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Alaska University Transportation Center

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Digital Dissemination Platform of Transportation Engineering Education Materials Founded in Adoption Research

UAF Contribution to Final Report
Task 5A: Offer several courses using non-traditional academic models and methods, and monitor results.

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National interest abounds in improving engineering education in the US. This interest stems from low performance on concept inventories (P.S. Steif, Dollar, & Dantzler, 2005; Paul S Steif & Hansen, 2006) concerns over the role of the US as a national economic leader (The National Academies, 2006), evidence of best practices in curriculum development and pedagogy, and a sense that we can just do things better. These concerns have led to the development of an abundance of materials and methods that are based on effective methods of development and/or been shown to be effective on student learning and other important educational outcomes.

While progress has been made in improving courses and curriculum, it is greatly hindered by inefficiencies associated with duplicating development efforts. For example, there are approximately 200 introductions to transportation engineering courses taught annually in the US and little evidence of sharing of materials (other than textbooks) in these courses. More knowledge is needed on how and why faculty and teachers adopt curriculum. Where do they go for resources when developing a new course or revising an old course? How do they make adoption decisions when they find curriculum? In what forms can dissemination venues (such as websites) take to optimize adoption? How can higher education and workforce development curriculum be shared efficiently? This project will begin to answer these important questions through an investigation of how faculty adopt curriculum when developing a new course or revising an existing course and using this knowledge to develop an architecture and sustainable plan for a web-based dissemination venue. In parallel with this work, faculty from University of Alaska, Fairbanks will develop and test courses focused on working professionals. We will monitor this course development process to add to our knowledge base for repository development.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

I. Introduction

This report is University of Alaska Fairbanks' portion of the PacTrans project: Digital Dissemination Platform of Transportation Engineering Educational Materials Founded in Adoption Research. It reports on Task 5A: Offer several courses using non-traditional academic models and methods, and monitor results. The UAF portion was given the contract G00008085-337104 and initiated in March 2012. The sponsor's contract number is University of Washington NO. 739439, which is a pass thru from USDOT contract DTRT12-G-UTC10. Task 5A Included:

- Reviewed published works in the engineering academic literature regarding non-traditional means,
- Examined modes that might work for courses offered to DOTs,
- Coordinated with media and IT specialists and integrated selected delivery mode(s) into teaching plans for several courses,
- Developed methods for evaluating results,
- Coordinated with DOT engineering education contacts in other states, and
- Offered courses and evaluate results, with attention to administrative and IT issues.

Obtaining continuing education is an ethical obligation for engineers and a necessary part of growing in their jobs, both to enable them to handle more complex technical tasks, and to maintain competency with changing technology. As the engineers advance in their careers, they must master administrative and management skills in order to advance their projects. Thus this continuing education is workforce development for the engineers themselves, and also for the workers who will be employed on their projects. Because most engineers of these target demographics already have jobs, this education must be made convenient for the working engineer and fit the situational needs of working engineers and their employers. This is especially true with engineers entering the transportation workforce. New civil engineers starting in transportation may have only one or two college transportation-related courses. Here we examine alternative modes of education delivery that take advantage of the great progress in electronic communications. Specifically, we critically examine non-traditional modes of offering academic education in transportation engineering subjects and identify situations where these modes may transmit knowledge effectively and factors in successful transmission. We utilized experienced instructors and drew on their knowledge of the administrative and pedagogical systems to offer and then critique various methods. This preliminary review could aid instructors preparing for first time entry into non-traditional education, but would also serve as preliminary selection guidance for non-traditional educational modes.

The following sections include a literature search and background information section, and detailed reviews of five non-traditional methods:

- Flip Classroom on 5S Principles in Lean Construction
- Google Hangout with DOT’s re: Leadership Learning
- Advanced Scheduling Techniques for Construction Management Certificate Program
- Overview three years of Video-Conferenced graduate courses.
- An undergraduate structures course for students in Alaska taught from North Carolina via video conference

Following the five reviews, we offer some overall recommendations. The last section has the references for the literature cited.

II. Literature Review and Background

There is an abundant literature dealing with various aspects of non-traditional approaches to teaching and learning, reflecting many developments during the past twenty years. In the area of so-called distance education, for example, a website hosted by the University of Wisconsin – Madison (2012) lists 51 journals and magazines related in some way to distance education, as of June 2012. Titles range from the *Journal of Asynchronous Learning Networks* to the *Turkish Online Journal of Distance Education*. Not surprisingly, 37 of these sources are available on-line. While there are many reports of successful applications of distance education and other non-traditional methods to the continuing education of employed professionals, it seems significant that little has been written about such uses for employed engineers and other technical professionals.

This literature review has two parts. The first part draws heavily from general reports on the subject and from applications in areas other than engineering. In addition, we cite descriptions of offerings for technical professionals culled from selected on-line sources that support such programs. The second part reviews three of the most pertinent articles from the benchmark journal, the Journal of Engineering Education.

Part 1, General

Scherrer, Butler and Burns (2010) reported on a survey of about 300 engineering students at their institution as to their perceptions of on-line education. The sample was a mixture of undergraduate, graduate, fulltime and part-time students and thus not necessarily representative of the employed professional seeking continuing education that is the focus of this project. In any case, the researchers found, *interalia*, that nearly all respondents found on-line courses to be more convenient than traditional classroom classes but that perceptions of effectiveness varied, with those who had more experience with such courses tending to rate on-line courses more effective.

Other reports give hopeful signs of the effectiveness of various on-line packages, such as eLive, VIEW, and HigherEd 2.0 (Chaturvedi et al 2011, Goesser et al 2011, Orange 2012). Uses to date have been primarily in undergraduate courses serving fulltime students, but offerings for non-traditional working professionals can benefit as well. Another paper (Frolic 2013) urges multi-university collaboration to develop on-line offerings. Once again, the focus is on undergraduate education, but it is appropriate to note that the suggested collaboration is already being brought to fruition by the current digital dissemination project of which this literature review is a part.

The “Teaching with Technology” website managed by the American Speech-Language-Hearing Association (ASLHA 2013) provides a helpful outline of various approaches to teaching and learning, as well as several valuable links to other related websites and articles containing more specific examples. The outline suggests three basic approaches:

> *__Fully Face-to-Face__*
>
> *The traditional method of teaching and learning is synchronous and typically involves the employment of a classroom where the professor and students interact within a certain time and space.*
>
> *__Hybrid or Blended Learning__*
>
> *Hybrid or blended learning combines face-to-face classroom interactions with distance learning techniques to disseminate information to members of a learning community. This type of learning blends the use of technology-based asynchronous teaching methods and traditional teaching methods.*
>
> *__Distance Learning__*
>
> *Delivering instructional and resource-sharing materials and information from the location at which they originate to other remote locations using audio, video, computer, or other multimedia resources. This process requires unique methods of course design and instructional techniques as well as a familiarity with technology.*

The “Teaching with Technology” website provides information primarily about teaching technology applications to typical fulltime undergraduate courses. This emphasis may be due to a lack of application within the realm of continuing education for working professionals, or it may simply be that there is less interest in compiling information about such applications. In any case, the website is a valuable resource for those seeking information about these continuing education applications.

