Delivery of ITV Chemistry Classes

David Martin
Western Kentucky University

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DELIVERY OF ITV CHEMISTRY CLASSES

A Thesis
Presented to
The Faculty of the Department of Chemistry
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

By
David Carlton Martin

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DELIVERY OF ITV CHEMISTRY CLASSES

Date Recommended  August 8, 2007
Sury Clay Bezd
Director of Thesis
Lawell W. Shank

Richard A. Bruni
Dean, Graduate Studies and Research  Date
15 August 2007
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Signature Page  
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Western Kentucky University (WKU) offered a course entitled Biochemistry for the Health Sciences in the spring semester of 2007. The course was taught in Interactive Television (ITV) format, and was the first time a class had been taught in the format enabling two-way communication by the Chemistry Department. One section was present in an ITV broadcast classroom on the main campus in Bowling Green, Kentucky. Another section received the broadcast on the campus of Western Kentucky University-Owensboro (WKU-O), at Owensboro Community and Technical College (OCTC), located in Owensboro, Kentucky. The purpose of this thesis is to evaluate the delivery of the chemistry class and to ascertain if ITV is a suitable format for chemistry classes.

Professor Larry Byrd taught the class in person to twenty-nine students in Bowling Green. David Martin, the author of this thesis, attended the class at WKU-O along with one student, who was required to take the class for her Health Sciences major. The thesis addresses the technical aspects of an ITV class, the logistical challenges faced at both locations, the subject matter covered, and the reactions of students. A survey was administered to the Bowling Green class and the Owensboro student was interviewed. Suggestions for improvements were made for future classes.
The conclusion is that ITV can certainly be used successfully for the delivery of chemistry classes. The student in Owensboro received an “A” for the semester. This result compared to 50% “A’s”, 32% “B’s”, 9% “C’s”, and 9% “D’s” and “W’s” for the total class. The most needed improvement for the class is the inclusion of demonstrations of laboratory experiments on video. The technical and logistical challenges encountered can be overcome with more experience on the part of the professor and improvements in the courier transportation system. This particular class is scheduled to be offered via ITV in the fall 2007 semester and will be broadcast to multiple remote locations. This limited study of an ITV chemistry class shows that the delivery method is appropriate and reasonable.

To broaden the statistical base for comparison of ITV classes to traditional classes, another series of experiments should be performed. A proposal for a study between a traditional class, an ITV main campus class, an ITV remote class, and a web-based class is included. This study is designed to compare student performance over a range of delivery methods for the same course.
I. REVIEW OF THE LITERATURE

A limited number of journal articles have been written about ITV and its effects on students and faculty. The more applicable articles were reviewed to gain insight into the learning process through ITV as seen by researchers in other institutions.

Sowell (1994) wrote that televised classes have the potential to create both quantitative and qualitative advantages for institutions. The classes can be broadcast to many students at remote locations, effectively allowing one professor to teach more sections of a course. This saves money for the institution and the costs of the remote infrastructure are less than hiring more professors. The University of North Dakota, North Dakota State University and the North Dakota State College of Science use ITV to offer degree programs to students in remote locations (Sowell, 1994).

Another benefit of televised classes is the ability to monitor the activities that go on in a class setting. Sowell contends that too many professors do not really teach the requisite subject matter but instead use class time to espouse personal opinions or agendas. He argues that the televised class could be easily videotaped for review by parents, administrators, and funding entities, to expose how money is being spent by the institution. Sowell concludes that professors will probably object to such scrutiny and invoke the principle of academic freedom to resist such review (Sowell, 1994).

In another general article about distance learning, Lozada (1997) cites some of the benefits and challenges for providers and users of ITV. A significant assertion is that students taking ITV classes must be self-motivated because they do not have the benefit of talking face-to-face with the professor. They must use the syllabus to stay on track and do not have the personal interface that on-campus students enjoy. Distance learners
want to be involved in the class and therefore do not want to only see a picture of the professor’s torso during a lecture.

Lozada also reported that ITV systems have improved over the years and now incorporate cameras that focus on any person speaking. The video portion of the broadcast is better because the image does not appear choppy as older systems were. Finally, ITV allows many people to take classes without the expenses of travel and travel time (Lozada, 1997).

Witte and Witte (2003) explored the differences between instruction and mentoring when applied to the internet and ITV distance learning. They first differentiated mentoring and instruction. “Mentoring can be defined as the process that is used to guide and facilitate a learner’s educational growth” (p. 17). By contrast, “instructors are predominately concerned with developing content knowledge and skills” (p. 17). Mentoring may involve working with a novice, an apprenticeship, building competencies, and/or dialogue to assist the student. In distance learning, a relationship that begins as an instructional one may transition into a mentoring relationship as the professor and student work more together (Witte & Witte, 2003).

The authors state that mentoring is limited by distance learning because of the limited direct interactions between professor and student. They also write that all students do not have equal needs for mentoring and most succeed without mentoring. However, the professor must be willing to get to know the individual student and apply mentoring appropriately. An ITV class is a closer duplication of a traditional class than is an internet class, because the student and professor can talk to and see each other.
Developing mentoring strategies for certain students is the challenge, so they can benefit from a relation with the professor (Witte & Witte, 2003).

Witte and Witte (2003) offer several techniques to implement a mentoring environment for ITV classes. A web site that supports the ITV class is recommended and can support the instructional goals along with mentoring goals. The “web site can be used to enhance or clarify expectations, refine and explain assessment methods, provide outline sessions, and afford immediate and effective feedback” (p. 19). A discussion board would be also useful for communicating between students across sites. A link on the website directly to the mentor would provide for private conversation. Finally, focus groups of mentors and students who have completed the class would give suggestions for improving the class. The authors conclude by stating that an ITV class is amenable to the mentoring process and such mentoring adds to the value of the class (Witte & Witte, 2003).

An interesting study by Annetta and Minogue (2004) examined the possibility of a new digital divide for people using ITV for professional development. There are many rural school districts in Missouri and Iowa and professional development for teachers may be problematic because of the physical distances from colleges and universities. A project was developed to bring science content to elementary school teachers during both the school year and in summer workshops. The ITV format enabled large groups of teachers to interface with experienced instructors, without the expense of travel and lodging (Annetta & Minogue, 2004).

The study examined the relationship between years of teaching experience and how effectively the ITV medium conveyed professional development courses. The
question explored in the study was “do elementary teachers in their first 5 years of classroom experience perceive ITV to be a more effective vehicle for science professional development than teachers with >20 years of classroom experience” (p.486). There is a documented difference between the comfort levels of people using the Internet, with users under the age of fifty being more comfortable than users over fifty years old. Another finding showed that for teachers in particular, teachers with fewer years of teaching experience use computers and the Internet at home to prepare lesson plans more often than more experienced teachers. Also, the teachers with more experience are more likely to take professional development classes in computer technology (Annetta & Minogue, 2004).

The authors report that there exists several digital divides, where one group of people employ digital technology more frequently than another group. Documented digital divides include differences between haves and have-nots, between races, between genders, between income levels, and between ages. Teachers may constitute another divide because of differences among school districts in providing training, support, and access to online materials. This study tried to ascertain if there is a digital divide based on teachers’ years of experience (Annetta & Minogue, 2004).

Students using distance education have reported that they desire “design clarity, interaction with instructors, and active discussion” (p. 489). A survey was administered following the conclusion of the ITV activities. There were statistically significant differences between the teachers’ responses, based on years of teaching experience, and how the ITV experience was rated as being effective. Teachers were divided into subgroups of 1-5, 6-10, 11-15, 16-20, and >20 years of teaching experience. The
The subgroup with the greatest experience was most favorable to the ITV experience. The subgroup with 1-5 years was the second most favorable respondent, and the least favorable response came from the 16-20 year subgroup. This result seems to be contrary to the other research reporting that older people are less comfortable with technology (Annetta & Minogue, 2004).

There is a two part explanation proposed for these results. The first is that the more experienced teachers view ITV as significantly different than on-line learning, because there is the opportunity to interface with the instructor and other students in a real time fashion. This is different than learning through typing text on-line. The second explanation is that the teachers in the study with >20 years of experience had endured being teachers and were appreciative of any professional development offered, regardless of medium. A digital divide for professional development might exist for teachers with 6-20 years of teaching experience and this group needs to be exposed to different technologies to optimize professional development (Annetta & Minogue, 2004).

