Videoconferencing as an educational tool. Research in the University of the Aegean

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Abstract:
Greece, a country with a great dissemination of schools in islands and mountainous areas, can benefit from the implementation of distance education methods. Videoconference, an important constituent in a distance education programme, is expected to be effective not only in cases where there are problems of delivering a course in a face-to face method but also as a teaching instrument that supplements traditional educational methodologies.

For this purpose, four different models applying videoconference have been developed at the University of the Aegean and a series of experimental lessons were implemented in school environment based on these models. These allow investigating the efficiency of videoconferencing as a tool in teaching, while giving an insight in the instructive, technical and organisational parameters that are introduced in the models.

The main conclusion is that in general videoconference is including transmission of data and shared use of applications is a powerful educational tool.

Index Terms: Distance education, videoconference, hardware and software for videoconference, synchronous teaching methods, asynchronous teaching methods

Introduction

Greece has a particular geographic configuration. It includes an exceptionally big number of small islands, as well as mountainous areas in the mainland, that create conditions of remoteness and isolation for part of its population. Despite mass urbanisation during the last fifty years, a considerable number of residents live in the above-mentioned regions. In order to meet social, political and strategic choices, which are directed towards ensuring acceptable standards of living in these areas, good infrastructure should be provided in various sectors, no matter the technical and economic difficulties that could be encountered.

These geographic characteristics, in relation to the socio-political strategy that is adopted, justify the presence of many single-teacher, multi-grade schools.

However, these schools face problems that often lead to the belief that quality of education provided is inferior to the rest of the schools [1] [2] [3]. It is thus questioned to what extent education provided in these schools prepares adequately pupils to meet the requirements of a modern social and economic environment. The truth is that these requirements are highly demanding. Pupils should get general and specialised knowledge and develop skills that cannot be easily acquired in the environment of a small and isolated school.

Information and Communication Technology (ICT) provides new ways of conducting teaching that could give solutions in the above-mentioned problems. Distance education with its two groups of tools, synchronous and asynchronous teaching methods, offers a dynamic arsenal for selecting a suitable strategy.

Among synchronous teaching methods, a well known but difficult application is videoconference. The term refers to an activity, which includes communication via the transmission of live video and sound between at least two points [4]. In the present paper the term "videoconference" also includes the transmission of data and the shared use of applications. In videoconference the usual educational material can be applied in the courses without many changes. Within certain (technical and pedagog-

ic) limits it is a form of education, which is closer to traditional teaching and, consequently, is immediately applicable in any type of student group.

In the University of the Aegean during the past years, distance education and specifically videoconferencing, has been a subject of intense research [5], [6], [7]. Different experimental models have been designed and implemented in school environment with the purpose of assessing their parameters and evaluating their effectiveness. These models are presented below.

The Aegean University

The University of the Aegean is a network-university with departments in 5 islands. This network- type organisation matches to a great extent the geographic dispersion of islands in the Aegean Sea.

In order to face operational problems -that originate mainly from its dispersion- the university is backed by a reliable state-of-the-art technology. This technology, appropriately adjusted, can also serve to support local societies in the small islands.

Education in the islands is a scientific field in which the University can offer a lot. Emphasis in education is along lines harmonised with the regional development targets which include the need for good quality of education at any level, thus also at the level of the primary school.

Within the above frame, the prime objectives of the research in the Computers Lab of the University's Departments of Education are:

- the introduction of ICT in primary schools
- the application of distance education programs in remote schools
- the investigation of the effectiveness of distance education in these islands

The investigation of various parameters concerning the above issues, lead to the conclusion that ICT, in combination to distance education, provides solutions to many problems in the field of education originated from the region's geography [8]. Within this framework, videoconference is an ICT application that helps Distance Education and this explains why it may become highly important for the Aegean region.

Rationale and targets of the videoconference experimental models

The reflection developed around distance education, led, in the year 1999 up to year 2002, to the conduction of a series of courses to students of primary schools, making use of videoconference. The Computers Lab had already a relatively rich experience from teaching a six-month course of information technology using videoconference, in the High School students of Tilos Island [9].

