Technology-Based Support for Quality Teaching and Learning at TAMUQ

doi:10.3991/ijet.v5i1.1124

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***Abstract*—This paper discusses the experience of utilizing technology-based instruction in teaching four undergraduate courses and two graduate courses at Texas A&M University at Qatar (TAMUQ). This technology-based instruction relied on the capabilities of Camtasia Studio and PowerPoint software for recording lectures or solutions of various problems. These recordings were made available to students through the Blackboard Vista and MediaMatrix systems. The students' feedback was assessed using a web-based survey that included questions about the quality of the recordings and their possible benefits to students in understanding the course material. The students' responses and the instructors experience have demonstrated that technology-based instruction contributed to enhancing students' learning experience, capturing knowledge of experts teaching the courses, and improving the exchange of information between instructors teaching a course in parallel at the main campus of Texas A&M University in College Station-Texas (TAMU) and TAMUQ. It was clear from the survey responses that the availability of lectures and solutions helped them to better understand the lectures and comprehend the course materials. It is believed that the multi-national environment at TAMUQ, where English is not the first language for most students, was a main factor in the positive response to the availability of recorded lectures and solutions.**

***Index Terms*—Camtasia, Recording, Streaming, Survey, Video-Conferencing**

I. INTRODUCTION AND BACKGROUND

The past decade has witnessed significant advances in developing software, hardware and internet applications for supporting technology-based instructions in order to enrich students' learning experience [1, 2, 3]. One of the primary outputs of technology-based instruction is to make available to students with recorded lectures and problem solutions produced using several software applications. The proponents of providing recorded lectures believe that it is an excellent method to [1, 2]:

- promote on-demand learning based on the student's availability, especially for nontraditional-age students who are working full time,
- reduce learning time because students can watch the lectures and solutions several times, and
- capture knowledge of experts who offer these recorded lectures and solutions

In spite of the above mentioned advantages, there has been a general concern in the literature that the availability of recordings might cause students to be less interested in attending classes and proposed that some measures should be taken to ensure that attendance in not adversely affected. Fro example, Young [4] offers the following primary guidelines to encourage students to attend classes with recorded lectures:

- Make classes more interactive.
- Give regular in-class quizzes.
- Shut off the camera when talking about what will be on the test.
- Wait 10 days after each lecture to offer a replay.
- Stop offering recordings if class attendance drops and start taking attendance that is considered in the final grade.

In addition, the study conducted by Young [4] documented the experiences from several case studies as follows:

- The availability of recordings had almost no impact on students' attendance. On the contrary, it was found that recorded lectures had the advantage of motivating instructors to spend more time to decide on the material that needs to be presented in class and material that should be recorded outside class time and provided to students. The outcome was more optimized class time to cover the course material efficiently.
- Other studies have shown that recordings helped to improve students' learning of the course material, and consequently, enhanced retention.
- Brittan-Powell, Assistant Professor of Psychology at Coppin State University, reported that recordings have led to fewer dropouts and improvements in grades in his courses. He also noticed that fewer students were showing up during office hours after he started providing lecture recordings.
- Brommer, Assistant Professor of Geography at the University of Alabama, indicated that the availability of recordings led to better classroom discussion.
- O'Neal, Senior consultant at the University of Michigan's Center for Research on Learning and Teaching, stated that "the heaviest users of lecture recordings will be high-achieving students, who already look for extra resources, rather than struggling students who might gain the most from watching lectures a second time" [4].

Another important aspect of technology-based instruction is video conferencing, which can be used to broadcast lectures live, or to show pre-recorded lectures as part of distance education [5]. More recently, video conferencing has offered a solution to avoid duplication in offering lec-

tures in universities that establish new campuses [6]. Freeman [6] states that video conferencing reduces cost of travel of lecturers between campuses and improves equity in education in different campuses of the same university. In spite of the many advantages of video conferencing, there have been several studies that focus on the adverse impact of video conferencing on the lecturing staff. For example, Knox [7] reports, based on several case studies, that video-conference lectures require more preparation time, the lecturer feels less in control of the lecture as he or she has to rely on support staff that deal with technical issues of video-conferencing, and in some cases lectures offered through video-conferencing are less dynamic when compared with live lectures.

