2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #38869

Experience with a Method Allowing One Instructor to Teach a Course in Two Classrooms Simultaneously at Different Locations

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When a program needs to serve students at more than one location, Zoom and other distance learning tools can be used to great advantage. These tools can make it possible to offer courses simultaneously at more than one location, leading to positive changes in course enrollment, retention, faculty workload, and operational efficiency.

The Department of Engineering Technology at Austin Peay State University, the author's institution, operates primarily from facilities at a satellite campus approximately 10 miles from the main campus. With the entire degree program offered at the satellite campus, the department also offers first and second year major core courses on the other (main) campus. This is done to attract students from that campus to the program, and the department depends on enrollment from both campuses to support upper level core and major concentration courses. After the second year, main campus students have had to shift to the satellite campus. This has a negative impact on retention. More recently, the department has expanded its offerings to include a new concentration offered on the main campus. For students in that concentration, the department needs to offer major core courses at both locations. Many of these courses are more engineering than technology in nature and are currently offered as traditional classroom courses.

To address this need, immediately prior to the COVID pandemic, the author offered a core course in thermodynamics using this technology. With this first effort, the two sections – counted as one class for load purposes - were each in specially-equipped Zoom classrooms. The instructor ran the course from one campus using classroom equipment, and students on the other campus participated using equipment in the other Zoom classroom. Despite the efforts of the distance education staff, this first attempt was not wholly successful due to issues with the classroom equipment. Experience with Zoom during COVID showed that, unlike the setup with the classrooms, Zoom could work quite reliably when run from the instructor's computer with the students participating using their own computers.

With the return to the classroom, the need to offer courses at both sites remained. Also, the need to bring students from both campuses into a single section remained, both to meet university class size requirements and to have one instructor teach both sections without requiring teaching overloads. Experience gained through several terms and with different courses, including courses teaching computer software, has resulted in a successful model of operation. This paper will share experiences to date and will address benefits in the areas of enrollment, retention, and faculty workload. Assessment and evaluation based on class work will be presented. While this has gone beyond a work in progress to reach a level of successful operation, more development is needed. The paper will also address projected improvements and ways to extend this practice to other courses.

Introduction - A Special Need for Video Technology

The COVID pandemic led to a temporary and immediate end to face-to-face instruction. Synchronous video and other distance learning tools were put to good use in coping with the crisis. In the process, a large body of practical experience was developed. A literature search returns an overwhelming number of results. At recent ASEE conferences, authors have presented papers describing their experiences with teaching engineering technology and engineering courses using distance learning tools. These papers not only address experiences with more traditional classroom formats, but also with laboratories and other activities that were thought to require a face-to-face setting [1-5]. Authors have documented lessons learned and how to profitably apply these lessons to improve instruction when used with face-to-face instruction [6-18]. Several authors have addressed the student perspective [9-11]. The search results presented here are by no means exhaustive.

While the need for video and other distance learning technologies diminished at some institutions, at others a need existed both before and after the pandemic. There is a long-recognized need for programs to reach students who cannot attend classes in a traditional campus setting. In some cases, students can meet in a classroom at a remote location, but cannot come to the campus. Work in this area predates the COVID pandemic [19-25].

The author's department has a need to use video conferencing and distance learning tools. Due to enrollment and faculty considerations, the department needs to bring students from two campuses together in one class. This helps ensure that the class is large enough to meet or exceed minimum class size requirements and will count as a full course for teaching load purposes. The use of video and distance learning technology described herein allows the department to offer courses from one site to groups of students on both campuses simultaneously. This provides a better and more convenient service to all students, and should help the department retain students. In 2008, Hossain and Latif describe an effort to teach classes simultaneously at different locations [25]. The work described here to offer classes simultaneously makes use of Zoom software along with D2L learning management software.

The degree program, a Bachelor of Science in Engineering Technology, is offered on two campuses separated by a distance of approximately ten miles. The primary (main) campus of Austin Peay State University is in downtown Clarksville, Tennessee, and operates on a traditional sixteen-week term schedule with mostly daytime courses. The satellite campus is located at Fort Campbell, a large military installation that straddles the state line between Tennessee and Kentucky state line. To support the military personnel, courses at that site run on accelerated eight-week terms and are offered primarily in the evenings. The population served at that site includes active duty military personnel and people working during the daytime in regional industries.

