A Method to Improve Course Instruction by Utilizing Teleconferencing Techniques

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ABSTRACT

Instructors teaching DC Circuits, Digital Circuits, and Active Circuits I and II at North Carolina A&T State University in the School of Technology have adopted the use of a teleconferencing room to conduct their lectures for class sizes up to 20 students. To better utilize these facilities, an alternative lecture approach was adopted that used the available technology which resulted in a more efficient use of lecture time and increased learning as perceived by the students. Notes referred to as skeletons aided lectures and were prepared to provide relevant figures, example questions, tables and diagrams without the need for them to be written by the instructor or students. This aid also saved time and gave the instructors freedom to add additional material or classroom assignments. Students spent the lecture writing information more applicable to their learning. Use of the teleconferencing room allowed for lectures to be recorded for future reference by the students currently enrolled in the course as well as future online students that desire classroom instruction as a supplement. From survey data, ninety-eight percent of the students viewed use of the skeleton notes as an enhancement to their learning. Eighty-eight percent of the students in the survey believed that their in class use of skeleton notes facilitated learning beyond their expectations. Since students are already familiar and virtually dependent upon modern consumer electronics such as calculators and smart phones with QWERTY keyboards that assist them in daily activities, the next logical step would be to incorporate the operation of tablet PCs in the teleconferencing environment. This step would make paper obsolete and allow almost instantaneous feedback during lecture for class assignments.

Keywords: College, Learning, Teleconferencing, Teaching, Historically Black Colleges and Universities (HBCU)

INTRODUCTION

Video conferencing is normally done when instruction is accomplished remotely. Students would meet in a videoconferencing room and the lecturer would teach the class from another site. Videoconferencing environments allow all the participants to be heard and seen. Notes are normally transmitted with the aid of Smart Boards, document cameras or PCs. Those notes via the PC are normally slide presentations, or demonstrations using simulation software. The other media focuses on the written notes. Over the past 3 years, the video conferencing room was used for DC Circuits, Digital Circuits and Active Circuits I and II. Each has a lecture and lab component, with both meeting only once a week. With only one lecture per week, it was necessary to insure completeness of each lecture. With the length of time for each lecture, students need to maintain engagement throughout the lecture

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to insure they grasped the information. This engagement consists of writing, talking, describing, and explaining which involves the instructor and their classmates. This type of engagement optimizes the learning environment [Gerace, 1].

