Design Issues for Videoconferencing in Earth and Life Sciences: The Case of the Agricultural University of Athens

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Abstract: In Earth and Life Science courses such as agricultural, environmental and biomedical courses teaching and learning conditions and requirements present certain peculiarities. In this paper, the case of the Agricultural University of Athens (AUA) is presented, in relation to the use of videoconferencing for instruction and learning. AUA is participating in a still running project, aiming to design and implement educational scenarios for the instruction of specific courses exploiting videoconferencing technology. It is hoped that with the use of this technology challenges related to particularities and special requirements of a university of this kind will be successfully answered. The methodology and the instructional design principles employed for the development of the educational scenarios as well as the experience gained, the obstacles encountered and the solutions proposed are outlined and discussed.

1. Introduction

Videoconferencing does not constitute an innovative practice. Over the past decades it has been applied extensively in sectors such as the corporate, the government, the healthcare and the education ones successfully or less successfully. Extensive research has been focused both on the technology of videoconferencing as well as the design and evaluation of case studies (Amento & Brooks 1998, Bonk & Graham in press, Burge 1994, Eastmond 1995, Isaacs & Tang 1994, Kaye 1987, McKenzie 2000, Locatis et al. 2006, Symth 2005).

The advantages and the opportunities presented constitute videoconferencing a valuable tool for Higher Education. More specifically, for Earth and Life Science courses –which are the focus of this paper–, videoconferencing seems to provide solutions and adequate support in demanding teaching environments. It fosters cooperation and collaboration among remote participants and remote institutions; it may support students in remote areas where access of experts or access to specialized activities is difficult; it can be the only solution in cases where access to specific events or locations is impossible or hazardous or in cases where complex objects or procedures have to be demonstrated in detail to remote participants (Neale et al. 1998); it offers the opportunity to interact with experts from around the world cost and time effectively. It appears to be a solution in the cases where increased interaction among the participants is expected or required as, in relation to other forms of remote communication and Computer Mediated Communication (e.g. email, chat, fora); it gives the possibility for visual contact which creates a sense of social presence and consequently a more comfortable learning environment (Mason 1994) as well as it permits a more direct and timely interaction among the participants.

In Earth and Life Science courses such as agricultural, environmental and biomedical courses, teaching and learning conditions and requirements present certain peculiarities such as the necessity for connection with external, remote, rural locations, greenhouses, animal units, demonstrations and simultaneous practical exercises of a large

number of students in constrained microscopic laboratories and contact with research institutions and other relevant facilities. Videoconferencing in this context seems to provide solutions to setbacks emerging from these peculiarities and also enhances and offers new potential to instruction, learning and hands on experience of the students.

In this paper we present the case of using videoconferencing for instruction and learning courses of the Agricultural University of Athens (AUA) in Greece. The AUA has been serving agricultural sciences, producing graduates as well as scientific knowledge through basic and applied research since 1920. It is a small university of 3500 students situated in a 25-hectare green campus equipped, among others, with auditoriums, laboratories, agricultural facilities -such as an arboretum, a vineyard, experimental fields, a flower garden, greenhouses, a cowshed, a sheep pen, a chicken coop, dairy installations, and aquaculture tanks. Furthermore, a number of farms located outside the campus and in remote areas around Greece are in the possession of the University, all targeted to serve the instructional and research needs of AUA. The University is consisted of seven faculties: Crop Science, Animal Science, Agricultural Biotechnology, Rural Economics & Development, Food Science & Technology, Natural Resources Management & Agricultural Engineering and a Science Faculty. Instruction during the first nine semesters includes lectures, laboratory work and field trips, while the tenth semester is devoted to the composition of a graduate thesis. Four months of practical training are also required to ensure familiarization with actual farm conditions. Furthermore, the AUA is playing a role as an invaluable advisor of the State in agricultural issues and it is actively participating in projects on rural development (AUA website).

Having realized the potential of ICT in education, AUA has invested in the area of new technologies: it has a number of ICT laboratories, it provides classes on ICT, it has two fully equipped videoconferencing rooms and also a mobile videoconferencing unit. There have been successful attempts in the past to employ videoconferencing in specific courses but ICT was not fully integrated in the curriculum, it was not systematically employed throughout instruction and the majority of the faculty members were not familiar with its use. It was, therefore, considered of critical importance to plan and organize the efficient exploitation of ICT for the attainment of the instructional and scientific objectives of AUA.