The main targets underlying the design and implementation of videoconference models were the following:

- Propagation of the use of computers in school and teachers' training in ICT. Active participation of teachers is assumed as being a key factor in any effort to apply distance education at schools. Acquaintance and familiarization with ICT helps teachers to appreciate the capabilities of ICT and become at first active participants in experimental projects and later regular users of computers in exercising their everyday teaching duties.
- Simplification and standardization in designing and revising educational material. The attempt to use simple, cost effective tools, as well as standardised procedures and methods is considered more important than collecting experimental data.

- Evaluation of the methods and examination of their advantages and disadvantages. Analysis of the results from the application of the methods, contributes in identifying gaps, miscalculations and weaknesses. Efforts were concentrated in improving these methods.

The following matters were investigated:

- Technical issues: Inadequate infrastructure is an obstacle for the materialization of distance education lessons. Equally significant obstacles are the schools limited financial means, the bureaucratic administrative structure, and mostly the lack of technological knowledge. Any selected solution should take into account these limitations.
- Didactic issues concerning differentiations in the instructional process. Distance education requires a change in the attitudes and roles of teachers and pupils and this requirement is worth investigating.
- Organisational issues. The lack of technical resources against the demand for educational quality, create the need for innovations in implementation. This leads to new ways of doing things to hierarchically satisfy all the necessary parameters.
- The effect of ICT on local communities. The school is an important institution in a small community. Its role is not confined in just educating children but in many ways it is in a constant interaction with the society. For that matter, the ways that ICT can help the community are also investigated.

General methodology

Each videoconference experiment consisted of four hourly phases. In the first hour teaching was conducted basically in a traditional way and the class teacher was helped in his/her job by the use of multimedia. In the second lesson the same teacher was teaching, but this time he/she used videoconference as a means for delivering the course. The third and fourth lessons were conducted by a distant teacher, not familiar to the students, using videoconference, while the class- teacher was present in the classroom acting as a tutor- facilitator. The reasons for following this scheme were:

(a) To examine whether acquaintance with the person delivering a videoconference course is or is not a significant factor [10] and

(b) To allow for comparison between the different teaching methods.

The experimental lessons specifications were as follows.

- In every experiment the fifth grade was the target group.
- Lessons of Geography and History were taught.
- The material, which is used at school for these courses, can be transformed from printed to electronic form rather easily; hence it becomes suitable for videoconference. Without differing substantially from that of school's textbook. The most important transformation was the division of each section in smaller subsections. The texts and images remained the same and were presented in the same order, enriched with some, carefully selected, extra multimedia material (photographs, diagrams etc). Students were taught the same school lesson provided by the school-textbook in a different manner.
- The school's curriculum was not modified, nor did the duration of each course in general.
- The time devoted to videoconference teaching in some cases exceeded that of a regular instructive hour, though by no more than five to ten minutes.
- There were no modifications of the usual teaching methodology, i.e. the division of time between homework assessment, delivery of the new course, oral comprehension questions and evaluation was kept the same.

Children were taught History and Geography, according to the school's curriculum, in the same didactic hour, the same day and for the duration that was defined in the formal timetable. The session was organised in a way ensuring that the frame, the difficulty level, the time boundaries and the general structure of an ordinary lesson are not distorted.

With respect to the teaching approach that was followed and the role that the instructor had, it should be mentioned that it was a teacher-centred one, thus closer to traditional teaching methods. This means that the teacher directed the course of the lesson and regulated the degree of coverage of the content (usually taking into account the class's average).

The reasons underlying this approach towards cognitive material and didactic methodology were:

(a) To keep a videoconference lesson as close as possible to that of a common and widely accepted form of teaching

(b) To eliminate as far as possible the (expected) students' enthusiasm for the medium and the new way of teaching, that could influence the results [4], [10].

Immediately after each lesson, students were given two questionnaires with the aim to examine the quality and the effectiveness of videoconference courses.