In addition to the overall positive experience reported in the literature in using technology-based instruction, a number of factors at TAMUQ have encouraged the authors of this paper to examine the impact of recorded lectures on the education experience at TAMUQ. Firstly, TAMUQ is a multi-national community where students come from about twenty countries where English is not the first language. Students admitted to TAMUQ have to pass the same English proficiency requirements as those applied to international students who are admitted at the main campus. Nevertheless, the authors of this paper have felt that the recorded lectures could contribute an added value in improving the communication of technical information to students. Secondly, the need arises in some cases for courses to be taught in parallel at TAMUQ and TAMU; a mechanism is needed in such cases to share lectures and diverse experiences in the two campuses. Thirdly, about 30% of instructors at TAMUQ come from TAMU and some of them continue to have teaching responsibilities at the main campus. As such, these instructors can record lectures and make them available to students at TAMU as part of a hybrid teaching approach as discussed later in this paper.

This paper is organized in four main sections. The first section presents a brief overview of the infrastructure, systems and software available at TAMU and TAMUQ to support technology-based instruction. The second section documents the experience at TAMUQ in supporting traditional teaching methods with recorded lectures and solutions of problems. An online assessment was conducted to obtain the feedback of students and the results of this assessment are summarized in this paper. The third section presents the experience of blended teaching in offering two graduate courses by faculty at TAMUQ to students at TAMU. The last section summarizes the experiences from technology-based instruction at TAMUQ and puts forward recommendations for future improvements.

II. SYSTEMS AND TOOLS FOR TECHNOLOGY-BASED INSTRUCTION

Texas A&M University supports internet applications for distribution of course content to students via secured internet access and provides tools for online teaching. An example of these internet applications is MediaMatrix (http://imedia.tamu.edu/) which is designed to handle internet media streaming content [8]. Using this system, an instructor can control the distribution of the course material to specific groups which are granted access to MediaMatrix. The University also maintains Blackboard Vista, which is a university–wide learning management system for teaching courses online [9]. This system is a secure environment for an instructor to share course material, assign homework, maintain a grade book, and receive homework solutions. In addition, a student can access his/her grades and monitor performance using this system [10].

The internet applications for technology-based instruction at TAMU are also accessible to TAMUQ. The infrastructure and tools at TAMUQ support the culture of technology-based instructions. For example, all TAMUQ students receive tablet personal computers (PC), and classrooms are equipped with tabletop microphones and pen-operated computer monitors that allow instructors to write electronic notes on the computer screen. The classroom computers have Camtasia Studio 5 which is a software used to record all screen activities including opening a file, executing a program, or writing using a stylus pen [11]. An instructor can access Camtasia Studio as a standalone application or through the PowerPoint software.

I. ENHANCED EDUCATION THROUGH RECORDED LECTURES AND SOLUTIONS

The setup to record the solutions consisted of a Toshiba M400 tablet laptop computer and a microphone for the recordings that were completed outside class, or a desktop computer with a wireless microphone for lectures that were recorded in class. The recordings were produced using Camtasia Studio 5 either as a standalone application or as a Microsoft PowerPoint add-in (http://www.techsmith.com/camtasia.asp). This combined software application allows managing the recording from the PowerPoint software, and developing an index of the recorded lecture that facilitates choosing the parts of the solutions (PowerPoint slides) that a student wants to review [12]. A unique feature of Camtasia Studio 5 that significantly improved the quality of recordings is the "Smart Focus" option. With this option, Camtasia Studio 5 zooms in and out of the screen following the motion of the writing pen, which gives emphasis on the part of the solution that is being discussed.

A. Courses and Assessment of Students Experiences

1) Math 151: Engineering Mathematics I

This is the first mathematics course required for all engineering students at TAMUQ. To prepare for the recording of course material, the instructors initially identified some typical questions to cover various topics and basic concepts**.** The recording starts with a PowerPoint slide, which includes illustrations and drawings needed to solve the problem. This is an important step in order to reduce idle time during viewing the recording and focus on presenting technical information within the shortest time possible. Then, the instructor describes the problem before writing the solution. Once the solution is complete, it is produced in two shareable formats: Adobe Flash (SWF) movie file and Windows Media streaming video (WMV format**).**

The solutions were made available to students via the MediaMatrix system. This is a streaming asset management and delivery system. The advantage of this system is that it provides a secure connection to share the solutions with students. Students were given the option to watch the recordings online or to download the recordings. In order to facilitate accessing the solutions on MediaMatrix, a link was created and placed on BlackBoard Vista. Students are

able to access all information relevant to the course including their grades on BlackBoard Vista.