In the realm of “hybrid or blended” learning, Sands (2002) describes efforts at the University of Wisconsin – Milwaukee; methods have included off-the-shelf Course Management Systems, such as Blackboard, Prometheus or WebCT, something as simple as email, or an information-rich method such as streaming video. He suggests and explains five principles to guide teachers in connecting on-line work with face-to-face teaching:

1. *Start small and work backward from your final goals.*
2. *Imagine interactivity rather than delivery.*
3. *Prepare yourself for loss of power and a distribution of demands on your time more evenly throughout the week.*
4. *Be explicit about time-management issues and be prepared to teach new skills.*
5. *Plan for effective uses of classroom time that connect with the online work.*

Garnham and Kaleta (2002) describe a collaborative project among five University of Wisconsin campuses and 17 faculty members to develop and present a variety of hybrid courses for undergraduates. Non-traditional methods included such new online learning activities as case studies, tutorials, self-testing exercises, simulations, and online group collaborations. Some instructors employed "online learning activities that required their students to become familiar with content prior to coming to a class discussion" (the so-called "flipped classroom" concept). Although rather lengthy, the ten "lessons learned" are valuable enough to include here:

1. *There is no standard approach to a hybrid course.*
2. *Redesigning a traditional course into a hybrid takes time.*
3. *Start small and keep it simple.*
4. *Redesign is the key to effective hybrid courses to integrate the face-to-face and online learning.*
5. *Hybrid courses facilitate interaction among students, and between students and their instructor.*
6. *Students don't grasp the hybrid concept readily.*
7. *Time flexibility in hybrid courses is universally popular.*
8. *Technology was not a significant obstacle.*
9. *Developing a hybrid course is a collegial process.*
10. *Both the instructors and the students liked the hybrid course model.*

The Teaching with Technology website also provides a discussion of various "educational technology options." It distinguishes between chat rooms and discussion boards; chat rooms are virtual rooms used by individuals to correspond with each other, whereas discussion boards are used by the entire class to post or read assignments, questions, case studies, messages and other information. E-mail should not be neglected as a "technology option." It is an asynchronous method used between instructor and student(s) and between individual students; messages can carry attached files.

Portfolios, commonly used by artists to demonstrate competencies and evidence of work completed, have morphed to become eportfolios, allowing students to contribute to digital archives "demonstrating growth, allowing for flexible expression (i.e. customized folders and site areas to meet the skill requirements of a particular job), and permitting access to varied interested parties (parents, potential employers, fellow learners, and instructors)." **(**Siemens 2004)

Finally, the Teaching with Technology website includes a link to information about learning objects, which are defined as "electronic (digital) modules of information that are usable and retrievable from a central information repository for educational purposes." (University of Wisconsin – Milwaukee 2008). Examples are tutorials on how to develop Power Point® presentations and the use of Windows Movie Maker®, which can be patched into any course presentation. A word of caution: The links to specific learning objects on the website were broken when tested in June 2013.

With regard to specific technology-based teaching and learning techniques, the flipped classroom has found wide favor among many educators. In the sciences, there are reports of success in chemistry classes and in applications to case studies (Arnaud 2013; Herreid and Schiller 2013). Pierce and Fox (2012) discuss the use of the flipped classroom in pharmacy education. McNulty (2013) presents a helpful though biased (He's the chief learning officer at an on-line learning company.) endorsement of the flipped classroom and other innovative techniques; he suggests they are effective in career and technical education as well as other realms. The literature seems to lack reports of flipped classroom use in the continuing education of technical professionals.

An EBSCO literature search on the terms "video conferencing" AND "continuing education" resulting in 39 returns, of which 30 were related to the health professions and none was related to engineering and associated fields. A selection of video conferencing use in medicine and pharmacy continuing education includes a report on "teledermatology," a new term describing the use of mobile, Wi-Fi-enabled, camera-ready tablets that allows "dermatological clinicians a new telemedicine tool and collaborative learning platform" (Brandt and Hensley 2012). A paper describing the use of video conferencing and asynchronous web-based outreach among clinicians at family medicine clinics in rural Oregon (Hartung et al 2012) reported that 90% of those surveyed were satisfied with the program. In a paper that is now 10 years old (Himpens 2003), describes the use of multipoint videoconferencing for continuing medical education in Belgium. Each session included oral presentations, interactive questions and answers, and a multi-site panel discussion. The author concludes, "Videoconferencing appears to be a suitable alternative to face-to-face seminars."

Thus, the medical professions have discovered the advantages of distance delivery for continuing education. As one more example, a study of the use of on-line webinars for pharmacists and pharmacy technicians (Zaragoza-Anderson 2008) found that method to be especially important for those in rural and remote regions. In addition, military pharmacy personnel serving overseas have been able to keep current in their profession.

The United States military has had some success with distance learning methods in its continuing education program for deployed service personnel. As one example, a paper by Strait (2009) describes a unique partnership between Old Dominion University (ODU) and the United States Navy.

> *TELETECHNET, as the distance learning system is called, delivers graduate and undergraduate courses to students who are unable to attend traditional campus classes. The ODU distance learning system includes a large modern facility which contains approximately fifteen studio classrooms equipped with cameras, tracking devices, instructor control panels, computers, monitors, and digital white boards. The audio system allows the professor to choose between a traditional microphone that is clipped to one's jacket or a sensor-mike that tracks the professor via a remote controlled camera as the professor moves about in the studio classroom. By selecting among the options available in the control panel, the professor is able to provide the students with a video presentation, internet access, a PowerPoint presentation, overhead projection, or digital*

> *white board notations. An integration of these options allows the instructor to broadcast a sophisticated and interactive presentation to students at extremely distant locations.*

The paper discusses five challenges associated with teaching warrior students in this Ships at Sea Program: The [on shipboard] Classroom Environment, Warrior Student Priorities, Communication Restrictions and Security Issues, Scheduling, and Stress and Isolation***.***

In a study of online graduate education in management, Millson and Wilemon (2008) investigated the relationship between four factors that describe and assess quality in distance education and ten different models of distance education. The factors are dialogue, structure, access, and flexibility, while the ten models range from the traditional on-campus model to a modified online model. They conclude that the modified online model has the highest applicability to graduate management education, while their institution-centered model and emporium model are least applicable.

Technical professional societies sponsor a variety of technology-enhanced continuing education opportunities, both real-time, or "synchronous," and on-demand, or "asynchronous." In the first category, the American Public Works Association utilizes both audio and audio/video conference calls based on GoToMeeting technology for its Emerging Leaders Academy and its Leadership and Management program (American Public Works Association). The Public Works Executive option for this latter program includes a capstone project; a student's presentations and defense of her capstone project takes place in a real-time video conference such as Skype. Similarly, the National Highway Institute presents real-time seminars in two so-called Web-conference series (NHI 2012). Because these seminars are recorded, they are placed on-line and available on an on-demand basis as well. A third example is the American Society of Civil Engineers live webinars series that includes a variety of both technical and management-related topics (ASCE Continuing Education 2013). Like the NHI seminars, these webinars are made available for on-demand, on-line use following completion of the live presentation.

The Transportation Graduate Certificate Program coordinated by North Dakota State University is an example of a totally on-line offering (TLGC n.d.). Students view and download course materials, submit assignments, are tested, and receive feedback, among other activities, all via the Internet. Although it originates as a series of live real-time video conferences, most participants in the Iowa Public Employees Leadership Institute (Iowa LTAP 2011) take part by viewing the recorded live workshops. Other examples of on-line, on-demand course offerings for technology professionals are the aforementioned recorded webinars and seminars presented by the National Highway Institute and the American Society of Civil Engineers.

Part 2, JEE papers

The *Journal of Engineering Education* is considered the benchmark peer-reviewed journal in the field of engineering education. Here we searched all the recent papers, April 2006 to January 2013, and found only three in that journal somewhat pertinent to our project. Although these three papers are not closely related to innovative teaching techniques for non-traditional, employed engineering professionals, they were the closest fit, so we reviewed them here.