Petracchi (2000) addressed the differences between ITV delivery and videotape delivery of classes in schools of social work at two major universities. Students at the University of Pittsburg (Pitt) enrolled in an ITV class with one classroom on campus and the remote classroom being about two hours away. The class met one time per week for fifteen weeks and students were evaluated by a midterm exam, a final exam, and a research paper. The University of Wisconsin-Madison (Madison) employed public television to broadcast a prerecorded videotaped course to remote students. The students could record the two hour broadcast for later viewing during the fifteen week term. This
class evaluation took the form of a midterm and final exam administered on the main campus. Both universities were familiar with distance learning (Petracchi, 2000).

The students in both groups were surveyed at the end of the class to capture their responses to the delivery methods. Results of the surveys were kept from the instructors until after final grades had been posted. The Pitt students evaluated the instructor’s interactive skills, the availability of resources, and their attitudes about ITV. Both groups at Pitt reported ease in understanding and interfacing with the instructor. They also reported no difference in accessing materials. Both classes were positive about video images on ITV. There was some concern about sound because students needed to be reminded to key the microphone before speaking. A majority of the students reported that the class met their expectations and 100% said they would take another ITV course (Petracchi, 2000).

Madison students responded to a survey addressing the instructor’s teaching skills, the technology, and the learning environment. A majority of the students recorded the broadcasts and viewed them later, and used them to review for exams. The flexibility of picking a viewing time was seen as a positive component. Most students were impressed with a segment which was videotaped at a local human services agency. The students responded favorably to the instructor (Petracchi, 2000).

The Madison students did have some issues with the videotape format. There was a tendency among some to procrastinate watching the tape and letting the tapes stockpile. Also, there was not immediate feedback to questions, but the questions could be posed to the instructor later. Seventy-five percent of the Madison students would take this format class again (Petracchi, 2000).
Petracchi (2000) concludes that both groups had positive experiences with distance learning, and neither method interfered with learning. The Madison students had more flexibility, while the Pitt students had more interaction with students and the instructor (Petracchi, 2000).

Petracchi and Patchner (2000) explored the experiences of three groups of students, with two groups in the ITV environment and the third in a traditional classroom. The first group was students who took the class in the ITV classroom on the home campus. These students had the class instructor in the classroom, along with the equipment for ITV broadcasts, and the ability to communicate with students at the remote location. The second group's remote site was about 100 miles away from the main campus and was equipped as a typical ITV classroom. These students could communicate with the main campus ITV class. The third group took the same course, but it was taught by a different instructor in a traditional classroom (Petracchi & Patchner, 2000).

This study differed from previous studies because it used the traditional classroom for comparison to the ITV remote class. Other studies have assumed that the main campus ITV classroom was comparable to a traditional class; however, the presence of the technology and a technician make that setting different from a traditional class. The students present in the broadcasting classroom are actually participants with the ITV technology (Petracchi & Patchner, 2000).

At the end of the fifteen week class, surveys of each group were taken and analyzed. The instructor's interactive skills, resource availability, and classroom experiences were evaluated. There was no statistical difference among groups regarding
their answers to the survey. The authors conclude that all the students had an educational experience that was comparable, regardless of class setting. Offering ITV classes allows remote students to benefit from course work without travel expenses, and the university benefits by offering multiple sections with one instructor (Petracchi & Patchner, 2000).

Petracchi and Patchner (2001) compared the assessment of students in a study over two separate years. Here, students taking an ITV class at the home campus and remotely were compared as to grades received. The study evaluated the same course, taught by the same instructor, in two academic years. Grades were based on two examinations and one research paper. The researchers found that there were no statistically significant differences between course grades for home campus and remote students. The authors conclude that ITV courses can be delivered with comparable achievement and satisfaction for students (Petracchi & Patchner, 2001).

Mash, Marais, van der Walt, van Deventer, Steyn, and Labadarios (2005) examined the interaction between students/lecturers and between students/students taking distance learning classes. ITV, WebCT bulletin boards, and WebCT chat rooms were compared to see which method resulted in the most effective conversations between lecturers and students. The conversations from each distance learning method were statistically analyzed to determine roles and information conveyed. Roles included elaborators, inquirers, explainers, lecturers, and evaluators. The ITV classes resembled a traditional classroom, where information is given between the instructor and students with little student to student interaction. By contrast, the WebCT classes enabled more student to student communication and therefore a more active learning experience. The significant difference between the ITV class studied and ITV classes cited so far in this
paper is that while the students could see the instructor, they were not able to talk directly via microphone, but communicated by telephone (Mash, Marais, van der Walt, van Deventer, Steyn, & Labadarios, 2005).

Hartman (1988) presented a paper about the first use of closed-circuit television to teach a chemistry class from Western Kentucky University. He reported that the students took the class Biochemistry for the Health Sciences and there was favorable student response, based on a class survey. A detail that made that class unique was that the students could not talk back to the professor in the broadcast classroom (Hartman, 1988).
II. ITV EQUIPMENT AT WESTERN KENTUCKY UNIVERSITY, BOWLING GREEN CAMPUS

The ITV broadcast originated in the Mass Media and Technology Hall on the campus of Western Kentucky University in Bowling Green, Kentucky. This building was built in 2003 and contains several ITV classrooms. The particular room used for Chemistry 304 in the spring 2007 semester accommodates 33 students. The room is approximately 45 feet wide and 35 feet deep. Tables are arranged in an amphitheater fashion on three tiers. The instructor is located at the front of the room with a variety of computer and electronic equipment, a wall mounted white board, a portable white board, a vertical projector, a pull down projection screen, and a lectern.

The students have microphones on the tables which are activated by holding down a button. When the microphone is used, a camera at the front of the room focuses on the speaking student. The image of the student is broadcast to all remote locations.

The instructor has several options for camera images to be broadcast. One camera, located at the back of the room, shows the instructor at the lectern in a body and face shot. A second camera, also at the back of the room, can focus on the white board or projector screen. A third camera focuses on the stage of the overhead projector so that images are clearer than being taken from the projector screen. A fourth camera is located on the front wall and can be focused on the students at their tables.

A television monitor at the front of the room can be selected to show remote location classrooms or the originating classroom. There are two television monitors on the back wall that are visible to the professor, but not to the students.
The instructor also has microphone choices so that lecture can be heard from the lectern or from a movable lapel microphone. The cameras, microphones, and zoom functions are controlled by a computer on the lectern. A mute button is located on the horizontal surface of the lectern. The mute button has an internal red light which illuminates when the button is pushed. This will cut off the sound broadcast to the remote locations.

There is a vertical projector to the right of the lectern. A document or a blank sheet of paper can be placed on the stage, and the image will be projected to the main classroom and remote locations. The professor can write on the blank paper to show the proper way to draw chemical structures or other information. The vertical projector has an automatic focus feature that is designed to keep the material on the stage in focus.

Two computer monitors are located on the left side of the lectern. One monitor is connected to a personal computer. The other monitor contains touch screen controls for the cameras, projectors, and sound systems. There are multiple tabs to allow the professor to select a variety of options for the broadcast.

The personal computer is connected to a projector located in the ceiling of the room. Images from the personal computer can be projected on the pull down screen located on the front wall. The personal computer is flexible with a variety of media available for projection.

There is miscellaneous equipment in the room to accommodate teaching and learning. The professor may sit in a tall chair behind the lectern. There is a facsimile machine on a table to the right of the lectern. A bookcase for supplies or materials is
located by the classroom door. There is an analog clock mounted on the back wall.

Overall, the room is modern, comfortable, and state-of-the art for ITV broadcasting.
III. ITV Equipment at Owensboro Community and Technical College, Main Campus

There are six ITV classrooms on the campus of OCTC. They can accommodate from 8 to 28 students. These are located in three different buildings and are assigned for each course based on student count. Each classroom has equipment which is common to an ITV operation. Generally, tables are arranged to allow each student to see the television receivers at the front of the room. The tables have accompanying chairs that are comfortable and will roll and swivel. The tables are equipped with microphones that are activated by a student pressing a button on the microphone. This enables the student to talk to the instructor and students at the broadcast site, and to other remote sites.

There is a television camera located at the front of the classroom that is focused on the students at the tables. When a student wishes to make a verbal comment, the student presses and holds the microphone button and speaks. The audio signal is transmitted to the broadcast site and is heard by everyone in broadcast and remote classrooms. In addition, the microphone button activates a zoom function on the camera and the camera zooms in on the speaking student. Therefore, the student is seen at other sites while the question is being asked. When no microphone is activated, the student can hold conversations with others in the classroom and audio signals are not transmitted to other locations. This enables tutoring without disturbing other students.

