

**AC 2008-281: THE VIRTUAL SYNCHRONOUS CLASSROOM: REAL TIME  
OFF-CAMPUS CLASSROOM PARTICIPATION WITH ADOBE CONNECT**

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# **The Virtual Synchronous Classroom:**

## **Real time off-campus classroom participation with Adobe Connect**

### **Abstract**

In metropolitan areas populated with technical industries, many employees desire a Bachelor of Science degree in engineering. However, the need for frequent commutes to university campuses poses a major deterrent to pursuing one. To serve this population, and enable their rich practical work experiences to enhance the education of our traditional on-campus students, we are implementing the following scenario.

*Local technical workers stay in their offices at lunch-time sitting at computers armed with headphones and microphones to attend, and participate in, an electric circuits class via an internet connection. Other students, on the university campus, sit in a traditional classroom setting augmented with room microphones. Both groups of students view the electronic whiteboard that is generated by the instructor writing on a Tablet PC projected to the campus classroom through an LCD projector and to the off-campus students through Adobe Connect software. Two students are not able to attend class today due to work and athletic commitments; they will view the Adobe Connect recording at a later time. One off campus student isn't clear on an example and speaks into her microphone to ask the professor for further clarification...*

This scenario affords the distance learner the ability a) to learn from the questions posed by the on-campus students, and b) the ability to interact with the instructor real-time in an efficient manner. Our implementation does not significantly alter the experience of the on-campus classroom, and it can be implemented in most classroom settings. Thus, it promises to be scalable to all of our engineering courses. In this paper, we discuss the benefits and challenges of this scenario as we have experienced them, suggest some best practices that we have discovered, and discuss relevant departmental and institutional issues.

### **Introduction**

Currently students interested in studying for a B.S. in engineering who work full time and/or live a fair distance from a university campus typically have limited options. 1) Enroll in fully online/video courses which are separate from the traditional on-campus courses. 2) Attend traditional day-time courses requiring long commutes and/or difficult arrangements to be away from work for a significant amount of time. 3) Find a program offering evening courses, and still possibly face long commutes. 4) Enroll in a course that is offered at a local classroom facility remote from the host campus. In our region, these last two options, once more common, are now only rarely available for engineering students. To address the needs of the remote engineering students, some universities have begun using web conferencing software<sup>1</sup> and the power of the internet to develop real-time interactive distance learning. Anecdotal

evidence suggests that by utilizing such a tool to effectively deliver a classroom experience without the typical commuting burden, more interested people would likely pursue the completion of their engineering degree.

With regard to providing distance learning for undergraduate engineering, we looked at six other institutions in our region that offer undergraduate degrees in engineering or engineering technology and six other selected schools nationwide whom we had heard were implementing some form of distance learning for engineering. We found that none of our regional schools offer distance learning undergraduate engineering classes or programs, although some offer graduate degrees limited to courses requiring minimal lab experience. Some local schools, though, are in the process of looking at appropriate tools that may be useful for undergraduate distance engineering courses. Among the nationwide universities we found a variety of online and hybrid courses offered utilizing either web conferencing software or video conferencing via television links to remote students. This model is in place or being developed for at least some aspects of course delivery at: Bethel University<sup>2</sup>, California State University Northridge<sup>3</sup>, Murray State University<sup>4</sup>, Penn State University<sup>5</sup>, Purdue University<sup>6</sup>, and University of Kentucky<sup>4</sup>. (There are likely numerous others at least at the exploratory stage.) Phone interviews with appropriate personnel at these six schools revealed that these schools are at varied levels of interaction between the faculty member and the remote student, and have courses at varied levels of adherence to the real-time distance learning format. Some schools offer entire classes via fully real-time two-way audio and video interaction between the faculty member and the remote students, while others utilize simply one-way audio for courses or limit their use of two-way interaction to informational sessions or small group interaction. Further, we found that specifically engineering-related courses available in a distance format seem to be limited to low level math or computer science courses or engineering courses that do not have a lab component. Our conversations indicated that a) each school must consider what is best for its constituencies and b) that interactive distance learning is gaining traction, but must be approached carefully, including careful coordination with administration and supporting departments.