A web-based survey was designed using Vovici Survey Software v4 in order to assess the students' experience with the recorded solutions [12]. The assessment questions were as follows:

- Q1: I have watched the solutions of the following number of problems:
- Q2: I am satisfied with the quality of the video part of the recordings:
- Q3: I am satisfied with the quality of the audio part of the recordings:
- Q4: The problems solved in the recordings represent the course material:
- Q5: The explanations of the solutions are clear:
- Q6: The solutions have helped me to understand the course material:
- Q7: The pace of the recordings is reasonable:
- Q8: The recordings of the solutions should continue in this course:
- Q9: I would like to see recordings of solutions in other courses:
- Q10: I would like to receive the video solutions on my iPod:
- Q11: I can access the video solutions easily:

In the first question, a student was asked to select the number of problem solutions that he/she has accessed before. As shown in the screen capture in Fig. 1, the number of choices was divided into four categories (six or more, three to five, less than three, and none). If a student answers "none" to this question, the survey will end and the student will not be prompted to answer the remaining questions of the survey (Questions 2 to 11). These questions focused on evaluating the quality and benefits of the recordings. For each of the questions (see Fig. 2), the student was asked to select from the following choices: Strongly Agree, Agree, Disagree and Strongly Disagree.

Survey participation was optional and conducted outside of class time. Of the ninety students enrolled in the course, thirty nine answered the first question in regard to the number of recordings that they watched. The answers to this question are summarized in Fig. 3. In this figure, the number of students that selected each of the answers is shown on the pie chart, while the numbers in parenthesis are the percentages of the students selecting each of the answers. As can be seen, only three students (7.7% of the students) did not use the recorded solutions. These results indicate that students' were interested in using the recorded solutions in their studies. Twenty nine students proceeded to answer the remaining questions in the survey. Figure 4 presents the number of students who selected each of the answers (Strongly Agree, Agree, Disagree, Strongly Disagree) for Questions 2 to 11. Figure 5 presents the same data in Fig. 4 but in terms of percentage of students selecting each of the answers. The following points summarize the main findings from these results:

- About 80% of students selected Strongly Agree or Agree for each of the questions (see Fig. 5). This response indicates that students have found the recordings to be useful for their studies.

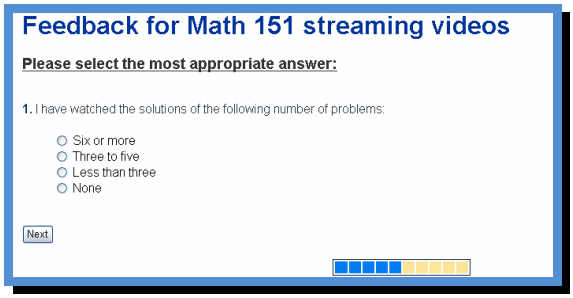

Figure 1. Screen capture of the first question of the survey.

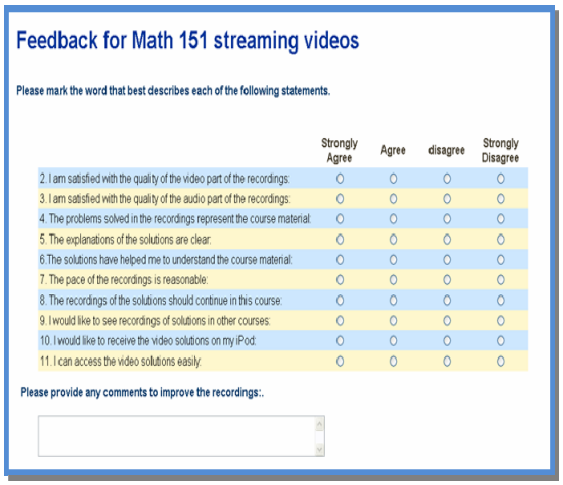

Figure 2. Screen capture of the assessment points in the survey.

