

A Study of the Effect of Instructional Media in an Undergraduate Electrical Circuits Course

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Abstract - In various studies, it has been demonstrated that instructional media plays an important role in instructors' teaching and students' learning. The purpose of this study is to assess the students' preferences for different instructional media and the impact of different instructional media on the students' learning and course-related behavior in an undergraduate electrical circuit's course. The instructional media under study were: Computer-based PowerPoint presentation, whiteboard only, combination of PowerPoint and whiteboard and combination of printed handouts and whiteboard. Two schools participated in this study: Rose-Hulman Institute of Technology (RHIT), Terre Haute, IN and Qingdao University, Qingdao, P. R. China. At RHIT, two midterm exams and one final exam were used to assess the learning effectiveness of different instructional media. To understand the course related behavior, each of the instructors were asked to assess their students' behavior in terms of attendance, amount of classroom interaction, percent of homework completion and web logins. At the end of the quarter, a questionnaire was collected from participating students to measure their preference for the instructional media. The same questionnaire was given to the students at Qingdao University to study their preference for different instructional media.

Index Terms - Instructional Media, PowerPoint, Students' learning

INTRODUCTION

In the last 15 years, PowerPoint has become more popular in college classrooms [1]-[4]. Many professors still prefer the traditional "chalk-and-talk" lectures. Although there has been much discussion concerning using PowerPoint in lectures [5]-[8], there is limited evidence to support the positive impact of a PowerPoint presentation on the student's learning, attitude and his/her course-related behavior (attendance, classroom participation and so on). Few studies exist to show the benefit of combining PowerPoint with traditional whiteboard lectures and reaping the benefit of both of them. One advantage of using PowerPoint is that it saves the students' time in taking notes so that the instructor can cover more material and examples in the class. An alternate way is to give the students

printed handouts in class. This study will focus on the following four instructional media and assess the effectiveness of them:

1. Whiteboard only (The instructor uses the whiteboard mainly and doesn't use any multimedia equipment. No printed handouts are given for most of the lectures. The instructor writes important concepts and solve problems on the whiteboard)
2. Computer-based PowerPoint presentation only (The instructor gives PowerPoint presentations in lectures and rarely writes on whiteboard. The professor presents a set of static slides and both the problem statements and solutions to the examples are presented in the slides.)
3. Combination of PowerPoint and whiteboard. (The instructor uses PowerPoint for key concepts and principles but whiteboard for examples. The PowerPoint slides have only the problem statements for in-class examples and the instructor works through the problems on the whiteboard.)
4. Combination of printed handouts and whiteboard. (The instructor works through in-class examples on the whiteboard and gives the students a copy of printed handouts which contains the basic principles and problem statements.)

The study was conducted during the 2007 and 2008 school years and included more than 200 engineering students who completed the electrical circuits course.

METHOD

Participants

Two schools participated in the study: Rose-Hulman Institute of Technology (RHIT), Terre Haute, IN and Qingdao University, Qingdao, P. R. China. RHIT is a private engineering institute in the Midwest United States and there are around 1800 full time students. Qingdao University is a comprehensive public university in China and the student population of full time students is approximately 40,000. The participants at RHIT were the students who enrolled in the Introduction to Electrical Circuits course in fall 2007. Six instructors taught 9 sections of 210 students and 134 students

(64%) completed the instructional media questionnaire. At Qingdao University, 113 students who are currently taking the Electrical Circuit course participated in the study and completed the survey.

Procedure

At RHIT, nine sections of Introduction to Electrical Circuits sections were taught by 6 instructors using different instructional media. All the instructors used a common syllabus, labs, homework, and tests. Two midterm exams and one final exam were used to assess the learning effectiveness of different instructional media. To understand the course related behavior, each of the instructors was asked to assess their students' behavior in terms of attendance, amount of classroom interaction, and percent of homework completion. At the end of the quarter, a questionnaire was collected from participating students to measure their preference for the instructional media. The same questionnaire was given to the students at Qingdao University to study their preference for different instructional media.

RESULTS

The study was started in fall 2007. At the end of the quarter, 134 students completed a questionnaire which was used to measure their preference for the instructional media. The students were asked to rate their preference for each of the four instructional media based on their experience in the electrical circuits course as well as other courses. The rating scale was 1 to 5 with 5 being the strongest preference. In fall 2008, the same questionnaire was given the students at Qingdao University and 113 students responded. Table 1 shows the average preference ratings for the students at both schools. The result of the survey indicates that RHIT students preferred combination handouts and whiteboard the most and PowerPoint presentations the least. Conversely, the students at Qingdao University preferred combination PowerPoint and whiteboard the most and rated PowerPoint only higher than the whiteboard only. It should be noted that the students at both schools preferred the two combinational instructional media methods more than either the PowerPoint or Whiteboard solely. The largest difference in the average ratings between the two schools was on the whiteboard only instructional media. The average rating at RHIT was 3.23 while the average rating of the Qingdao University was 2.20.