Our approach uses web conferencing software (Adobe Connect) as the primary course delivery mode for remote students, but remote students do come to our campus for labs. Since we are a small engineering program, we do not have the resources to generate separate sections of courses or to offer courses specifically for remote learners, so we are using web conferencing software to bring our on-campus classroom to the remote learner in what we are calling our Virtual Synchronous Classroom (VSC) (while also accommodating for evening/weekend labs). We adopted this approach in large part since the remote learner is typically older and more mature in life experiences than the traditional undergraduate student, and thus brings added enthusiasm and practical experiences to our classroom. Affording the remote student the ability to participate in our campus classroom enriches all involved. To accomplish the VSC, our campus classroom is equipped with a Tablet PC, microphones, speakers, and web cams in addition to our standard equipment that includes a podium PC, an LCD projector and a document camera; the remote student is equipped with a microphone, headphones and possibly a webcam. We have found that the learning environment is quite good, though still not as good as if the remote student were physically present in the classroom. However, in our experience, there are students for whom physical presence is not an option or highly inconvenient, so they are very pleased to be in a 'virtual synchronous classroom'.

We have developed our VSC out of the merging of two phenomena. 1) We desire to accommodate our students who work full time, but have a need to change how we are doing this. 2) Our colleagues in our university's School of Business and Economics have a similar desire, and had gained some initial experience with Adobe Connect. This past year, we have collaborated with our business colleagues in using an internal university grant to purchase equipment to enable the VSC. We quickly identified first one, now eight (as of January), engineering students to participate in our courses using the VSC setup.

This paper will first describe our VSC and how we are implementing it along with discussion regarding student and faculty experiences. We will then discuss the relevant larger institutional and departmental issues as we move ahead with this powerful combination of technologies.

## **Methods**

### *Virtual Synchronous Classroom Hardware Configuration*

We have two physical campus classrooms equipped for use as a VSC. One is a rather large (44' w x 30' d ) engineering laboratory (see appendix A). It contains 18 student workstations (for up to 36 students) equipped with a PC and electrical engineering lab equipment. The other is a more traditional classroom, but the student tables are surrounded by workstations at the perimeter of the room, thus this classroom is also larger than a typical classroom at our university.

The classrooms also contain an instructor Podium station equipped with a PC (connected to a video projector), a document camera and lab equipment. The instructor can project either the screen of the podium PC, the screen of a portable PC, or the document camera image to the video projector. For the VSC, we have chosen to use the portable PC option primarily in order to put the image from the instructor's personal Tablet PC on the screen. This allows the instructor to annotate PowerPoint slides (as an example) during the lecture, instead of either writing on the whiteboard at the front of the room or using the document camera. For remote viewing and recording, the instructor can configure Adobe Connect software to transmit the Tablet PC screen, the podium PC screen, or the document camera image.

Because of the large width of the classroom, we found it necessary to use two array microphones (mounted above the whiteboard at the front of the room) to adequately pick up student comments for Adobe Connect to transmit and record for remote users. We have found that the array microphones do pick up the instructor's voice quite reliably when the students in the classroom are quiet. When the students are talking during group work, however, and the instructor wishes to be heard by the remote students, it is advantageous to turn down the array mics, and use the lavalier mic. All three microphones (two array and one lavalier) are fed into a small mixer before being connected to the instructor's Tablet PC. (We have found fixed settings of the mixer inputs are adequate.)

A web cam mounted on the instructor's podium provides an image of the instructor when (s)he is at that location. Another web cam is pointed at the projection screen. Although the resolution is inadequate for reading the screen, if the instructor points at locations on the screen, the remote student can generally tell what the instructor is pointing at. To provide a general perspective of

activity in the room, we can connect a third web cam mounted in a corner of the room, but the increased bandwidth can lead to poor audio quality.

More details of our hardware setup are included in Appendix A.

We should mention that our Instructional Technology Services “ITS” department has a license for Adobe Connect, and provides the server and support for that portion of the system. That portion of the system is not addressed in this paper.

### *Office hours and homework*

Another important element of any class is instructor availability for student questions, a.k.a. “office hours”. Adobe Connect and the Tablet PC are helpful here, as well. The remote student and faculty member can talk via the phone while the faculty member writes on the Tablet PC so the remote student can view it from his/her computer. (We have used this so far only a very limited basis, but it is quite effective). If the remote student also has a Tablet PC, Adobe Connect will allow both to write on the same electronic whiteboard simultaneously. (We have not had the opportunity to do this yet, but we are pursuing outside funding to support providing tablet PCs for a limited number of distance students.) Further, the instructor may choose to asynchronously respond to a student by recording the answer using the Tablet PC and Adobe Connect. In either of the latter two cases, the instructor could make the response available to other students as well.

It should also be mentioned that the Tablet PC is useful for prompt feedback for grading when the remote students submit their work electronically. The instructor can ‘critique’ the electronically submitted assignments using the Tablet PC stylus, and then simply email the graded assignment, without the need for the student to come to campus to pick up the assignment.