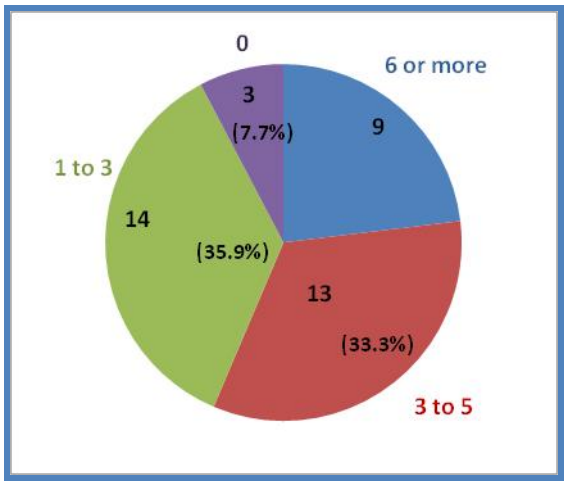

Figure 3. Responses to First Question of the Survey for Math 151.

- The responses to questions 8 and 9 strongly show that students would like to see the recordings continuing in this course and expanding to cover other courses.
- In answering question 10, students have commented that it will be useful to have the solutions available on their iPods. However, some students indicated that they do not own iPods in order to fully utilize the benefits of having the solutions available in this format.
- The vast majority of written comments provided by students have complimented the quality of the recordings and encouraged continuation of this effort in various courses.

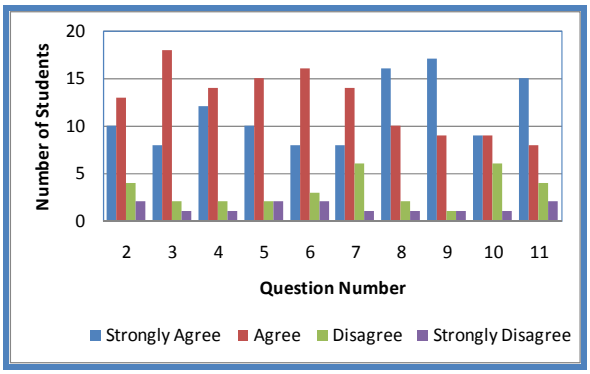

Figure 4. Distribution of Answers to All Questions by Number of Students for Math 151.

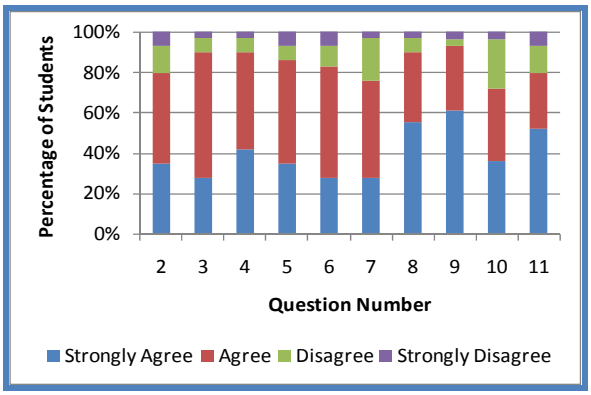

Figure 5. Distribution of Answers to All Questions by Percentage of Students for Math 151.

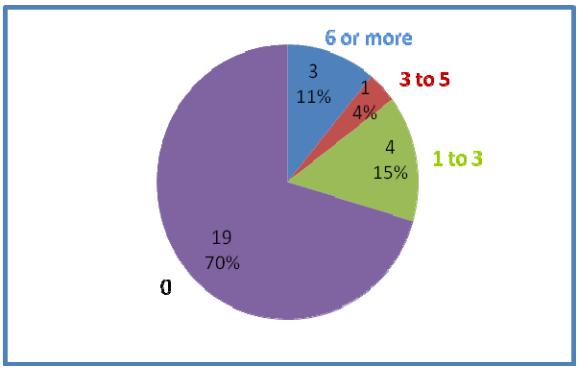

Figure 6. Responses to First Question of the Survey for ISEN 302.

