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ESTABLISHING A VIDEOCONFERENCING INFRASTRUCTURE IN THE REPUBLIC OF MACEDONIA AS AN ENGINEERING EDUCATIONAL SERVICE

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Abstract: New educational requirements stimulated by the innovative telecommunication technologies together with novel educational materials and methodologies pave the way for the introduction of high end videoconferencing systems that can be used to establish distance learning environments. Video Conferencing can enhance the educational opportunities offered by distance learning based systems; it reduces the costs of teaching and learning, by allowing a real time connection with different university sites and thus reducing mobility needs, while students can have larger access to a variety of degree programmes, learning material, different educational approaches, methodologies and contacts with international experts. In this framework, the three-year ViCES (Video Conferencing Educational Services) Project was launched by the University of Florence (Italy) and the Ss Cyril and Methodius University (Republic of Macedonia). This was financed by the European Commission within the TEMPUS (Trans-European Mobility Scheme for University Studies) programme for the period 2009-2012. The project is made up by consortium member institutions from Belgium, Hungary, Italy, Republic of Macedonia, Republic of Serbia and Albania. With tutorials and expertise of the consortium member Universities in the European Union and in Western Balkans, the TEMPUS ViCES project will provide different university sites in the Republic of Macedonia with a technological videoconferencing infrastructure and an innovative self sustainable learning environment that eases student and academic access to a wide and novel amount of educational services. The adopted approach will also represent an interesting good practice which might be introduced in other educational contexts (e.g. consortium universities in Republic of Serbia and Albania) to increase co-operation and internationalisation opportunities among different institutions. The project will also support the harmonization process of different curricula at a national and international level among higher education institutions. The educational services offered via this environment will be designed to be adoptable to multicultural and multilingual environments. This paper presents the sustainability and educational approach used in the ViCES project learning environment.

Keywords: TEMPUS Joint Project, videoconferencing infrastructures, information and telecommunication technologies, distance learning, curricula harmonisation.



1. Introduction

Higher Education plays a very important role in the development of human beings and societies and enhances their cultural and economical development. Higher education can take place in a wide range of educational environments that have different educational goals. Since the traditional classrooms cannot effectively provide this, new educational environments should be exploited.

New educational paradigms and innovative education practices, stimulated by the new information and telecommunication technologies, can be used to improve the delivery of education by providing instant access to the latest learning materials and to put the best possible resources in use (teachers, tutors, virtual laboratories and learning methodologies) for the support of the educational process [1].

Students are becoming very familiar with the possibility to use different technologies for their studies and research. Technology itself is not inherently good or bad for educational process support. It is the way it is used to achieve the learning outcomes that matters and that can be treated as a learning experience itself. Higher education faces new challenges that come with the increased usage of the technology. One of the most specific challenges of technology supported education is to deal with different cultural backgrounds of students [2]. This is especially important when students are using synchronous distance educational environments such as video conferencing, since they may not be aware of the existence of different cultural backgrounds, and do not have time to explore the cultural context of lecturing defined by the instructor or the other class participants. This issue becomes even more evident when it is part of mutually recognized curricula among several different countries [3].

Video conferencing opportunities, used in combination with other educational services, significantly ease this access by lowering the cost of original production of educational material and increasing the possibility to update educational materials more frequently [4][5]. On the other hand, the educational environments based on technology have a need of continuous upgrade which emphasizes the economic sustainability of such environment.

The European Higher Education Area development is addressed with the Bologna Process [6][7]. This process, since 1999, has been devoted to create more attractive, comparable, compatible and coherent education systems throughout Europe. In order to achieve these objectives and encourage cooperation between countries, the higher Education institutions, are taking part in a wide range of programmes, such as: LLP (Lifelong Learning Programme) [8], ERASMUS MUNDUS [9], TEMPUS (Trans-European Mobility Scheme for University Studies) [10]. These programmes stimulate European higher education institutions to harmonize their curricula in order to engage in global collaboration for sustainable development.

In this framework, the University of Florence and the Ss Cyril and Methodius University launched in 2008 a three-year TEMPUS Joint Project called VICES (Videoconferencing Educational Services) financed by the European Commission in the frame of the TEMPUS IV for the period 2009-2012 [11].

The project, carried out by the University of Florence and the Ss Cyril and Methodius University in Skopje, together with all consortium members (three partner Universities of the European Union and one University in Albania (AL), 6 Universities and the Ministry of Education in Republic of Macedonia (MK) and one University in Republic of Serbia (RS)), will introduce a new approach towards the treatment of Information



Communication Technologies at University level. It is expected that VICES will provide an environment that will ease the process of harmonization of different curricula among educational institutions.