### *Best practices*

Our list of best practices (Appendix B) focuses on two areas: quality assurance and setup. We have just described our setup, now we address our quality assurance methods.

We have found that it is very important to have real-time monitoring and some pedagogically redundant alternatives to ensure a quality learning environment for both the on-campus and remote students. To minimize the need for a paid technical attendant, we approach real-time monitoring in the following manner. Although the instructor teaches primarily from the Tablet PC, a second computer located at the instructor podium is also logged in to Adobe Connect in order to provide the instructor a view of what the remote student would see. Since the instructor is rightfully focused on teaching, and not monitoring the VSC, we also have a student in the class log in to Adobe Connect using a classroom PC or laptop. This student can alert the instructor if there is an audio or application sharing problem, and this student can also monitor any chat dialogue done by a remote student. Even though the instructor has visual access to these same things, so far we have found that they can easily overlook them in the midst of a class session.

We have also discovered that the Tablet PC needs to be as powerful as possible. This is especially true if the course uses software and hardware that tax the CPU such as the following: a web cam, Labview, MATLAB, Multisim, etc.

Since technical difficulties will arise, the instructor must have multiple options for simultaneously teaching both the on-campus and remote students. Three primary failure modes that would be catastrophic without redundancies are: the in-class projector, the Tablet PC, and the classroom audio system. Here are the alternatives we use when these items fail, none of them are ideal, but all are workable when needed. Another option is to simply move the class across the hall to our second VSC equipped classroom, if available.

- If the in-class projector fails during class, we can point our document camera to a segment of the classroom's physical whiteboard and teach from there. Alternatively, we could point one of our webcams to the whiteboard. Its resolution is poorer, though, so the document camera is preferred. [Note also that the document camera uses a lot of internet bandwidth which causes visual delays and may reduce audio quality.]
- If the Tablet PC fails for whatever reason, the instructor station PC can be used for projecting software, and the instructor can write on a piece of paper at the document camera for projection to both the classroom screen and Adobe Connect.
- If the classroom audio system fails, the instructor's voice can be sensed with the Tablet PC's internal microphone.

### *Labs*

One of the deterrents to offering purely online engineering courses is the lab issue. Typically programs offering distance learning do one of the following: a) eliminate labs in the online classes, b) keep labs to a minimum and make special arrangements for students to occasionally come to a lab facility, or c) have remote students do labs at their place of work if that is possible. We are in agreement that labs are vital to learning. That is why we see the VSC as just part of the educational experience. There is still a need for all students to be physically present to do labs and to have some face-to-face interaction with the instructor (or a TA) and other students. So in reality our VSC course is actually a hybrid of remote and on-site participation. Most course content can be delivered via Adobe Connect and Blackboard, with the strengths inherent to those venues, but we still maintain the important personal interaction and lab work on site. This model still requires commuting, but at a substantially reduced frequency and not necessarily during the normal working hours. We have found this model to be attractive to our adult learner students. Attending in person only once a week or possibly every other week for lab and personal face time is clearly an advantage for the working student. This format, where the student comes to campus for labs, is so far meeting the needs of all involved, and is our preferred format.

### *Exams*

There are mechanisms for administering exams via Blackboard and similar tools, but they are not practical for our engineering exams which emphasize hand written mathematical problem-

solving, not just right answers. Although other adequate avenues may exist, for now we have chosen to require the remote student to come to campus for exams.

## **Results and Discussion**

### *VSC successes:*

Since the beginning of Spring quarter 2007, one student who works full time has been able to complete two courses using our VSC, one by viewing recorded lectures, and one by remotely participating live. He otherwise would have been forced to quit pursuing an engineering degree. This student travels for business trips, and has found the option to either participate live or view class recordings particularly beneficial. This student will continue to complete our year long Electronics course sequence via our VSC and is generally pleased with the results.

Currently four students are participating in our second quarter sophomore level Circuits course via VSC, and three students are participating in our Control Systems Design course via VSC.

Other students have made use of our VSC as well:

- We have recorded most class days in three different Circuits and Electronics courses, and as needed in one Signals and Systems course. This has enabled our remote students, as well as ill students and travelling student athletes, to view class sessions they otherwise would have missed. Further, many students who were present in class have chosen to view one or more recorded class sessions to review the material, especially in preparation for exams. Our university uses the course management tool Blackboard. By simply listing the URL for a classroom session recording on the course Blackboard site, we can make it available to the student on demand from within a password protected environment.
- One professor pre-recorded a class session since he would be absent due to conference attendance.