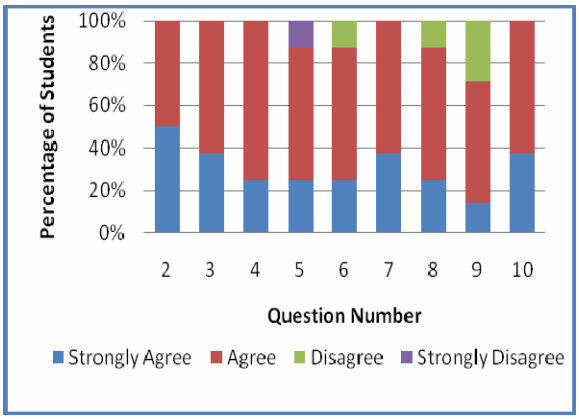

Figure 7. Distribution of Answers to All Questions by Number of Students for ISEN 302.

2) ISEN 302: Economic Analysis of Engineering Projects

This is a required junior level course for students at TAMUQ in Mechanical, Chemical and Electrical Engineering programs. Similar to the Mathematics course, this course is administered through Blackboard Vista. The course content includes fundamental concepts of engineering economics, time value of money, interest rates, present worth (PW) analysis, annual worth (AW) analysis, benefit/cost (B/C) analysis, breakeven and sensitivity analysis, and cost estimation.

Videos of fifteen lectures were created for this course, which incorporated audio combined with PowerPoint slides or word documents. The recordings were conducted in class using a desktop computer and a wireless microphone. The set of notes for this course were all prepared using PowerPoint software and these are the same slides provided with the textbook prepared using the course instructor, who is also and the author of the textbook (Dr. Leland Blank). All lectures were recorded and made available to students through the same venues discussed above (MediaMatrix and Blackboard Vista).

Slight changes were made to the course assessment survey used in the mathematics course in order to obtain students' input about the lectures instead of problem solutions. Twenty seven out of thirty students answered the survey. Seventy percent (19 students) of these students indicated that they did not use the recorded lectures (Figure 6). However, the remaining 30 percent (8 students) who used the recorded lectures indicated that the lectures were useful for them in understanding the course material and they recommended recording lectures in other courses. As shown in Figure, 7, about 93% of the students voted "Agree" or "Strongly Agree "about the benefit of the recordings to their study. It was noticed that the availability of recorded lectures to students did not affect class attendance. This is in agreement with observations by other instructors from various universities [4].

The comparison of the survey results for this course versus those of the mathematics course indicates that students are more interested in reviewing recordings of solutions than recordings of lectures. Nevertheless, the authors believe that recording the lectures have other benefits that are summarized as follows:

- Capture the knowledge of the expert who is teaching this course. The instructor of ISEN 302 course was a visiting faculty at TAMUQ and he is the author of the textbook "Economic Analysis of Engineering Projects". The recoded lectures will be a great resource for instructors who will teach this course in the future. In addition, these lectures can be used to ensure consistency in offering the same topics in different semesters.
- Make the lectures available to students who have excused absence; as such, the instructor does not have to put an extra effort to provide the course material to these students.
- Help students to review the course material before exams.
- Help the instructor to better organize and deliver course material, especially for an international setting with students from many countries whose first language is not English.

3) MEEN 221 Statics and Particle Dynamics

This is a sophomore level course that is required for all engineering students at TAMUQ. This course includes topics such as equilibrium analysis, calculations of internal forces, analysis of trusses and frames, principles of dynamic analysis of particles, kinetics analysis of particles, and conservation of energy of particles dynamics.

Twenty five students were enrolled in this course. Only one example was provided o students on calculating internal forces and plotting shear and moment diagrams. This was a topic that the instructor felt that students needed more instruction than the time allowed in class for this topic.

Twenty three students out of twenty six answered the survey. Twenty students indicated that they used the recorded solution in their study (Figure 8). As presented in Figure 9, about 89.4% of the students voted "Agree" or "Strongly Agree "about the benefit of the recordings to their study. These results indicated that the overwhelming majority of students found the recordings to be helpful to them in understanding the recorded example.

4) ENGR 482 Engineering and Ethics

Students at Texas A&M University are required to take Ethics in Engineering as part of their curricula. The primary objective of this course is to introduce students to common methods for analyzing and resolving ethical problems in engineering. This course involves discussions on critical case studies that offer a rich environment for exchange of ideas and points of view among students. One instructor from the philosophy department in College Station, and several others from engineering at TAMU and TAMUQ were involved in teaching the course material.