Online learning, both for fulltime degree seeking students and for working professionals, is so commonplace that it hardly qualifies as “innovative” today. As early as 2007, more than 60% of the 5.7 million hours of courses that Boeing Company provided to more than 150,000 employees were offered online. (Lawton et al, 2012. pp. 246) Yet, whether such innovation is an effective means of transferring knowledge continues to be a concern. A cooperative study between the University of Washington and Boeing studied the connection between the so-called learning sciences and the engineering workplace. The results indicate that such an approach is, indeed, effective. A database management course called ENOVIA Essentials, taken for many years by some 13,000 Boeing employees, was selected for study. Comparisons were drawn between the traditional classroom approach (the control) and a revised version employing online teachings methods (the treatment). Results, in summary, were as follows: “Treatment course participants learned more overall than did control course participants, with more positive attitudes towards the course content and their future learning. Learning had less dependence on initial knowledge. The collaboration capabilities of the LMS [learning management system] supported course development, but had limited spontaneous use by students during the experiment.” (ibid, pp. 244)

The term “screencast” refers to the use of video from a computer screen output combined with realtime audio commentary. A study of its educational use over two semesters of an introductory undergraduate engineering course explored the connection between screencast use, the perception of having gained a deeper understanding of the course material based on this use, and actual course performance. (Green, Pinder-Grover & Millunchick, 2012) Findings indicate there are both perceived and actual benefits to the method. In addition, undergraduate students are likely to enhance their self-sufficiency by using screencasts.

In a study that focused on how students’ interactions with the courseware in a web-based interactive statics course, the research question addressed the degree to which such involvement affected their learning gains. The hypothesis that learning gains from online courseware increase with usage was validated. Statistically significant gains were found, and students’ self-regulation of use was an important factor. (Steif & Dollar, 2009) Although the research involved an undergraduate course, the need for experience with the method as a condition for greater effectiveness has implications for adult, working professionals who may have variable familiarity with such web-based approaches.

III. Review of Five Non-traditional Methods in Engineering Education of Working Professionals

Here we describe five applications of non-traditional methods to continuing education for employed professionals. The five are:

a) Flip Classroom on 5S Principles in Lean Construction, Dr. Bennett
b) Google Hangout with DOT's re: Leadership Learning, Dr. Perkins
c) Advanced Scheduling Techniques for Construction Management, Dr. Bennett
d) Construction Management Certificate Program - Overview three years of Video-Conferenced graduate, Dr. Perkins and Mr. Whitaker
e) Undergraduate structures course for students in Alaska taught from North Carolina via video conference, Dr. Hulsey

Each instructor will describe the methods and results in their own words, but generally each description will cover these items:

- Course or session title, timeframe, leader/instructor, origination location
- Content
- Participants – where, employers, experience
- Delivery methodology
- Administrative and IT issues
- Assessment
  - Pro
  - Con
- Conclusions/recommendations for that application

Following these five descriptions in Section III, Section IV will be a separate section with observations, conclusions, overall recommendations, and suggested further studies.

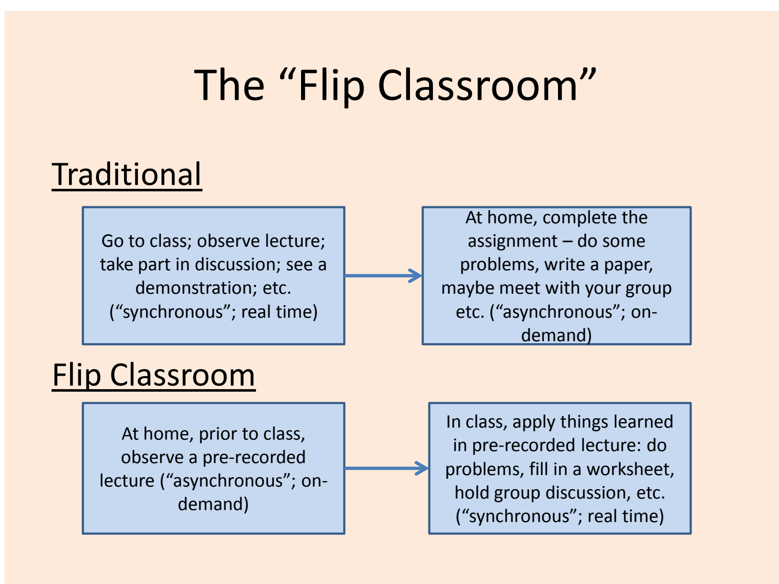
III.a. A Flip Classroom

Dr. F. Larry Bennett, PE

The traditional classroom approach to learning is to start with some in-class instruction such as a combination of lecture, discussion, and demonstration, followed by such out-of-class activities as completion of a problem set, preparation of a paper, and/or a group meeting to solve an assignment. The first of these two steps, which may be preceded by a reading assignment, is undertaken synchronously, with all students participating at the same time (though not necessarily in the same location, if some sort of interactive video conferencing is utilized). The second step takes place asynchronously, with students proceeding at their own individual pace (or their groups' pace) to complete assigned, out-of-classroom, learning activities by a specified deadline.

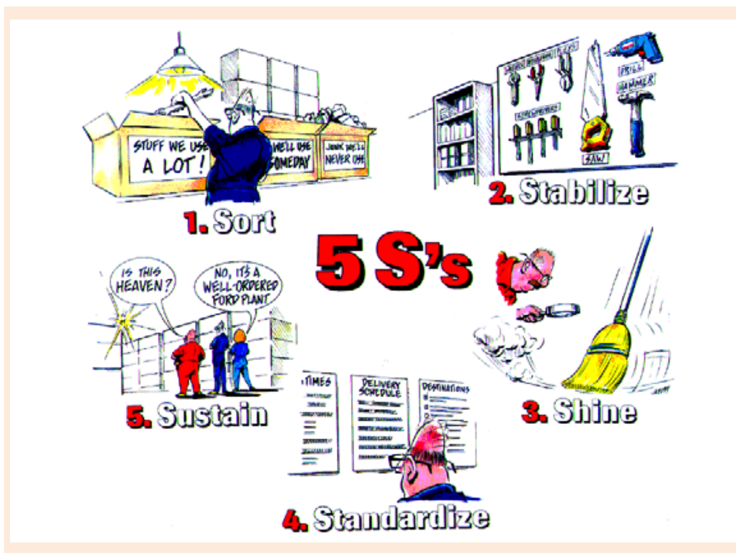
The notion of a "flip" (or "flipped") classroom is to carry out the same sequence of activities but to reverse the settings in which they take place. Thus, students observe a lecture prior to class by viewing a video (usually available on-line) prepared by the instructor. This activity takes place asynchronously, with the student proceeding at her own pace and taking as much time as needed to comprehend the material, by repeating, stopping and starting, and reviewing, using the features afforded by the video-watching technology. Following this preparation, in-class efforts consist of activities that otherwise would be done as "homework" – completion of a problem set, group discussion to complete a worksheet, consultation with the instructor, and the like. (University of Alaska Fairbanks 2013, University of Northern Colorado, n.d.) Thus, "the whole classroom/homework paradigm is 'flipped'. What used to be classwork (the 'lecture') is done at home via teacher-created videos (also known as vodcasting) and what used to be homework (assigned problems) is now done in class.)" (Bergmann 2012)

The following illustrates the essence of the contrast between traditional and flip classroom:



To test this method in an environment involving continuing education for working professionals, one segment of a course in Lean Construction was presented using the flip classroom. The course, designated as CE 656I Principles of Lean Construction, was a one academic credit hour module, part of the Design and Construction Management Graduate Certificate Program. (University of Alaska Fairbanks College of Engineering and Mines. 2013) Students were all located in Fairbanks and were employed as engineers in both the private and public sector. In this instance, video conferencing was not used, since all students met face to face with the instructor, F. Lawrence Bennett, P. E., PhD, in Fairbanks for the six 2 ¼ hour class meetings held between March 18 and April 4, 2013.