Of the four courses in which our remote students relied on our VSC for content delivery, all class sessions but three were successfully recorded. There were two class sessions which were not monitored real-time, and the audio was not working properly. There was one class session where neither the instructor nor the classroom monitor noticed that the recording feature was not turned on.

### *VSC challenges:*

As indicated earlier, quality assurance takes planning and forethought. We are still working at developing our procedures for assuring a consistent, quality learning environment for both the on-campus and remote student, with minimum distractions. We recognize that the procedures associated with the VSC cannot be too time consuming if they are to be repeated in more classes or perhaps throughout our entire engineering curriculum.

Audio and visual issues have taken the most time and consideration. There is the familiar tradeoff of cost versus audio quality and image resolution. Bandwidth issues, especially with the video links, are a concern, as well as the basic quality for both. There are higher quality, more expensive options available, but at this point we feel we are getting the 'most bang for the buck'. When it comes to remote users, their own local network and ISP will help determine the overall effectiveness. (One remote student has viewed a class from various points around the world due to his work travel, including twice from Turkey. He has discovered that hotel internet access bandwidth can be sufficient, but not always.) Further, as we have been experimenting with our setup, we have discovered that what works best for one instructor, does not necessarily work the best for the other, and yet we share the same classroom. This makes good communication and compromise vital. We have now settled on a setup that we are both happy with.

The VSC challenges the instructor to modify his/her pedagogy away from pointing to a whiteboard or screen. The instructor must consistently remember both audiences as (s)he teaches. This can be mentally taxing at first, but with experience this becomes less and less of a problem. Another challenge is enabling remote students to collaborate with other remote students or with on-campus students in design teams. We are investigating document sharing options and wiki tools, and are considering using Tablet PC's in combination with Adobe Connect for this purpose as well.

The Tablet PC in combination with Adobe Connect would also enable the remote student to share his/her "in-class" work with the instructor and the rest of the class during in-class problem solving segments. The cost of the Tablet PC, however, can be prohibitive in many cases. One solution may be acquiring outside funding.

Finally, we are still finding ways to streamline the daily setup to minimize the instructor's time and attention required for the VSC, and to improve reliability of the VSC. Instructors must be consistent to set up everything correctly before the class session begins, including such things as remembering to start the recording of the session or turn on the audio! Some automation here may be helpful long term, and the web conferencing software is continually improving as well to perhaps aid this automation. We have found that the in-class student monitor is invaluable to assist the instructor in ensuring the VSC is operating correctly.

#### *VSC faculty perspectives:*

While the VSC is mentally challenging and has a definite learning curve, the advantages are numerous and make the effort worthwhile. The first mental challenge is to get comfortable with the web conferencing software and the classroom setup, and to determine a modified pedagogy that meets the instructor's style and preferences. Daily mental challenges include the need to constantly consider both audiences while teaching, troubleshooting any technical issues with a captive audience, and performing the daily setup and termination tasks for every class session.

The instructor, though, sees direct benefits of this hard work. It is terrific when a student has to miss class to be able to tell him/her: "watch the recording!" That is a fabulous option that was previously unavailable. Further, if the instructor needs to be away from campus for a conference

or meeting, (s)he can teach it live remotely, or pre-record it, eliminating the need for otherwise altering the class to accommodate the conference. The students most commonly needing/desiring to take a class remotely are also highly motivated and bring a welcome diversity to the classroom. It is fulfilling to meet the needs of these students and to benefit from their perspectives. The VSC is also preferable to commuting to campus to teach or attend evening courses. Finally, the VSC resembles distance communication that takes place in industry. Video conferencing is now in common use. The skills and perspectives that the instructor and students must develop to enable the VSC are the same that global engineers must develop. So, in one sense, the VSC provides an avenue for keeping current.

Since the Tablet PC provides the ability to "write" on PowerPoint slides, and to "copy and paste" items on an electronic whiteboard, we would use it even if we were not doing a VSC.

Setting up and using a VSC clearly requires more effort, especially during the start up and learning phases. It takes time for the instructor to begin to feel comfortable operating with a student focus divided between physically present and distantly located students, as well as successfully managing the technology details. However, with time it gets easier, and we feel that the benefits make it worthwhile. The dual benefits of being able to supply class sessions either live or recorded for later viewing are powerful tools both for the distance learner and for the traditional student.