TABLE 1
AVERAGE STUDENT PREFERENCE FOR
EACH INSTRUCTIONAL MEDIA

School	Number of students	Average Class Size	Instructional media			
			A	B	C	D
RHIT	134	23	4.15	3.87	3.23	1.91
Qingdao	113	60+	3.44	4.49	2.20	2.27
Total	247	--	3.83	4.15	2.76	2.07

(A) HANDOUTS AND WHITEBOARD COMBINATION, (B) POWERPOINT AND WHITEBOARD COMBINATION, (C) WHITEBOARD ONLY, (D) POWERPOINT ONLY

Figure 1 shows the distribution of the students' rating score at both schools among the four instructional media, the two combinational choices received better scores than either PowerPoint only or Whiteboard only. The results on the graph showed that the RHIT students preferred the white board only better the students at Qingdao University. At Rose, 2% of the students gave the lowest rating to the whiteboard only instructional media. Conversely, more than 20% of the students at Qingdao University gave the lowest rating to the whiteboard only. In addition, the students at Qingdao University most preferred the combination of PowerPoint and Whiteboard and 60% of their students gave the highest rating, in contrast with only 23% RHIT students rating it the highest.

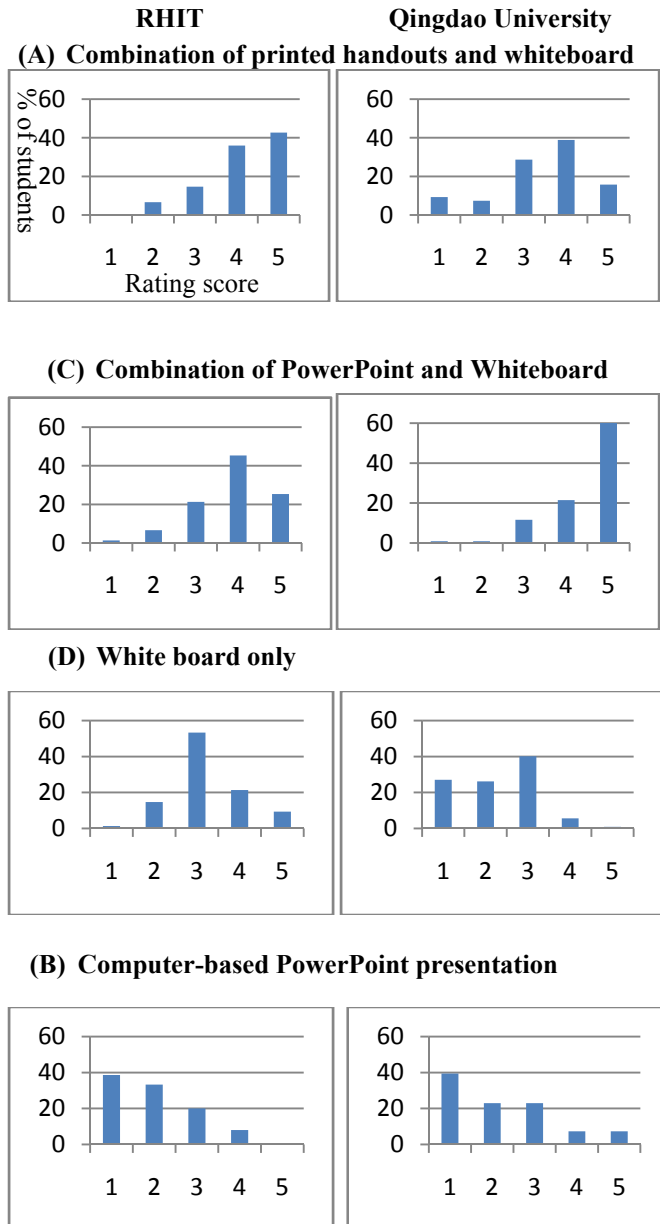


FIGURE 1

STUDENTS' RATING DISTRIBUTION OF THE FOUR INSTRUCTIONAL MEDIA (A) COMBINATION OF PRINTED HANDOUTS AND WHITEBOARD), (B) COMBINATION OF POWERPOINT AND WHITEBOARD, (C) WHITEBOARD ONLY, AND (D) COMPUTER-BASED POWERPOINT PRESENTATION.

