

AC 2009-2024: STUDENT OUTLOOK TOWARD MEDIA-BASED MODULES IN ELECTRONICS AND NETWORK ANALYSIS

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STUDENT OUTLOOK TOWARDS MEDIA BASED MODULES IN ELECTRONICS AND NETWORK ANALYSIS

Abstract

This research explores the use of Media Based Modules in teaching undergraduate electronics and network analysis to develop student insight of engineering basics and to complement traditional teaching methods. It also explores the evaluation outcomes of student outlook towards media based modules. This development as well as lessons learned in the first two years of Media Based Modules in undergraduate engineering courses namely, Circuits, Electronics, Network Analysis, Matlab/Java in computing for engineers, and C++ for digital computation is examined and some figures are presented. A concluding section is offered that evaluates the effectiveness of complementing traditional teaching methods with Media Based Modules.

Introduction

This paper provides the results of a survey and feedback of an assessment prepared by students on their outlook toward a media based instrument that was employed in the teaching of Electronics and Network Analysis. The analysis of this paper follows comparable studies on media-based instruction. Cohen et al¹ who found that students learned additional information from such instruction techniques in contrast to traditional modes of instruction. Moreover, Powell et al² further explored this analysis and found that such instructional techniques were helpful in raising the GPAs of the students.

PSpice, an acronym for Personal Simulation Program with Integrated Circuit Emphasis, is a general purpose analog circuit and digital logic simulation software used to check the reliability of circuit designs and to predict circuit behavior. SPICE³ was originally developed at the Electronics Research Laboratory of the University of California at Berkeley. PSpice is a commercial version of SPICE and is now owned by Cadence Design Systems. Supplementary information about PSpice is available at <http://www.cadence.com>

Electronics and Network Analysis: Course Outline

The Electronics course deals with an introduction to electronic devices and their applications. The course covers an introduction to the physical operation of semiconductor devices. The basic electronic semiconductor devices such as the diode, the field-effect transistor, and the bipolar junction transistor are studied. Device models are developed to aid in circuit analysis and design. Biasing, small-signal and large signal analysis and the principles employed in the design of electronic circuits are included in the course. Students also gain experience in applying PSpice to electronic design and visualization. Circuit Analysis is a pre-requisite course. Mostly students from the electrical engineering program enroll in this course, as it is a required course for their major. This course is a four credit hour course (two 75 minutes combined with a three hour laboratory meeting each week). A pilot study was conducted for this course. Students completing this course should be able to:

1. Analyze circuits containing electronic devices using suitable models⁴⁻⁶.
2. Analyze linear circuits containing operational amplifiers⁴⁻⁶.
3. Design circuits containing electronic devices to control signals⁴⁻⁶.
4. Use PSpice to design and analyze electronic circuits.

The Network Analysis course deals with a general introduction to elementary rules, theorems, and laws applicable to AC circuits. The course includes an introduction to differential equation modeling and analysis of linear circuits with sinusoidal inputs (power, phasors, impedances, and admittances). A complete treatment of circuit analysis in the frequency domain (Bode plots, frequency response, Laplace transforms, and Fourier analysis) is included. Laboratory work emphasizes frequency response, circuit synthesis, and PSpice simulation/modeling. This includes building and testing circuits to show and support theoretical concepts. Differential Equations and Circuit Analysis are prerequisite courses. Mostly students from the electrical, mechanical, navel architecture, marine engineering programs enroll in this course. This course is a required course for the electrical and marine engineering majors. It is a three credit hour course (a two hour combined with a two hour laboratory meeting each week). A pilot study was conducted for this course. Students completing this course should be able to:

1. Develop models of circuits in terms of differential equations⁷⁻¹⁰.
2. Analyze circuits containing resistors, capacitors, inductors and op-amps driven by sinusoidal inputs by using the concepts of phasors, impedances, admittances and compute power⁷⁻¹⁰.
3. Use Laplace transforms for the analysis of circuits in the s-domain including Bode plots and frequency response. Also, perform Fourier circuit analysis⁷⁻¹⁰.
4. Use PSpice to simulate and analyze simple circuits.

The abovementioned courses have a laboratory component where students build simple electric circuits and make measurements in the laboratory by using basic laboratory equipment, computer simulation tools, and work in teams.

The aforementioned course outcomes support and realize the ABET Criterion 3 outcome and assessment for accrediting Engineering programs¹¹.

Method for Evaluation and Information Gathering

The objective of this research is to evaluate the results and feedback of a survey concluded by the students. These surveys were based on their attitude towards media based modules that was used in the instruction of Electronics and Network Analysis courses. The modules were used to complement traditional instruction and to assist student insight of engineering fundamentals. These modules also serve as an interactive design space where they can get instant response to what-if problems.