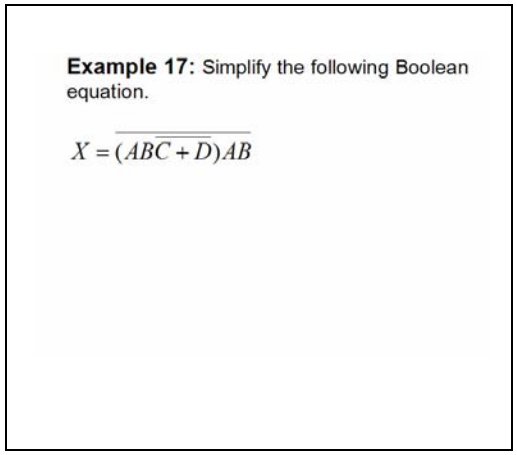

Figure 1: Example of Skeleton for Digital Circuits course

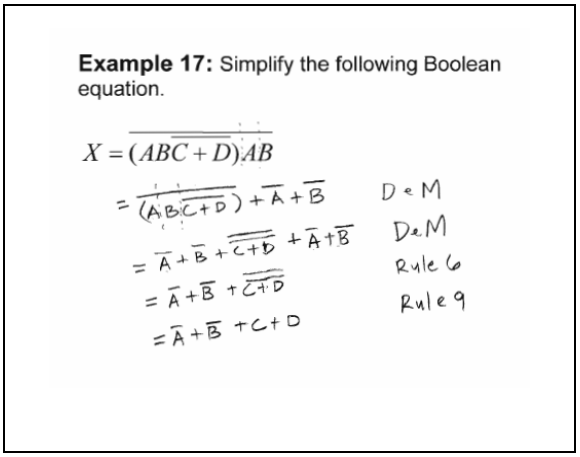

Figure 2: Completed Notes from Skeleton

The solution was determined by using a skeleton of the lecture notes. This skeleton would include questions, tables, equations, and circuits that normally would consume lecture time if written or drawn, but did not enhance the learning of the students. Excluded from the skeleton notes are problem solving techniques. This skeleton would be posted in each student's Blackboard account for the course or distributed to the students prior to the start of class. The instructor would then utilize the videoconferencing environment to display the notes as solutions were being completed. Students with their copy of the skeleton notes would follow the instructor and complete the notes, thus maintaining their engagement throughout the lecture. Figures 1 and 2 give a digital circuit example. Figure 1 is the skeleton with the example question and Boolean equation given.

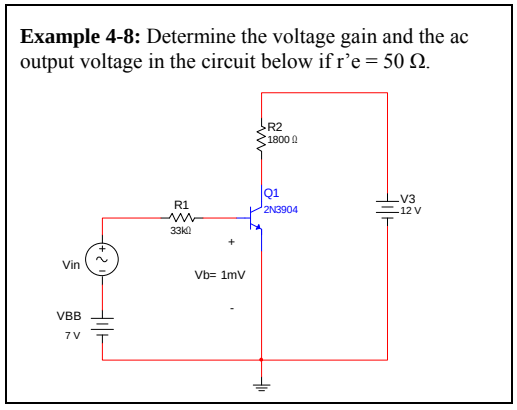

Figure 3: Example of Skeleton for Active Circuits I course

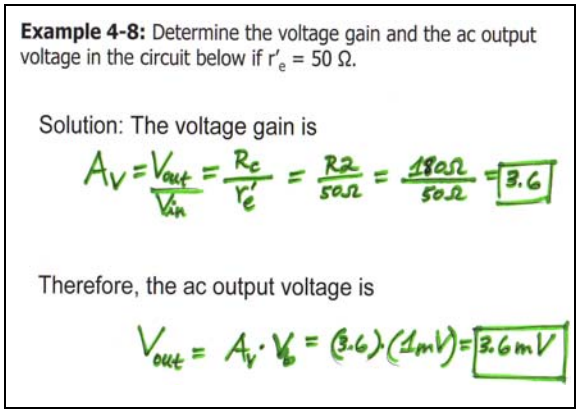

Figure 4: Completed Notes from Skeleton

Figure 2 is the completed notes detailing the steps for students to follow. Students gain from the solving of the problem rather than the writing of the problem. Similar results were also obtained via teleconferencing techniques in an Active Circuits course. Figure 3 depicts an example of a simple npn bipolar-junction transistor amplifier circuit. A skeleton is provided and the students are then requested to engage in the solution of the voltage gain and the ac output voltage of the device as depicted in Figure 4 instead of using valuable class time drawing the circuit since it was already provided.

LECTURE TYPES

Most educators regularly review their approach to teaching especially when students do not respond as expected concerning material covered. Their approach may center on how the information is disseminated to the students during lecture. With use of a videoconferencing environment, the approach changed to utilize the additional features offered. Initially the teaching method of choice was to conduct lecture with the use of a dry-erase/chalk board which will be termed as the Traditional method. Another approach used slides with some form of display. We label that Projection Method. In a videoconferencing environment, lectures are displayed for students in class and potentially for those online who desire remote lectures. Another feature of videoconferencing is the ability to record. This feature allowed the use of recorded lectures including student questions to be added to blackboard via a link from a server PC as a supplement for an online course.

