

## APPLYING DIFFERENT MODELS FOR VIDEOCONFERENCE UTILIZATION IN ENGINEERING EDUCATION

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**Abstract** — *This paper aims to present some experiences in engineering education using videoconference systems at Polytechnic School of Sao Paulo University. At Polytechnic School there are three videoconference rooms operating and other three are under construction. These rooms are part of Poli-Virtual Project that provides our Teaching-Learning environment where we plan to offer many courses in a distance-learning format and also systems for traditional education. This infrastructure intends to improve the information achievement, the learning quality and the interaction between teacher/students. Here we show some decision we have taken about the rooms' draw up and some important points when we are dealing with didactic material production. For the best utilization of these videoconference rooms and their resources, three models of distance courses are proposed. The main difference between the models related to the participants' distribution in the rooms. These three models are applied in engineering courses and all the pros and cons are evaluated.*

*Index Terms*  $\frac{3}{4}$  videoconference, engineering education, distance learning.

### INTRODUCTION

Keeping in mind the necessity of renew the traditional education with digital technologies and multimedia elements, and that distance learning is becoming a reality, Poli-Virtual Project has been developed in Polytechnic School of São Paulo University. Poli-Virtual [2] is relating to on-line teaching and community services that intend to make our School more efficient in many aspects. It provides our Teaching-Learning environment where we plan to offer many courses in a distance-learning format and also supporting systems for traditional education.

This environment provides video on demand systems, videoconferences rooms, support system for on-line courses development, knowledge multimedia database system and the automation of all students' administrative process as consulting schedule classes, grades, teachers' information and course information.

To support these entire Webs[1] based services it is necessary to create a specific transmission infrastructure. The project creates a high-speed network using ATM technology (Asynchronous Transfer Mode) backbone linking all the Polytechnic School departments. It forecasts a central site that has video servers and tertiary memory for educational material storage. Associated to this site there are a studio for the production of multimedia material and a videoconference room. At the departments were implanted sites to receive data from the central studio. Each department has a videoconference room also.

This system intends to improve information achievement, the learning quality and the interaction between teacher and students. Here we focus on the options did for the system construction. The information available and the interactivity were our priorities in the system drawn up.

### FIRST STEP – THE ENVIRONMENT

The videoconference technology is the way of learning face-to-face at a distance and gives us the opportunity to enrich our classes with new teaching resources. It is also a way to reach out to students geographically distributed. For this reason, we specified and constructed rooms where it is possible not only give classes to other sites using videoconference equipment but also to record these classes to have this material documented and available to future utilization, even on the Web. Besides distance learning, these rooms were designed to place meetings, small conferences, debates, workshops and remote training.

Design the best meeting environment for the videoconferences, an environment where people can work together from distant locations just as naturally and effectively as if they were in the same room, isn't an easy job. Our experience showed that the courses based on videoconference must be draw up for no more than twenty students. Frequently, a classroom that works well for ordinary class works just as well as for videoconference class. Although, it's very important to choose a room that has few or no windows, because daylight is a variable light source and can conflict with interior room lighting. So,

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windows were closed and covered. The room must comfortably fit all of the people that will participate at the videoconference, and must be also accessible to people with disabilities. Sound is just as important as the picture in videoconference, and then we need to think about microphone placement when we were planning our room.

Moreover, we have to deal with details as illuminations, acoustics and the entire infrastructure to produce a high quality video material. For the rooms implantation we hand with this problems as following [3]:

- Illuminations problems – to resolve these problems we installed some specific lights at a 45° angle, because indirect lighting minimizes shadows on participants' faces[4].
- Acoustics problems – the room that we choose for the videoconference didn't present the acoustic response compatible with the required environment and if you didn't resolve this problem at the end you will achieve a very bad audio component quality. We decided to cover all walls with foam and fabric, installed carpets and acoustic observer material at the ceiling. Therefore, we reached videoconference classroom without sound reverberation.
- Sound quality – we have used as few microphone as possible, based on our observation that the more microphone we had, the more background noise we picked up.
- Environment color – the walls colors and teachers' clothes colors have a direct influence in video final quality. Nowadays we recommend our teachers not to wear white or stamped clothes when they are using the system.

Another important considerations are some details we defined to improve the interaction between the videoconference participants. For this reason the videoconference room and all the details are carefully planed to maximize the image quality and the interaction between the participants. It's easy to see that a video classroom production isn't easy to implement and demands efforts that extrapolate engineering domains.

### SECOND STEP – THE MATERIAL PREPARATION

The strongest message received from videoconference users is that the videoconferencing “talking-heads” experience is not a sufficiently compelling reason to justify installation of expensive videoconferencing equipment in substantially more than a few select conferences rooms. Users state that the value in meetings has as much, or more, to do with the information handled in the meetings, as it has to do with seeing people. Specially for engineering education, where

mathematics demonstration, constructions, structures and mechanics models, electronic board and so one, are usually the classes' subjects.