The topic undertaken using the flip classroom approach was 5S Fundamentals. The essence of this technique for reducing waste in the construction industry, which originated in the Japanese auto manufacturing industry, is a simple, common sense effort that focuses on Sort, Straighten (or Stabilize), Shine, Standardize, and Sustain. [The corresponding Japanese words also begin with s!] Here is a cartoon that illustrates the five elements:



Because the concept is simple and straightforward and thus easily packaged into a short lecture, it was selected to be presented using the flip classroom. Students were instructed to watch a pre-recorded lecture on this topic prior to the second class meeting to be held on March 21, 2013. The instructor was video-recorded giving the 23 minute lecture at a recording studio operated by the UAF Office of Information Technology; the result was made available to students several days prior to March 21 at http://echo.uaf.edu:8080/ess/portal/section/d46fabe5-b609-454d-8cf7-e91311711b8f . The lecture includes a several-minute YouTube video describing a successful application of 5S fundamentals.

The classroom part of this 5S Fundamentals segment consisted of student discussion groups, in which they talked about how the principles might apply to their work situations. The essence of the worksheet asked them to "suggest how those five principles could be applied in your workplace and/or a related setting." Following those group meetings, a general discussion took place. After that discussion, students completed a brief evaluative questionnaire related to the effectiveness of the flip classroom in learning about the topic. Total class time spent on the topic was about 40 minutes.

Here is a summary of students' evaluative comments:

- All felt they learned valuable knowledge about 5S concepts and applications.
- The time spent was about right. About 30 minutes to view the lecture fit well within the workday.
- Positive aspects were time to digest information and think about examples, saving of lecture time, and chance for in-class group interaction.
- Negative comments related to a) minor time inefficiency (materials were reviewed briefly in class after students had watched the video) and b) a large file size that precluded watching at home, thus requiring watching at work where time is limited.
- A suggestion for improvement was that more complex concepts are probably more suited to this approach; this topic was so simple that the advantage of watching the video on one's own and being able to repeat and review was not taken advantage of.
- There was no clear indication of a preference for this method compared to the more traditional approach.
- Students used either desktop personal computers or laptops to view the video.

Administrative and IT kinds of issues were few. Clearly there is a need for the instructor not to wait until the night before to get ready for class. Recording the lecture was painless, thanks to the interest and support provided by personnel from the UAF Office of Information Technology. Students must be instructed on how the access the recorded lecture, and this was accomplished both by an announcement during the preceding class and by information on the course website. A warning about the video's approximate file size would help students decide where to watch it. A small amount of extra time by the instructor is needed to pre-record the lecture that would, in the traditional setting, be given in class.

The experiment was a success. As much learning was achieved during this departure from the normal lecture-then-homework routine as would have occurred using that more traditional approach. If nothing else, the novelty afforded by this technique provides some variety that in itself can be motivating. An entire course provided in this manner is probably not appropriate, but one can envision a short course for working professionals of, say, one day duration in which participants view some prerecorded materials prior to their in-person attendance. Would they be willing to do so? Sure, at least if they earn credit (PDH's or whatever) for both their pre-class and in-class efforts.

III.b. Google Hangout with DOT's re: Leadership Learning

Dr. Robert A. Perkins, PE

Google Hangout (GHO) is an interactive video chat that runs over the Internet. There are other, similar systems, such as Skype. Such systems are in fairly common use today and their basics are not mysterious to those who have used them. Here we tested several aspects of GHO that relate to graduate education of working professionals: set up for new users, firewalls, breaking class into multiple groups and re-forming, sharing documents, and aspects of screen share.

- Course or session title:

Best Practices in Leadership Development in State DOTs

- Timeframe,

Eight hours on 17 April 2013

- Leader/instructor,

Drs. Robert A. Perkins, PE, and F. Lawrence Bennett, PE

- Content

The seminar involved managers of leadership development programs in several state departments of transportation and UAF researchers into those programs. The participants presented information about what their departments are currently doing regarding leadership training, and then broke into two discussion groups, and then reconvened to present the result of their discussions.

- Participants – where, employers, experience

A conference was held using an Internet video chat format (Google Hangout) on 17 April 2013. The participants were: Alaska DOT: Clint Adler and Dave Waldo of the Alaska DOT&PF, located in Fairbanks, Alaska, Renae Johansen and Kathryn Overton of Montana DOT, located in Helena, Montana, James Boyd of the Wyoming DOT, located at his home near Cheyenne, Wyoming, and Matt Cronk of Washington DOT, located at his home, and Drs. Perkins and Bennett, of UAF, located at the university campus in Fairbanks. .

- Delivery methodology

The method was to use 100% on-line video chat, Google Hangout, for the instruction, and Google Docs for file transfer. The conference had a plenary session, where all 10 participants were in the same chat room and could see each other, followed by splitting into two groups in separate chat rooms, where only those in a group could see each other, and that was followed by reconvening all participants in the same chat room. Prior to the conference, the instructor contacted each of the participants, reviewed the basics of the chat, and checked their firewall would allow the chat. This was best accomplished with a speaker-phone, so instructor and participant could talk while getting things set up.

- Administrative, media and IT issues

GHO runs on a web browser and requires only a small program that installs the first time GHO is used. That program coordinates the video camera (webcam) and the program. Most modern laptops have a built in webcam, while most desktops do not. A USB webcam can be purchased for as little as $25; the model we used cost about $50. However, some students may not have a webcam for their work computer and would need to buy one. Once the webcam and browser are functional, there is little else in the system.

During a session all the participants are on camera, but the visage of the speaker is large in the center of the other computer monitors, while the other participants are in a smaller pictures towards the bottom of their monitors. The speaker has an option of changing from broadcasting his camera, presumably his face, to broadcasting his computer screen. This is valuable if, for example, the speaker wants to show PowerPoints or such. During that screen broadcast, the audio remains on. Here are some issues:.

- Gmail accounts. Each participant/student needs a Google account. Gmail accounts are available free. Our university, UAF, is on the Google system, so we do not need a Gmail account. Note, there are some other systems, besides Gmail, that are part of the Google system. The students could get their Gmail account, and then use it through their Internet connection.
- Firewalls. We were concerned that some agencies might have a firewall that prevented use of the GHO. Some may, but we tested all ours in advance and there were no problems.
- Browser. Google frowns on use of Internet Explorer (IE) and sends messages encouraging participants to switch to Google Chrome or another browser. We ignored the error message and used IE without any other problems. We used Firefox as well with no problems and no warning messages.
- Classroom use. Two participants used a “smart classroom” setup, that utilized a camera and screen from video conferencing. This basically worked, but they were too far away from the camera and thus were not as “close” to the conversation.
- Work from home. Two of the participants were at their homes, one because he was telecommuting that day and the other because he was snowed in. One of those had connectivity problems from time to time. Another, who participated as a guest lecturer from his work, could not get his camera to work, although the rest could hear him.
- Preparation and Murphy’s Law. For all the participants, we had a brief session a few days before to check out the system, firewalls, and so on. All these were successful. On

the day of the seminar, Murphy awoke and issues arose. For example, one participant had borrowed his wife's laptop because it had a better camera, and then he forgot his wife's password.