Traditional Lectures

In traditional lectures, instructors normally write a majority of the information important for the students to learn on the dry-erase/chalk board. Some of the information is only conveyed through speaking. According to Hull [4], this approach to instruction has been effective for millennia. In many cases this requires plenty of writing from the instructor and student, but the writing does allow for a reasonable pacing on instruction. When the instructor writes the notes on the board, students are able to see and process the progress development of the material [Hull, 4]. Table 1 lists the disadvantages of the traditional lecture method as stated by Hull [4]. Students participating in the survey were asked to give one advantage and one disadvantage of traditional lectures. This survey is in Appendix A, and Table 2 lists the results. From the students' perspective, copying notes from board aided in their learning. The act of writing the notes, kept them engaged during the lecture. This agrees with Gerace [1] as it relates to an optimal learning environment. If a student struggles in note taking their learning during lecture is hindered. According to the survey results in Table 5, this was the least liked by the students with only thirty-eight percent desiring this teaching approach.

1. Difficulty in drawing complex pictures or schematics
2. Time used in drawing circuit diagrams
3. Possibility for error by the students in recording notes
4. The inability of the instructor to saved their written notes for future review

Table 1: Hull's [4] list of disadvantages to Traditional Lectures

According to students' response good note taking was a necessity, but they were challenged when the instructors gave verbal and written information simultaneously. They would normally write what was written. Some lecturers would give large amounts of notes, with not enough examples, or limited visual aids. Others felt that instructors would inadvertently block the view of the written notes while writing. These lead to their low approval of this method.

Advantages	Disadvantages
1. Learning through copying the notes	1. Student must take good notes
2. Level of explanation	2. It is challenging to write what was written and listen to the lecturer simultaneously
3. Ability to ask question	3. Too much writing
	4. Not enough time to copy notes
	5. Not enough examples
	6. Not enough visuals
	7. View of written notes blocked by instructor

Table 2: Advantages and Disadvantages of Traditional Lectures from Student survey in Appendix A

Projection lectures

Projection lectures involve use of overhead transparencies or electronic projection. Both presents legibly formatted notes with graphics. Electronic projections have the advantage of videos and animations imbedded in the PowerPoint slides [Hull, 4]. Overhead transparencies allow the instructor to easily write on the slides but this is difficult with the electronic projections using PowerPoint. The danger of projection lectures is the potential for disengagement by the students which impacts their learning, especially if completed notes are given to the students. A major advantage of Projection lectures for the instructor is having prepared lectures that can be updated and reused. Table 3 lists the advantages and disadvantages of electronic lectures from the student survey. According to the survey results in Table 5, sixty one percent of the students preferred these types of lectures.

Advantages	Disadvantages
1. Notes already prepared	1. May not see step-by-step solution of problems
2. Less writing, more attention to words spoken by instructor	2. Limits student involvement or engagement in lectures
3. More visuals	3. Slides may be distracting with additional graphics or animation
	4. Potentially too much information on individual slides
	5. Potentially too much information per lecture
	6. Boring

Table 3: Advantages and Disadvantages of Electronic Lectures from the Student survey

Skeleton aided Projection Lectures

Skeleton aided projection lectures are projection lectures with incomplete notes supplied to the students. The incomplete notes include graphics, questions, tables, charts, and circuit diagrams that do not add to the learning by writing. Students attending these lectures, complete these incomplete notes during lecture, insuring some level of engagement [Hull, 4]. Items such as solving a problem are left blank and completed during lecture which utilizes the advantages of traditional lectures in which learning is reinforced through writing. Figure 5 and 6 illustrate another skeleton aided example in Digital Circuits course. Figure 5 is the skeleton of an example question to determine the Boolean equation from a given logic circuit. Figure 6 is the completed page of notes that demonstrates a process used to reach the solution. Use of the skeleton saved the instructor lecture time by eliminating the need to write the material in figure 5. According to the survey results in Table 5, Ninety-eight percent of the students felt these skeletons were helpful; enhances their learning, and recommended them over Traditional.