The ITV classrooms also contain a telephone and, possibly, a fax machine. These devices enable the students, instructor, and facilitator to communicate even if there are technical difficulties with the ITV equipment.
The Chemistry 304 class in the spring of 2007 used an ITV classroom located in the OCTC Learning Resource Center (library). This is the smallest of the ITV classrooms and was assigned because the class had only one registered student. Measuring 12 feet by 18 feet, the room is also used for seminars and meetings on occasion. The room has a conference table measuring four feet by ten feet, with eight upholstered chairs. There are four microphones which are accessible by the students spread at intervals on the table. Cables run from each microphone into a hole in the table, under the table, and then to the audio equipment at the front of the room.

There are two television monitors at the narrow front of the room. One monitor displays the OCTC classroom in a broad view. The other monitor shows the instructor at Bowling Green. The television monitors have audio volume controls so that the volume can be tuned appropriately. The television monitors are relatively large for the size of the room and seeing the monitors is not an issue.

Because this classroom is located in the Learning Resource Center, noise levels emanating from the room might disturb other students in the stack and study areas. The room has one door which could be closed if needed. Since the class was held at 5:00-7:20 pm, there were not many students in the area and we were never asked to close the door. Most ITV classrooms have rules that prohibit the consumption of food and drink in order to protect the electronic equipment. This room was an exception since the equipment on the table was only four microphones. Since the class overlapped a normal dinner hour, we elected to eat while in class.
The classroom used during the spring semester met the needs of the student and the instructor. The size and equipment was appropriate for the use and there were no logistical problems caused by the room setup.
IV. ITV PROCEDURES FOR WESTERN KENTUCKY UNIVERSITY, BOWLING GREEN CAMPUS

A typical class began with the professor greeting the students as they entered the ITV room at WKU. Usually there were handouts, graded homework, or quizzes located at the lectern to be picked up by the students. They would also turn in any materials that were due that day. The professor would check with WKU-O to see if we were receiving the audio and video signals and he would take corrective action if necessary. At five o’clock, he announced the topics for the lecture and began to present the material.

The camera views that were used most often were a head and shoulders shot of the professor at the lectern and the vertical camera focused on the text. He alternated between these two cameras as needed to make salient points about the material. Occasionally, the professor used one of the rear cameras to show the wall mounted white board as he wrote reactions or drew compounds.

As the lecture progressed, the professor asked questions about various topics, expecting answers from the students in his classroom. Sometimes the students would answer, but some questions required an answer from the professor. When the students did answer, they did not usually key their microphone, so WKU-O could not hear the answer. This was usually not a major issue because the professor would usually repeat the answer at the lectern. However, there were times when WKU-O had to ask for clarification because we had not heard the original reply. By keying the microphone, the front camera would focus on the speaking student so WKU-O could see as well as hear the student.
The class in Bowling Green and the student at WKU-O were required to take quizzes and tests periodically. During these times, there was very little interaction on the television equipment and the task proceeded as it would in a traditional classroom. The students in Bowling Green had the advantage of being able to ask the professor directly if they did not understand a question. The WKU-O student had to key a microphone and thereby interrupted the home classroom if we had a question. Fortunately, this did not occur very often.

Occasionally, the class was interrupted by electronic interference noise. This was audible in the broadcast classroom and caused the class to be stop temporarily. The exact cause of the interference was usually not found and may have come from other classrooms in the building. We were told at WKU-O to turn off our cell phones before each class as interference has been known to emanate from them. Cell phones in the building or classroom may or may not have contributed to the problem.

If the professor left the lectern, then his words were difficult to hear because of the distance from the lectern microphone. We suggested that he wear the portable microphone to maintain contact as he moved around the front of the room.
V. ITV PROCEDURES FOR OWENSBORO COMMUNITY AND TECHNICAL COLLEGE, MAIN CAMPUS

The advantage of an ITV class is that students save time and money by not having to travel to a central campus to take a class. The challenge is to make the class experience as equitable to a traditional class as possible. Chemistry 304 required that tests, quizzes, and homework be administered at both locations and then graded by the professor in Bowling Green. The courier system was used to meet these needs.

A courier is a student who attends classes on both campuses. The courier is paid a travel allowance to transport materials from the main campus to satellite campuses, and vice versa. The professor prepares tests, quizzes, and handouts for both classes and delivers a package for WKU-O to a collection point on campus. The courier picks up the materials for all remote classes and drives them to WKU-O.

Class materials for several ITV classes are collected in the WKU-O office in the Learning Resource Center. The courier drops off the items collected at WKU and picks up return material before the return trip. In the spring 2007 semester the couriers made 4 round trips per week between campuses.

This system is simple in concept but the execution proved to be sometimes problematic. The materials from WKU did not always arrive before the time required. In those instances, the professor was notified. In some cases, a document could be sent via email or fax and printed off by the facilitator before class. In other cases, the WKU-O class made the best of the situation by taking copious notes without benefit of a handout. However, the WKU-O student then had to reconcile the notes with the handout with extra study time.
Chemistry 304 is a combination of organic and biochemistry for students majoring in health fields. The class consisted of lectures delivered on Monday and Wednesday evenings from 5:00 pm to 7:20 pm. A typical class at WKU-O started with turning on the two television sets and checking the microphones to see if they worked properly. The professor in Bowling Green would ask if we were ready and then he would begin lecture.

The cameras were sometimes focused on the professor and sometimes on the projector. He could write on the projector platform and the image was transmitted to us. There was an automatic focus function on the camera which could also be overridden to zoom in on a particular section of the platform.

A property of the system is a time lag on audio signals between the two locations. This required some adjustment on the part of the speaker because approximately two seconds would elapse between speaking into the microphone at WKU-O and hearing you speak in Bowling Green. The reverse was not true; the television images and audio were synchronized from the main campus. The audio lag took some effort to get used to because we might begin talking, over the professor, who was continuing to speak.

Since the class lasted two hours and twenty minutes, the professor gave a break at about halfway through the session that lasted about fifteen minutes. This time could also be used to retrieve any email correspondence directed to the facilitator.

After the final portion of the lecture, the professor would dismiss class. We could ask questions about the lecture or assignments for a period of five minutes, and then the ITV system would shut off its signal from the main campus. This is programmed so that money will be saved. We were aware of this and therefore made our remarks quickly.
VI. ITV TECHNICAL CHALLENGES

The theory of ITV is relatively straightforward. A university may reach students at remote locations by broadcasting lectures to a special classroom, which is equipped to allow communication back to the home campus. Paperwork can be delivered to the remote locations via facsimile machine, electronic mail, courier, or other mail service. The students in the remote location can take tests, quizzes, and exams at the same time as the students on the home campus. However, technology presents challenges and this ITV class was no exception.

Perhaps the simplest system should have been the courier method of delivering materials between WKU-O and Bowling Green. There were two couriers employed in the spring 2007 semester. One person made the round trip on Mondays and Wednesdays; the other traveled on Tuesdays and Thursdays. Pickups and deliveries were made at Garrett Hall on the campus of WKU. The WKU-O office in the Learning Resource Center served as the drop-off point on the OCTC campus.

The system was not as reliable as it should have been. Materials going in either direction had to be at the pickup points before the arrival of the courier. This was sometimes impossible when preparations were made on the day of the lecture. While this is standard practice for classes held on one campus, ITV puts a constraint on time that is not encountered normally. Another problem could be encountered if the courier was ill and unable to make the trip as scheduled.

Other systems were available to replace the couriers. Facsimile (fax) machines have been used for years to send exact copies of documents between physically separated locations. Faxes operate over telephone lines and only work if the telephone line is
intact. Briefly, the person sending the fax enters a telephone number, inserts the original pages, and presses send to start the process. At the receiving end, the document is printed one page at a time and delivered to the recipient. If everything works properly, the sender will receive a document confirming the transmittance of the document.

For various reasons, the fax system did not always work as intended. There was a fax machine in the ITV broadcast classroom at WKU. It did not work consistently and this was particularly irksome when the professor was trying to fax a pop quiz at the beginning of lecture. He would then have to ask a technician to go to a different fax machine and try the transmittal again. This may or may not solve the problem. The fax unit at WKU-O was located in the office adjacent to the ITV classroom. Office workers reported that the machine had not always been reliable in the past and receipt of documents could be problematic. So the fax system was not a completely reliable alternative to the courier system.