To understand why the students were in favor of a specific instructional media, the questionnaire also contained some items that assessed the students' attitudes towards the instructional media. Responses were on a 5-point scale, where 5 indicated strongly agree and 1 indicate strongly disagree. Table II shows sample questions and the average scores of the students' responses. The survey results showed that the students at both schools preferred the hard copies of the handouts and felt it made their notes more organized. More students at Qingdao University felt that the use of PowerPoint increased their learning and interest in electrical circuits. The results also indicated that students at the schools may have a different preference for the contents of the printed handouts.

TABLE II
SURVEY QUESTIONS AND THE AVERAGE SCORES

	RHIT	QINGDAO
I think the use of PowerPoint is/(would be) helpful in increasing my learning in this electrical circuits course.	3.33	4.04
The use of PowerPoint does /(would) increase my interest in this course.	2.79	3.49
I wish the professor would spend less time using PowerPoint slides and more time using the whiteboard.	3.00	2.68
I think it is helpful if the instructor provides a hard copy of the presentation/handouts.	4.52	4.33
I prefer the handouts contains not only the key concepts and principles but also the solutions to the examples.	4.56	4.51
When I have a copy of the presentation, I am less likely to pay attention in class since I already have the material.	2.53	2.22
My notes were more organized when the professors gave a hard copy of the handouts.	4.04	3.89
I prefer that the instructor uses PowerPoint for key concepts and principles but whiteboard for examples.	3.50	3.31
I prefer that the instructor uses printed handouts for key concepts and principles but whiteboard for examples.	3.89	3.19

Table III shows the RHIT students' average test grades based upon the instructional media used by the instructor. Two midterms and one final exam were given to the students. It should be noted that this data was not available at the time of publication for Qingdao University. The final exam was weighted twice as much as each of the midterms and this weighted average is also shown on the table. Table III shows that there was no significant difference in student performance on tests regardless of the instructional media used or their personal preference. Although the students at RHIT most preferred the combination of the printed handouts, the average exam grade was only the 3rd highest. The whiteboard only section received the highest average grade but was the third most preferred instructional media.

TABLE III
AVERAGE STUDENT TEST SCORE BASED UPON INSTRUCTION MEDIA

	Test 1	Test 2	Final	Weighted average
Whiteboard only	81.17	82.21	79.26	80.48
PowerPoint only	80.91	82.54	76.60	79.16
PowerPoint and whiteboard combination	78.40	74.76	78.29	77.44
Handout and whiteboard combination	79.05	78.37	76.86	77.79

Table IV shows the results of the instructor evaluations on course-related behavior based upon instructional media. The attendance rate slightly dropped at the end of the quarter for most of the sections and there was no significant difference due to the type of instructional media used. Regardless of the students' preference, there was also no significant difference in the student's class participation or homework submission.

DISCUSSION

The study showed that the students at Qingdao University, China rated the PowerPoint presentation higher than the students at RHIT. The authors attempted to identify some causes for this disparity. One of the reasons may be the difference in class size. The electrical circuits class at Qingdao university typically have more than 60 people, while the average size of the electrical circuits class at RHIT was 23 for fall 2007. For large size class, the computer-based PowerPoint presentation may have some advantages over the whiteboard because of its clarity. It is clearer for the students to read the contents from the projector than the writings on the whiteboard. There may be more class interaction in a small size class than large size class. It will be necessary to do further study to verify that these were indeed the causes for the disparity. Additionally, tablet PCs have become more popular and should be included in the follow on study. Another research question would involve examining the changes in course behavior and response based upon the engineering course.

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TABLE IV
RESULTS OF INSTRUCTOR SURVEY GIVEN BY THE INSTRUCTOR OF USING DIFFERENT INSTRUCTIONAL MEDIA:

Survey questions	Weeks	A	B	C	D
What is the average attendance rate of the lectures?	1-4	98.6%	98.0%	100.0%	95.8%
	5-8	94.0%	97.0%	94.0%	95.8%
	9-10	96.2%	84.5%	84.3%	83.3%
What is the average class participation rate of the class? (Class participation includes asking questions in class, answering instructor's questions)	1-4	65.0%	30.0%	31.6%	20.8%
	5-8	65.0%	50.0%	31.6%	20.8%
	9-10	65.0%	45.0%	31.6%	33.3%
What is the average percentage of the students who turned in the homework?	1-4	98.0%	98.0%	100.0%	95.8%
	5-8	95.5%	97.0%	100.0%	95.8%
	9-10	92.0%	80.5%	94.7%	79.1%

(A) HANDOUT AND WHITEBOARD COMBINATION, (B) POWERPOINT AND WHITEBOARD COMBINATION, (C) WHITEBOARD ONLY, (D) POWERPOINT ONLY