The curriculum combines a common foundation with concentration options in different areas. All students complete general university core requirements, specific requirements in mathematics and physics, and a set of major core courses. Students also complete a sequence of courses in the area of concentration. In their third and fourth year, students complete a set of upper level major core courses, and they complete the courses required for their concentration.

Since the late 1990s, the department has operated primarily at Fort Campbell, with the entire degree program at that location. Courses are offered in the evenings and on an eight-week term schedule; features that are not attractive to most students of traditional college age. The department has also offered a limited number of courses on the main campus. This has allowed main campus students, mostly of traditional college age, to at least start the program without having to go to the satellite campus. After their second year, students from the main campus have had to shift to taking classes at Fort Campbell. These students have had to shift from daytime classes taken in sixteen weeks to evening classes taken in eight-week terms. Students need to have transportation to Fort Campbell and to qualify for a pass to get on post. This need to change campuses and schedules has had a negative impact on recruiting and retention of main campus students.

Courses need to be offered at least once every year. Students would be best served if the department could offer all courses in full, stand-alone sections on both campuses. However, for many classes, enrollment is not sufficient and there are not enough faculty to support separate sections for each campus. After the second year, main campus students have had to shift to the Fort Campbell campus.

In recent years, efforts to increase enrollment at the university have resulted in higher enrollment in the major and increased demand for engineering technology classes on the main campus. Also, the department expanded operations with a new concentration in mechatronics. This concentration is offered on the main campus; for other concentrations, concentration-specific courses are only offered at the satellite campus. With this new concentration, students can take both lower level core and concentration courses on the main campus. However, students still needed to take at least some upper level major core courses at the satellite campus.

With the use of video technology, one faculty member can offer a course to students at both the main and the satellite campus with a single course offering. While students used to daytime classes are forced to shift to evening classes operating on eight-week terms, with the video technology we can keep them from having to travel to the other campus. Using video in this way can lead to a significant improvement in how the department serves students on the main campus.

Evolution of the Process

To meet this need, the author set out to develop a method using Zoom to teach classes simultaneously at both campuses. Starting with one course in January, 2020, before the disruptions caused by the COVID pandemic, the author has now used the techniques described in this paper to offer classes simultaneously in classrooms at two locations. This has included four different courses in the major. Three of the classes were upper level classroom courses – lecture courses in thermodynamics, statics and strength of materials, and in problem-solving in engineering technology. Total enrollment in these courses has been around 25-30 students. The fourth course was a lower division course where students are expected to learn basic solid modeling using CREO Parametric software. All of these courses are required for majors in all concentrations.

The pilot course was offered during an eight-week accelerated term starting in January, 2020 and ending in early March. The class used was the thermodynamics course required for all majors. This class is offered once a year for students at the 3rd and 4th year level. Zoom classrooms had been set up on both campuses and were to be used for this class. The instructor would teach from the classroom on the satellite campus and had the majority of the students in that classroom. While the instructor would be available to meet during office hours held on both campuses, the smaller group on the primary campus participated in the class solely via video.

While this pilot offering provided proof of concept, it was not a resounding success. The system linking the two classrooms proved to be unreliable. When everything worked, the class functioned reasonably well. However, all too often there was difficulty with the equipment. Despite efforts by the support staff going above and beyond reasonable expectations, the class suffered due to equipment-related problems. There was significant loss of class time as attempts were made to find and resolve problems. Difficulties were exacerbated by the fact that courses were being offered in the evening, outside of regular staff hours and from the satellite location. These problems affected both sites.

As the eight-week term came to an end, the magnitude of the COVID threat had become apparent, and the university shifted to remote instruction via Zoom across the board. For the author, this experience with Zoom had provided valuable experience, as the author had other eight-week courses to start and a design software class to continue on the sixteen-week schedule.

The campus was closed, and instructors could not rely on equipment in classrooms. In the classroom, the author used (and uses) a document camera to project from a writing pad to the screen. While also using Powerpoint slides at times, the author finds it most effective to be able to lay out material in writing. This is critical when demonstrating homework and other problems. Writing on a pad has proven to work better than a digital tablet.