Another technology option to deliver documents is the electronic mail system. Colleges and universities establish e-mail accounts for faculty, staff, and students. Once e-mail addresses are exchanged, an almost infinite amount of information can be exchanged in letters and attachments. On several occasions, material was e-mailed from the professor to the graduate student at WKU-O. Relatively small attachments (1-5 pages) were generally received without incident. Sometimes it was necessary to send 30-40 pages of text and this presented some challenges. Print time became an issue with such large documents and this could run up against the time a lecture was to begin. The departmental secretary in Bowling Green experimented with translating a large chapter into Portable Document Format (PDF) and then e-mailing it as an attachment. Because a
low resolution was used, the pages were blurry when received in Owensboro. This
necessitated the resending of the chapter via the courier system. Electronic mail is a
viable means of communication, but there are limitations when trying to transmit large
documents.

Another area where technology could be challenging was in the operation of the
cameras and microphones at WKU. Different camera views could be selected to
emphasize different points of the lecture. Sometimes there was confusion about which
camera was live and sending images to WKU-O and we were not seeing what was
intended. Another issue involved the camera focused on the writing surface of the
projector. This camera had an automatic focus function which did not always perform as
intended. The professor had to override the automatic function periodically. The camera
issues may have been a combination of electronic errors and a learning curve on the part
of the professor. Owensboro would alert the professor of problems via our microphones,
but this would interrupt the flow of the class.

The microphone system could also be problematic. WKU-O would occasionally
lose the audio signal from Bowling Green. There were several reasons for this. The
microphones are controlled by a computer keyboard device and sometimes the wrong
microphone could be selected. Another situation occurred when papers were laid over
the control panel at WKU. This could cause the microphone to be switched off. It was
difficult to tell when the microphone was off because we did not know if there was
simply nothing being said at any given time. There were also audio difficulties if the
professor moved away from the lectern and he was not wearing a portable microphone.
When Owensboro realized there was an audio problem, we would key our microphone
and notify the professor. Fortunately, audio transmission to WKU did not seem to be an issue.

Another property of the audio system is that when any student keys the microphone, the camera zooms in on the student and the other location(s) can hear and see the student. There were very few times that the students in Bowling Green used the microphone when asking questions or making comments. This was not a major problem per se for WKU-O, as the class was centered mainly around lecture and not on discussion. However, other classes with different emphases may want to require that all students key the microphone when making any type of comment.

The research conducted on ITV revealed an alternative method of using microphones in the classroom. Some classes have microphones suspended from the ceilings at all locations and all the microphones are on all the time. This caused distractions for the instructors and the students because every sound in the classroom was broadcast to every other classroom. The WKU method of having to key the microphone is recommended for ITV classes.

The technology used for ITV has improved over the years and the system is now more user friendly than ever. Professors should be able to deliver concise lectures with a minimum amount of technical difficulties.
VII. ITV DEMONSTRATIONS

An aspect of a chemistry class being taught on ITV is the challenge of laboratory exercises and how to deliver them to the remote locations. A lecture based ITV class, including this one, is relatively easily delivered. But learning about chemistry is certainly enhanced by the use of laboratory classes, which are usually offered as an adjunct to the lecture course. The logistics of the ITV class prevent the remote locations engaging in a laboratory exercise. Although it would be theoretically possible for simultaneous laboratory experiments to occur, the issues of equipment, supplies, waste disposal, safety, and appropriate facilities would add expense and require a teaching assistant to be present. Therefore, an alternative method to provide laboratory learning is to broadcast pre-recorded demonstrations.

Two general methods to allow students access to video recorded demonstrations are reasonably inexpensive and amenable to both ITV and internet technology. The first involves purchasing pre-recorded compact discs (CD's), incorporating the video demonstration into a PowerPoint presentation, and broadcasting the presentation as an addition to the lecture. The second method would install the demonstrations on the course website, so that the students could access the video at their convenience. While other technologies exist, these two methods are straightforward and both could be used to enhance an ITV class.

A source of high quality CD's is the website of the Journal of Chemical Education, which is published by the Division of Chemical Education of the American Chemical Society. One CD-ROM series is titled “Chemistry Comes Alive!” and consists of eight volumes that cover many aspects of chemistry. The particular volume that is
applicable to this class is Volume 5, containing sections on organic and biochemistry. Under organic chemistry, there are seventeen subsections, and each subsection contains more divisions. The divisions contain movies or still pictures that show chemical reactions or properties that relate to organic chemistry. There are approximately one hundred total divisions. For example, the subsection “Alcohols” includes movies titled: oxidation of alcohols with chromic acid, oxidation of glycerin with solid potassium permanganate, Lucas test for primary, secondary, and tertiary alcohols, the ethanol cannon, and constructing a baster ball cannon.

The biochemistry section is divided into four subsections, each with multiple divisions. The carbohydrate subsection has movies titled: dehydration of sucrose with sulfuric acid, sucrose dehydration gives sulfur dioxide, Fehling’s test for reducing sugars, Benedict’s test for reducing sugars, osazone formation, oxidation of sucrose with potassium chlorate, combustion of nitrocellulose, and destructive distillation of wood. Movies range in length from about ten seconds to two minutes. The contents page allows the viewer to select which movie to watch and includes a transcript of the voice layover.

There are detailed instructions on the website and on the CD-ROM to transfer the video or picture files into the computer hard disc. A professor could transfer as many movies as needed for a PowerPoint presentation for a particular lecture, or use the original CD-ROM as a source during the lecture. For example, when discussing the halogenation of alkenes, the color change of bromine from brown to colorless in the presence of a carbon-carbon double bond could be shown as a movie and add to the value of the lecture.
The second method to incorporate demonstrations into a class is to install the movies or pictures on the instructor’s website. This may require the purchase of a license to allow multiple viewers access to the material. The advantage of this method is that the students could access the media at their convenience outside of class time. Students could study the laboratory demonstrations repeatedly, if necessary, to master the material.

There is one additional method to allow students to watch some demonstrations at their time of choosing. The instructor’s web site could contain directions or a link to lists of demonstrations available on the web. Such lists are extensive and the quality of the movies varies widely. Some research would be necessary to focus on the exact demonstration desired.

The websites that contain relevant material follow. The website for “Chemistry Comes Alive!” is: http://jchemed.chem.wisc.edu/JCESoft/Programs/Video_CD.html. Each volume of the series costs $75.00; a set of all eight volumes costs $450.00 and is a savings of $150.00. A website that contains links to a multitude of sources is: http://www.chemistrycoach.com/Links%20to%20chemistry_experiments.htm. Another website that contains many videos of organic chemistry experiments is: http://www.uni-regensburg.de/Fakultaeten/nat_Fak_IV/Organische_Chemie/Didaktik/Keusch/D-Video-e.htm

There are advantages to buying videos that are already made or using videos that are available on the internet, as opposed to creating custom media in a university chemistry department. The expenses of chemicals, equipment, and time are significant. Producing a quality CD-ROM or video requires proper lighting, a logical script, proper equipment, people to perform the experiment, and time to rehearse and film the demonstration. In addition, there are safety requirements which would preclude filming in a television studio without special setups and precautions. The time spent producing a
demonstration would be significant. When all factors are considered, it makes sense to purchase or use media made by others.
VIII. THE CHEMISTRY CLASS

The course that was studied here is entitled “Biochemistry for the Health Sciences.” It is designed for students in health fields and was a four credit hour course, one hour more than typical classes. The class is a combination of a review of organic chemistry and an introduction to biochemistry. There is an emphasis on the practical aspects of organic and biochemistry relating to human health. Students in allied health programs, physical education, recreation, institution administration, and health and safety could benefit from the class. The spring semester of 2007 was the first time the class had been taught as an ITV class, with the capability of two-way communication.

The professor provided a course syllabus that detailed the requirements regarding contact, attendance, tests, quizzes, homework, grading, the textbook, important dates, and contact information. An important part of any syllabus is the procedure to contact the professor. The document listed the professor’s name, his office location, and his office phone number. He also listed his home phone number and a time range for home phone calls. Finally, the professor included a table of his office hours and directions for making office appointments.

Because the internet is accessible to all WKU students, the professor included his e-mail address for written communication needs. The e-mail system allows for a great deal of flexibility in communication. Messages may be printed if a paper file copy is needed. The delivery and receipt of messages can be tracked. Messages can be forwarded to other people, if needed, and others may receive courtesy copies of the correspondence. Finally, e-mail can be virtually instantaneous or can be accessed at the leisure of the recipient.
The professor provided an address to his website that provides information and tutorial support for chemistry students. The website includes video demonstrations and text on a variety of chemical subjects.