STUDENT IMPACT

Demographics

The student population that participated in the survey was currently taking courses that utilized skeleton lectures at the time this paper was written. The data are in Table 4. There were a total of 49 out of 55 students that agreed to take the survey. These students were in Digital Circuits, Active I and Active II circuits. Their GPAs range from 2.00 to 4.00. They represent degrees offered in Electronics Technology with concentrations in Information Technology, Computational Technology and General concentration. Students ranged in classification from sophomores to seniors and included 10 females. The actual survey is in the Appendix A

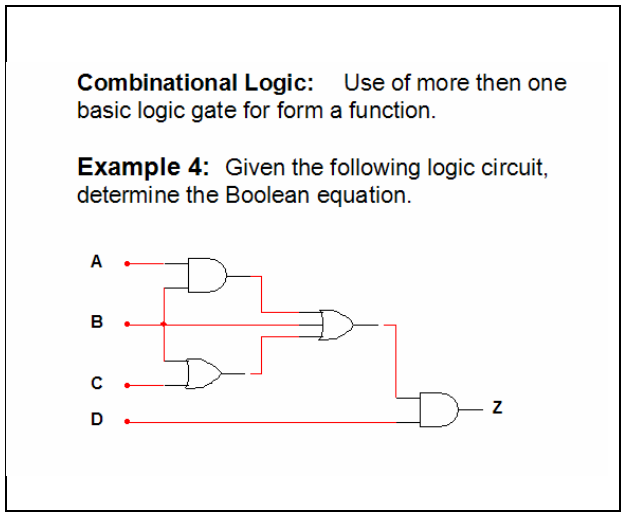

Figure 5: Skeleton of Digital Circuit example

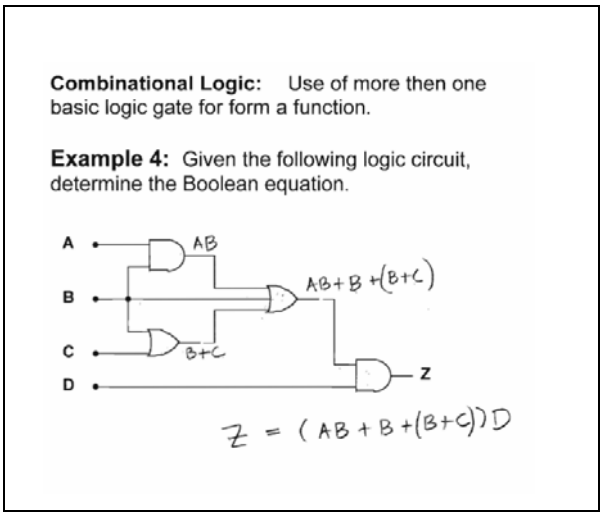

Figure 6: Completed notes for from Figure 5

Survey Results

Table 5 displays the student response to the survey in Appendix A in terms of percentages. The questions compare student experience regarding different types of lectures. Each of the questions had four possible responses, strongly agree, somewhat agree, somewhat disagree, and strongly disagree. The % Agree category combines both strongly and somewhat agree. Based on the results, the students overwhelmingly prefer Skeleton aided lectures over the traditional and projection without skeleton notes.

Gender		Classification		GPA		Major	
#	Options	#	Options	#	Options	#	Options
39	Male	0	Freshman	3	2.00-2.49	19	Electronics Technology
10	Female	8	Sophomore	31	2.50-2.99	8	Computational Concentration
		13	Junior	12	3.00-3.49	23	Information Technology Concentration
		28	Senior	3	3.50-4.00		