- o Etiquette. During the preliminary hook up the participants were told about the mute and camera options and suggested they keep their mikes muted unless they speak. If the mike is live, then things like a squeaking chair can cause the camera to focus on them, rather then the speakers.
- o Telephone. It is good to have a cell phone and land line connection to participants available. (Murphy's Law - stuff happens.)
- o Screenshare - windows That feature allows the presenter to broadcast his video monitor screen rather than his camera. Some manipulation is required using graphics such as PowerPoint, since if the PowerPoints are shown in the full screen mode; the presenter cannot get back into the Hangout mode. A simple option is for the presenter to leave PowerPoint in the editing mode, but then the slide is half sized and consequently about one-third size on the other participating videos. A simple workaround is to use the Windows shortcut keys, Alt-Tab, to shift between programs. The audio from the Hangout continues while the screen shows the monitor.
- o Screenshare - programs. Besides PowerPoint, other programs such as the screens from Word, Excel, and MS Project can be shown on the remote monitors. Caution is needed regarding font size. The remote view is only about half the size of the presenter's view. This can be up-scaled by using the *zoom* feature in *view* menu. However some programs, such as MS Project, do not have that zoom feature. The may be overcome by using a large font. We were not able to get videos, either mpeg or wmv, to display on the remote monitors.
- o Google also has a site for sharing documents. One sets that up and then gives others permissions to work with documents. This requires the others have a Gmail or other Google system account. There may be a little advantage to this compared with emailing the documents, for example, late entrants could get documents that were placed during the class.
- o GHO has a chat feature that would allow participants other than the presenter to make a note or convey information to the presenter or other participants without disturbing the presentation (pass notes in class).

- Assessment
  - Pro
    - o Simple, inexpensive, no coordination with IT people (usually).
    - o Little special training is needed; the system is generally intuitive to many. However 5 to 10 minutes is enough for most web savy people who were not previously familiar with it.

- Seeing the faces keeps people connected – eye contact.
  - It's easy to set up separate hangouts for splinter groups.
  - With a little practice, PowerPoints and other media can be used, although the size is limited to a box within the viewer's monitor – not full screen.
  - Participants do not need a UAF email account, as they would for our Blackboard electronic course management system.
- Con
  - Changes in Google. There seem to be new "features" that pop up and slow up direct hook up and frustrate giving step by step instructions.
  - Some initial training is a good idea and this requires some effort by the instructor prior to class.
  - In a different venue, one student used an iPad propped up – this worked but led to distractions associated with body positions vs. camera and so on. GHO technology should work in a mobile situation, but for instructional pedagogy the student should be seated in a comfortable room. A cube farm might work, but earphone and care with the microphone mute would be needed.
  - Since everyone (usually) tunes in at once, there can be confusion if one or two have issues, for example one has their microphone muted.
  - GHO class size was limited to 10 and the newest version is purported to handle 15; however the picture size gets smaller and the direct contact feature probably fades at about 10 – one cannot keep eye contact with too many.
  - Google has new features and advertising and invitations to join things. These are a distraction to someone new to the system.
  - Failure to mute means that just shuffling papers or clearing your throat makes the offender the center of attention.
  - Bandwidth can be an issue. It generally results in jerky movements. If a participant is logged off their system they just disappear from the screens – the other participants do not know if they have been cut off or if the other has shut their camera off.
  - The Google file transfer system, Google Docs, is handy, but requires some extra steps to download, compared with a simple email attachment. Thus, it requires a little training for a one-time class. For a class over several sessions, this should not be a problem.
  - We had two presenters in one room, each on their own computer. This led to feedback problems. These are easily controlled with muting, but some difficulty, if one presenter wants to ask the other presenter a question.

- Observations, conclusions, overall recommendations, suggested further studies

All the respondents agreed that GHO would be good for a class size of 10 or less. Because the face to face contact is somewhat intense, class sessions should be limited, certainly less than half a day. For a two-hour class, several times a week, it would work well.

The technical problems we had were all minor human error-type problems and probably unavoidable. However having a brief training session before the first class is probably wise.

In general for on-the-job training, there is an advantage to getting the trainee out of the normal workplace and workspace. This avoids distractions. Also, a bored or distracted student can tune out of a webinar completely. For GHO, since the student is connected in face-to-face contact, the student may be able to stay in their accustomed workspace with the personal interaction of the hangout overriding the local distractions. Some consideration should be given to use of earphones and miniature microphones.

For a class that used Excel spreadsheets, the students could be asked to solve problems and present the solution to the rest of the class. Also, groups or teams could be used in separate hangouts, although the instructor could only be included in one hangout at a time – he would need to log out of one in order to join another.

For overview, lectures, and discussion, GHO is great. For engineering classes where typically there are a lot of equations and on-board problem solving, it would not work by itself. If GHO was combined with an on-line whiteboard feature, where the students could flip between the whiteboard and the hangout, it might work quite well, and this should be tested.

There is virtually no expense to using GHO; however, this may be offset by Google's endless barrage of new features and social media interactions and invitations.

We recommend further use of GHO in a course of some length, several hours a week for a several weeks or a whole semester. This will give the instructor an opportunity to work through the best use of the interaction, such as student presentations, display of homework, and use of the Google Docs system.

We recommend a computations type course using a white board or tablet in conjunction with GHO.

We also recommend trying GHO in a cube-farm using earphones and microphones, for its effect on both the students and their neighbors.

III.c. An Interactive, Video Conference Format Class in Project Scheduling Techniques

Dr. F. Larry Bennett, PE

As part of the University of Alaska Fairbanks Graduate Certificate Program in Design and Construction Management, a one-credit course in Advanced Project Scheduling Techniques, CE 653D, was presented in Fall 2012. Classes were held twice a week on Mondays and Wednesdays, for three weeks, between November 26 and December 12. Each class lasted 135 minutes, to comply with the total time requirement for a one-credit graduate course. The class schedule – between 3:00 and 5:15 PM – was such that students and their employers each contributed time to class attendance: 3:00 to 4:30, say, on the employer's workday, and 4:30 to 5:15 on the employee's own time.

As prerequisites, students were expected to have had experience in some aspect of project management and to be familiar with both the basics of project scheduling and the rudiments of one project scheduling software package. Students came from a variety of public and private backgrounds, including a public transportation agency, design consultancy, and construction contacting. They were located in both Fairbanks and Anchorage.

The course originated in Fairbanks where the instructor, Dr. F. Lawrence Bennett, P.E., is located. His background includes various positions in construction, such as planning and scheduling engineer, owner's on-site representative, field engineer, and project manager, in addition to 29 years on the University of Alaska Fairbanks Engineering Management faculty, prior to "retirement" in 1997.

Course Goals and Content

The stated course goals were as follows: (General goal) Become familiar and comfortable with the use of two popular project scheduling software packages, Microsoft Project® and Primavera®. (Specific learning objectives) 1) Learn many of the advanced features of Microsoft Project® and Primavera®. 2) Apply those advanced features to actual real-world projects. 3) Compare and understand the differences between the two software packages.

The following quotes from the course description in the syllabus:

"For those with some experience with network scheduling for projects, this course explores basic and advanced features of two popular programs – Microsoft® Project and Primavera®. Resource analysis and scheduling, cost applications, scheduling monitoring, report generation. Techniques and practical applications.