A significant part of the syllabus listed important dates that would affect students during the semester. The syllabus listed dates for dropping the class without a grade, when to change from audit to credit, when to drop to receive a grade of “W”, when to change from credit to audit, break days, and test days. In addition, a detailed class meeting calendar listed each class meeting and highlighted the test dates. The entire semester was mapped with days of the week and dates clearly delineated.

A syllabus will normally specify the textbook and other supplies needed for the class. This class used a text that was in the process of being written by the professor. Therefore, the students did not simply purchase the text from the University Bookstore. Instead, chapters were copied and provided to the students as they became available. An advantage of this method was that the total cost of the text was forty dollars, as opposed to the normal charge of more than one hundred dollars. The students were responsible for compiling the chapters into a three ring binder. The binder was also used to keep all of the supplementary handouts for the course.

Another portion of the syllabus addressed the topics covered in the class and the number of class meetings devoted to each topic. As with many college courses, the outline was written to address an ideal situation and the actual schedule was somewhat modified. However, the outline did serve to keep the students on track with subjects covered and to be covered.
One page of the syllabus addressed the absenteeism and tardy policy. The consequences of missing or being late to a class were clearly delineated. A student’s grade would be affected with points taken off at the rate of one half point for tardies and two points for absences. The professor therefore made it very clear that regular attendance was necessary to do well in the class.

The syllabus included a statement about compliance to equal opportunity for education programs for students. Students with disabilities who need accommodations in the form of academic adjustments and/or auxiliary aids or services were instructed to contact the Office for Student Disability Services. That office would then provide the student with a letter of accommodation for the instructor.

The final portion of the syllabus was a detailed worksheet for the recording of grades and the calculation of the course grade. It was divided into two parts, one for scores up to midterm and one for after midterm. The instructions were precise and allowed the students to know where they stood regarding their grade throughout the class.

The professor used the first part of the first class session to go over the syllabus in detail. All of the rules and expectations for the class were delineated and explained. Throughout the class, the syllabus proved to be accurate and an aid for the students.

The academic portion of the class began with a review of ionic and covalent bonding. The first handouts were a periodic table and a worksheet for Lewis dot and dash structures. Using the periodic table facilitated the review of the basic concepts of metals, nonmetals, the noble gases, families, and periods. There is a stair step line that divides the metals and nonmetals, and it was emphasized that this class would deal mainly with the nonmetals. The elements that the students would encounter most often in
the class were given as hydrogen, carbon, nitrogen, oxygen, phosphorous, sulfur, selenium, and iodine. A review of covalent bonding followed.

The professor provided a handout that detailed how to draw Lewis dot and dash structures. He delineated a six step procedure that showed in detail how to proceed to draw the structure of covalent bonds. The class spent time reviewing the method and then practicing structures given for homework. This emphasis on bonding was necessary because subsequent lectures on organic structures depended on knowing the proper bonding behavior of elements. The handout was precise in its directions and the examples were appropriate.

The students received the first of the textbook chapter handouts. The chapters follow a common layout that is designed to facilitate learning. Each chapter starts with an overview, followed by a list of objectives for the chapter. There are logical subdivisions for the chapter, which would generally include structures, nomenclature, chemical properties, physical properties, sources, and derivatives of organic compounds. A typical page includes text and several illustrations of structures. In addition, there are appropriate tables included where lists of compounds and their properties are tabulated for quick reference.

A feature of the text is the inclusion of “check tests” at the end of sections. These tests were only a few questions in length, but are designed to insure understanding before moving on to new material. To further assist the student, the answers to the check tests are given.

The end of the chapter includes a list of terms used in the text. The students were usually assigned homework to write the term, give its meaning, and give examples of the
term. Following the term list are several questions that cover topics from the chapter. Some of the questions were to have the answers given at the end of the text. However, this was not available since this class did not have a complete text to use. The professor assigned homework from the questions, and required that the question be rewritten, the answer given, and an example given if not already a part of the answer. The questions could be answered by examining the chapter and by referring to class notes.

Saturated hydrocarbons form the basis for organic chemistry, so the first chapter received addressed their structures and properties. The chapter began with an introduction and objectives. A section that discussed the first ten alkanes came next, followed by a section on structural isomers. Nomenclature was presented, and then sources of organic compounds were discussed. The chapter then explored the physical and chemical properties of alkanes. The chapter concluded with presentation of cycloalkanes, followed by terms and questions.

The professor presented this chapter by using lecture and the electronic aids afforded by the ITV environment. He would thoroughly review each page of the chapter that he deemed appropriate. To facilitate his presentation, he used the camera and presentation stage, and the transparency projector. There were several options available in order to make a point. The professor could simply read and emphasize points from the referenced text. He might project the text page onto the television monitor and point to details. He could also draw on the transparency stage to modify structures from their printed form. There was also the option of writing on a whiteboard that could be televised to WKU-O.
Perhaps because of the nature of the material presented, there was not a significant amount of discussion between the professor and students during class. Questions were certainly allowed; there just did not seem to be many asked during a lecture. The professor did attempt to engage students by asking questions frequently, in the form of completing his sentence. However, the answers were usually short and discussion, as would be appropriate in a smaller class or with a more debatable subject, simply did not occur.

The next chapter covered alkenes, alkynes, and aromatic hydrocarbons. The chapter was laid out typically and homework was assigned to reinforce understanding. A large number of illustrations made the material more visual than simply text would. After two chapters, a solid organic chemistry base was being built for future biochemistry topics.

The professor emphasized the relation between the chemistry and human health because the course description referred to practical applications of organic and biochemistry. His lectures were full of references telling the effects of chemicals on humans. There were many personal stories of interest showing how chemistry affects everyone in a plethora of ways. The professor’s experiences added to the examples in the text and brought reality to the subject.

With the third chapter, the class started to shift beyond the chemistry of hydrocarbons to include the element oxygen. This addition enabled the study of alcohols, phenols, and ethers. The text first classified alcohols, then named them, and discussed their physical properties. A section on alcohol preparation preceded the discussion of chemical properties. Five important alcohols (methanol, ethanol, isopropyl alcohol,
ethylene glycol, and glycerol) were discussed in the last alcohol section, with their applications to humans.

This chapter continued with thiols, phenols and ethers. There were explanations for nomenclature, properties, and uses for each. The students had check tests, terms, and questions to aid their learning. The chapter served to start the bridge between organic and biochemistry.

The logical next step in the study of organic chemistry is to examine compounds that contain oxygen that is double bonded to a carbon atom. Aldehydes, ketones, carboxylic acids, and esters were the subject of the next chapter. This material was generally more technical than the previous chapters because of the complexity of the compounds. The chapter started with the carbonyl group that is common to all of these compounds. Sections followed on naming aldehydes and ketones. Their physical properties came next, with emphasis on electronegativity within the carbonyl group.

The chapter continued with the preparation of aldehydes and ketones through oxidation of alcohols. The chemical properties of these two families of compounds were presented, and the first half of the chapter concluded with important aldehydes and ketones.

Carboxylic acids were next, were named and their preparation described. The physical properties, chemical properties, and important examples were described. The final portion of the chapter addressed esters, with the typical sections of nomenclature, physical and chemical properties. An interesting section addressed acetylsalicylic acid, or aspirin. As usual, a comprehensive list of terms and questions concluded the chapter.
The focus of the class continued to shift towards biochemistry with the introduction of the chapter on proteins. The chapter discussed the composition and size of proteins, along with their function and classification. The professor gave a great deal of information on the classification (neutral, acidic, and basic) of amino acids. Students were required to memorize the structures of several amino acids. This was followed by listing the essential ones. A discussion of optical activity (D or L) explained the differences between the optical properties of carbohydrates and amino acids. The dipolar nature of the acids and electrophoresis were presented next. The portion on proteins concluded with studying insulin, hemoglobin, and primary, secondary, tertiary, and quaternary structures. As with most of the chapters, there were some sections that were not emphasized at the discretion of the professor.

Biochemistry continued with the chapter on carbohydrates. Photosynthesis was discussed, followed by carbohydrate classification. There were several sections on the detailed structures and properties of monosaccharides, disaccharides, and polysaccharides. The important carbohydrates discussed included glyceraldehyde, dihydroxyacetone, ribose, deoxyribose, glucose, galactose, fructose, maltose, lactose, sucrose, starch, glycogen, and cellulose. Diabetes concluded the chapter.