A suite of electronic learning tools were used to teach this course. Some of the lectures with significant philosophy content offered in College Station were transferred through a secure web site and made available to students in Doha. The recorded lectures were of great importance to the instructor at TAMUQ as it helped him in ensuring that the course offering at TAMUQ was consistent with the course at TAMU in College Station. In addition, the recorded lectures will be used as a resource for future offerings of the course.

A virtual classroom environment was established in Blackboard Vista where students from both campuses were asked to get engaged in discussing=different topics. Students were able to present their views or offer comments on the discussion posted by other students. In addition, lectures were recorded and shared between the two campuses, which enhanced communication among students in both campuses and provided valuable cultural exchange.

The development of this technology-rich course was useful in several ways:

- Ensure consistency in the course topics and discussion in both campuses.
- Make some specialized lectures that were offered by several guest lecturers in College Station available to students in Qatar.
- Keep archives of course content as a resource for future offering of the course.
- Engage students in both campuses in the discussion of topics that encourage cultural exchange.

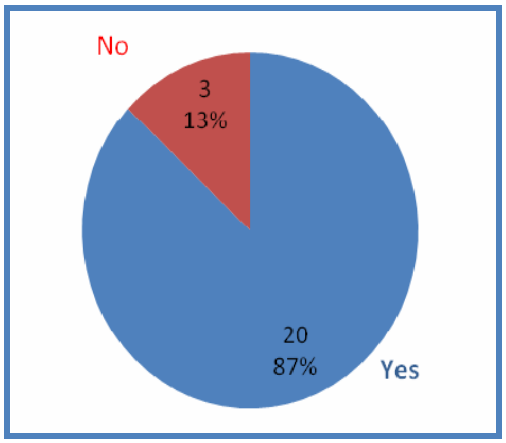

Figure 8. Responses to First Question of the Survey for MEEN 221.

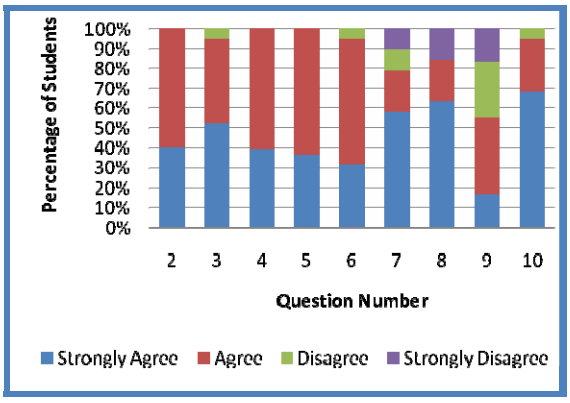

Figure 9. Distribution of Answers to All Questions by Number of Students for MEEN 221.

B. *Distance Teaching of Graduate Courses*

Two graduate courses were taught by instructors at TAMUQ to students at TAMU. The first course was ELEN -613: Rectifier and Inverter Circuits. This is a core course that all graduate students in the power systems division of the Department of Electrical and Computer Engineers are required to take. The course was offered in the Fall semester of 2008. There were 10 students enrolled in this course. The instructor has taught this course several times while he was at TAMU and he has a well-developed set of notes.

During the first few weeks of the semester, the instructor broadcasted all lectures through a video conferencing system. In addition, the instructor posted downloadable notes on BlackBoard Vista a few days before the lecture. The video conferencing unit allowed the instructor to transmit a live video of himself while lecturing or to share the PowerPoint slides. The overall experience of students was positive; however, the instructor felt that the frequent switching between slides during lecturing and the video streaming during discussion with students was distracting to both the instructor and students. It was difficult for the instructor to deal with some technical problems in video conferencing such as the delay of broadcasting or unpredictable loss of connection, while he was trying to focus on efficient delivery of the course notes.

The instructor included several computer simulations from his own research and from the internet. Unfortunately, there were delays in broadcasting these large simulation files, which adversely impacted the lecture flow and

quality. Therefore, the instructor decided to follow a hybrid teaching approach in which he recorded two lectures every week and he met with students once a week through video conferencing for discussion. Recorded lectures were posted on the MediaMatrix system for students to download. During the discussion, a video of the instructor was transmitted most of the time, while PowerPoint slides were transmitted only if it was necessary for the discussion. This approach has lead to a reduction in the number of times that the instructor had to switch between video streaming and power point slides, and consequently, helped in improving the flow of lectures and maintaining the students' focus on the technical content. In fact, some students commented that they benefited from this approach more than traditional lectures because they had the recorded lectures to help review some of the difficult technical concepts. The amount of material and topics covered in this hybrid teaching approach was very similar to the material that the instructor covered in previous traditional offerings of this course. In the official evaluation of this course, students commented that the recorded lectures were of high quality.