The opportunity was presented with a horizontal project for all the Greek Universities named “Integration and Exploitation of New Technologies in Education” funded by the Ministry of Education and the European Union (EU). AUA participated in this project, starting on September 2006 up to the present with the aim of exploiting the videoconferencing facilities and integrating videoconferencing in teaching and learning (Sideridis 2005).

The implementation of such a project was not without challenges and setbacks. Instruction, learning and research in an agricultural university and in earth and life sciences courses more generally, present a number of particularities as it has already been mentioned. These particularities combined with the lack of prior research in the specific area of earth and life sciences were among the main challenges initially presented to our team, during the design phase of the project.

The objective of this paper is to present all these problems, the experience upon designing the implementation of videoconferencing in the AUA and cooperating with the members of the faculty. It is expected that the design and implementation approaches applied in the AUA as well as the specific videoconferencing sessions proposed could be transferred to other Earth and Life University Courses. The particular conditions of the AUA, as described above and will be elaborated further down, are common for most University Departments and Schools of similar scientific fields. In section 2 and 3 we present the methodology and the instructional design principles, respectively, employed for the development of the educational scenarios. A brief description of the structure of the scenarios is outlined in section 4 and finally in section 5 we conclude with the outcomes and the experience gained.

2. Methodology and Approach

The core of the project team was consisted of faculty members, the technical support personnel and two external specialists in the area of ICT and new technologies in education. At an initial stage, a Design Team was formed with the aim to plan, design and organise, with the cooperation of the Technical Team, the implementation of videoconferencing in the instruction process in AUA.

Among the objectives of the Design Team was to motivate and support the staff of AUA to employ such a practice in their teaching, to present the potential of the new technologies and the best possible ways to benefit from them, while the cooperation of the Technical Team was crucial for coping with the barriers and limitations presented by the technology. The Design Team, after investigating the particularities and the requirements for instruction in AUA, concluded in a set of design principles and created a template used for the development of educational scenarios describing the implementation of videoconferencing. The Design Team worked together with members of

the teaching staff and, through semi-structured interviews, recorded their viewpoints, their needs, requirements and expectations regarding videoconferencing as a practice in relation to their courses. As a next step, the Design Team worked together with the teaching staff, which had shown interest in using videoconferencing in their classes, and with the template scenario as a basis, developed the relevant educational scenarios fully customised to the needs and requirements of the lecturers, the courses and their students.

One of the main challenges for the Design Team was also to persuade the teaching staff for the benefits of the integration of such a technology in their classes and familiarise them with its use. At the beginning a small number of instructors were familiar and positively inclined towards videoconferencing and the use of new technologies in instruction and learning. The majority of instructors were suspicious and sceptic that such media would benefit their courses. As an approach for familiarising the AUA faculty members with videoconferencing, open seminars, presentations and demonstrations of videoconferencing were conducted. Also, a leaflet describing the benefits and potential uses of videoconferencing in higher education with case studies and practical educational scenarios, designed for use specifically in the AUA, was distributed to all members of teaching staff. The key step in this approach, though, appeared to be the personal contact of the Team with the instructors. Members of the Design Team would make appointments with instructors that had expressed interest in finding out more about the project and visit them in their offices. Through personal interviews and informal discussions the team would record the nature and content of the courses they taught and would propose to them specific educational scenarios for integrating videoconferencing in their classes in the most efficient way possible. To those instructors accepted to try, both the Design and the Technical Teams would be fully available and in close contact with them in order to plan the videoconferencing session.

3. Instructional Design Principles

Videoconferencing technologies present the instruction with a new dynamic (Kaye 1987, Garrisson 1989) and a novel framework requiring, therefore, the re-organisation and re-design of the content and the method of instruction. The design of the implementation of the technology in the educational process was twofold: (a) the planning and definition of the educational dimension and (b) the fine-tuning of the technical factors (e.g. technical equipment, presentation guidelines). Both these aspects have to be equally addressed since the experience of the participants in one of these affects the experience in the other aspect, as well.