The first questionnaire included formulated questions about the technical completeness of the courses (quality of sound and picture, speed, size of pictures, etc). The factors that influence the effectiveness of the course were located with this way, according to the opinions of students.

The second questionnaire was a part of the evaluation of the method's efficiency. In fact efficiency assessment was attempted in two phases. The first part consisted of oral comprehension questions from the remote teacher. Questions and answers appeared in the slide presentation program. The written test (i.e. the second questionnaire) was in a form familiar to students (corresponding figures, completion of spaces, multiple choice etc). The written tests were collected and were later corrected by the remote teacher.

Technical issues

For the conduct of the experiments, in every case, the following hardware was used:

A computer, a camera that was connected to the computer, a 55,6 Kbps modem and a simple telephone line or an ISDN telephone line, a microphone and speakers and finally, in some schools a video projector with projection surface of 1,5 by 1,5 metres, in others a 25" television and in very small classrooms computer monitors. In the side of the remote schoolteacher, a similar system was used, without however the video projector.

It was not used technology that its cost would be unbearable for the financial means of an average Greek primary school. Correspondingly, the programs that were used are of the widest distribution, that is to say, Windows, Netmeeting for the communication between the remote teacher and the students and for the transmission of picture and sound and finally, PowerPoint as a slide presentation program.

We knew in advance that the connection speed would be a cause of problems. The highest connection speed with the use of 55.6 Kbps modems was not to exceed 33, 6 Kbps (in practice the connection speed oscillated between 22 and 30 Kbps). In case of the ISDN telephone lines, the transmission speed was constantly 64 Kbps. For that matter it was judged essential to make some adjustments for the reduction of volume of data:

- Reduction of the size of picture files, with reduction of the colour depth and increase in the rate of compression.
- Reduction of the number of colours per transparency in PowerPoint.
- Extensive use of multimedia elements (sounds, video and images) was avoided. The designing team did not use very impressive multimedia features when presenting the educational material

since this would result in delays in transmission and it would also distract pupils' attention from the didactic material to the presentation medium

- Low use or total elimination of slide animations in the transparencies of PowerPoint.
- The remote teacher spoke slowly and clearly. He/She was asked not to make abrupt and fast movements.
- The settings of Netmeeting for the transmission of picture were set in favour of the speed and less video quality (without the existence of obvious quality reduction).

At the same time, automatically, elements with regard to the quality of the telephone line, the speed of data, sound and picture transmission, were recorded from a program. This data are straightforwardly comparable with the data collected from the questionnaires of technical completeness of the courses and give an objective and not a subjective impression for the quality of the electronic means and programs of videoconferencing.

In the second round of videoconference experiments, additional techniques were used in order to achieve better results.

(a) If available, a second telephone line was used for voice transmission.

(b) In order to further decrease the volume of transmitted information, some necessary files of the courses were sent with e-mail few days before the conduct of the corresponding courses. The school-teachers had to install them in the hard disks of the computers of their schools.

Hence, applications -namely PowerPoint- was running directly in these computers and the distribution and the shared use of application was from the side of the school and not from the side of the remote teacher. This had the following positive results:

- The transparencies were presented in students immediately, because they were in the hard disks of the schools' computers.
- The only information that was transmitted from the remote teacher, besides his/her speech and video, was the command to change the transparencies.
- The remote teacher knew in advance that the delay of transmission was going to occur in his/her side. But he/she also knew beforehand the line of the slides and the structure of the lesson, so that it was possible to arrange the flow of course. The above subterfuge did not become perceptible from the students.

We must draw attention to the fact that there was an ongoing effort to balance the ideal with the limitations of reality. This was achieved using the above-mentioned technical and methodological tricks, making a large number of tests and keeping always in mind that the quality of the didactic material had to be preserved at any cost.

An important point that concerns planning of each course and the creation of cognitive material should be pointed out. Creating it was a laborious process. For each course there were dedicated roughly two hours for scanning pictures and texts, creation of transparencies in PowerPoint and searching the Internet for more material. Another hour was dedicated in the creation of one evaluation questionnaire.