Student Statistics

The total number of students who took part in the survey at SUNY Maritime College was thirty five (35) of which sixteen (16) were enrolled in the Electronics course and nineteen (19) were enrolled in the Network Analysis course. Out of the total participants, 60% were senior, 31%

were junior, and 9% were sophomore. The age of students varied from 20 to 33 years. 25% were 20 years old, 40% were 21 years old, two students were 22 years old, 14% were 23 years old, one student was 24 years old, one student was 28 years old, two students were 30 years old, and one student was 33 years old. The average student age was approximately 22 years old. Students ranked themselves regarding computer skills based on a 1 to 10 scale. Of the thirty five participants, 63% thought their level of computer skills to be 7 or higher and 37% below 7. 97% of the participants were male.

Media Based Module for Teaching Engineering Fundamentals

A new media based module was contrived for teaching PSpice for Electronics and Network Analysis course. Students enrolled in the course had access to the media based module which was housed on a network drive. To gain access to the modules, they had to use a campus computer to log onto their accounts. The module starts by demonstrating a step-by-step simulated instruction to learn some of the basic procedures of using PSpice – analysis of a resistive circuit, DC, AC, and Transient analysis.

The module explains all the essential setups, file saving, operating the program, and observing the results through text editor and screen captures. Each main point is depicted in adequate detail. Students accessing the modules are not under any time limitation or rush; they can go through the modules at their own speed and in their own time.

Assessment Method and Plan of Research

Students were requested to log into their campus account and download the module from a specified folder on a network drive. They then examined the module on their own. Most had no prior experience with PSpice simulation at the time of the execution of this media based module. They were able to pursue and figure out the module with relative ease and with minimal amount of time. In the next laboratory session they employed PSpice to analyze and simulate the given laboratory that was due for that day.

The principal assessment goal was to assess student outlook towards media based modules. To this end, a survey comprising of 12 questions was given to students enrolled in Electronics and Network Analysis at the conclusion of the laboratory session. The full survey used in this research is shown in Table 1. The back of the survey asked for comments regarding the use of media based modules.

The survey was given to the students by requesting them to offer their level of agreement on every statement using a typical five-level Likert scale with higher values suggesting greater levels of agreement with the statements. The scale is selected as follows:

1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree

Table 1: Survey

ENGR 387/383 Electronics/Network Analysis							
Survey of Student Outlook towards Media Based Modules							
Major: EE	ME	MEES	Rank: So	Jr	Sr	Age: _____	
From a 1 to 10 scale, 10 being best, I consider my computer skills at _____					Sex: _____		
Please choose one answer for each of the following questions:			SA	A	N	D	SD
1.	I am highly conversant with using a wide array of computing applications such as MS Office.		5	4	3	2	1
2.	I feel technology driven instruction techniques facilitate ease of learning CAD tools such as PSpice.		5	4	3	2	1
3.	I would prefer to use technology based instruction techniques while learning to use PSpice when I practice by myself.		5	4	3	2	1
4.	Technology driven instruction plays a paramount role in making learning enjoyable.		5	4	3	2	1
5.	I think learning CAD tools such as PSpice will be beneficial to my prospects.		5	4	3	2	1
6.	I feel technology related instructional materials are difficult to understand.		5	4	3	2	1
7.	Technology based instruction techniques are more helpful than textbooks in the learning process.		5	4	3	2	1
8.	Technology based instruction techniques are intriguing and help me concentrate on the subject matter better than other techniques.		5	4	3	2	1
9.	Traditional methods do a mediocre job when dealing with learning CAD tools such as PSpice.		5	4	3	2	1
10.	I can learn in an unhurried manner and pace myself using technology based instruction techniques.		5	4	3	2	1
11.	Technology based instruction techniques get me more involved in the subject matter.		5	4	3	2	1
12.	I was encouraged to experiment and learn more due to technology based instruction.		5	4	3	2	1

Notes: The following acronyms are used for each major.

EE: Electrical Engineering

ME: Mechanical Engineering

MEES: Marine Electronics and Electronic Systems

Numerical Outcome and Investigation

Numerical outcomes from the thirty five participants are presented in Table 2. The group average scores for all questions are notably above 3.0. This result shows that as a group, students either strongly agree or agree to all statements which show that they have optimistic outlooks toward media based modules. Evaluating average scores across individuals, 83% of students (29 out of 35) have positive responses.