Scheduling assignments, written report, student presentations, no final exam."

Thus, the course was intended to teach advanced features of two project scheduling programs. But it was also intended to have those features applied to real projects. And, most importantly, participants were to use those application efforts to analyze and evaluate the usefulness and limitations of the software packages in their professional work situations.

Course Delivery

Classes were delivered via the satellite-based, interactive network operated by the University of Alaska Statewide Office of Information Technology, utilizing facilities maintained by the University of Alaska Fairbanks Center for Distance Education (CDE). Equipment in the CDE classroom in Fairbanks includes a video camera which the instructor can manipulate, a parabolic microphone to capture instructor comments and classroom discussion, and a video screen that displays 1) an image of the program being broadcast – at the instructor's option, either a camera view of the classroom or the program being shown on the instructor's computer – and 2) an image of the camera view from each remote classroom. The normal (nowadays, anyway) smart classroom computer setup is available, including provision to connect the instructor's laptop computer in order to display a Power Point Presentation, for example. [An alternative is to use the classroom computer to show such Power Point from a flash drive.]

In the remote classroom (in Anchorage in this case) is located a video screen displaying the program originating in Fairbanks and a view of the other site(s), a camera that captures the remote class in action, and a microphone for use by the remote students.

The class was conducted in much the same way that a traditional lecture-discussion class would be carried out. Because of the nature of the course content, a great deal of the "lecture" material was presented as a demonstration, with the instructor performing a series of keystrokes on the computer, after which students were invited to mimic those operations to achieve, hopefully, the same results. Students were required to have loaded both Microsoft Project 2010® and Primavera P6® onto their laptop computers, which they brought to class.

Two reports were required of each student, one on the use of Microsoft Project 2010® on an actual project, including some of the software's advanced features, and the other a similar effort utilizing Primavera P6®. In addition to written reports, each student presented oral summaries, in front of the camera and supported, in most cases, with some sort of visual backup such as Power Point.

Evaluation

Course management went smoothly. The Design and Construction Management Certificate Program operates a website with pages devoted to each course. (University of Alaska Fairbanks College of Engineering and Mines. 2013) Course documents and other information are available for downloading. The challenge is for the instructor to upload the materials timely; in this case, this goal was achieved. Written reports were sent to the instructor via e-mail, were commented upon using the WORD Review feature, and returned to students via e-mail. In addition, students were encouraged to contact the instructor via e-mail with questions and comments.

Two primary challenges made the course less than fully satisfactory. First, the various protocols required in order to download free student versions of the software packages were frustrating and time-consuming at best. The instructor could have been more helpful by providing clearer and more complete download directions. In the end, all students were successful in obtaining the needed software.

The more significant challenge related to the quality of the video image transmitted from Fairbanks to the remote site in Anchorage. With so much of the on-screen content shown as computer screen imagery, and with the need for students to be able to see that imagery in order to mimic the commands, it follows that the image must be clear enough to read. Such was not the case in many instances, which left remote students to “fend for themselves.” Although such an approach might be considered to have a positive effect on learning (“The harder you work, the more you learn.”), it was apparent that those students were left frustrated and often unable to keep up. Thus, the technology must be improved through greater bandwidth, faster refresh rates, or whatever is needed to produce a clearer image. Another approach might be to show on the transmitted program only a portion of the computer screen so that the size of the characters was increased considerably. Until the image clarity problem is resolved, courses of this nature ought not to be presented at remote locations using existing technology.

Students believed the course content was meaningful and useable and the course packaging was appropriate. Further, they suggested the scheduling was reasonable and as good as possible, given their busy work schedules. For improvements, they suggested more interaction and question/answer opportunities for all participants and less lecture. In addition, some pre-set data files could be used for relatively short exercise assignments. They also noted that problems with the video conferencing feature, which occurred several times, took valuable time away from student learning. On a scale of 1 to 5 (5 high), they rated the course at between 3.5 and 4.0, primarily because of problems with video transmission.

In the future we need to test other means of transmitting quality video, when computer output is displayed on the screen. One possibility is larger font sizes, but many programs use default fonts that may not be changeable.

III.d. Overview of Three Years of Video-Conferenced Graduate Courses for Working Professionals

Keith Whitaker, PE

The Design and Construction Management Graduate Certificate Program offered by the University of Alaska Fairbanks (UAF) Department of Civil and Environmental Engineering features one-credit and three-credit courses that are all offered to remote classrooms by video conferencing. Remote classrooms may be located at any compatible video conference location but are typically offered in several UA sites in Alaskan communities, usually Fairbanks, Anchorage, and Juneau, and sometimes Palmer, Sitka, Ketchikan, or other smaller communities.

Video conferencing is also available to individual remote computers, however for several reasons this option is not actively promoted and often discouraged. Technologically, bandwidth constraints on private internet sources create video and audio feed losses and the OIT support personnel at UA have no control of equipment and service beyond the UA network. From an educational perspective, it has been observed that additional learning is derived from direct in person student interaction. Gathering remote students in a classroom, rather than on individual computers allows for additional sharing of ideas and encouragement to learn in the subject matter.

The program features one-credit academic courses, usually with six 2 ¼ hour class meetings in the late afternoon in a three or six week format. Typically the employer pays the course tuition and one hour of work time in class, while the student is not paid for the other hour and the time to prepare homework and such.

- Course or session title, timeframe, leader/instructor, origination location

Between 2009 and 2013, UAF has offered over 30 courses by video conferencing in Alaskan Cities: Fairbanks, Anchorage, Juneau, Palmer, and Sitka.

Courses have been offered primarily in a late afternoon timeframe and some evening formats. This time allows for the working professional to take the courses and allows for the recruitment of highly qualified technical adjuncts that are also working in the industry. The one-credit courses have been run from late October through December and Mid January through March to also accommodate the working construction professional by avoiding the busy Alaska construction season.

Course instructors have included current and veteran University faculty as well as first time instructors. Instructor’s technical abilities have ranged from seasoned professional to the technically challenged.

Origin location has mostly been from Fairbanks locations but has also included both Anchorage and Juneau. As the opportunity is available some instructors have taught at least one class from what is otherwise the remote classroom location.

- Content

The program features courses in three major content areas including Project Management, Human Resources and Communication, and Construction Technical. Courses within these areas have included planning, scheduling, risk analysis, proposal writing, legal principles, contracting methods, estimating, and others related to the management of the design and construction process.

- Participants – where, employers, experience

Most of the initial participants were from the Alaska DOT. The program now has a strong involvement from both public and private employees. Most of the participants had more than 10 years of experience. About half were engineers.

- Delivery methodology

The courses all used video conference technology, and connect UA venues that are connected with Internet II and a wide bandwidth. Initially most of the classrooms were arranged for conferences, and not for lectures. The initial connections were monitored by a central video conferencing group (OIT) that was available by phone if needed, although they often listen-in to the conferences. One set of courses was held at non-UA venues and these suffered from bandwidth problems.

- Administrative and IT issues

Generally the video rooms are under control of the owner of the building, often a UA academic entity, while the video conferencing equipment is under the control of the central video conferencing (OIT) group. Thus to schedule a set of classes, the coordinator or instructor must contact the central OIT group that must in turn contact the building owner and verify the room will not be in use. OIT cannot schedule the class until this is lined up. Since the building owner may have no interest in the course and may be reluctant to give up their space, the scheduling of the room for the conference may be delayed. Matters of building keys, entry times, and such can arise.