The author did not have a document camera at home, and found cameras were on back order. Much earlier, the author had been issued a web camera for online instruction. This was pressed into service, a mount quickly constructed, and this was used as a document camera. The resolution was good enough for what was written on the pad, especially when that could be followed up with a scan of the notes posted on D2L. This home-built document camera was a critical element in the author's ability to carry on with classes during the pandemic shutdown, and to continue with the program described here after the return to the classroom.

Returning to campus with much valuable experience in using Zoom for instruction, the author was able to continue to develop and refine the process of teaching classroom courses simultaneously at two locations from one classroom. Lessons have been learned with practice. Over time, the author made a change from teaching from only one location to alternating between the two classrooms. A better camera was purchased with manual focus control. This proved to be a significant improvement over the older camera. Students are now told to bring their laptops to classes even when the instructor is in the room.

A second instructor has run courses using these methods. To date, that instructor has relied primarily on equipment found in the Zoom classrooms. These efforts have been hampered by equipment difficulties. The experiences described in this paper will be applied to help with courses taught by other faculty members.

Current Practice

In current practice, two sections of each class are listed; one on the Fort Campbell campus eight-week schedule and one on the main campus. The main campus listing is for a half-semester which corresponds to the eight weeks of the satellite campus schedule. This does lead to some difficulties, as the two terms do not mesh well together. For example, during the first eight weeks of the spring semester, the final exam is scheduled during the spring break on the primary campus. Students with spring break plans must request and be granted an incomplete grade so they can take the final on their return. While two sections are listed, the instructor teaches both as one class for load. For exams, the instructor is present in one classroom and the lab technician proctors the exam at the other site. Since these courses are offered in the evening, special arrangements have been made by the department for the lab technician to work outside of regular hours.

The following points describe the best practices as developed to date. The pattern of operation described here specifically fits two classrooms where both are within a reasonable driving distance for the instructor. It can be adapted to other situations.

- **The instructor should alternate between the different classrooms/campuses on a regular basis.** Neither group of students should be taught solely over a video link. This allows students in both groups the opportunity for face-to-face interaction with the instructor, and no group should be made to feel that they are of lesser importance.

  In cases where students receive financial aid where the amount differs between classroom and online courses, having the instructor in the classroom with all students at least part of the time helps the student justify receiving support at the level for classroom courses.

- **Plans and equipment need to be in place to function despite problems with equipment. Minimal reliance should be placed on classroom equipment unless proven to be highly reliable.** With the pilot course and several courses that followed, operations were badly affected by problems with the equipment in the classrooms. With time and experience, the author found ways to continue with a class even if critical equipment was down.

  One advantage to relying on equipment independent of the classroom is that no special classroom setup or equipment is needed. However, it is an added burden on the instructor to bring in and set up equipment.

  At this time, the author relies on his own laptop computer system and a portable document camera system. This has proven to be highly reliable. The only technology needed in the classroom is the main classroom projection system.

  In the classrooms at the author’s institution, the projection system and the document camera can only be used through the classroom system switch. If the switch is not functioning, the author cannot connect directly to the screen or to the document camera. It is understandable why instructors are not given physical access so they can start unplugging cables, plugging in other cables, etc. However, if it were possible to allow for a direct connection, more use could be made of classroom equipment while minimizing the risk of disruptions due to equipment failures.

One piece of equipment needed in the classroom is a stand-alone monitor. Currently, the author works solely with the monitor on the laptop. This monitor becomes overly cluttered with the image being presented to the class and the Zoom screen. A workspace with a monitor would be desirable.

- **Students are told to bring their own laptop computers to classes.** For students at the site reached via video, the laptops provide a backup option. This covers problems with the video link and with the main classroom screen. For students in the classroom with the instructor, the use of laptops may be necessary. IF there are problems using the main classroom screen, students can sign in with their laptops. While it seems odd to have students in the classroom following an in-person class on their laptop screens, this has been necessary at times.