The professor provided a handout on digestion. Details were provided about carbohydrates, proteins, triglycerides, and cholesterol. The handout contained tables to summarize digestion pathways. This section was a strong link to the health science aspect of the course.

Biochemistry continued with the chapter on enzymes, vitamins, and hormones. The first section addressed the classification of enzymes. Examples were given of
hydrolases, oxido-reductases, transferases, lyases, isomerases, and ligases. The functions of enzymes followed, with details on apoenzymes, cofactors, and holoenzymes. Since water-soluble vitamins serve as enzyme cofactors, a discussion of eight vitamins was presented, along with the health effects of vitamin deficiencies. Enzyme action, specificity, and inhibition concluded the enzyme section.

Hormones were presented next, along with the endocrine system. A very detailed table showed the specific gland, its hormones, the action site, and the effects of the hormone. As usual, the chapter concluded with terms to be defined and questions to be answered.

The final chapter for the class addressed cellular metabolism, and it was the longest chapter. The energy pathways inside a cell were studied from a biochemical standpoint and connections to the human body were made. One of the primary compounds for energy storage is adenosine triphosphate. Its relation to adenosine diphosphate, inorganic phosphate, and energy was covered extensively. The coenzymes nicotinamide adenine dinucleotide and flavin adenine dinucleotide were discussed with their oxidized and reduced forms in the electron transport system. The Krebs cycle explained the production of electrons and protons needed for the electron transport system.

The next section discussed glucose metabolism and the Embden-Meyerhof pathway. The chapter concluded with fermentation, lipid metabolism, ketosis, protein metabolism, and the urea cycle. These topics were not covered in as much detail as the previous sections, but their significance to the human body was addressed.
The class provided an excellent study of organic chemistry and biochemistry for students in the health fields. Relations between chemical compounds, structures, energy, and the human body were well documented. A plethora of material was provided, including the text, handouts, review sheets, practice tests, quizzes, and exams.
IX. TEXTBOOK

The professor used a text that he authored and was editing during the spring semester of 2007. His plan was to use the spring ITV class to help point out areas of the text which needed improvement, clarification, or correction. Generally, the class was given one chapter at a time to study. This methodology worked for the most part, because by the end of the semester there had been many suggestions made to edit the text.

The text was laid out very logically and was clearly written. Each chapter started with an overview, followed by objectives. Each section of a chapter addressed a specific aspect of organic or biochemistry, and each section included check tests to make sure that material was understood before introducing new material. There were many illustrations, diagrams, tables, and figures in each section. The chapters concluded with extensive term lists and questions to complete topic understanding. The text was an asset to the class because of the detailed nature of the writing while also explaining concepts clearly. There was an improvement needed which should be in place by the fall 2007 semester. Students would benefit by having the complete text before the first class section. Some students rely on reading ahead and also use references to research materials that may not be clear to them. The professor is committed to finish the text before the next term begins.

The text added an appropriate level of detail for the class. With the availability of the complete text as the next semester begins, the students will benefit and learning will be enhanced.
X. INTERVIEW WITH WKU ITV FACILITATOR IN OWENSBORO

Western Kentucky University employs an ITV lead facilitator in Owensboro, whose job is to coordinate the classes received at WKU-O. The facilitator began his ITV career while attending the then named Owensboro Community College and helped classes receiving ITV broadcasts from The University of Kentucky from 1991 to 1993. He then obtained his General Studies degree from WKU and began working for WKU in 1993. The facilitator has seen several changes in the way that ITV classes are taught and broadcast over the past seventeen years.

Originally, when a class was broadcast from WKU-O, the professor was assisted by a facilitator who sat off camera near the lectern and controlled all of the camera and microphones used in the class. This required that a facilitator had to be available for each class and had a more critical role than the facilitators of today. The professor delivered the lecture material and did not have to be concerned with the technology options during class. Today, the professor chooses their own camera shots and is assisted by computer touch screens to change options, without the presence of a facilitator in the broadcasting classroom.

Another major difference between classes now and then centers on the microphones used by students at any location. Previously, the microphones were always open and all of the sounds produced in the classroom were broadcast to the other locations. This could be very distracting as the microphones picked up side conversations, paper rustling, textbooks opening, coughs, sneezes, and every other sound that is associated with a college classroom. Now, microphones must be activated with a button and this eliminates random noise distractions.
There is a facilitator assigned to each receiving classroom under the present system. These are part-time, paid employees who assist in the logistics of the class. They distribute materials to the students, proctor examinations, and perform minor troubleshooting when needed. The facilitators retrieve materials from the WKU-O office and return materials to Bowling Green via the courier system. Facilitators are assigned to a particular class for the semester the class is taught.

The lead facilitator coordinates the functions of the other facilitators and hires new facilitators when needed. He also troubleshoots equipment problems, schedules rooms for classes, and communicates with the ITV personnel at WKU. On average, about fifty classes are received on ITV each semester at WKU-O. In addition, several classes are broadcast each semester from WKU-O. The lead facilitator has been involved with ITV for seventeen years.

One of his observations is that some students adapt better to an ITV class than others. Students who relish personal contact with the professor may be disappointed to learn they cannot go to the professor's office after a lecture for discussion of a point. The student may also be embarrassed to raise a question during the lecture because the question will be broadcast to all receiving locations as well as the broadcast classroom. Both of these objections can be alleviated somewhat with the use of the internet for communication, but the personal interaction is still lacking.

Another aspect of ITV that affects students in a positive manner is that many of them have work schedules that would preclude them going to Bowling Green to take classes. The ITV system allows the student to take a class without investing three hours
per class for travel, parking, and rushing to the lecture site. Likewise, ITV allows WKU to reach students at multiple remote locations while only employing one professor.

Just as some students are more amenable to ITV than other students, some professors are more comfortable with the system and its technology than others. Professors may not be comfortable with using computers in general and the variety of technology in the classroom may be overwhelming. As a consequence, some professors have been known to simply use one camera shot of themselves for the entire lecture and have not used any auxiliary devices, such as the document camera. This makes the lecture somewhat less interesting.

The technology used in ITV has improved over the years. The original broadcasts were over T1 telephone lines, but now utilize an Internet Protocol (IP) system to transmit audio and video. The IP system has eliminated the jerky video images that were common in the past. Most of the current technical problems center on the audio portion of the system.

While open microphones are no longer an issue, a problem still exists when students at the broadcast location do not key the microphone when asking a question or making a comment. This may cause confusion on the part of remote students, who may then have to ask for clarification and thereby interrupt the lecture. The professor may add to audio problems by walking away from the lectern and its microphone and not using a portable microphone. Some broadcast classrooms are equipped with a lapel microphone that has a six foot long cord attached to the lectern area. Professors may forget that they are tethered to the lectern, walk away, and break the microphone or the cord.
XI. INTERVIEW WITH WKU-O ITV STUDENT

The class studied was unique because there was only one student taking the class at the remote Owensboro location. She gave her opinions about the ITV class as it related to such classes in general and the learning of chemistry in particular. This student is in the first year of the radiography program at OCTC. The class was required for another major she is pursuing, Health Sciences, through WKU. This was the first semester the class was offered on ITV. The student could not have taken the class in Bowling Green because of her time commitments to the radiography program. When she was asked to take the class via ITV, she agreed and thereby helped to complete this thesis project.

Addressing the technological issues, the student saw an improvement in the way the class was presented as the semester went on. The professor became more comfortable with switching cameras appropriately. He also used the document camera more, as opposed to showing the white board. The professor also observed the video feed coming from WKU-O to assure that we were receiving the correct information from Bowling Green.

Because the textbook was being developed as the class progressed, no student had a complete textbook at the beginning of the semester. The WKU-O student expressed that this was an issue with her learning the material, as she learns best by having a textbook with all of its references available throughout a class. She is used to referring to references in a text to clarify points of study when necessary. The draft chapters of the text that we received did not contain references.
Another opinion was that the questions on the handouts provided by the professor were more useful for test preparation than the questions at the end of each chapter of the text. This student felt that the questions in the text were somewhat redundant. The handout questions were more valuable in mastering the material.

At the beginning of the semester, some materials were not delivered to WKU-O in a timely fashion. This improved during the semester as alternative methods were employed. More lead time would have enabled the student to better prepare for the lectures.

A final technological issue was that the class in Bowling Green never did use the desk microphones properly when asking questions or making comments. The professor would answer a question posed by a student in his classroom, and the WKU-O student was sometimes confused about the answer because she did not hear the question and understand how it applied to the lecture. The WKU-O student was very hesitant about asking for clarification, as this would have interrupted the lecture again. Instead, she would ask the WKU-O graduate student to try to explain what was happening.