Instruction with the use of videoconferencing may present a learning environment rich in stimuli and possibilities, but also requires a more detailed planning than the conventional methods of instruction. A number of factors such as the synchronous and asynchronous interaction and communication among the participants, the number of points and participants, the motivation of the students, the turn-taking by students or speakers, the balanced cooperation and participation of all participating points, the quality of the educational content and the technical support available are critical factors that have to be addressed during the design phase.

Our initial objective was to investigate the settings of the instruction in the AUA and assess the conditions under which videoconferencing would in fact benefit the instructional process. That was also an initial challenge, given the lack of similar case studies in the literature and the unique character of an agricultural university regarding the content and the requirements of the courses. It was, therefore, considered of high importance to map the instructional settings of the University and plan in advance and in detail the channelling of the educational content and the relevant instructional method through videoconferencing and not only relay on the state-of-the-art technology to merely support the conventional lectures of the instructors. The educational scenarios were designed and planned in detail in full cooperation of the participants with both the Design and the Technical Teams. The aim was to benefit from the session and exploit fully the potential of the technology considering the instructional objectives of the course.

For the case of an agricultural university, there are a number of additional factors that have to be considered. The crucial point was the legitimacy of the integration of videoconferencing in a class. It was considered of high importance to implement videoconferencing only in the cases where this would actually be the answer to specific problems or where it would genuinely improve the quality of the course. During the interviews and personal meetings with the instructors, the Design Team would examine and assess whether the use of videoconferencing in the class would benefit the course and whether it would be the best approach possible in order to meet the instructional objectives of the course. Videoconferencing would only be recommended in the cases that it would in fact be the best solution for coping with any problems or enhancing and improving the quality of the course.

Further down, we elaborate on examples of the real needs that emerged and demonstrate the necessity of videoconferencing sessions for specific courses. These needs go beyond the level of communication and collaboration among remote participants, as would be the case in other higher education institutions. Videoconferencing seems to provide a solution for practical, logistical and physical problems, such as visits to remote or restricted areas and demonstrations of experiments which would otherwise be difficult or impossible, that have been constraining the quality of the courses and have been limiting the instructional objectives. It is obviously not suggested that videoconferencing should substitute the experience of the direct contact (Bonk & Graham, in press).

3.1 Mapping the Instructional Setting in AUA in Relation to Videoconferencing Potential Use

A critical design principle was the connection of the university with external locations. Compared to other university departments, such as Mathematics or Philosophy, there is an increased need for connection with external locations. Students have to practice in areas such as fields, animal units and research institutions. Collaboration is not the main instructional objective but rather the detailed presentation and clarification of locations, processes and features of livestock and vegetation that would otherwise be impossible for the students to attend. The profile of the AUA and the particularities and the requirements emerging, demand for a more careful design and planning.

Linking of the instruction with real conditions locations, such as productive units, hydroponics laboratories, animal production units and greenhouses is essential for the curriculum of AUA. In most of the cases, though, travelling of the students and instructors to remote locations is difficult or impossible. Similarly, attendance of activities of research centres and institutions is highly valuable especially for postgraduate students. Presentations of such research activities and interaction with experts could motivate the students to focus on similar research areas. Videoconferencing again seems to be a solution that will allow the students to access areas that would otherwise be impossible and interact directly with specialists in the area, without leaving the university campus. Further down some examples of the needs for videoconferencing emerging in specific courses in the AUA are presented.

For the course "*Anatomy of Productive Animals*" the students have to observe a demonstration of animal organs in the anatomy laboratory. The laboratory, though, has a capacity of approximately 25 students, while the total number of students that have to attend this course each semester is about 400. Following the conventional methods of instruction, the students had to be separated into groups of 25 to attend the laboratory demonstration and therefore the demonstration had to take place 16 times, with the subsequent implications to the time-scheduling of the course and the quality of the organs that had to remain on display for more than one days. Furthermore, a number of students refrain from attending the demonstration due to relative bad environmental conditions in the laboratory.

