An Investigation of the Attitude of Learners toward Media Based Instructions of PSPICE in Electric Circuits Analysis

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Abstract

This paper explores the assessment results of an investigation of learners' attitude toward media based instructional tool. The investigation is based on a survey completed by forty students enrolled in Electric Circuits courses at Ohio Northern University. The students are majoring in different engineering disciplines, namely computer, electrical and mechanical. The instructional tool is designed to tutor students on how to use the PSPICE circuit simulation program to analyze electric and electronic circuits. The information and data collected from survey and questionnaires was analyzed and used for the evaluation of attitudes toward the use of this media based instructional tool. Students have responded favorably to and expressed their satisfaction with the developed media based instructional tool.

Introduction

In recent years and due to the evolving technology and its attendant introduction of new material into the curriculum, most colleges face a demand to optimize their curriculum and increase the content of courses. This challenges educators to determine more efficient ways of designing their courses and presenting the material - the way they want it to be and not the way others want it to be since they are considered to be the experts in their areas - in order to ensure that students are provided with information to help them pass along the essential knowledge of their field and acquire computer skills to be adequately prepared to function as high quality professionals of the future.

For computer skills, computer simulation provides a simplification of reality due to its role in the design, analysis and evaluation of systems. A variety of software tools are available to simulate electric circuits. The most used software is PSPICE, a simple, an-easy-to-use software, and it can be downloaded free of charge from http://www.engineers-international.com/freeshare.html.

Meeting the instructional needs of students to learn the material is the keystone of every effective program. The tools of educational technology and software hold tremendous potential for improving both teaching and learning processes. Cohen et al [1] performed analysis of 74 studies that compared visual-based instruction with traditional instruction. They found that students learned more from visual-based instruction than from traditional teaching. It is evident from the paper by Powell et al [2] that computer based instruction may be the key to improving the grade point average of students. Bartsch and Cobern [3] found that PowerPoint presentation can be beneficial to students' learning. Papers [4-8] reported that those who integrate technology in the learning process believe it will improve learning and better prepare students to effectively participate in the 21st century workplace. Today, educators are concerned with how to use

technology to enhance and enrich their learning environments rather than asking whether to use it.

Multimedia which is defined in paper [9] as "the integration of video, audio, graphics and data within a single computer workstation" and according to Willis [10] multimedia enables the instructor to custom design and individualize instruction and learner to "plan, execute, and manage" his or her learning experience at the rate, place, and time of the learner's choice. Folkestad and De Miranda [11] have used multimedia through screen-capture to teach students how to use CAD software. They reported that students were unsatisfied with this instructional tool due to its fast pace and the need to switch back and forth from the recorded lecture to the CAD software. In this paper, a new instructional tool is presented and the problems encountered in reference [11] are solved by having a variable pace (slow, medium, fast) which allows the students to proceed at their desired pace. The files in this instructional tool have a different format and extensions that overcome the second problem in [11] and students can see both windows (screen captured window and the software window) simultaneously, eliminating the need to switch back and forth. This paper is organized through sections. The first section describes the course. The data collection and assessment method is described in the second section. This is followed by the results of the assessment and finally the conclusion.

The Course

At Ohio Northern University, the college of engineering offers two courses in electric circuits namely Circuits 1 and Circuits 2. The survey and questionnaires are conducted in Circuits 2 course. The Circuits 2 course is a four credit hour (three-50 minutes lecture meetings and one- 2 hours laboratory meeting each week). It has students from computer, electrical and mechanical engineering programs. The outcomes of the course are to:

1. analyze ac circuits using basic laws, analysis techniques and network theorems.
2. analyze ideal transformers and circuits with mutual coupling.
3. Solve for power quantities in ac single and three-phase circuits.
4. use appropriate software tools to analyze ac circuits.
5. design ac circuits and safely conduct laboratory experiments.

The course outcomes support and meet the following items of ABET-criterion 3 and listed here for convenience.

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs
(d) an ability to function on a multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Data Collection and Assessment Method

The purpose of this paper as mentioned is to report the results of a survey and questionnaires that the participants completed based on their attitude toward the media based tool that was used in the instruction of PSPICE for electric circuits analysis.