Table 2: Statistics from All Participants

ID#	Sex	Age	Rank	Major	Comp Skill	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Ave.
1	F	21	Sr	EE	7	4	4	5	4	4	3	5	4	4	4	5	5	4.3
2	M	20	Jr	MEES	8	4	5	4	3	5	3	3	5	4	4	4	4	4.0
3	M	20	Jr	EE	8	3	4	4	3	4	4	2	4	4	4	4	4	3.7
4	M	20	Jr	EE	7	4	4	5	4	5	4	3	4	5	4	5	4	4.3
5	M	20	Sr	MEES	6	4	4	4	4	4	4	4	5	4	4	4	3	4.0
6	M	23	Sr	EE	8	3	2	2	3	1	1	3	3	4	3	2	3	2.5
7	M	21	Sr	MEES	5	4	3	4	3	3	4	5	4	4	4	5	4	3.9
8	M	23	Jr	EE	7	4	4	5	3	4	5	4	5	5	4	5	5	4.4
9	M	21	So	EE	6	4	3	5	5	4	4	5	4	5	4	5	4	4.3
10	M	30	Sr	EE	3	4	5	3	4	5	4	4	4	4	5	4	5	4.3
11	M	21	Sr	EE	9	4	4	3	5	4	3	4	5	4	5	4	5	4.2
12	M	21	Sr	EE	8	4	3	4	3	4	4	4	4	4	4	4	4	3.8
13	M	23	Jr	MEES	10	3	4	3	3	5	3	4	4	5	4	4	4	3.8
14	M	21	Sr	MEES	6	5	3	4	5	4	4	5	4	5	4	5	4	4.3
15	M	20	Jr	EE	9	3	4	3	4	5	3	4	5	4	5	4	4	4.0
16	M	22	Sr	EE	7	3	4	3	4	4	3	4	5	4	3	4	4	3.8
1	M	33	Jr	ME	9	5	4	4	4	5	3	5	4	4	5	5	5	4.4
2	M	24	Sr	MEES	8	4	5	4	5	5	5	4	5	5	4	5	5	4.7
3	M	28	Jr	ME	6	3	2	3	3	2	3	3	3	3	2	3	3	2.8
4	M	21	Jr	EE	7	4	4	4	5	3	1	4	4	3	4	4	3	3.6
5	M	21	Sr	MEES	6	4	3	2	2	1	1	3	2	4	3	2	3	2.5
6	M	20	Jr	EE	8	4	5	4	5	4	3	4	4	4	5	4	5	4.3
7	M	20	Jr	EE	5	3	2	4	2	1	2	3	2	4	3	2	3	2.6
8	M	20	Sr	MEES	8	4	5	4	4	5	4	5	3	4	4	4	5	4.3
9	M	23	Sr	EE	8	3	2	3	2	4	2	1	2	4	3	2	3	2.6
10	M	21	Sr	EE	10	5	4	3	4	3	2	4	4	3	4	5	4	3.8
11	M	21	Sr	MEES	4	4	3	4	3	3	3	4	5	3	5	4	4	3.8
12	M	21	So	EE	7	4	5	3	4	3	4	5	4	3	4	4	3	3.8
13	M	30	Sr	EE	4	3	4	4	4	3	3	3	4	5	4	5	4	3.8
14	M	21	Sr	EE	8	3	5	5	5	4	3	5	4	3	4	4	4	4.1
15	M	21	Sr	EE	9	4	5	4	4	3	4	4	4	5	5	4	5	4.3
16	M	21	Sr	MEES	7	5	4	5	4	5	4	4	5	4	5	5	5	4.6
17	M	23	Sr	EE	8	4	5	4	5	4	4	5	4	4	5	4	5	4.4
18	M	20	So		5	3	3	3	2	3	2	2	3	3	3	1	3	2.6
19	M	22	Sr	EE	9	4	5	4	5	5	5	5	5	5	4	4	5	4.7
Average		22.2			7.1	3.8	3.9	3.8	3.8	3.7	3.3	3.9	4.0	4.1	4.0	4.0	4.1	3.9

Tables 3 and 4 compare the majors of the students. The respondents consist of 22 electrical engineering majors, 2 mechanical engineering majors, 10 marine engineering majors, and 1 undecided engineering student. The students are mostly male and senior with average ages of around twenty two. Table 4 shows the average age of participants by major.