Another intriguing benefit to the recorded classes is that the instructor can also review them as an 'instant replay' experience and use this to help him/her improve his/her teaching style and practices, not unlike an NFL team reviewing the games tapes to aid in identifying its own strengths and weaknesses. This could also conceivably be used for peer review of classroom instruction.

#### *VSC student perspectives:*

When surveyed, students in the courses that were shared as VSCs generally indicated that remote learning can be effective via the virtual classroom, though physical presence is still preferred (Appendix C). Of 32 students surveyed, only one (on-campus) student indicated that technical issues associated with the virtual classroom was highly distracting. All but four out of 25 students adapted to the setting when viewing a recorded class session. All but two students managed fine with nearly no IT support. The one primarily remote student was very enthusiastic about this form of learning.

This remote student, a Boeing employee, determined that our VSC engineering program was by far the best solution to continue his learning for an undergraduate electrical engineering degree. He sees himself as a "worst case" scenario, working full time with a long commute to campus as well as traveling for business. The remote student even suggested that there were so many other people in his position that we could significantly increase the number of students in our engineering programs by offering the VSC option. He found that the hybrid approach worked quite well for both Circuits and Electronics: he liked the combination of advantages from participating in class remotely as well as the personal interaction and instruction gained by

commuting for weekly labs. The remote student also said that for him, the virtual classroom is almost as good as being there.

Throughout the different courses which this remote student has taken, different technical issues have arisen. He was impacted most by audio and video issues; most of these issues, though, were resolved as the professors got used keeping up with Adobe Connect. He has also experienced some set up and connection issues related to Adobe Connect, especially related to having his microphone set up properly to be able to interact live with the class. Troubleshooting has allowed us to resolve most of the problems that the remote student has encountered as well as giving us additional experience with resolving these problems quickly.

The different habits of the professors also presented some interesting problems for the remote student. For instance, one professor “likes to walk to the screen and point to items directly on it, rather than using the pen tablet. This works well for the students in the class, but if you are online you cannot see what he is pointing to.” This problem has been addressed by moving the position of a webcam to focus on the projected screen, allowing any remote students as well as anyone viewing a recorded session to see generally where the professor is pointing. As the professors gain more experience and feedback with teaching using Adobe Connect minor issues like this will probably be resolved. Despite the different problems that we’ve encountered, the remote student thinks that our VSC set up works well.

Students in the classroom can also benefit from the VSC. Besides the ability to view recorded class sessions, students have also benefited from the ability to watch the presentation live during class. For some students unable to see the projector screen easily, it was advantageous to watch the PowerPoint and other projected presentations on their local computer station. This also had the added benefit of ensuring that Adobe Connect was recording everything as it should.

Students agree that having a student willing to monitor the Adobe Connect window to ensure that everything - including the audio - is working correctly is quite beneficial for both the remote student and the rest of the class who may later view the recorded class sessions. The student assistant was also able to benefit from the additional focus on the lecture necessitated by monitoring Adobe Connect.

One student who responded to the survey indicated a strong distaste for this style of teaching. That particular student strongly preferred a professor using the physical whiteboard. While one student out of 32 is not a cause for significant concern, it does raise an interesting issue. While we have not investigated SMART Boards or similar technologies, the use of an intelligent whiteboard would allow for professors to retain this classic teaching element while still meeting the needs of distance learners and continuing to record class sessions.

Overall, from a student’s perspective, our VSC is quite beneficial and well worth the minor problems encountered.

### *Institutional / departmental perspective*

In order to sustain and expand our VSC efforts, institutional and departmental support is mandatory. Our VSC effort began with an institutionally funded grant, so we have enjoyed some institutional support from the beginning. Initially we had identified a departmental goal of serving students who are working full time, so we sought out the internal grant funded by our Computer and Information Services (CIS), Instructional Technology Services (ITS), and our Center for Scholarship and Faculty Development (CSFD) offices. In awarding the internal grant, these offices indicated their ‘blessing’ from the beginning.

Moving forward, though, we face two primary challenges:

- 1) meeting the technical demands of quality and scalability.
- 2) determining which courses should/will be offered via our VSC and then equipping the relevant faculty to make the transition.

Meeting the technical demands requires good communication between ITS, CIS and the relevant faculty/departments in order to determine where responsibility lies, and also to determine the source of any technical problems. Although our communication is quite good, we are all very busy and somewhat unfamiliar with the knowledge that each entity has regarding our VSC technologies. Meeting technical demands also requires money and network bandwidth. Again, though we all agree that we want to move ahead with our VSC, we still must determine which entity or entities will fund it and what technical changes may be necessary. We are still at the learning stage. We expect our current VSC format to be scalable to accommodate many remote students per course. As long as students use the ‘push to talk’ feature for their microphone and make limited use of their web cams, many remote students can participate without impacting bandwidth. Since our class sizes are small (less than 30 students) we should be able to accommodate roughly 50% of our class size in remote students, if not more.