1. Participants

The pool included forty students enrolled in two classes of Circuits 2 at Ohio Northern University. There were 85% male and 15% female. Of the forty participants, 95% were classified as sophomores and 5% were seniors. The students' age ranges from 19 to 23 years old. Sixty percent were 19 years old, 33% were 20 years old, and three students are older than 20 years, which means that the average participant was 19.5 years old. Students have classified themselves regarding computer knowledge based on a score ranges from 1 to 10. There were 75% considered their level of computer knowledge to be 7 or higher and 25% below 7.

2. Media based instructional tool

A new instructional tool was created for the teaching of PSPICE for electric circuits analysis. This instructional tool employs a prerecorded simulation through Camtesia screen-capture software showing every step of the simulation. It starts by opening the PSPICE Schematics, selecting the parts, arranging these parts, wiring the parts together to depict and represent the circuit to be analyzed. Also, the instructional tool shows all the required analysis setups, saving the file, simulating the circuit, and obtaining the results through text editor and plots. Dr. Al-Olimat (the second author) has created this teaching tool from students' point of view; he was aware of and sensitive to the technical obstacles that media based instruction learners face. During the instruction, every step is explained in detail and calls student attention to the main points. This is necessary since students do not have to be at a specific time and place to use it. As an example of what the window of the instructional tool looks like, Figure 1 shows the tool on teaching students how to modify the value of the ac voltage source of a given circuit.

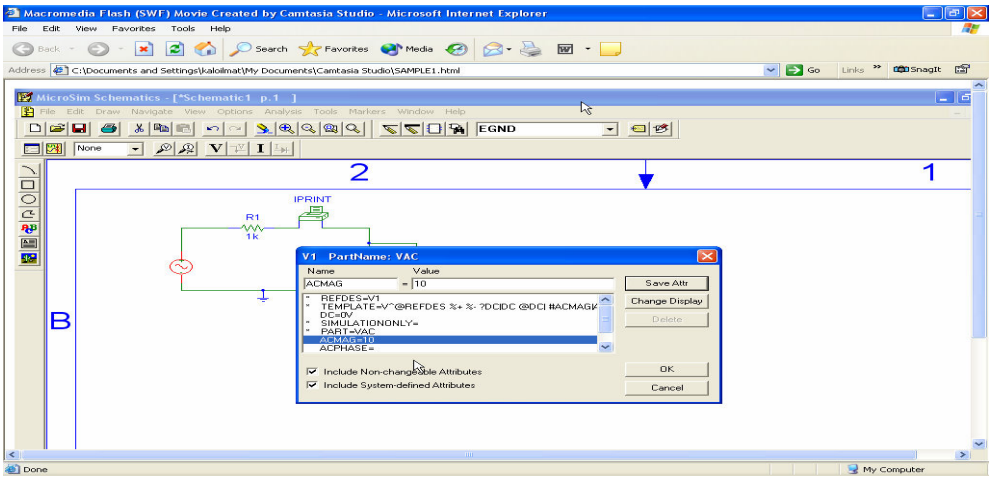

Figure 1 A Step of changing the value of the voltage source

3. ***Measures***

At each computer in the laboratory, a file that contains an example of simulating a given electric circuit was loaded. Students have opened that file and start watching and following the instruction. Students have never been exposed to PSPICE for ac circuits analysis at the time of the implementation of this media based instructional tool. They were able to follow and understand the instructional steps without a great deal of time or effort. Then they have used PSPICE to analyze the given circuit in their laboratory that was a requirement for that laboratory completion.

The primary assessment goal was to measure the attitude of students toward this instructional tool. In order to perform this assessment, a survey that consists of 11 questions was administered to students in two different offerings of Circuits 2 at the end of the laboratory session. The survey sheet is shown in Table 1.