In total, an experienced in the use of computers schoolteacher, is supposed to dedicate twelve hours in order to prepare material for only four hours of teaching with the use of multimedia. Even if this time is admissible when it is for experimental purposes, it is impossible to be dedicated by the schoolteacher during his daily duties.

Effectiveness of the methods

As already mentioned for the assessment of students' performance traditional evaluation tools were used, that measure the students' and the class performance in a mark/score system. The marks of each pupil were added to produce the total marks of the class for each lesson and this was compared to the total mark produced in a similar manner in the same group where the traditional approach has been applied. The most important results are shown below.

The differences among the 4 experimental lessons as well as between each of them and that of the traditionally taught group vary around 10 percent.

There were two exceptions:

(a) The results from the first test in each videoconference session were not as good as the rest of them. This was attributed to the pupils' first surprise and astonishment, which created distraction of attention.

(b) In a specific session, the students failed to get good scores. This was attributed to a connection failure that resulted in the interruption of sound and video transmission. Although the malfunction was corrected in ten minutes this time was enough to fatally derange the flow of the lesson. Students lost their interest and much time was consumed for restoring order in the class. It should be noted that all methods utilizing technology are vulnerable in such breakdowns.

From the students' assessment, an element emerges not directly related to videoconference but rather to the subjectivity of teachers in the evaluation of students. Important divergences were observed between the general impression that a teacher has for each one his students and the results from the four comprehension questionnaires of each videoconference session.

Unimportant differences were observed between the first course (traditional with the use of multimedia) and the rest of three courses (videoconferences with multimedia). Multimedia seemed to contribute to the method's efficiency but did not seem to be the most significant factor. Despite limitations in the organisation, the videoconference as an educational tool produced satisfactory instructive results.

The students in the target group mentioned that in general they understood the contents of the experimental lessons better than they usually understand the contents of a lesson traditionally taught. Their view was that the content was "explained better". According to their opinion, reorganizing and breaking in small subsections (slides) the educational material of each lesson, helped in the formation of this impression.

According to written comments, the students attributed their positive attitude towards the courses in the behaviour of the distant teacher and in his/her particular care for the course. It appeared that, between the remote teacher and the students, a personal relation was developed despite the distance that separated them. This interpersonal relation can be to some extend explained: Before the experiments the remote teachers communicated and co-operated with the local class teachers. In doing so the remote teachers were aware of the conditions in every class; they even knew the students' names. This had beneficial results in the attitude of students towards the lessons since they did not feel alienated.

The students were seeing the remote teacher in a window that occupied the 1/6 of the projection surface. The space had been forecasted to be empty in the transparencies so that the teacher's image would not cover text or pictures. This size was judged satisfactory by the students, who anyway, observed the interruptions in the teachers' movement (due to low bandwidth).

It appeared that an important factor for the students was the size of letters in the texts that were commented as adequate even for the students that were sitting far from the projection screen. The students also gave positive comment for the quality of sound (crispiness and continuity) and did not appear to be bothered from the minor discontinuations that did not influence the flow of course. In the videoconference sessions where the presentation files were installed in the local computers and not transmitted, the above results (quality of video and sound) were even better.

The duration of each course was slightly longer than that of an ordinary instructive hour. The students however had the sense that the course lasted the same or even less than usual. This constitutes a clue of effectiveness of this way of teaching and of the success of the methods used, because they kept the interest of students unabated, thus creating the impression that the hour rolled faster.

Instinctively, students conceived that the more suitable courses for teaching with multimedia and videoconferencing are these with rich material in pictures, that is to say History, Geography and Study of natural world. In contrast, courses as Language and Mathematics, gathered a small percentage of preferences. More than half of students would prefer all courses to be taught with this particular way. A likely explanation is the students' enthusiasm for "the new way of teaching".

With respect to the factors that led to dissatisfaction in the experimental lessons the following hold.