This paper explains an approach to deploy such educational environment. The designed learning environment addresses multiple levels of technology and services that need to be implemented. This paper gives details on educational services and their implementation, related organizational services, and financial input to provide sustainability of the whole video conferencing educational environment.

The video conferencing infrastructure is presented in section 2 of this paper. Section 3 explains the proposed educational methodology for implementing multicultural educational services. Section 4 discusses the financial sustainability aspects of our video conferencing environment. Section 5 concludes the paper.

2. VICES Video Conferencing Infrastructure

R. Macedonia has a population of 2 million inhabitants, an area of 25,333 km², five state owned Universities and several private Universities. The Macedonian Academic and Research Network (MARNet), delivers advanced information and communication infrastructure to the academic and research communities in R. Macedonia. MARNet is connected to European Academic Network via GEANT network.

Video conferencing involves a two-way video, audio and data communication between two or more parties over a remote connection. Video conferencing is carried out over a variety of media, the most popular of which uses Internet Protocol (IP) technology. The cost of video conferencing over IP is getting so low that it has become the most popular means of video conferencing [12].

A very important technical issue when dealing with video conferencing is the video format resolution [13]. It is obvious that larger audience requires better video resolution. Unfortunately, this also means that more communication bandwidth should be dedicated to the video conferencing session, which in turn makes it more difficult providing the needed quality of service. The connection bandwidth that can enable high quality video conferencing in Full HD is 4 Mbps.

Today, multipoint videoconferencing capability is a required component for any collaborative application. Over 40% of today's meetings consist of individuals from three or more sites. The first factor that must be considered when implementing multipoint videoconferencing is network bandwidth. It's important to note that multipoint videoconferencing meetings are simply multiple point-to-point meetings terminated on a central videoconferencing management system. If such system should be capable of simultaneous termination of 4 videoconferencing sessions, at 15.3 Mbps each, a 61.2 Mbps should be guaranteed by a central site where the management system is located.

A national educational video conferencing network will be based on Polycom's HDX series installed in every major university throughout the country. It also includes multi conference management centres, video recording and streaming servers. Polycom technology was accepted as being the best for this activity because it has a wide range of video and teleconferencing solutions based on open standards.

The VICES project will provide one centred Video conference management system and seven video conference classrooms in R. Macedonia, as well as two video conferencing classrooms in Albania and Serbia [11].



The Video Conference management centre will be facilitated by the Macedonian Academic and Research Network (MARNet), due to the already established management of the academic network infrastructure. This equipment will consist of three parts: management server, recording and streaming server and multipoint conference units. The management server will be able to utilize and optimize the network traffic generated by the video conferencing sessions. The recording and streaming server will provide recording capabilities for any video conferencing sessions, thus enabling their later streaming to any web enabled client [14]. It has to be stated, that in this case, the students will not be able to interact with their instructors. The multipoint conference units should enable parallel and multicast session among different video conferencing classrooms. Figure 2 presents the geographical placement of the video conferencing classrooms within R. Macedonia.

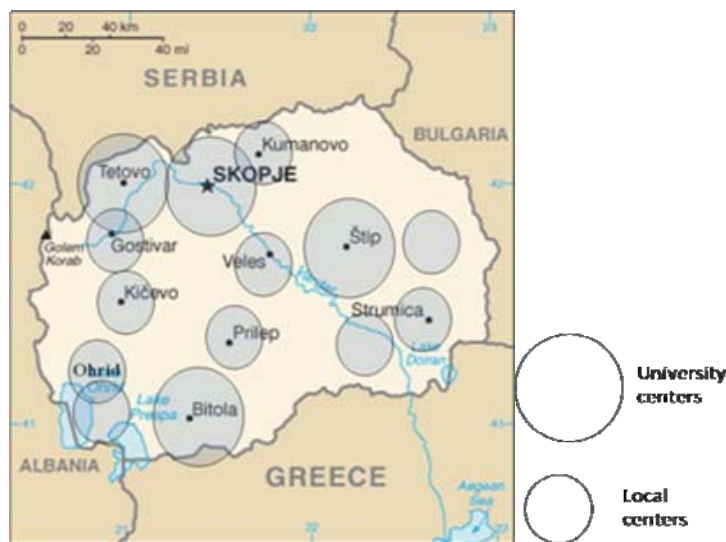


Figure 2. Video conference classrooms geographical distribution in R. of Macedonia

The classrooms locations are determined according the locations where the Universities that participate to project have dispersive centres. As it can be seen from this figure, a significant population in R. Macedonia is covered, providing equal access to more than 80% of students to the higher education facilities.