Once the set of classes is scheduled and begun, there are seldom IT issues. Occasionally the equipment in a remote venue has been tampered with – turned off, unplugged, or wires switched to accommodate other users of the facility. There seems little defense against this. Often this problem must be solved by the remote students. If they are at a UA site, there is a building coordinator that can assist them or no matter the location they can call OIT on a cell phone and get advice and instructions. But petty tampering and recovery can be a distraction.

Initially the video conferences were scheduled based on class times. The video connection did not "open" until the start of class, so potential connection problems were not apparent until then – limiting the time to solve them without excessively delaying the class. Scheduling practices now plan for 10-15 minutes prior to the start of class.

At UA the OIT group is very accommodating and OIT has not charged the Engineering College for their service. The remote UA venues likewise do not charge a fee.

- Assessment
  - Pro
    - Video conferencing is the easiest type of distance learning for the instructor, since there need be no changes in lecture style or modifications to course content to fit alternative delivery methods. Since the conference call is initiated and monitored by OIT staff, only brief instructor training is needed at first to review available equipment, but use of the remote control equipment is largely intuitive for most faculty.
    - The instructor can see the remote class and make eye contact and receive questions real time.
    - It is possible to tie in a single student via an Internet connection if a classroom option is not available.
    - When needed by the coursework, students can make live presentations to the class no matter where they are located.
    - Beyond the course learning objectives, students gain understanding of industry communication options, benefits, limitations, and etiquette. For rural and remote construction projects this is an especially critical issue to be understood.
  - Con
    - Glitches with the equipment happen. These can generally be remedied by the students without too much trouble or time lost. It is important that students and new instructors experience well running equipment for the first class or two. Also, we recommend having one experienced staff or student in each of the rooms for the first class. After that, if there is a problem it will likely not discourage students completely.
    - Once a venue is scheduled for a class, it is difficult to change venues, if something does not work out. For example, we discovered that the bandwidth of a location was highly variable and essentially unusable at times, although theoretically there was enough. Also a change in equipment from one location to another often requires time to learn operation of the equipment for remote students or the instructor.

- Students have indicated that they appreciate meeting the instructor in person and gain more benefit from the course when they do. Some course locations and instructor schedules do not allow for any in person meetings.
- While the delivery method is easiest for the instructor and is similar to a single location lecture, the instructor must still be pro active in keeping the remote classroom(s) involved with the origination class. While the instructors can see the remote students it is easy to only interact with in-person students and the experience for the remote student becomes similar to watching a prerecorded class. Instructors must also consider logistics of providing in-class handouts.
- Using one-credit modules that divide the work into pieces that the students can use put to use has a great appeal to working students. However, since the classes move rapidly toward completion (typically 16 days from start to end when the class is offered in three weeks), there is less time for the instructor to adjust course content, change directions, or make up lost time if needed.

- Conclusions/Recommendations

The use of Video Conferencing for course instruction is well suited and recommended for all types of construction and transportation training and education. Its use can provide for fully remote offerings of training or education programs to facilitate continued education of the working professional workforce. Its use also provides educational opportunities to remote students who would otherwise be unable to travel to a training location. Issues observed in its implementation can be overcome with minor administrative and instructor planning or training.

- Schedule the video conference sessions to extend prior to and beyond the actual class time. 15 minutes before will allow for some equipment problem solving if necessary. 15-30 minutes after will allow for instructor overruns or student interaction time.
- Insure and double check location scheduling of both origination and remote sites for both the Video Conference and the physical room. This is often two separate schedulers.
- Provide opportunities for instructors to originate one class per semester from otherwise remote classrooms.
- Provide pre course video conferences for new instructors to practice on the system. This allows for technical training as well as for teaching style adaptation. It is also beneficial for instructors to sit in, or video conference in to other courses to see how other instructors make use of the technology that is available.
- Encourage instructors to have students explore the use and possibilities of video conferencing as part of coursework. This allows for expanded learning of both the student and instructor beyond the stated course outcomes.

III.e. An undergraduate structures course for students in Alaska taught from North Carolina via video conference

Dr. J. Leroy Hulsey, PE

- Course or session title

Structural Analysis, CE 331, a three-credit undergraduate course.

- Timeframe,

  Spring 2013, three times a week for one hour, starting at 8 AM Alaska Time.

- Leader/instructor,

  Dr. J. Leroy Hulsey, PE

- Origination location

The course described is an undergraduate, junior-level class in elementary structural analysis. It is a required course and it is the first time at this University an undergraduate class in structures has been taught via distance education

This course was taught live from North Carolina State University (NCSU) in a studio that provided the proper bandwidth to professionally connect with a classroom equipped by the Video Conferencing Center of the Office of Information Technology (OIT) at the University of Alaska. Because the course was taught live, it provided the opportunity for the students to participate in the lectures by asking questions and interacting with the instructor.

I prepared for the lecture at the North Carolina State University Studio for Distance Education, which enabled me to present lectures using an electronic tablet. The lectures were presented live and many of the prompts were prepared on the tablet prior to the lecture. The lecture began at 12 PM Eastern Time. Each lecture was saved in a electronic file. This enabled students who missed class to get a copy of the lecture by email. If a student was to be gone for more than one lecture, Dr. Hulsey requested that the OIT record the lecture. This video recording was then made available for the students to hear the lecture and study the important points that were made during the lecture period.

- Content

The objective of this course is to provide each student with a thorough understanding of the theory and application of structural analysis. Emphasis was placed on developing the ability to analyze problems. At the conclusion of this course, students were expected to understand the following:

  - equilibrium

- reactions
- shear and moment diagrams for beams and frames
- truss analysis
- deflections of trusses, beams and frames
- influence lines
- indeterminate structures

- Participants – where, employers, experience

The proposed outcome by taking this course is to provide fundamental knowledge to Civil & Environmental Engineering students at the junior level. In order to qualify to take this class, students must have successfully passed courses in “Properties of Materials” and “Mechanics of Materials.” Thus students had demonstrated at least minimal study habits and analysis skills. Based on meeting the minimum perquisites, students from any University could be invited to take this course. Students attended the lectures by meeting in a smart classroom that has video sending and receiving technology.

- Delivery methodology

This course was delivery by video conferencing. During this, my first distance delivered course, I discovered that, contrary to expectations that students taking structures, mathematics or the sciences would give up a significant amount of learning through this approach; rather the teacher has more tools to illustrate and demonstrate concepts through the use of sophisticated visual media. By using this approach, the teacher can actually create a virtual laboratory to illustrate sample behavior during testing. This is very difficult through the more traditional methods.

- Administrative and IT issues

Some of the important administrative and IT issues for presenting a class in distance education are:

- At the start of class, the electronics systems are not necessarily automatically ready for the instructor and student. Systems are typically shut down or dormant prior to the lecture period and they require a startup. If the instructor is in the classroom and they are teaching to other areas such as remote locations and or students at home connected with a lap top; the instructor can start up the equipment. However, if the instructor is at another location (the case being discussed here); then the system must either be turned on by some employee of the University or we will need to train the students to bring up the system a few minutes prior to starting class. The later was used for this class. We trained three students so that if two were absent, one was still available to start the system. This approach worked extremely well. It should be pointed out however, that a week at the beginning of the semester needs to be devoted to working out all of the wrinkles in the system.