Table 1 Survey Sheet

GE 202 Circuits 2
Survey of Students' Attitude toward A Media Based Instruction

Major: CmpE EE ME Academic status: So Jr Sr. Age:_____ Sex:_____

In a 1 to 10 scale, I consider my computer knowledge at_____

Please choose one answer for each of the following questions:	SD	D	N	A	SA
1. I consider myself to be excellent in operating computer applications such as MS Words, Excel, PowerPoint, etc.	1	2	3	4	5
2. I enjoy learning PSPICE using media-based instruction	1	2	3	4	5
3. I believe that the more teachers use media-based instruction, the more I will enjoy learning.	1	2	3	4	5
4. I feel uncomfortable learning PSPICE using media-based instructional materials in my own time.	1	2	3	4	5
5. I feel nervous when I know that I need to use technology related instructional materials.	1	2	3	4	5
6. I believe it is important for me to know how to use PSPICE.	1	2	3	4	5
7. I concentrate better when a media-based instruction is used.	1	2	3	4	5
8. Learning PSPICE is faster using media-based instruction compared to traditional methods.	1	2	3	4	5
9. I can learn more from media-based instruction than from traditional books.	1	2	3	4	5
10. Using media-based instruction improved my engagement in the learning process.	1	2	3	4	5
11. Using media-based instruction motivated me to do more simulation.	1	2	3	4	5

Students were asked to indicate their level of agreement on each statement of the survey using a five-point Likert scale with higher values indicating greater levels of agreement with the statement. The scale is defined as1 for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree. This methodology is often used to ensure that participants make at least some commitment toward attitude.

4. Results

1. Statistical Results

The data obtained from the computer engineering students is shown in Table 2. Table 3 shows the data obtained from electrical engineering students, while the data obtained from mechanical engineering majors is shown in Table 4. Although this paper does not analyze the results based on individual majors, but they are reported here for the reader to see the difference among majors' responses. The overall average of responses is shown in table 5.

Table 2 Data from Computer Engineering Majors

Student No	Sex	Ac Status	Age	CK	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Average
1	M	SO	19	8	4	4	3	2	2	4	3	4	3	4	4	3.36
2	M	SO	20	10	5	4	4	2	1	5	5	4	5	4	4	3.91
3	M	SO	20	10	4	3	2	2	1	4	3	2	3	2	2	2.55
4	M	SO	19	9	5	4	3	3	2	4	3	4	3	4	4	3.55
5	M	SO	23	8	5	4	4	2	1	5	4	4	5	4	3	3.73
6	M	SO	19	9	5	5	5	3	1	5	4	4	5	4	5	4.18
7	M	SO	19	8	4	4	3	2	1	4	3	4	3	4	3	3.18
8	M	SO	19	9	5	3	2	1	1	4	2	3	2	4	2	2.64
9	M	SO	20	7	3	2	3	3	1	4	4	5	4	3	3	3.18
10	M	SO	20	6	3	3	2	5	3	3	2	4	3	3	2	3.00
average			19.8	8.4	4.30	3.60	3.10	2.50	1.40	4.20	3.30	3.80	3.60	3.60	3.20	

Table 3 Data from Electrical Engineering Majors

Student No	Sex	Ac Status	Age	CK	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	
1	M	SO	19	8	4	4	4	3	3	5	5	4	4	4	3	3.91
2	M	SO	19	7	4	5	4	2	3	5	4	5	5	4	3	4.00
3	M	SO	19	7	2	4	4	2	4	5	4	5	4	4	3	3.73
4	M	SO	20	6.5	4	4	3	3	2	3	3	4	4	4	3	3.36
5	M	SO	20	8	4	3	4	2	2	4	3	3	4	3	3	3.18
6	M	SO	19	6	3	4	2	3	3	4	2	3	2	3	4	3.00
7	M	SO	20	4	3	4	4	2	3	5	4	3	3	3	3	3.36
8	F	SO	20	6	4	3	4	2	3	4	3	2	3	3	2	3.00
9	F	SO	19	7	5	3	4	4	4	4	4	2	3	3	2	3.45
10	F	SO	19	6	3	4	4	1	2	4	5	5	5	4	3	3.64
11	F	SO	19	7.5	3	4	4	2	1	5	3	5	3	4	3	3.36
12	F	SO	19	7	1	2	4	3	4	4	4	5	4	4	3	3.45
average			19.33	6.7	3.33	3.67	3.75	2.42	2.83	4.33	3.67	3.83	3.67	3.58	2.92	

