of "ODYSSEAS", an exploratory team is developed and contributes to the scientific ground of the introduction of new teaching levels and cognitive materials.

Observation team: The task of this team is to concentrate on the observation of the actions of the implementation sector having the supervision of the general design. The members of this team participate with their current authority and duties: Minister of Education, Director of Primary Education Department, School Inspectors, School Principles, President of IT Department at the University of Cyprus, Bank of Cyprus.

Project supporting team: It is made out of four students from the Primary Education Department of the University of Cyprus as a part of a project for the course "Introduction to the IT Science". These are Tofarou S, Andreou I, Demetriou S and Agapiou N.

A2: Actions Design – Development of the timetables

At this stage the actions are design and become a part of an agreed timetable.

A3: Decided teaching methodology.

A3.1: Choice of introductory model of the long distance teaching.

The student will come in touch with the new teaching model step by step, in order to be paced with as easy as possible to the new teaching environment. This well be accomplish with the implementation of the three faces meaning teleteaching, virtual class and teleconferencing. (Anastasiades, 2002a)

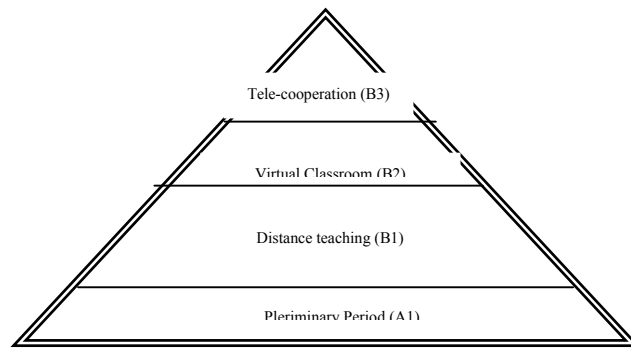


Figure 1. The steps of the teaching methodology

### A3.2: Choice of methodology for the participating audience.

In order for all the participating kids selected to take place in the proposed setting, a discriminatory methodology of the audience is implemented, dividing it into active and passive. The active audience consists of eight (8) students sitting at a parallel shape with the teacher on top with the board. The active audience students switch along the way of the teaching cycle, in order to gain the experience of the pilot program. With this all the kids are part of the process.

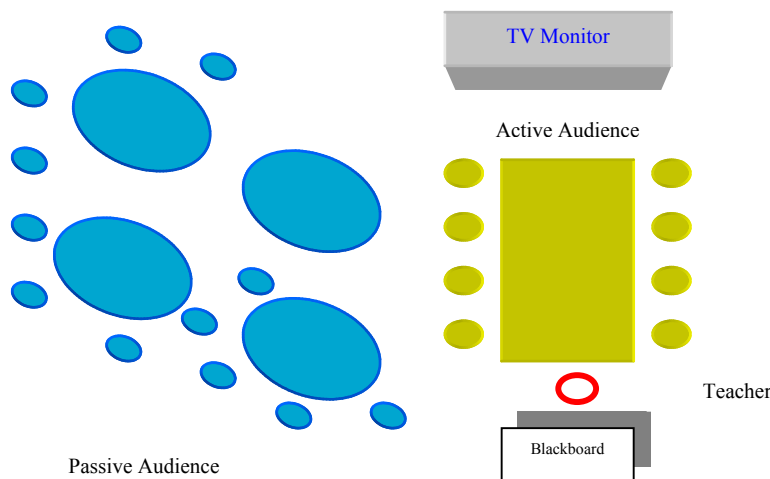


Figure 2. The classroom architecture model

### Implementation

The program was completed in five eighty-minute sessions through teleconferencing. The first session was more of an introduction to the course, the second and the third sessions were in the form of an imaginary class, on the fourth session the two groups worked together, and on the fifth the results were announced.

During the first session the children from the two groups involved were introduced to each other and Mrs Eleftheriou, the teacher from Eleneo School introduced the subject "Identifying variables". Sheets of paper with a circle of a different size on each one were given to them and they were asked to spot the variables. Finally they were asked to answer the question: "Why ships don't sink in water?" They were also asked to conclude the manner in which they should go about answering the question.

At the second session which had the form of an imaginary class, teacher Mrs Philippidou from the 9<sup>th</sup> Elementary School of Pafos gave a number of problems to different groups of children and they were

asked to point out the constants and variables in each case. The active audience, eight students from each school – Nicosia and Pafos – announced the results after each discussion.

Next, a problem was given to the groups of the two schools. The children had to investigate the problem and set the constants and variables. They also had to point out the way the problem had to be solved, so as to reach to a safe answer.

The third session was also conducted in front of an imaginary class. Teacher Mr Christoforides from Eleneio School introduced the “subject of sound”. After both classes had investigated the intensity of sound they were asked to answer questions about sound and for each question to point out the constants and variables. It was pointed out that for the investigation of any event they had to define all the variables and constants involved for the particular event, to keep all variables constant except one and to do the same for every variable keeping the rest of them constant. The results were announced using the same method as in the previous session. To that teleconferencing was also kept the model of active and inactive audience. At the end of the session they were given eight events and they were asked to investigate them, (one each group) during their neat meetings. Between the third and the fourth meeting the students from both schools had formed eight groups each consisting of three to four students in order to cooperate and present one subject for the Science Fair.

The groups of students in cooperation with their distance groups had to:

- a) select and investigate a project of common interest.
- b) present the course taken in order to reach the Science Fair
- c) make a construction or an experimental procedure connected with the research, in order to gauge the response and reaction of the visitors at the fair.