Table 4: Population of Students participating in Survey

FUTURE INNOVATION

Use of Tablet PC

According to Gill [2] tablet PC were unveiled in the late 2002. Wireless connectivity comes standard on all models of tablet PCs. Use of skeleton lectures was a success in learning as stated by question 21 in Table 5, but not environmentally friendly. With medium class sizes that utilize these lectures, paper usage increased dramatically due to printing of lecture notes prior to the lectures. The instructor used a document camera to present the lectures. Some lectures exceeded 50 pages/slides of notes. Even when printing 6 pages/slides to a page there is still heavy toll paper usage and the copy machines. Use of Tablet PCs by the instructor and students solves the paper issue and gives additional features. The document camera would be replaced by the Tablet PC. Universities already supplying laptops to their students could supply tablet PCs. With this scenario, students would be required to bring their tablet PCs to class. This would result in lectures without paper usage. Along with the environmental impact is the ability to share data via the web. Software gives the instructor the ability to control anonymity. With the availability of wireless connectivity within these videoconferencing rooms, all class assignments could be completed with use of these Tablet PCs. Students viewing the class remotely could post solutions and be apart of the class discussion. Gill [2] surveyed students using Tablet PC for a particular class. Eighty-nine percent of those students approved of their usage electing to take additional course that required tablet PCs for the lecture.

CONCLUSION

Based on the statistics in Table 5, use of skeleton lectures in a videoconferencing environment succeeds to enhance education in the classrooms. Ninety-six percent of the students viewed the skeleton lecture notes as a helpful tool. Ninety-eight percent believed the Skeleton lectures help them in their learning process. Ninety-eight percent of the students preferred Skeleton lectures over traditional ones. Eighty-eight percent of the students would like to have the recorded skeleton lectures as a supplement to an online course. Eighty-eight percent of the students admitted that they exceeded their expectations for learning when taught in this format.

Acknowledgements

This was supported by Department of Electronics, Computer, and Information Technology, School of Technology and the Multimedia services at North Carolina A&T State University.

% Agree	#	Question
95.8	11	In your current class, are the abbreviated notes helpful?
69.6	12	In your current class, is use of the video helpful?
38.8	13	Would you prefer a traditional lecture?
60.9	14	Would you prefer a PowerPoint lecture?
97.9	15	Compared to your experiences with traditional lectures did the skeleton enhance your learning?
98.0	16	Would you recommend the skeleton lectures over traditional lectures to future students?
87.7	17	Would you view a recorded Skeleton lecture if available with an online class?
33.3	18	Did knowing that you were being recorded hinder you from asking questions?
98.0	19	Did you like the instructors approach to teaching the material?
58.3	20	Was there too much material being taught during the skeleton lectures?
87.8	21	Did you exceed your expectations for learning in this course?
53.1	22	Could you have been taught the same amount of material in a traditional lecture for this course?
42.9	23	Could learning have occurred more with traditional lectures compared to the skeleton lectures for this course?
47.1	24	Could you have been taught the same amount of material with PowerPoint lectures for this course?
48.9	25	Could learning have occurred more with PowerPoint lectures compared to skeleton lectures for this course?

Table 5: Results from survey of students currently in courses that utilize skeleton lectures

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APPENDIX A

Video Lecture Survey page 1

Types of Lectures

Traditional	The instructor conveys lecture material with the aid of a chalkboard or dry-erase board. Students are responsible for writing all the relevant notes spoken and written during lecture.
PowerPoint	The instructor conveys lecture material with the aid of traditional PowerPoint Slides. Students may have access to the slides, but the notes are not abbreviated. If needed, students may add additional comments to the slides, but the majority of lecture time, students listens to the lecturer. The notes are displayed using a projector or in a video conferencing environment.
Skeleton	The instructor conveys lecture material with the aid of abbreviated notes given to students prior to lecture. As the instructor completes the notes, students complete these abbreviated notes given prior to class. Video of the notes being completed are recorded in a teleconferencing environment for future use.