From a more psychological perspective, the student felt that the ITV format was impersonal. The student did not feel that she was interacting with the Bowling Green class. The experience was impersonal and isolating. She hesitated to ask questions because the entire broadcasting classroom would have to focus on her. She preferred to have the opportunity to talk to the professor in person either before or after class.

Overall, the WKU-O student was appreciative of the opportunity to take the class via ITV. The technological and logistical problems were outweighed by the ability to complete the class without travel. The presence of the graduate student helped her.
XII. TEST ADMINISTRATION PROCESSES

An aspect of most chemistry classes is the administration of tests, quizzes, and homework. This class was no different, but the logistics involved with the remote location required extra planning and execution to make testing fair and equitable for both locations.

The professor provided many opportunities for the students to make a higher grade by completing homework assignments, which were turned in for grading. At WKU-O, a system developed where the homework was faxed to Bowling Green, followed by delivery of the original document via courier. Even though this was a redundant system, it worked because of the unpredictability of the courier system. The homework was returned with a grade, and turnaround time was seldom an issue.

Quizzes were handled in a similar manner. One property of the WKU-O site was that if the student had a question about a portion of the quiz, then she was hesitant to interrupt the entire class in Bowling Green to ask it. The graduate student at WKU-O would try to answer her questions without broadcasting to the originating classroom.

Four major tests were given during the semester, with the finished product being faxed and then sent via courier to WKU. Again, the graduate student attempted to answer questions about the test to prevent disturbing the class in Bowling Green.

The logistics of administering tests, quizzes, and homework in the ITV environment requires some extra steps. However, it can be done efficiently and fairly.
XIII. TUTORING WKU-O ITV STUDENT IN OWENSBORO

The student at WKU-O had a resource during this class to help her master the chemistry involved. The undergraduate had not taken a dedicated Organic Chemistry or Biochemistry class before this one. She had taken general chemistry and had been introduced to a brief outline of organic, and had used biochemistry in her Anatomy and Physiology classes. The university allowed her to enroll in this class based on her general chemistry background.

Many of the details of the class were new material for the student. The graduate student had the benefit of completing several Organic and Biochemistry classes. Therefore, he was able to tutor the undergraduate during and outside the class. In general, the undergraduate would work homework to the best of her ability and ask for help as needed. Sometimes an alternative method of solving a problem was presented that made a concept clearer. The graduate student also recommended which topics to concentrate on for tests and quizzes. On occasion, the graduate would help the student study for tests.

This system benefited the WKU-O student. Because the student did not have face-to-face access to the professor, some of her questions may not have been answered. With a larger remote class, the opportunity for interfacing directly with the professor would be decreased. Since ITV classes usually have a facilitator who is not well-versed in the subject area, consideration should be given to the idea of having a graduate student or other resource person available for assistance in the remote classroom. Even with the availability of a website and Blackboard, personal assistance would add to the learning experience.
XIV. ITV STUDENT SURVEY AT WKU, BOWLING GREEN

During the fourteenth week of the class, the students at the Bowling Green location completed a survey, which had been created by the graduate student, about the ITV class. The survey was conducted in a confidential manner and respondents were not identified in any manner. The professor asked the students to fill out the survey during a class, collected the completed forms, and returned all of the surveys to the graduate student at WKU-O. The purpose of the survey was to analyze the effect of the ITV environment on the students located in the broadcasting classroom.

Results of the survey are depicted in Table 1, Student Survey. A four point response system was used, with the scale ranging from strongly agree, agree, and disagree, to strongly disagree to each of ten questions. The responses were totaled and percentages were calculated. There was space at the bottom of the survey so the students could write in any comments they wished to make. Eighteen students completed the survey.

Over seventy-five percent of the respondents reported that they were able to interact with the presenter, learned new chemistry, felt comfortable asking questions, could view overhead material easily, and easily understood questions from the remote location. Over eighty-five percent reported that neither the ITV equipment nor the remote location distracted from the class. These results suggest that the majority of students were not negatively affected by the ITV experience.

However, two questions show that the class was not a perfect situation. Thirty-four percent of the responders felt that the presenter was not easy to follow and understand. This result may be due to factors other than the ITV environment and the
instructor, such as the comfort level of students in an upper-level chemistry class and the class is required. Additionally, thirty-nine percent reported that the class was negatively impacted by technical difficulties. These results may be due to the technical challenges faced early in the semester with selecting the proper camera and microphone. There was also only one written comment returned on the survey. The comment stated that audio feedback was an occasional problem.

Perhaps the most telling response was whether or not the student would take another ITV class, either remotely or at the main campus. Seventy-seven percent indicated that they would, and no one strongly disagreed with the possibility of enrolling in a similar class. A logical conclusion is that a majority of the students in Bowling Green felt that the class could be taught successfully in an ITV format.
## XV. TABLE 1. ITV STUDENT SURVEY

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I was able to interact with presenter</td>
<td>50%</td>
<td>28%</td>
<td>17%</td>
<td>6%</td>
</tr>
<tr>
<td>2. I learned new chemistry content in these classes</td>
<td>67%</td>
<td>28%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>3. The presenter was easy to follow and understand</td>
<td>50%</td>
<td>17%</td>
<td>28%</td>
<td>6%</td>
</tr>
<tr>
<td>4. The class was negatively impacted by technical difficulties</td>
<td>6%</td>
<td>33%</td>
<td>39%</td>
<td>22%</td>
</tr>
<tr>
<td>5. I felt comfortable asking questions of the presenter</td>
<td>56%</td>
<td>22%</td>
<td>22%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Table 1. Student Survey (cont.)

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. The equipment in the room distracted from the class material</td>
<td>6%</td>
<td>6%</td>
<td>56%</td>
<td>33%</td>
</tr>
<tr>
<td>7. The remote location distracted from the class material</td>
<td>0%</td>
<td>11%</td>
<td>44%</td>
<td>44%</td>
</tr>
<tr>
<td>8. I could view overhead material easily</td>
<td>61%</td>
<td>28%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>9. I easily understood questions and comments from the remote location</td>
<td>56%</td>
<td>44%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>10. I would enroll in another ITV class, either remotely or at main campus</td>
<td>33%</td>
<td>44%</td>
<td>22%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Note: The sums of the percentages do not necessarily equal 100% due to rounding.
XVI. FINAL GRADES

One way to judge the effectiveness of teaching a class in a new way is to compare grades before and after the change. If the teaching methods were comparable, then reasonably the grades should be comparable. The professor stated that in past semesters most of his students had received “A’s” or “B’s” for the same class. With the ITV variable, the grades were consistent with past semesters.

Specifically, a total of twenty-two students took the class in the spring 2007 semester. The grade distribution had eleven “A’s”, seven “B’s”, two “C’s”, one “D”, and one “W”. The lone WKU-O student received an “A”. The grade components were listed in detail in the class syllabus. Quizzes, including graded homework, comprised twenty percent of the grade, with four tests contributing twenty percent each, for the total of one hundred percent. One quiz before midterm and one quiz after midterm were dropped from the average. This permitted students to do relatively poorly on quizzes twice during the semester without penalty.

Because the WKU-O student did so well, it would be easy to say that there is no difference between a live classroom setting and a remote ITV setting. However, one student does not provide enough statistical proof of equality. More data will need to be analyzed as this course is taught via ITV in future semesters. The only thing that can be said after this first trial is that the remote student’s grade did not seem to be adversely affected by the ITV experience. It should be kept in mind that the student was dedicated and was able to memorize large amounts of material readily. She also had the assistance of the graduate student who was able to help her in her studies.
XVII. Future Experiment

Interpretation of the results from this study, conducted in the spring of 2007, is limited by the low enrollment in the Owensboro classroom. While the WKU-O student did receive an “A”, it cannot be statistically concluded that the two methods of delivering the class are equivalent. Factors impossible to evaluate are her aptitude for chemistry, her self-motivation, the availability of the graduate student, or a combination of factors that overcame differences in the class formats. Therefore, a long term study should be performed to statistically compare student performance in an ITV format versus a traditional class. It would also be advantageous to later expand the study to include a class presented via the internet to ascertain if differences exist in that arena.