3. Educational methodology for implementing multicultural services

Video conference increases access to educational resources, degree programmes and promotes intra University cooperation. Videoconferencing education services, used in combination with other learning services can significantly ease this access by lowering the cost of the original production of educational material and increasing the possibility to update educational materials more frequently [15].

The components of the learning environment that promote the usage of video conferencing services can be itemized as follows: educational methodology used in the learning process, mapping of video conferencing technology onto the educational methodology, and institutional factors influencing the educational process [16].

In order to make video conferencing function effectively, instruction and course content must be interactive, and the instructor must exhibit flexibility and creativity when teaching the class. The key issue here is to adopt both technology to



educational methodology and educational methodology to technology, thus providing the engaging learning environment that can suit different learning styles.

Video conference enables the use of multimodal content (video, audio, and data) that should be presented to the students. A typical scenario for a 30 students' classroom includes 2 video screens (or one screen divided in two parts) that are presented to the students at the same time – one for standard video conferencing and one for educational material. The usage of multimodal content increases the chances of positive learning outcomes since they provide the opportunity to incorporate the variety of learning styles.

The VICES video conferencing portal enables students from different Universities to attend different lectures on the same or similar subjects. Students are able to exchange their ideas and educational findings with wider student communities that share similar interest. Emphasis should be given on the interaction among the participants of the learning process. In the case of live video conferencing, every participant's intervention (especially instructor's presentations) should be limited to 15 minutes. This approach suits two purposes. It provides the creation of videos that can be re-used for different curricula, but, more important, it gives the other participants a chance to discuss and provide feedback which can be of essential importance in the case of multicultural learning environments.

The videoconferencing session should be treated differently when it is established between two nodes or among more than two nodes. In the case of a point to point video conferencing session, the instructor (one node) and the students (the other node) can be easily prepared prior to the session (through some background reading) for the video conferencing subject and possible cultural differences. In this case, the most important element is to provide the interaction between two subjects.

In the case of multipoint video conferencing, the organization of the whole session requires a more carefully planned action. Our general guideline approach is to have three main parts to the videoconferencing support class activity (Figure 3):

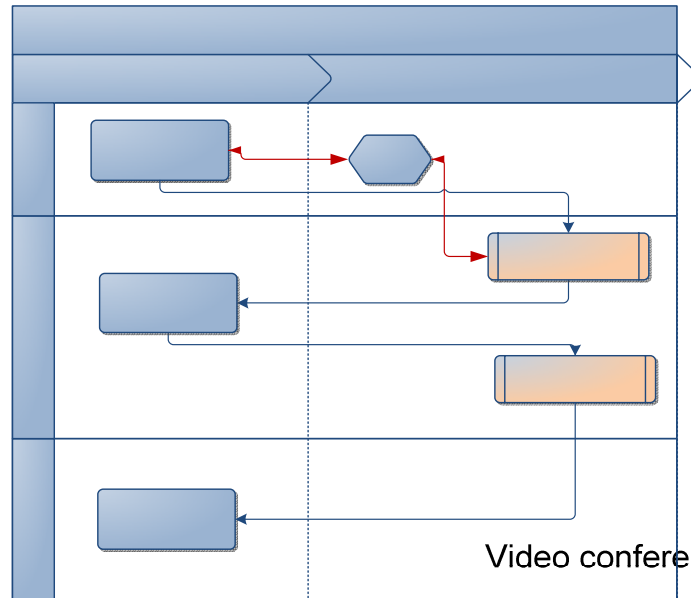
- First part: interactive preparatory activities that can be supported by different technologies depending on chosen instructional design models. These includes background reading, in class discussion at local level, determination of the most important issues to be discussed with other participants, etc.
- Second part: video conferencing session delivery which can be defined as a presentation from a recognised expert done through videoconferencing. The videoconferencing sessions should be recorded and made available afterwards to all interested parties. This part can be further divided in three sub-parts:
 - instructor's (speaker or expert) presentation (no longer than 15 minutes)
 - local class discussion explaining the points made by the expert, and defining the issues that need further discussion (moderated by local moderator in each video conferencing node, lasting 5 to 10 minutes)
 - video conferencing supported group discussion among all video conferencing sites to discuss different open issues. This discussion session should be also recorded and made available afterwards to all interested parties.