- A given lecture's success is highly dependent upon the capacity of the system (bandwidth) and that the system is up and running. In order to meet this objective, IT personnel must be available to insure that the lecture will be successful. In this case, video conferencing technology was utilized on two different campuses. Thus, IT personnel were often needed at both campuses to monitor and answer questions. Generally, however the system at North Carolina State University was available and I was trained to solve most of the technical problems and we only needed IT personnel at the receiving end. Thus, prior to the lecture, the University of Alaska Fairbanks sent NCSU a signal to turn on the system and it was then up and ready to receive. The students were still needed to turn on audio and adjust the video.

- Assessment

The students were excited about the course but they would have preferred that I had been present in the classroom and available for questions. Although I believe my lectures were better than when they are taught live in the class room, my reputation preceded me and the students wanted me to be in the classroom with them. I believe if the camera would have been available to enable me (the instructor) to see all of the students; their response to the concept of distance education would have been different. Further, I returned and taught in the classroom for a couple of weeks and this enabled them to see both approaches. There is no doubt that availability is compromised through the distance approach.

- Pro

The lectures and the ability to demonstrate virtual testing is tremendous advantage. Further, the ability to record and provide the lectures to students for the purpose of advancing their learning is a definite plus.

- Con

The experience in this setting was restricted to some degree because the class room setting at the University of Alaska Fairbanks did not have a sufficient number of cameras to enable the instructor to see all the students in the class room. There were about 21 students and I could only see approximately ten. Thus, this produced a significant limitation in teaching to the entire class.

Some students were upset that the instructor was not readily available for consultation and they would have preferred that I was there in the class room. It was a general belief that the video conferencing was not as effective as teaching in the classroom.

- Conclusions/recommendations for that application

Considering that this was the first time that we have taught an undergraduate course in structural analysis through distance education. If this is done again, there are many ways to improve the presentation and improve the learning. It is absolutely critical to have enough cameras that the teacher can see all of the students; this connection is critical. If these improvements are made this forum can be more effective than teaching by the more traditional methods. Further, if distance education is being employed, it is critical that the Teaching Assistant be excellent as this person is the first point of contact.

IV. Observations, conclusions, overall recommendations, suggested further studies

Employers of engineers, especially state transportation agencies, note the lack of comprehensive undergraduate training in specialty areas. A variety of post-graduate education programs, such as the traditional MS, work for a few students; however most students need education modalities that fit with a work schedule that often involves summer overtime and travel. The time demands of the education must conform to the students' life style, which also values "work-life balance." The education system must account for the fact that engineers can earn a livelihood without the advanced education. Delivering this specialty education with techniques that are convenient for the working engineer would benefit the engineers, the employers, and, ultimately, the public.

In the project we offered a variety of courses and modules by alternative methods and evaluated the administrative efficiencies and the effectiveness on student learning and satisfaction. One alternative method was the "flipped classroom," whereby the students observe a lecture prior to class by viewing a video (usually available on-line) prepared by the instructor. This activity takes place asynchronously, with the student proceeding at her own pace and taking as much time as needed to comprehend the material, by repeating, stopping and starting, and reviewing, using the features afforded by the video-watching technology. The classroom session in-class efforts consist of activities that otherwise would be done as "homework" – completion of a problem set, group discussion to complete a worksheet, consultation with the instructor, and the like. Our flip classroom was offered during an evening class in "lean construction" and was well received by the students, but for our research, we learned about the practicality of making the video, coordination with the campus video production groups, and mounting the video on the college server. For another example we used an interactive video chat, Google Hangout, to hold an eight-hour seminar, which included breaking the class into two groups for special discussions and re-convening the groups for a final session. We learned about the practicality of training participants in the use of the system, problems and their resolution, and system limitations. For another method we taught a full three-credit undergraduate course remotely, using video conferencing, with the instructor located several thousand miles away – we have extensive experience teaching graduate courses remotely, but the purpose of this was to learn how undergraduates reacted, compared to graduate students. Finally, we used video conferencing to teach a course that made heavy use of computer programs, and experienced the limitation of bandwidth on the program and resultant loss of video image clarity, and experimented with work-arounds via student laptops.

We added a summary report about our early work with using video conferencing for specialized courses in construction management.

Detailed observations and conclusions are described in Section III for each of the modes. Here we offer some general observations:

From the instructors' standpoint, some methods are very similar to traditional classroom teaching, while others are much different. It is important to keep this in mind when discussing alternative and/or innovative teaching. One instructor may describe a new method daunting while another may adopt it vigorously – they may not be describing the same method. Also staff support may be crucial for one method and not important for another – the support may be there in one situation and absent in another. Students too may have very different situations.

Some methods allow flexibility of time and place for both the instructor and the students, which are generally asynchronous methods, implying convenience. But often these methods are very time demanding on the instructor – designing a web-based course, then offering it. Other methods, such as video conferring are not flexible regarding time and place and require a special room and dedicated bandwidth. But this method takes little extra time or effort for the instructor, once the systems are in place.

The literature review indicates little widespread use of alternative methods for continuing education of technical professionals. The medical profession has embraced the idea in a big way; we should continue to monitor their efforts.

Many of these techniques can have useful application in remote regions. In Alaska at least, such regions do have technical professionals who can take advantage of such courses. For example, while there are large DOT offices in three of our regions Fairbanks, Anchorage and Juneau, there are much smaller satellite offices in Nome, Valdez, Sitka, and Ketchikan where remote instruction could be valuable.

Some undergraduates felt short-changed by the distance delivery, apparently not because of the classroom instruction, but because they wanted the instructor available outside of class. This may be much less of a problem with working professionals, who do not expect the instructor to be available. It has not been a problem with graduate students.

For any of the alternative methods to be successful – offer an advantage to learning for employed engineers and other technical professionals - several things must be present:

1. The subject matter must lend itself to the method. For example, the method used for training students how to give effective presentations might not work for training students how to solve engineering/quantitative problems.
2. Our research involved senior faculty who were interested in the new methods. Thus there was no need to “sell” the methods. The faculty were willing to spend the time to learn the new methods and tolerant of many bumps in the “learning curve.” Faculty who felt pushed into using a new method might not be so positive.
3. We had an established student clientele, and in most cases the methods were introduced as an experiment that was a small part of their learning experience. Thus the students were also tolerant of the bumps. This was not the case for some of the undergraduates who felt they were losing by not having the instructor in the classroom, or rather, have the instructor available for out of class consulations.
4. UAF has excellent support from the Office of Information Technology (OIT), especially the Video Conferencing and Training staff. In addition, for the course taught from NC State, their staff was very helpful. In addition, the UAF library had a faculty support group that helped with video production.

Thus, some care is needed when extrapolating our findings. All four pieces: proper method, faculty buy-in, student buy-in, and support, are needed for success.

A fifth item might be having a situation where the faculty and students can try out a new method. For further development, we suggest working with faculty who are new or relative newcomers to non-traditional teaching methods and examine how they adapt to using some of the new methods and what materials they need. Although the current project research examined several modes of offering non-traditional education in a variety of administrative contexts, the instructors and local administrators were part of the research team. We next recommend some improvements to some of these methods, but the main recommendation will be to work with instructors who have not used these methods. We suggest developing some training materials, offer some training, and develop some “packages” of materials that incorporate instructional material, especially the short video presentations that are used in the “flipped classroom” modality. Specifically, we need to know if instructors who have not used these electronic methods are willing to adopt them and under what circumstances, and which course characteristics are conducive to these methods. UAF sponsors a Fundamentals of Engineering review course that uses many instructors, and the conversion of this series of lectures to a flip classroom will enable analysis of a number of instructor types and course materials. In addition, we suggest developing modules in transportation engineering. This will enable the extension of the flip classroom using video conferencing, since the students will be located three different DOT regions.

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