We have given some thought to which courses will be implemented in a VSC format. Initially we are offering the VSC as needed by our current students. In the future, though, we hope to allow students who enter our university to complete their Bachelor of Science in Electrical Engineering almost entirely through the VSC format provided they arrive with an Associate of Science (AS) degree and relevant engineering coursework. (Our university requires only two general education courses for students transferring in with certain AS degrees.)

Our ITS office will provide the necessary faculty and student training. We expect our engineering faculty will have the technical skills to implement the VSC in their classes when provided with adequate training.

### **Conclusion**

The VSC has now enabled students to take some of our courses who would otherwise have been unable to take them. And, it has enhanced the learning of traditional students who missed class or wished to re-view the class session. We will continue to use our VSC for these purposes. Further, we will continue to enhance the quality and reliability of our VSC in hopes of

extending it to our entire engineering curriculum and thus extending our curriculum to many in our region who are not currently able to pursue completion of their engineering degrees. At the same time we will retain the indispensable value of hands-on and face-to-face components through on-campus lab sessions.

It is important to note that we do not see this as completely replacing the traditional classroom, but rather as a tool that can make it possible for full-time working students to complete their degree by removing some of the prohibitive obstacles, while also enhancing the educational experience for on-campus students (via recordings of class sessions for later review). By significantly reducing commuting trips to campus by through the option of either participating in the synchronous classroom experience or viewing recorded class sessions when necessary, we can provide marked increased flexibility to the student who works full time during the day. We believe this scenario will make it possible for some students to complete their degree where they otherwise would not, and also make the experience less personally painful. So far our students (both on-campus and remote) are very appreciative of this resource. All agree, though, that no virtual experience can fully replace hands-on learning: it must be retained. We also recognize the value of occasional face-to-face interaction for effective problem solving and clarification of misunderstandings on the material, etc. The key idea is that we can retain these clearly desirable elements as per a traditional class while at the same time leveraging the resources offered by the technology to ease the burden on the student without sacrificing quality.

Since we are still new to the technology that enables the VSC, there will likely be other unforeseen applications that will benefit engineering education. For instance, we are beginning to think through the aspects of the VSC that are promising for study-abroad programs. The VSC technology might enable the study-abroad student to complete a critical class at the home institution even while he/she is abroad. Or, the VSC technology might enable an on-campus faculty member to remotely guide the study-abroad student via regularly scheduled remote meetings.

Finally, we suggest that the VSC may be a significant avenue to educating yet another under-represented group in engineering education: the full-time worker who desires an engineering degree. At a time when fewer teenagers are choosing engineering, but the nation sees the need for more engineers, the VSC may be one of the answers.

[We will post some links to a recorded session, as well as the PowerPoint slides of this talk at our VSC web site: <http://myhome.spu.edu/ryanl/2007SPUTechGrant.htm>.]