By giving such structure to this session, we try to make sure that the interaction will take place, but at the same time, that the issues discussed within the videoconferencing will be somehow filtered to their importance. The discussion that will be recorded, in our opinion, will reflect mostly the cultural differences, or the



things that really need further elaboration. The local discussion, on the other hand, will also help students to overcome potential language barriers.

- Third part: Interactive follow-up activities that should follow different instructional design models and can be supported by different technologies (e.g. wiki, mail based collaboration or blogs).



Video conferencing supported lecture plan re

Figure 3: Video conference supported class lecturing

local

The multipoint videoconferencing session can be especially engaging for students when it involves more than one lecturer, allowing students to follow and participate in the discussions among different experts on certain issues. Having in mind that the experts can come from different backgrounds, this scenario can really be recommended (when feasible) in order to give an added value to personal learning experience for different groups of students. In this scenario, experts would usually join only the discussion part of videoconferencing session (Figure 4).



Local discussions

Figure 4: The VICES multipoint video conferencing session with participation from two students nodes and two experts nodes.

The VICES Videoconferencing Educational Services will be evaluated by students at the last year of the three-year Environmental Engineering Curriculum introduced at

Follow up activities

Wiki, e-mail, blog discussion



the Ss Cyril and Methodius University in Skopje in 2008, that foresees the mutual recognition of degree titles with the University of Florence [17] using standard evaluation techniques adopted to video conferencing systems [18]. The students have been present during traditional classes given by their instructors in the instructor's country (different cultural background for the students). After the video conferencing lectures on certain subject, they will be asked whether the video conferencing is useful for their studies when compared to the traditional approach.

The questionnaires given to the students for evaluation will include three types of questions regarding: student experience in using video conferencing technologies in education, multimodal accessibility of the educational content, and the quality of service of the video conferencing.

4. Financial sustainability aspects of our video conferencing environment

The cost of video conferencing cannot be reduced to the cost of installing videoconferencing units in classrooms. The cost involves the long-term requirements necessary for educational change in conjunction with ICT.

The primary stakeholders interested in using videoconferencing services are Higher Education Institutions (Universities, research centres) and students, but on a wider scale, government and non government organizations, companies and general public can be also treated as stakeholders. The short term cost related to video conferencing can be divided into three main categories:

- infrastructure costs (telecommunication hardware, videoconferencing servers and end-units, the adaptation of the classrooms, audio equipment, presentation equipment, software);
- staff costs (experts, local moderators, technical staff, administrative staff);
- ongoing expenses (data and telecommunication volume, external services).

These costs can be covered from the following potential revenue sources:

- renting the infrastructure to the government and companies (by providing them the access to the networking infrastructure and directory services, or to the video conferencing servers for optimizing and recording the video conference sessions);
- dedicated lectures and seminars offered to specific target groups;
- providing access to recorded video sessions.

The videoconferencing environment reduces costs of travel (which is very important in case of geographically dispersed Universities such are the Universities that have joined the ViCES network). The most important benefit of establishing a national video conferencing infrastructure on a national level, is to provide the network of institutions with a tool for easily sharing their educational materials, and working together in joint projects, not only at a national but also at an international level. The potential of this possibility is worthy of any long term investment.

5. Conclusion

Higher Education will play a central role to realize the Europe of knowledge in the decade up to 2020. A great number of initiatives are actually carried out in this direction from the European Commission and member states.

New educational requirements and novel educational methods, such as Video Conference, supported by new telecommunication technologies enable almost instant access to the latest educational materials and methodologies.



In this framework the European funded TEMPUS Project VICES (Videoconferencing Educational Services), carried out by the University of Florence and the Ss Cyril and Methodius University in Skopje, was launched and financed by the European Commission for the period 2009-2012. This project introduces a new approach towards the treatment of Information Communication Technologies at University level with the purpose to increase the virtual student, academic staff mobility and the access to educational services. This approach will also enable a higher level of harmonization of different curricula among partner institutions and at an international level. This will increase the usage of new ICT technologies within the educational process, thus making it more efficient at the same time.

Videoconferencing can help to make the different systems of higher education more compatible and comparable, and also to promote equal opportunities to access quality education. Furthermore, it can guarantee accessibility and lifelong learning as an integral part of education systems, by introducing flexible learning paths to its participants. Finally, a very important benefit in establishing a video conferencing infrastructure at a national level is that of creating a network of interconnected educational institutions which can share their educational materials and can also cooperate in joint projects at an international level.

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