1.	What is your GPA?	Below 2.0 ☐	2.00 – 2.49 ☐	2.50 – 2.99 ☐	3.00 – 3.49 ☐	3.50 – 4.00 ☐
2.	What is your Classification?	Freshman ☐	Sophomore ☐	Junior ☐	Senior ☐	Other ☐
3.	What is your Gender?	Male ☐	Female ☐			
4.	What is your major?	ECT-Gen ☐	ECT-Comp ☐	ECT-IT ☐	Undecided ☐	Other ☐
5.	Check the courses you have taken that utilize the skeleton lecture approach?	ECT 211 ☐	ECT 213 ☐	ECT 312 ☐	ECT 314 ☐	Other ☐
6.	Which class are you taking the survey in?	ECT 211 ☐	ECT 213 ☐	ECT 312 ☐	ECT 314 ☐	
7.	What did you like about traditional lectures?	_____				
8.	What did you not like about traditional lectures?	_____				
9.	What did you like about PowerPoint lectures?	_____				
10.	What did you not like about PowerPoint lectures?	_____				

Video Lecture Survey page 2

	STRONGLY AGREE	SOMEWHAT AGREE	SOMEWHAT DISAGREE	STRONGLY DISAGREE
11. In your current class, are the abbreviated notes helpful?	☐	☐	☐	☐
12. In your current class, is use of the video helpful?	☐	☐	☐	☐
13. Would you prefer a traditional lecture?	☐	☐	☐	☐
14. Would you prefer a PowerPoint lecture?	☐	☐	☐	☐
15. Compared to your experiences with traditional lectures did the skeleton enhance your learning?	☐	☐	☐	☐
16. Would you recommend the skeleton lectures over traditional lectures to future students?	☐	☐	☐	☐
17. Would you view a recorded Skeleton lecture if available with an online class?	☐	☐	☐	☐
18. Did knowing that you were being recorded hinder you from asking questions?	☐	☐	☐	☐
19. Did you like the instructors approach to teaching the material?	☐	☐	☐	☐
20. Was there too much material being taught during the skeleton lectures?	☐	☐	☐	☐
21. Did you exceed your expectations for learning in this course?	☐	☐	☐	☐
22. Could you have been taught the same amount of material in a traditional lecture for this course?	☐	☐	☐	☐
23. Could learning have occurred more with traditional lectures compared to the skeleton lectures for this course?	☐	☐	☐	☐
24. Could you have been taught the same amount of material with PowerPoint lectures for this course?	☐	☐	☐	☐
25. Could learning have occurred more with PowerPoint lectures compared to skeleton lectures for this course?	☐	☐	☐	☐

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Claude Hargrove has been at North Carolina Agricultural and Technical State University at the rank of Assistant Professor since Fall 2004. He received his PhD at North Carolina State University in 1999 in Biological Engineering. Other degrees earned at North Carolina State University were MS in Computer Engineering, BS in Electrical Engineering and a BS in Computer Engineering. Courses taught using this technique are Electric Circuits, Digital Circuits and Mechatronic systems. He has served as the Co-Advisor for the IEEE student chapter, Chair of Central Carolina IEEE section, member of Epsilon Pi Tau, and Graduate faculty for the Technology Management PhD consortium sponsored by Indiana State University. Interest includes biotechnology and STEM education. Submitted another paper to 2008 ASEE South East Section Annual Conference titled "A faculty's approach to retention".

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Fereshteh Fatehi received the B.S. degree from Shiraz University in 1972, the M.S. and the Ph.D. degrees from Montana State University in 1993 and 1995 respectively, all in electrical engineering. She worked as a research associate for one year at Iowa State University. Currently, she is a professor in the Department of Electronics, Computer and Information Technology at North Carolina A&T State University. Her research interests are in industrial control, robust control, robust system identification, power system stability and control, power electronics and application of robust control in power systems. She is the author and co-author of over 10 articles in journals and conference proceedings. She is a member of Phi Kappa Phi, IEEE, and Graduate faculty for the Technology Management PhD consortium sponsored by Indiana State University.