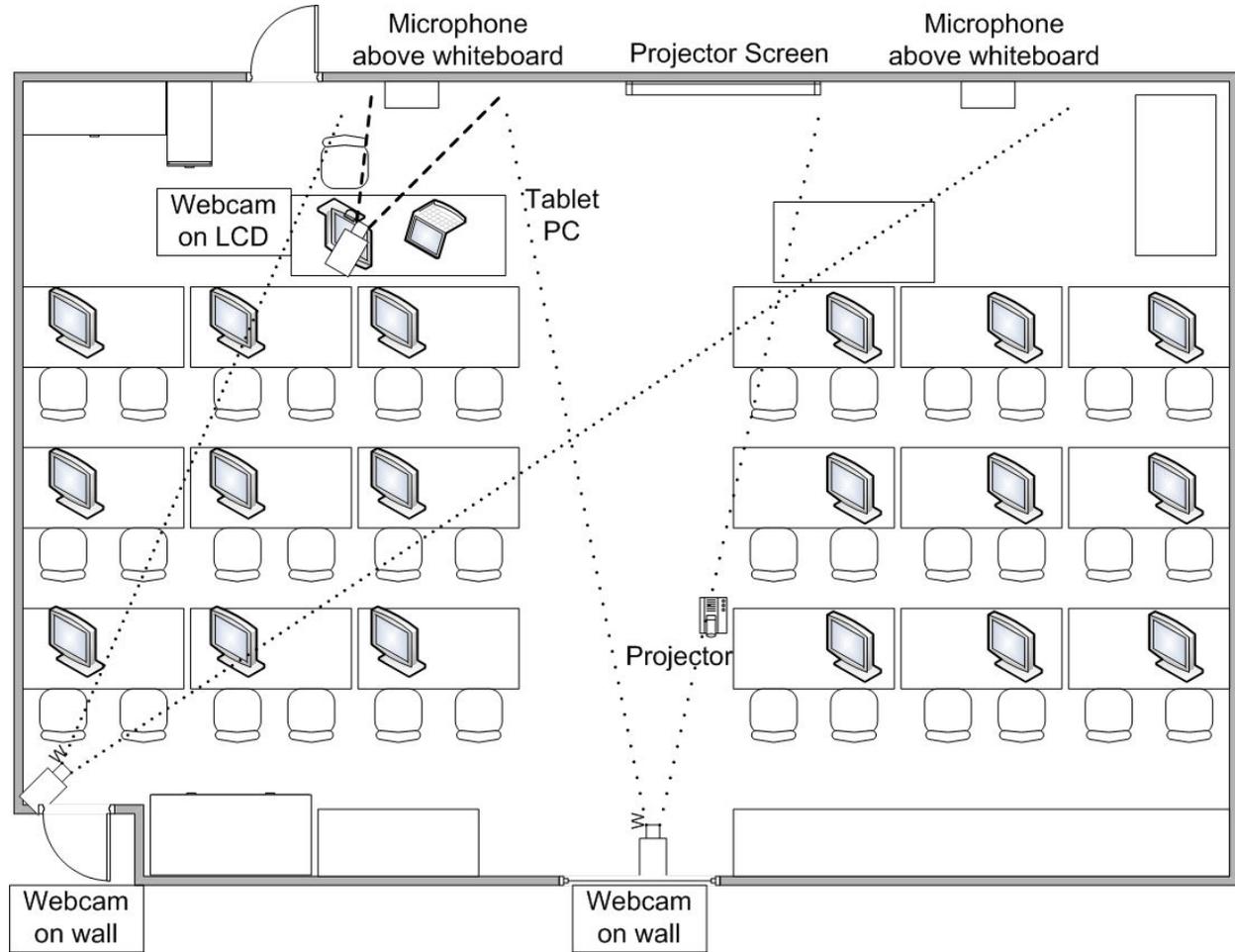
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## Appendix A – Equipment

Figure 1 shows the layout of our course and the location of our VSC equipment. Table 1 lists the specific hardware that we use in our VSC.



**Figure 1– VSC physical layout with equipment locations.**

**Table 1– Equipment used as of November 2007**

<i>Item</i>	<i>description/source</i>	<i>approximate cost</i>
Tablet PC	Lenovo Model X60	\$ 2200
Array Microphone	<a href="http://www.AcousticMagic.com">www.AcousticMagic.com</a>	\$ 250 each
Lavalier Microphone	<a href="http://dak.com">dak.com</a>	\$ 50
4-input Mixer	<a href="http://dak.com">dak.com</a>	\$ 30
WebCam	Microsoft LifeCam VX-3000	\$ 50
Cables	(depends upon environment)	\$ 100
Total		\$ 2930

## **Appendix B – General Best Practices**

### *Setup*

#### Adobe Connect Meeting setup

1. Two computers - one for sharing/projecting to on-site projector, the other to view what the off-site student sees.
2. Full duplex audio
3. Wired Ethernet
4. Make the session available to anyone with the URL, then the instructor does not have to give each person permission to join and does not have to enroll each person.
5. Use one meeting for the entire quarter. Recordings can still be saved with separate names and URL's.
6. Share the entire Tablet PC desktop.
7. Set it all up about 10-20 minutes before class.
8. Have a checklist for all the needed steps for setup and termination of a class session.

#### Microphone and camera

1. Place web cams to view the instructor at the Tablet PC and the instructor at the screen.
2. Use a lapel mic for the instructor when students are talking amongst themselves.
3. About 15 minutes before class starts, do an audio test with any live, remote students.

## Whiteboard

Use Powerpoint or Windows Journal on a Tablet PC for electronic whiteboard rather than Adobe Connect's whiteboard.

## Recording

Record the class sessions. Give the class session a name that describes the day's content.