- **There should be a back-up plan with equipment in place if needed**, so that a class session can proceed without undue disruption due to equipment problems. In the case of power failure or Internet breakdowns, the only option is to replace the in-class session with asynchronous content at a later date.

- **When the instructor is at one site, a person is needed to support the class at the other site.** If any classroom equipment is being used, this person needs to be able to start and manage this equipment. This can be done by a student worker.

  For in-class exams, someone needs to be present to proctor the exam. A student worker who is taking the course cannot be given this task. Another faculty member, a graduate assistant, or a department employee such as a lab technician can perform this function.

  Going beyond current practice, help would be needed with any laboratory work, and help could be needed to move the courses into a more interactive mode.

- **Learning management systems for online, asynchronous instruction should be used, and the option to record classes should be used.** The use of learning management systems with classes of all types has become accepted practice. Under these circumstances, the use of such systems is necessary. In the author's current practice, the instructor records the classroom sessions and posts links to these sessions for students. Students report that this is very helpful, as it allows them to repeat a part of the presentation when needed later. Material that once would have been written on the board is written on paper. After the class session, the instructor scans and posts these notes. At the author's institution, all courses have a site on the learning management system (D2L) used by the university. Video links and notes are posted on this site.

An additional advantage to recording the class is that recordings of past classes can be used as supplemental material in current courses. If a class session must be missed, a recording can be posted via D2L to take the place of the class session. Also, recordings may be used to supplement class sessions.

Assessment and Evaluation

Grade data has been used as a direct indicator for assessment and evaluation. Data from two offerings of a required course for all majors in thermodynamics was compared. The first section used was taught in Spring, 2020, and ended just before the COVID shutdown. This was the first attempt at teaching two sections simultaneously. This was done using Zoom classrooms and suffered from equipment difficulties. The second section used was taught in Spring, 2022 after much had been learned. In this class the instructor was able to use stand-alone equipment and had far fewer technical difficulties.

Students are given a comprehensive, in-class final examination. This exam covers quite a bit of material and is hard for students to complete in the time allowed. High scores of 90-100% may not be a reasonable expectation. The score does give a relative indicator of student performance and has been taken as the best indicator of student learning. Results are given in Table 1.

Table 1: Total Score on Subject Area Problems
Thermodynamics Course
Comprehensive, In-Class Final Exam

	Spring 1/A, 2020			Spring 1/A, 2022		
Location	Satellite	Main	Difference	Satellite	Main	Difference
Instructor	In Room	Video Feed	(Abs Value)	In Room	Video Feed	(Abs Value)
Students	18	9	-	18	6	-
Median	75%	58%	17%	60%	59%	1%
Average*	69%	58%	11%	59%	57%	2%
Sample SD	19%	13%	6%	20%	17%	3%
Max Score	88%	81%	8%	91%	74%	17%

*Average calculated without zero values

In the class data from the initial effort (2020), scores were higher for the group with the instructor in the room than for the group using the video link. The biggest difference is seen in the median scores (75% vs 58%); there is less difference in the maximum score (88% vs 81%).

The results for Spring, 2022, reflect changes in the procedure for offering these courses. The instructor was still operating from one classroom, and the other group participated solely via video. However, the instructor was not relying on the classroom equipment and was instead using a laptop computer and portable document camera. This was another difficult exam under tight time constraints. The author was surprised to see how close the median and average scores were for the two groups. The only surprise was the large difference in the high score (91% vs 74%). The high score may have been something of an outlier for the class as a whole.

In the fall of 2022, the author shifted to a pattern of alternating between the two campuses. Also, courses where students were taught to use software tools were included. The three courses include a course on problem-solving in engineering technology where students are taught how to use EXCEL to analyze and display data (Table 2), an engineering analysis course on topics from statics and strength of materials (Table 3), and a course teaching the basics of solid modeling design software using CREO Parametric (Table 4). In instructional style, the statics and strength of materials course has the most in common with the thermodynamics course. Final exams are comprehensive and students may not finish the entire exam in the time available; it may not be reasonable to expect high exam scores. All are major core courses and, except for the solid modeling class, these are for 3rd and 4th year students.