The proposed study will encompass several class variables and will also address variables among students. There are four class variables involved. One is a traditional class, the second is an ITV class on the main campus, the third is an ITV remote class, and the fourth is a Web-based class. Optimally, all of the classes should be presented by the same professor. If a graduate student or tutor is available for any one class, the same service and the same level of service should be provided for all of the classes. It is anticipated this study will encompass more than one semester. All of the students in each of the class types will be asked to participate in the pre-tests, post-tests, surveys, and class activities relating to the study.

The control will be the traditional class taught in a face-to-face manner by the professor. This class should also use the teaching aids used by the experimental classes, such as texts, handouts, videos, demonstrations, and web resources. The control class is designated as such because the chemistry class has been taught that way many times.
Two types of ITV-based classes are proposed, one that is located on the main campus with the professor present, and the other located at a remote location receiving the ITV broadcast. There may be more than one remote location utilized during a semester. All of the remote locations will be considered in the statistical analyses. The primary question to be addressed is whether or not an ITV format causes a change in overall student performance and perception compared to a traditional class.

The fourth type of proposed class will be web-based; however, this class has not yet been developed for the Biochemistry for the Health Sciences course.

The start of the process will be to administer a pre-test for each student enrolled in each class. The pre-test will be based on general concepts of inorganic, organic, and biochemistry. By pre-testing, classes can be compared with respect to the initial base knowledge possessed by students. This will also enable the professor to see the areas that need special emphasis to bring all students to the academic level required.

The next step will be to record the major test grades of each student by location during the semester. The class performance on each test will be computed and then statistically compared to the performance of the traditional class on the same test. If there are four major tests, then there will be four results to be compared to the benchmark. The major tests would include the final exam. The final grades for all students in the four groups will also be compared in the same manner.

An opinion survey will need to be administered to each class towards the end of the semester. The purpose of the survey is to capture the viewpoints of the students regarding the technology utilized during the semester and whether or not the technology affected student performance. If one of the classes is web-based, a slightly different
survey will be administered to those students. The survey will also be given to the traditional class, but on certain questions, the “neutral” response will be available. The surveys will be analyzed by percentages and compared to each other.

The final task required of each student will be to complete a post-test. The same test as the pre-test can be used if the original pre-test was not returned to the students. The results of the post-test will be compared to the class average final grade and compared to the performance on the pre-test. Statistics will reveal if there are significant differences between an experimental class and the traditional class.

The appendix to this thesis contains examples of pre- and post-tests, surveys, and statistics. Statistical analysis will play a crucial part of the experiment. The computer software Microsoft Excel contains a statistical package that can be used for the purpose of comparing data from classes to the control class. The primary procedure will be to use Excel to run a t-test on the two sets of data for comparison of means. In this case, the null hypothesis can be stated that there is no difference between the student achievement based on delivery method (face-to-face, ITV with professor present, ITV at remote site, web). If the absolute value of the calculated t value is greater than the critical t value for the appropriate degrees of freedom, then the null hypothesis will be rejected. If the absolute value of the calculated t value is less than or equal to the critical t value, then the null hypothesis will not be rejected. Excel will also be used to compare the variances of the two sets of data, using the F-test.

Another analysis that must be made is to compare the results of each class on the pretest. If the classes are not at the same level statistically on the pretest, then the
comparison will require analysis of variance (ANOVA) techniques. ANOVA would account for differences in variation indicated by the pretest.

By comparing student performance in a controlled setting, the differences (if any) between methods of delivery can be evaluated. The proposed experiment will involve several classes and, most probably, more than one semester. The experiment will complete the analysis that was begun in the spring of 2007, and provide valuable information for future delivery of chemistry classes.
XVIII. SUMMARY

The purpose of this research project was to determine whether or not the delivery via ITV of an upper level chemistry class was viable. The short answer is yes it is, and the reasons for this conclusion are delineated below.

The research project encompassed an entire semester of observing an ITV chemistry class. The findings reflect both the technical challenges of the class and the psychological attributes of being a remote location student. The research was thorough and complete because the graduate student was present at every class session, as opposed to a smaller sample of sessions.

Chemistry 304 contained a significant amount of material designed to teach students the fundamentals of organic chemistry and biochemistry and their relation to the health fields. Therefore, the class was lecture-based and the students were expected to take appropriate notes. The ITV environment proved to be appropriate for the student at WKU-O. The lectures were received in a generally clear fashion and the information was processed correctly by the WKU-O student, as evidenced by her final grade (an “A”). Tests, quizzes, and homework were submitted to the professor through the courier system or via facsimile. Overall, the logistics of the class were comparable to a regular class, with some room for improvements noted.

The professor improved in the course of the semester in the logistics of broadcasting the class. Training on the technology used in the ITV class should be improved so that professors are more comfortable with the equipment from the first day. Students in all classrooms should be required to key the microphone when asking any
question. The courier system should be improved with more reliable deliveries between campuses.

The class could be enhanced by the addition of video laboratory demonstrations. Blackboard or an equivalent web-based adjunct to the class would allow student-professor interaction to facilitate learning. Consideration should be given to the idea of having a graduate student available for tutoring services at the remote locations.

A time could be set aside for the remote locations to be able to ask questions of the professor at the end of lecture, without the presence of the broadcasting class students. This would allow more personalization between the professor and the remote students to occur. This would have to be at a regularly scheduled time, before the broadcast window was terminated at the end of each class.

The ITV delivery of Chemistry 304 is an acceptable means to reach a larger number of students than in a regular campus classroom. The logistical challenges can be overcome and a high quality educational experience can be provided for students. The ITV method for teaching this class is recommended as an alternative to face-to-face delivery.

The proposed study will provide a statistical basis for comparison of classes delivered by different methods. The study will be able to definitively answer questions about student performance in different settings.
XIX. REFERENCES


XX. Appendix

A. Pre-test and Post-test
B. Survey for Traditional, ITV, and web-based classes
C. Examples of Statistics
A. Pre-test and Post-test

The pre-test will include questions relating to the following topics in chemistry:

a. Lewis diagrams
b. Alkanes, alkenes, and alkynes
c. Carbohydrates
d. Enzymes
e. ATP and ADP
f. The Krebs Cycle

The post-test can be the same test as the pre-test as long as the pre-test was not returned to students. The primary professor will be responsible for creating the tests.

B. Survey for Traditional, ITV, and Web Classes

The following survey will be given to all classes. There are separate sections for the ITV and web classes. The response range has been simplified to three categories: agree, disagree, and neutral.

Survey for Students in Chem 304

Please answer the following questions about this particular class using the answer scale:

A: Agree  B: Disagree  C: Neutral

1. I was able to interact with the presenter. A B C
2. I learned new chemistry content in these classes. A B C
3. The presenter was easy to follow and understand. A B C
4. The class was negatively impacted by technical difficulties. A B C
5. I felt comfortable asking questions of the presenter.

**Traditional and ITV classes answer questions 6-10 below.**

6. The equipment in the room distracted from the class material.  A  B  C

7. The other location distracted from the class material.  A  B  C

8. I could view overhead material easily.  A  B  C

9. I easily understood questions and comments from the other location.  A  B  C

10. I would enroll in another ITV class, either remotely or at main campus.  A  B  C

Comments:

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________


**Web-based classes answer questions 6-10 below.**

6. The equipment required distracted from the class material.  A  B  C

7. The other location distracted from the class material.  A  B  C

8. I could view required material easily.  A  B  C

9. I easily understood questions and comments from others.  A  B  C

10. I would enroll in another Web class.  A  B  C

Comments:

____________________________________________________________________

____________________________________________________________________

____________________________________________________________________
D. Examples of Statistics

The following is an example of the statistics used to compare student performance in two classes.

<table>
<thead>
<tr>
<th>Class A Test 1</th>
<th>Class B Test 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>87</td>
<td>89</td>
</tr>
<tr>
<td>76</td>
<td>77</td>
</tr>
<tr>
<td>79</td>
<td>99</td>
</tr>
<tr>
<td>93</td>
<td>67</td>
</tr>
<tr>
<td>98</td>
<td>92</td>
</tr>
<tr>
<td>67</td>
<td>78</td>
</tr>
<tr>
<td>88</td>
<td>99</td>
</tr>
<tr>
<td>75</td>
<td>84</td>
</tr>
<tr>
<td>73</td>
<td>72</td>
</tr>
<tr>
<td>94</td>
<td>76</td>
</tr>
</tbody>
</table>

Mean A 83  Mean B 83.3

F 0.87089

F Critical 0.314575

t Calculated -0.062283

t Critical 1.734064

The null hypothesis is retained in this case, meaning there is no significant difference.