The above assignments were given to the students without any particular instructions of how to accomplish them. The groups had to decide of ways and means of co-operation.

During school periods or during their free time the children worked in their groups and placed the questions which needed farther investigations, the points they had to give more attention, and the specific tests they had to accomplish and finally come to a safe conclusion.

On the fourth session, both groups (Nicosia – Pafos) worked out together, they exchanged ideas, and completed their papers so that they would investigate the questions given to them, and work out the right answers to specific test.

Finally during the fifth session the two groups presented the results of their experiments, comparing them with each other, and whenever there was a disagreement over an answer they had agreed to repeat the tests after all the essential explanations were given. Finally there was a summary of all the tests and they were invited to the science fairs in June at their schools. The fairs were arranged at different dates so that both schools could attend both fairs.

As a high light of the whole procedure is to conduct the science fair. The basic achievement of learning experiences is the involvement of children in scientific experiments and tests and especially specific ways of designing and working out tests in order to reach the proper results.

During the sessions the students worked together in order to preset all their researches and experimental procedures they have accomplished on their science class, so that they will gauge the response and reaction of the visitors at the fairs.

The school function is the accomplishment of a teaching procedure which needs preparation long before the presentation day. During the presentation period for the fair the children are invited: a) to carry out some tests and present the results and the way in which they have reached their conclusions of their investigations. b) to make a construction of an experimental procedure connected with research, in

order to gauge the response and reaction of the visitors at the fair. The course of the research is concluded between stages: placing hypothetical questions, identifying variables and arriving at a conclusion.

A part from being able to gain abilities through experimentation, the children are able to gain scientism knowledge, improvement of oral communication, to co-operate in learning procedures, creativity and sensory.

Above everything the fair creates the opportunity for the parents to involve themselves during the learning procedures. Finally involvement in science fairs motivates children, and creates positive thinking towards Science.

### Evaluation

“ODYSSEAS” methodology is drawn upon the summative assessment model (Calder, 1995). Nevertheless a complete evaluation methodology is needed due to the particularities of distance-learning programs (Anastasiades 2002). The preparation of such method in order to evaluate the “ODYSSEUS” program is one of the most important aspects of the program itself. “ODYSSEUS” evaluation model is applied across three different levels of efficiency: to the teaching level, to the learning level and to the social level.

At the teaching level, the proposed methodology uses students and teachers evaluations concerning the teaching approach followed. Evaluation aims at pointing out the weaknesses at the design and implementation of the lessons’ units, good practices that should be expanded, friendliness of the program, effectiveness of teaching approach were the key aspects at this level of evaluation.

At the social level the model is concerned whether or not the distance learning experience has altered and to what direction the image and the sense that students have for the role of the teacher and for the school surroundings as an institution promoting social interactions. Finally the model evaluates learning efficacy. For this cause we used a test that examined specific skills prior to and at the end of the Science Fair learning approach. Tests were given to students by their class teacher immediately before and a month after the completion of the approach.

The test included two different tasks that aimed at evaluating the ability for experiment design. Task A presented a problem situation and asked from students to trace the correct question for the inquiry they should perform for solving the problem. Students needed to choose which variables they should maintain constant and which to change during the execution of the experiment, which would give an answer to the original problem. Task B presented specific data that students could use in order to answer to a given problem. Both tasks required students to give explanations regarding their thinking.

Table 1 presents the percentages of students’ correct answers at the two tasks included in the pre-test and in the post-test. Due to the space limitations we will not present an analysis of students responses nor will we have the chance to comment upon the difficulties presented in their reasoning.

Table 1. Learning effectiveness Evaluation

	<b>Eleneio Elementary School, Nicosia</b>		<b>17<sup>th</sup> Elementary School, Paphos</b>	
	<i>Pretest Success</i>	<i>Posttest Success</i>	<i>Pretest Success</i>	<i>Posttest Success</i>
<b>TASK A</b>	7,7 %	89,5%	7,7 %	76%
<b>TASK B</b>	13%	77%	9,3%	92%

Data analysis provides us with an image of improvement in student's performance at tasks involving experiment design. We could therefore draw useful conclusions regarding the effect of a Science Fair approach to the development of thinking skills.

## **CONCLUSION**

In the context of the emerging Information Society the use of basic teleconferencing, email and electronic file transfer systems in combination with the optimum use of the world wide web are changing the educational landscape as we know it today. The basic characteristics of the new educational environment focus on the process of open, distance learning via electronic connections to universities and on life long learning. The hybrid learning environment is a conceptual and functional integration of traditional educational methods and new modern approaches.

It is important that this is the first time in the area of primary education in Cyprus that such an endeavor is attempted, which is marked by three main factors. The first one refers to the morphology of the entities that participated both in the planning and the execution of this pilot program, which clearly shows the great potential realizable through the cooperation of the State and the Public Sector with the University and the Private Sector. The second one refers to the methodological approach of separating the class into active and passive audience – as part of model A – with a constant alternating of these roles by all the students. At this point we should note that the methodology which was chosen is a novel interim–transitory approach, as it ensures the equal and escalating participation of all the students in the new learning environment, without disrupting the relation of the children with the traditional teaching system or the general operation of the school – we should not forget that the pilot is applied during the conventional operation of the two schools. The third factor regarding the pilot program is the fact of its implementation in public elementary schools of Cyprus, which largely ensures the propagation of the results to the entire education community.

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