Table 2: Total Score on EXCEL Problems Problem-Solving Course Comprehensive, In-Class Final Exam			
	Fall 1/A, 2022 (Aug-Oct)		
Location	Satellite	Main	Difference
Instructor	Alternating	Alternating	(Abs Value)
Students	17	11	-
Median	90%	79%	11%
Average*	81%	78%	3%
Sample SD	20%	13%	7%
Max Score	100%	94%	6%
*Average calculated without zero values SD = Standard Deviation			

Table 3: Total Score on Final Exam Problems Statics and Strength of Materials Course Comprehensive, In-Class Final Exam			
	Fall 2/B, 2022 (Oct-Dec)		
Location	Satellite	Main	Difference
Instructor	Alternating	Alternating	(Abs Value)
Students	21	9	-
Median	72%	89%	-18%
Average*	68%	81%	-13%
Sample SD	17%	15%	2%
Max Score	96%	93%	3%
*Average calculated without zero values SD = Standard Deviation Students-Only Students Who Finished the Course			

Table 4: Total Score on Problems Solid Modeling Course Comprehensive, In-Class Final Exam			
	Fall 2/B, 2022 (Oct-Dec)		
Location	Satellite	Main	Difference
Instructor	Alternating	Alternating	(Abs Value)
Students	10	9	-
Median	93%	93%	0
Average*	91%	93%	2%
Sample SD	6.8%	4.4%	2.5%
Max Score	98%	99%	1%
*Average calculated without zero values SD = Standard Deviation Students-Only Students Who Finished the Course			

No trends or consistent bias to one group or the other appears in the data. While some variation is seen between the two groups in the median and average scores, this does not appear to be affected by how the students received instruction. Where one might expect more difficulty in teaching software via a video link, the strong performance of both groups in the solid modeling class does not bring out any problems.

Aside from the initial offering in 2020, no apparent difference can be seen with the instructor alternating between the two sites. For this aspect, indirect indicators based on the instructor's interactions with students may be the better indicator. When teaching solely from one site, there were strong indications that students at the video site were not fully satisfied with this arrangement. Meetings outside of class time with the students helped, but only so much. With the move to having the instructor alternate between sites, the sense that this is a problem has diminished significantly. Students were bringing concerns to the instructor before; with the instructor alternating between classrooms, concerns are no longer being heard. Students do appreciate being able to take courses without having to travel to a different campus.

Assessment and evaluation based on direct indicators from final exam work shows that student performance is similar whether the instructor is present in the classroom or linked to the classroom via video. While data is not available to gauge student satisfaction, conversations with students indicate that having the instructor be present part of the time in each classroom is a better arrangement.

Future Directions

Through experience, the author has developed a process for teaching groups of students simultaneously at two locations. The author has gained experience using this technique in traditional classroom courses (thermodynamics, statics, strength of materials) and in courses where students learn to use computer software. This approach has been developed to a state where student performance has been consistent with performance seen when all students were in the same classroom.

Several areas for improvement remain. This method for instruction was developed to meet a need by students to take required classes without having to change campuses. It also meets a need by the department to have enough students in classes to meet enrollment requirements. So far, this method has been used primarily by the author; only two other faculty members have attempted this on a limited basis. There is a need to expand this operation to include other courses taught by other instructors. The author believes that this method has reached a level of maturity where other faculty members can follow this model of operation.

Most of the classes taught using these techniques have been traditional lecture classes. With the video link, it can be even more difficult to engage students directly. More effort needs to go into developing and incorporating techniques to increase student engagement during class. Another goal for these courses is to include laboratory experiences in these classes. Again, work is needed not only to develop labs but to work out how best to do labs under these conditions.

This work was launched prior to the COVID pandemic. With the pandemic forcing a shift out of the classroom, a great body of experience was developed. The work described here is based largely on local experience. More needs to be done in drawing from the experiences reported by others to improve this model of operation.

Conclusions

To meet a specific need for our department and our students, the author piloted a program to allow one instructor to teach groups of students simultaneously on two campuses. This program was started prior to the COVID pandemic. After it became possible to return to the classroom, development work continued. At this time, this method of instruction has been brought to a level where courses can be reliably offered at two or more locations simultaneously by a single instructor.

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