- The results revealed that noise in the classroom constituted the main factor of discomfort during the experimental lesson. Up to a degree this was expected. Classrooms had to be rearranged, the computers and the rest of the electronic equipment stimulated the curiosity of students and there was a usual agitation that had changed the everyday routine.
- A second important factor of dissatisfaction was that, some students could not observe the lesson because the students sitting in front of them prevented this. This was the case in very small schools, with just one or two computers, where students had to observe the lesson from one or two monitors divided in small groups, or from one 25" television. In other schools the use of a video projector and a big screen averted such problems.

Conclusions

The conclusions drawn from the class experiments of above models can be grouped in categories as follows.

Cost effectiveness
With respect to the cost, the use of low cost equipment and of simple or ISDN telephone lines was a deliberate and strategic choice. One of the main targets of the experiments was to prove that videoconference can be a cost effective teaching method. The use of expensive equipment (such as high bandwidth connections and advanced apparatuses), even if leading to better results, would abstain a lot from being an immediate and large-scale method.

Within this framework, the proposed experimental methods have the advantage that they are not expensive. The most important cost concerns the acquisition of a video projector. This is perhaps the only cost for a school, if already equipped with computers. For very small classrooms, a 25" television is adequate (and almost every school has one).

Technical efficiency:
Taking into consideration the "live" character of videoconference is easy to understand why it is vulnerable to technical malfunctions. The effects of a breakdown may be devastating for the specific lesson. In a web based lesson the asynchronous character of the method leaves room only for local malfunctions (malfunction of a computer) that can be easily overcome.

Operational efficiency:

For the application of models that use videoconferencing, a schoolteacher faces problems with respect to the production of the necessary material. The obstacles become unexcelled when the schoolteacher is inexperienced in the use of computers. Therefore two basic needs emerge:

- Training of schoolteachers in ICT applications. This will prompt the teachers to make use of new technologies either in the class or for the preparation of the courses.
- Development, most likely by specialised institutions, of essential and easily accessible multimedia applications accompanied by appropriate instructive books. This would exempt schoolteachers from the effort of producing the necessary educational material and would allow them to concentrate in improving and adapting the material to the needs of their classes.

The instructors' role:
In the experimental lessons, the local schoolteacher has a multiple role. He/She has to use the computer, deal with technical problems and actuate students. However, equally if not more important, is the role of the distant teacher who has to get acquainted with students and gain their trust in a very short period of time, despite the distance that separates them. The creation of an interpersonal relation is much needed for a successful teaching.

During implementation, the role of teacher changes and the extent of change depends on the method applied. The local teacher becomes a tutor/coordinator but not with the same responsibilities in each case. In videoconference the local teacher has a strong presence in classroom.

Teachers who in general wish to keep a high degree of control over their classes seemed to be willing to accept videoconference rather than other experimental methods. This is due to the teacher-centred character of videoconference which in this sense is closer to traditional teaching. Thus it seems natural to the teacher to transfer didactic duties to another teacher (even a remote one), being assured that they keep in touch with the class, retaining the right to intervene whenever they considered it necessary.

The students' role:
A student in a videoconference lesson has more or less the same role as in a traditional lesson. He/she has to attend the lesson, ask questions; answer comprehension questions and has to be slightly more disciplined than usual. The scene dramatically changes in web-based lessons. The student becomes the centre of the lesson, participates actively in selecting the cognitive material, and chooses the path to follow. In this case personalization /collaboration are the dominant teaching methods.

Comparative Performance:
The data that were collected from the videoconference lessons show the effect that had on students. This is apparent through their views and through their scores in comprehension tests. Still unknown are the results that videoconference would have over a longer period of time, when the initial enthusiasm of students settles down.

The impression that the experimental lessons created to students, is not based so much on the distant character of them, but mainly on the multimedia way of presentation. In a traditional lesson, multimedia elements would constitute just a supplement. In the experimental methods, multimedia elements are of vital importance.

The experimental methods presented here lead to optimistic thoughts for the future of videoconference in education. We have the sense that the means passes from the phase of growth and investigation of its potential uses, in the phase of maturation. Perhaps the time is near that it will take its place in the educational process not as an emergency solution, but as another form of teaching, next to the already existing and widely accepted methods.

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