The conditions in other laboratories, such as the laboratory of *Biochemistry and Molecular Phytopathology Research* are not too different. The laboratory has a capacity of only 5 students at a time, and therefore the students have to be separated in small groups. The large number of students attending the course leads to time-scheduling problems and setbacks for the instructional objectives of the course. Videoconferencing and remote attendance of the students again presents a solution to the aforementioned problems. Real time projection of the image in the laboratory to the videoconferencing room was considered as a solution to this problem, allowing thus a large number of students to attend the demonstration simultaneously.

Laboratories, such as the *In Vitro Cell Culture Laboratory* of the Animal Production Department, only permits a limited number of students to make observations though the inverse microscope –one student at a time-. Furthermore, to avoid contamination of the cells only small groups of three students can enter the laboratory at a time, while the total number of students that have to take up this activity each semester is 40. This causes problems to the time-scheduling of the course but also the time-delay of the observation under the microscope by all the students consequents to changes in the conditions themselves under observation – a phenomenon that may occur while a student is making an observation under the microscope, such as the diffusion of gene material in an ovary, may be impossible to be repeated for all the students, compromising, thus, the instructional objectives of the course. For such particular cases, we investigated the possibility to project the image from the inverse microscope as well as the image of the researcher present at the laboratory, performing the experiment and giving clarifications, in real time, to the videoconferencing auditorium so that whole class would be able to observe simultaneously.

Similar problems are presented for most of the laboratories and the laboratory sessions where images from the microscope have to presented and discussed. Especially in the case of the *Central Electronic Microscope* which is of high accuracy and fidelity, projections of images in real time were not possible since the microscope cannot be moved due to security reasons. The teaching staff had to present the images from the microscope in slides, tables

and graphs on the board. Real time projection of the images on the Central Microscope to the other microscope laboratories simultaneously would dramatically improve the teaching process, as reported by the teaching staff.

In courses such as *"Apiculture"* students are required to visit the beehives which are located in the university campus, together with the instructor and attend the presentations. In certain cases, though, as for example in the case where students present allergies to the bees or when the bees behave aggressively due to bad weather conditions such presentations are difficult to take place. Real time linking of the hives with the videoconferencing rooms and remote attendance of the presentation of the instructor by the students would overcome such barriers.

In a number of cases there are situations emerging that require direct, timely and accurate scientific communication with other members of the academic community, the media and even the public as, for example, was the case of the "Chicken Flu". In such cases, scientists of the AUA -Animal Production Department in this particular case-, are deluged daily with questions concerning the specific problem. In situations like this, videoconferencing presents the solution which will permit an immediate response from the AUA and the simultaneous and comprehensive information of the community on such crucial issues with little delay and limited consumption of resources.

The Animal Production department, as well as other departments of the AUA is cooperating with other university departments such as the Writtle College and the University of Padova. Their cooperation is referred to areas such as the Animal Welfare. Remote communication with the conventional means, such as phone and email, has proven to be insufficient. Furthermore, frequent visits of the researches are not always possible due to resource constraints (e.g. cost, time scheduling). Within the framework of this cooperation, videoconferencing could provide a valuable tool for the researchers to present their facilities and their achievements and go into as much detail as to presenting the livestock itself in its natural habitat.

The cooperation among departments of different European universities, specializing in similar subject areas is, nowadays, essential and beneficial both for the students as well as for the academic community. Videoconferencing can provide easy, direct and timely access to specialists from other universities, which is extremely valuable in the cases where specialization to different sectors of science becomes imminent. Through videoconferencing the students may be exposed to different viewpoints and practices which would otherwise be difficult and limited. Similarly, faculty members and researchers in geographically dispersed universities in Greece can easily meet, through videoconferencing, discuss and exchange ideas and viewpoints on particular issues without having to leave their campus, and with the possibility for the students to attend their discussion, eliminating problems such as time-scheduling, travelling, venue availability and availability of all the participants.

There have been cases where the instructor has to leave the University for visiting other remote universities. In these cases his/her lecturing should not been interrupted. Instruction could be carried on, via videoconferencing, without the need to substitute the instructor or cancel the lectures.

In a number of cases, during the course, students are visiting other universities, carry on some laboratory work and present their work back to their tutors in Greece. Presentation via videoconferencing gives the opportunity to the supervisor of the student at the remote university to attend the presentation as well, and intervene with questions and comments. The participation of the supervisor would otherwise be extremely difficult due to time and resource constraints.