## *Quality Assurance*

## Monitoring

1. Ask students to speak up when asking questions or making comments.
2. Ask a student in the class to monitor the Adobe Connect screen from a classroom computer or his/her laptop to ensure the right windows are being shared and the audio is working well. If there is a live, remote student, this on-campus student can also monitor any chat requests.
3. Have a clearly understood procedure for the audio participation of remotely located students so they can be acknowledged and be able to participate effectively.

## Backup plans (These are imperative!)

1. Have a plan for simultaneously teaching both on-campus and remote students **if the projector fails** during class. [We can use the web cam intended for the instructor pointed to the white board.]
2. Have a plan for simultaneously teaching both on-campus and remote students **if the Tablet PC fails and/or locks up** during class. [We can use the podium computer for projecting any software, and use either the document camera or the web cam pointed at the physical white board.]
3. Have a plan for simultaneously teaching both on-campus and remote students **if the classroom audio system fails**. [The instructor's voice can be sensed with the Tablet PC's internal microphone.]

## **Appendix C - Fall 2007, technology grant survey results**

32 surveys completed

(out of 33 students participating in the relevant courses, EE 2726 and EE 3721)

### *Summary of results:*

- In general, the students indicate that learning can be effective via the virtual classroom.

- Physical presence is still preferred.
- Only one student indicated that technical issues associated with the virtual classroom was highly distracting.
- All but four students adapted to the setting when viewing a recorded class session.
- All but two students managed fine with nearly no IT support.
- The one remote student was very enthusiastic about this form of learning.

*Specific results:*

Responses to the most relevant questions are shown below. The number of students responding is in ( ).

Question A: As a student in the traditional classroom setting, please comment on the learning experience

- (1) The technical issues associated with the virtual classroom were highly distracting and significantly reduced the learning experience.
- (15) The technical issues associated with the virtual classroom were distracting, but did not significantly reduce the learning experience.
- (17) The technical issues associated with the virtual classroom were hardly noticeable.

Question B: Did you view a recorded class session? (25) Yes (8) No

If yes, how would you rate the difficulty of viewing the course sessions?

- (1) Extremely difficult
- (9) Somewhat difficult
- (4) Initially challenging, but intuitive
- (11) Easy

Question C: Did you view a live class session from a distance?

(1) Yes      No      With your own mic?   (1) Y      N

If yes, how many times? 80%

If yes, was there adequate information provided to successfully attend and participate in class sessions? (1) Yes   No

Question D: If you answered yes to either questions B or C:

- How well do you believe you adapted to this new learning environment?
  - The new environment was too distracting and impeded learning.
  - (4) I had significant difficulties adapting

- iii. **(10)** I initially had some difficulties, but quickly adapted
- iv. **(10)** I adapted immediately without significant difficulties.

b. Was the bandwidth adequate to support the multimedia applications used during the class sessions with minimal delays?

- (18)** Yes      **(3)** No

c. How would you rate the adequacy of IT support for the course.

- i. **(1)** Excellent - all problems fixed without delay
- ii. **(13)** Good-Some delays, but problems ultimately addressed and fixed
- iii. **(2)** Poor - Significant delays or ignored completely
- iv. **(7)** N/A - no technical support required

d. Overall, how effective do you believe the synchronous online learning experience was?

- i. **(2)** Not very effective
- ii. **(14)** Somewhat effective
- iii. **(7)** Very effective
- iv. **(2)** Extremely effective

e. How would you compare the virtual classroom to a traditional classroom learning environment?

- i. **(2)** When compared to a traditional classroom setting, the virtual classroom does not provide an adequate instruction/learning environment. It is a *poor* substitute for in class learning.
- ii. **(20)** The virtual classroom provides a satisfactory learning environment, but it is *not as good* as collaborating in-person.
- iii. **(3)** The virtual classroom provides an excellent tool for real-time virtual distance learning that is *as good* as a traditional classroom setting (being there).
- iv. The virtual classroom environment is actually *better* than a traditional classroom setting considering the additional features (i.e. reduced commuting, session recording).

Other feedback from various students:

- There were difficulties with audio for the remote student using a mic
- The student who participated remotely for 80% of class sessions said that the virtual classroom is almost as good as being there.
- "I had a very hard time focusing."
- "Without in person instruction, I would not recommend it."

- "I strongly disliked it. I would much, much rather work on a whiteboard than either the display pad or power point presentation."
- If the instructor points to the screen or uses the whiteboard, then video of these needs to be better.
- Several students requested being able to save the entire recording to their computer rather than relying on streaming.
- "The videos were exceptionally helpful for studying."