Table 3: Sex and Rank of Participants by Major

	EE	ME	MEES	Undecided	Total
Proportion Male	95%	100%	100%	100%	97%
Proportion Sophomore	9%	0%	0%	100%	9%
Proportion Junior	32%	100%	20%	0%	31%
Proportion Senior	59%	0%	80%	0%	60%
Number of Respondents	22	2	10	1	35

Table 4: Average Age of Participants by Major

	EE	ME	MEES	Undecided	Total
Average	22	30.5	21.2	20	22.2
Standard Deviation	2.8	3.5	1.3		3.2
Number of Respondents	22	2	10	1	35

Table 5 sums up the average replies for each question by major. Even though there are not sufficient data points for each major to carry out significant evaluation, the table provides insight into similarities and differences in the outlooks of students. As predicted, the average scores for the undeclared majors were lower than those with confirmed majors. The marine engineering students experience regarding media based modules were slightly better than all other majors. Most students have indicated that their experiences were good, as shown by the numerical feedback and by their remarks that is provided in the following section. While looking at the whole data simultaneously with the student remarks, the experiences of the students appear to point out that while they enjoyed the media based modules in PSpice, they rather use this in combination with traditional instruction.

This research will be repeated over the next several years to carry out meaningful comparisons among different majors, rank, age, and sex.

Table 5: Average Reply for Each Question by Major

	Question	EE	ME	MEES	Undecided	Total
1	I am highly conversant with using a wide array of computing applications such as MS Office.	3.7 (0.6)	4.0 (1.4)	4.1 (0.6)	3.0 (--)	3.8 (0.6)
2	I feel technology driven instruction techniques facilitate ease of learning CAD tools such as PSpice.	4.0 (1.0)	3.0 (1.4)	3.9 (0.9)	3.0 (--)	3.9 (1.0)
3	I would prefer to use technology based instruction techniques while learning to use PSpice when I practice by myself.	3.8 (0.9)	3.5 (0.7)	3.8 (0.8)	3.0 (--)	3.8 (0.8)
4	Technology driven instruction plays a paramount role in making learning enjoyable.	4.0 (1.0)	3.5 (0.7)	3.6 (1.0)	2.0 (--)	3.8 (1.0)
5	I think learning CAD tools such as PSpice will be beneficial to my prospects.	3.7 (1.1)	3.5 (2.1)	4.0 (1.3)	3.0 (--)	3.7 (1.2)
6	I feel technology related instructional materials are difficult to understand.	3.2 (1.1)	3.0 (0.0)	3.5 (1.1)	2.0 (--)	3.3 (1.1)
7	Technology based instruction techniques are more helpful than textbooks in the learning process.	3.9 (1.0)	4.0 (1.4)	4.1 (0.7)	2.0 (--)	3.9 (1.0)
8	Technology based instruction techniques are intriguing and help me concentrate on the subject matter better than other techniques.	4.0 (0.8)	3.5 (0.7)	4.2 (1.0)	3.0 (--)	4.0 (0.9)
9	Traditional methods do a mediocre job when dealing with learning CAD tools such as PSpice.	4.1 (0.7)	3.5 (0.7)	4.2 (0.6)	3.0 (--)	4.1 (0.7)
10	I can learn in an unhurried manner and pace myself using technology based instruction techniques.	4.1 (0.7)	3.5 (2.1)	4.1 (0.6)	3.0 (--)	4.0 (0.7)
11	Technology based instruction techniques get me more involved in the subject matter.	4.0 (0.9)	4.0 (1.4)	4.2 (0.9)	3.0 (--)	4.0 (1.0)
12	I was encouraged to experiment and learn more due to technology based instruction.	4.1 (0.8)	4.0 (1.4)	4.1 (0.7)	3.0 (--)	4.1 (0.8)
	Number of Respondents	22	2	10	1	35

Note: Standard deviations in parentheses below averages

Student Remarks

Students were instructed to write some remarks regarding media based modules at the back of the survey. Some of the student remarks are included as follow:

- Media based instruction is new to me but is good teaching method.
- The most part I enjoyed learning from this class was PSpice using media based modules. I can go through the module step by step and on my own time.

- I enjoy learning by doing and the media based module helped me accomplish that.
- I liked the fact that I can learn the modules on my own pace and time.
- Need more explanation on how to use the program.
- The manuals are too complicated to understand and take too much time to get information out of it. With media based instruction I was able to learn the material quickly and the module showed me all the steps needed to run and simulate the circuit.
- Without the tutorials PSpice is complicated to use, this was fun!
- Media based modules should be used in conjunction with lectures.
- I don't like media based instruction because no one is there to help me when I get problem. This should be used with traditional lectures.

Conclusion

This paper offered the outcome of a survey taken by students enrolled in electronics and network analysis course at SUNY Maritime College to measure the efficacy of media based modules in teaching engineering fundamentals. From the survey results and student feedbacks in this pilot study, it is concluded that media based modules, complemented with traditional instruction, is what students desire. Media based modules offers a great support to the student's grasping engineering fundamentals in an accelerated approach. The authors plan to repeat this research over the next several years and disseminate the results to the educational community in suitable publications.

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