In cases where cooperation between students and supervisors is essential for the conclusion of studies (e.g. final dissertation) but difficult or even impossible due to specific problems (e.g. health problems) videoconferencing can bridge the gap between the supervisor and the student cooperating remotely through videoconferencing software on their desktop computers (Smyth 2005). Remote students, disabled or working students can even attend lectures online or offline from their home or other locations, via direct link with the videoconferencing rooms.

4. Educational Scenarios

Based on the aforementioned principles, the instructional settings mapped and the emerging needs, the Design Team developed a number of customized educational scenarios in cooperation with the Technical Team so as to ensure the availability of the technical equipment in order to realize these scenarios. Additional equipment was purchased by the AUA such as specialized cameras for the microscopes and mobile units for the connection of the videoconferencing rooms with external locations. Based on the aforementioned methodology, we have designed 19 scenarios which correspond to almost all the categories/types of uses of videoconferencing in higher education.

The first step for the development of the scenarios was the production of a generic template focusing on the points which had to be addressed during the elaboration of each scenario. The structure of the template and the educational scenarios developed within the framework of the project are outlined in Tables 1 and 2 correspondingly.

Required Field	*Description*
Designated faculty member	Denotes the name of the tutor responsible for the videoconference session.
Date	Denotes the time/date of the implementation of the session.
Type of use	Denotes the model of videoconference. The session is classified according to its content and demands into one of the following categories: Lecture/ tutorial, seminar, presentation, collaboration between researchers (research seminars, supervision of dissertations), demonstration of experiment or process, debate.
Conference type	Denotes the number of connected sites which can be either two (point to point connection) or more than two (multi-point connection).
Sites	Names the sites which will be connected during the videoconferencing session.
Target group	Denotes the group the videoconferencing session is targeted to. This target group may include students (undergraduate and postgraduate), university staff, researchers, public audience etc.
Length	Denotes the length of the whole session.
Brief description	Describes briefly the session.
Why videoconferencing	Justifies the need of videoconferencing and its added value compared with traditional teaching methods. Describes how videoconferencing will improve the quality of the course.
Integration in the curriculum	Denotes the course or the courses in which the session is integrated.
Instructional objectives	Denotes the educational/instructional objectives of the session which should always be defined before a videoconference teaching session, as well as before a traditional face-to-face teaching session.
Participants	Defines the number and the roles of the participants.
Preparation/planning	Outlines the preparation which should take place before the videoconference.
Educational/support material	Describes the nature of the educational or other material used during the session. (e.g. powerpoint presentations, video, photos, audios etc.). Also determines the type of additional technical equipment which might be required during the session.
Detailed description	The whole session is described in detail including the actions of the tutors, the type and the duration of the activities, the presentations, the interaction and the discussion. It is important to determine in detail the whole session in advance.
Further exploitation of results	One of the main targets of the project was the development of the infrastructure needed to support effective videoconferencing. This infrastructure includes technical equipment, trained personnel, educational scenarios and learning objects. In this field, the possibility of reusing all the above material either as means of teaching and learning or as reference objects is described.
Technical context	Denotes the technology used and the additional equipment which might be needed for implementation of the videoconferencing session.
Evaluation comments	Denotes the evaluation of the whole videoconferencing session, the informal feedback and the experience acquired.

Table 1: Structure of the template used for the development of the educational scenarios