The positive experience from the first course encouraged adopting the same approach in another course, CVEN 689-Constitutive Models for Bituminous Materials. There were five graduate students enrolled in this course, which it was the first time to be offered. Similar to the ELEN 613 course, the experience in the hybrid teaching of CVEN 689 was extremely positive. In general, it was found that the time required to prepare a recorded lecture was about 30% more than the time needed to prepare a traditional lecture. The added time was needed to consider carefully the flow of information in the recording and to decide on the points that would require more explanation since the students were not available during lecturing for the instructor to receive "immediate feedback". The time spent to produce each lecture (recording and post processing) was about 50% more than the actual time of the lecture (50 minutes). This added time was the result of pausing the recording in order to examine the lecture content, and sometimes to edit lectures especially the audio part of the recording that is easily affected by background and surrounding noise. However, the availability of the recorded lectures means that the time required to teach this course in the future will be reduced considerably. The positive experiences with this hybrid teaching approach are expected to encourage TAMUQ faculty to continue to participate effectively in teaching graduate courses at TAMU.

III. CONCLUSIONS

The support of conventional education with technology-based instruction enriched the learning experience of students at TAMUQ. Also, it presented the material in a technology-based environment that students are familiar and comfortable with. In particular, it provided students with the opportunity to review the course material based on their availability.

The students' responses to the survey strongly indicate that they have benefited from the recordings of problems and they wish to see this effort expanded to cover other courses. The recordings of problem solutions were of immediate benefits to the students, who used these recordings to study the course material. The recordings of lectures were of less benefit compared with the recordings of the solutions to problems. The primary users of these lectures were students who missed classes for university-excused reasons, and needed to review the lectures to better understand the course material. However, these recordings had other benefits especially in capturing the knowledge of experts who might not be able to offer the course in all semesters. Therefore, the recorded lectures are an excellent resource for other instructors of this course to ensure consistency in course offering in various semesters.

The technology-rich ethics course offered a unique opportunity to share the Engineering and Ethics course content between TAMU and TAMUQ. This was very useful to ensure consistency in offering the course between the two campuses, and to share lectures given by specialized experts in College Station with students in Qatar. In addition, the sharing of discussion through a virtual environment assisted in providing students with a unique cultural exchange.

The hybrid approach of teaching graduate courses was an improvement over the live lecturing via video conferencing. This approach allowed the instructors to focus on the course technical topics instead of managing some of the difficulties encountered in lecturing via video conferencing. Students commented positively on the advantage of having the recorded lectures for studying the course material and as a future resource for them. It is believed that the success of this approach will encourage more instructors to offer distance graduate courses between the two campuses and share faculty expertise and resources.

IV. RECOMMANDATIONS

It is recommended to continue in recording solutions of problems in various courses at TAMUQ. Given the time that it is required to prepare high quality recordings, the courses' instructors have to carefully select the problems that are solved in these recordings such that they have a long term value (at least for three semester). It is recommended to continue recording lectures of visiting instructors who are experts in the topics being taught; this recorded material is a great resource for future offering of the course. Analysis of more students' responses is needed to better determine the benefits of recording of lectures taught by full-time instructors at TAMUQ. In addition, careful consideration should be given in the future for the frequency of recording lectures; in general, time and resources should be allocated such that the value of recorded lectures extend beyond the semester that the lectures are recorded in.

The use of hybrid approach that combines recorded lectures and live discussion is preferred over distant-taught courses that are presented entirely live. However, it is recommended that this distance teaching approach at TAMUQ is limited to graduate courses that are offered at TAMU. It is believed that extension of the hybrid teaching approach to undergraduate courses will require much more time commitment, and measures that need to be taken to ensure that students do watch the recorded lectures and participate in discussion.

ACKNOWLEDGMENT

The authors wish to acknowledge the technical support of Dr. Yakut Gazi from Information Technology Services during the recordings of the solutions.

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Manuscript received 25 October 2009. Published as resubmitted by the authors February 12, 2010.