That information might be in the form of PowerPoint presentations, animations, videos, objects or machetes observation, paper handouts, or notes on a whiteboard. So, we enhance our videoconferences rooms with additional equipment. They are providing with:

- Main camera: that show mainly the professor image.
- Documents camera: where are possible the documents, slides, objects and models exhibitions.
- Auxiliary camera: that show the students image.
- Whiteboard: allowing to show applications from the PC or creating in real time notes and diagrams.
- VCR: where it is possible to run a video, transmitting it to the remote site.
- Laptop: that is used to run and share software and image storage in it.

These auxiliary equipment allow to share applications and information, promoting change knowledge and collaborative work.

Before beginning a videoconference session, the teacher must to plan the class, doing its script and organizing all the material that will be used.

### VIDEOCONFERENCE MODELS PROPOSED

But, how must we distribute the participants in the rooms? How this distribution interferes on the interactivity? How can we optimize the interaction between professor and students? First of all, it's necessary to understand the videoconference mechanisms and dynamism, especially when the class will be delivered to more than one remote site at a time – that is, using a multipoint connection. It is important to observe and to try different tools, didactic material and activity to evaluate and learn what works and what doesn't. By this observation, it is easy to conclude that distance learning works best when it's not dominated by lecture and when students have many chances to share ideas.

For the best utilization of these videoconference rooms and their resources, three models of distance courses are proposed and applied. The main difference between the models is related to the participants' distribution in the rooms. In this way we established three videoconference courses format, that are:

- Students in both rooms, configuring present and remote students;
- Students only in the remote room or rooms (in case of multipoint videoconference);
- Teachers in the both rooms sharing de course.

Let's describe each situation that performer the models proposed.

### Students in Both Rooms

It's very common to think about organizing a course with two site students, one local and other remote. Mainly because is an economic way to deliver courses. So, we try this with two rooms connected by videoconference system, where each one hosted between 10 and 20 students.

Our experience has demonstrated that is very difficult to deal with local and remote students at the same time. Local interaction is much more natural and easy, and the professor expresses this by her/his look and gesture. Frequently, he/she addresses the talk to local participants. It is very difficult to perform a balanced course for both sites. When this kind of overbalance occurs, the course quality will probably be different for local and remote students. And we have found that this reflects at each classroom average grade.

To avoid this situation it is necessary to stimulate the remote participants interaction all the time, asking questions, applying activities, and mainly, looking to the people in the remote classroom, i.e., looking to the camera that are capture the professor image. However, these differences will be never masked.

### Students Only In The Remote Room

Another model that we have tried was maintaining students only in remotes classrooms. The professor is keeping alone in the local videoconference room. The videoconference can be distributed in more than one room (multipoint connection) or just one. In this situation the professor can address her/his talk exclusively for the students that are participating remotely. This brings enormous benefits for the course quality. The students feel that they are the professor's target and feel more comfortable to interact with him/her.

In spite of this, it is necessary to take care of some details. At videoconference it is normally recommended to mute the microphone when we are not talking for some length of time, because some noise can be captured from the system and it will switch or activate the voice channel to this room [5]. This action cut the voice streaming that comes from remote room, degrading audio quality. However, keep the students' microphone muted difficult professor's sensibility to students' response from the course. So, if the students are inhibit to express their opinions, the professor will go ahead without realize the students' doubts or comments.

An option that we had found is take one of the students as deputy all of them. This person will sign to the professor when the students have some difficulty or comments. He/she will also do the mute and camera control. So, the professor could have a feedback from this person.

### Teachers In The Both Rooms

The third model is based on maintain an professor and students in two rooms connected by videoconference system. Our experiment was performed between two partners engineering schools. The professors worked at the same engineering area, but they were experts in complementary subjects. So, it's possible to them to draw up a four hands course. Each professor held the mute and camera control and each talk took half time of the lesson. The both professor were present during the entire lesson.

The professors' presence in the rooms, due his/her knowledge in the area, stimulated positively the students' reaction. They encouraged students' questions and debates. Applying this model was a very gratifying experience. The average grades were very high in both groups.

### FINAL CONSIDERATIONS

We have used videoconference system at engineering course only to enrich our classes with new teaching resources that are away from the Sao Paulo University. Although at this moment we aren't planning offer the entire engineering program using videoconference. We believe the practical program parts are very important, and we don't consider yet the possibility to substitute the laboratories for any kind of remote interaction. The experiences described here allowed establishing these three videoconference models, and from them we can optimize the interaction between professor and students.

The students' behavior observation was very important to refine the models. The third one gave us the best result. Of course it isn't one model that could be always applied. It was a particular situation where there are two experts and two groups of students. Unfortunately it doesn't occur always.

The second model gave us good results too. We recommend it application. On this way the professor's attention is focus on the students who are remotely. This situation allows a better interaction and lesson's quality increase.

We don't recommend the use of the first model presented, because it decreases the course quality when professor prioritizes the local students. However it's quite impossible to avoid this situation.

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