Title	*Type Of Use And Conference Type*	*Sites*
The Chicken Flu	Lecture open to the public (multi-point)	AUA, Universities of Patras, Macedonia and Thessaly
Demonstration of animals' organs from the Anatomy Laboratory of AUA	Lecture/Tutorial (point to point)	Anatomy Laboratory of AUA Videoconferencing (VC) room of AUA
Telediagnosis of the welfare of farm animals	Collaboration between researchers (multi-point)	VC room of AUA, Animal Unit (Oinofyta) Writtle College,University of Padova
Presentation of a student's thesis – final dissertation (Collaboration between the University of Padova and theAUA)	Presentation (point to point)	VC room of AUA Professor's office University of Padova
Lecture from the Writtle College	Lecture (point to point)	AUA – Writtle College
Lecture of Professor from the AUA	Lecture (point to point)	AUA -Writtle College
Videoconference between professors from agricultural depts. in England, Italy, Greece for "Animals' Welfare"	Collaboration between researchers (multi-point)	AUA - Writtle College University of Padova
Demonstration of an experiment with the use of an inverted microscope	Lecture/Tutorial (point to point)	VC room of AUA In Vitro Cell Culture Laboratory of AUA
Videoconference targeted to students with special needs	Lecture/Tutorial (point to point)	Professor's office in AUA Student's location
ICT in Agriculture	Lecture/seminar (multi-point)	AUA, University Depts. in Greece, State admin. Offices for Agriculture
Exploitation of videoconferencing technology in higher education	Seminar (multi-point)	AUA, Universities of Macedonia, Patras and Thessaly
Demonstration of " electrophoresis gel" (method for the depiction of DNA)	Demonstration of process (point to point)	VC room of AUA Molecular Phytopathology Lab. of AUA
Disinfection process in a greenhouse	Demonstration of process (point to point)	VC room, AUA Greenhouse
Projection of image from the central microscope of the phytopathology lab	Lecture/Tutorial (multi-point)	Central microscope room of AUA VC room of AUA
Side effects to humans by the use of chemicals for the production and maintenance of agricultural products	Lecture (point to point)	VC room of AUA VC room or office in a university hospital in Australia
Hydroponics cultures of horticultural products	Demonstration of process (point to point)	Hydroponics Greenhouse, Greece VC room of AUA
Vaccination of plants in a greenhouse	Lecture/Tutorial (point to point)	Greenhouse in Thessaly, Greece VC room of AUA
Live demonstration of hives	Lecture/Tutorial (point to point)	Outdoors hives in AUA campus VC room of AUA
Lecture with subject: "Presentation of the activities of the CNAP Institute of the University of York – UK"	Lecture (point to point)	VC room of AUA VC room of CNAP Inst.

Table 2: Educational scenarios developed within the framework of the project

5. Conclusions

One of the most significant effects of the project described in this paper, up to this point, was the response received from the faculty members. As a first step, we cooperated with those who had initially shown some interest in the project and those who were familiar with the new technologies or had already implemented videoconferencing sessions in their classes and developed a number of educational scenarios. The exploitation of the already existing experience affected positively the progress of the project as the participants were more receptive and effective. At a later stage, we disseminated our work and made presentations to a wider audience consisting of faculty members with an enthusiastic response. We worked together with a number of faculty members and eventually developed 19

scenarios for use in the courses of AUA, instead of 8 scenarios as it was initially planned within the framework of the project. An essential prerequisite for ensuring a positive response from the lecturing staff was to establish real needs and demands in the instruction process where videoconferencing is in fact the most appropriate and effective solution.

Fear of technology was another barrier that we had to cope with. A number of the faculty members were sceptic towards videoconferencing perceiving it as something complex and possibly causing more problems than those intended to solve. Our approach for coping with this fear of technology was to present some demo videoconferencing sessions linking the videoconferencing room with the silkworm laboratory through the mobile unit, where a faculty member made a demonstration regarding the reproduction of silkworms. Additionally to that we supported them both for the educational as well as the technical aspect. We took up the task to plan and organize the sessions for them, while being in constant contact for getting feedback or comments for the progress of the work. The goal was to take the load of planning, organizing and supporting such sessions from the instructors.

The methodology for design and implementation presented in this study combine a more generic approach for introducing videoconferencing in an area not extensively familiar with the use of such types of new technologies for instruction, as well as a more customized and focused approach for addressing the specific needs of courses such as those included in an agricultural university. The blended learning approach eliminated the isolation of the students as is the case in other distance learning environments (Locatis et al. 2006). If close linking of the new technology and the conventional instructional methods had not been established, the response from the members of the faculty would not have been feasible.

The programme's next phase will involve the realization and the testing of most of the aforementioned educational videoconferencing scenarios during the semester starting September 2007, where more data and results are expected to be elicited. Consideration of the specific needs and requirements of teachers and students, of the course special conditions regarding universities of similar to AUA fields and exploitation of the potential of videoconferencing in relation to these needs remains of high importance for an effective introduction and design of the implementation of videoconferencing in the higher education classroom.

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