Table 4 Data from Mechanical Engineering Majors

Student No	Sex	Ac Status	Age	CK	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	
1	M	SO	19	7	5	4	5	2	3	5	3	5	4	5	4	4.09
2	M	SO	19	7.5	4	4	2	3	2	4	4	4	4	3	4	3.45
3	M	SO	19	5	3	3	3	3	2	4	3	2	3	3	2	2.82
4	M	SO	19	7	4	3	3	2	2	4	3	3	3	4	3	3.09
5	M	SO	19	7	5	3	3	4	2	3	3	4	4	3	3	3.36
6	M	SO	19	8	1	3	3	2	1	4	4	5	5	4	2	3.09
7	M	SO	20	7	4	5	4	4	1	3	4	5	3	4	4	3.73
8	M	SO	19	4	4	4	2	2	1	5	3	3	3	2	3	2.91
9	M	SO	19	6	3	5	4	1	2	4	4	5	5	4	4	3.73
10	M	SO	20	4	4	4	4	3	3	5	3	4	4	4	3	3.73
11	M	SO	20	7	4	4	5	1	1	4	5	4	5	4	3	3.64
12	M	SO	19	8	4	4	4	1	1	4	4	5	5	4	4	3.64
13	M	SO	20	8	4	4	4	2	2	5	5	3	3	4	4	3.64
14	M	SO	19	7	4	4	4	2	2	4	3	4	3	4	3	3.36
15	M	SO	20	7	3	4	4	2	3	3	4	3	3	4	4	3.36
16	M	SR	21	8	5	4	4	2	1	5	4	5	5	4	3	3.82
17	M	SR	22	8	5	5	5	5	1	5	4	5	5	5	5	4.55
18	F	SO	19	7	4	4	5	3	3	5	5	4	4	4	5	4.18
average			19.56	6.8	3.89	3.94	3.78	2.44	1.83	4.22	3.78	4.06	3.94	3.83	3.50	

Table 5 Overall Average of Responses

Average of All			19.55	7.2	3.83	3.78	3.60	2.45	2.03	4.25	3.63	3.93	3.78	3.70	3.25

The pool has 10 computer engineering majors, 12 electrical engineering majors and 18 mechanical engineering majors. The statistical results of each statement in the survey with respect to each major and to the whole pool are presented as follow.

- *I consider myself to be excellent in operating computer applications such as MS Words, Excel, PowerPoint, etc.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%				20%	30%	50%	4.30
Electrical	58%	42%	8%	8%	34%	42%	8%	3.33
Mechanical	95%	5%	5%		17%	56%	22%	3.89
Average	85%	15%	5%	2%	22%	45%	26%	3.89

The majority have indicated that they are excellent in operating computer applications (71%).

- *I enjoy learning PSPICE using media-based instruction*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%			10%	30%	50%	10%	3.60
Electrical	58%	42%		8%	25%	59%	8%	3.67
Mechanical	95%	5%			22%	61%	17%	3.94
Average	85%	15%		5%	25%	58%	12%	3.78

Majority of students indicated that they have enjoyed learning using this instructional tool (70%).

- *I believe that the more teachers use media-based instruction, the more I will enjoy learning.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%			30%	40%	20%	10%	3.10
Electrical	58%	42%		8%	34%	83%	8%	3.75
Mechanical	95%	5%		11%	17%	45%	22%	3.78
Average	85%	15%		15%	22%	50%	13%	3.60

Majority of students supported the idea of media based instructional tool (63%).

- *I feel uncomfortable learning PSPICE using media-based instructional materials in my own time.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%		10%	50%	30%	%	10%	2.50
Electrical	58%	42%	8%	50%	34%	8%		2.42
Mechanical	95%	5%	17%	45%	22%	11%	5%	2.44
Average	85%	15%	13%	48%	27%	7%	5%	2.45

Majority of students disagreed with the statement which means that they have felt comfortable with the instructional tool (61%)

- *I feel nervous when I know that I need to use technology related instructional materials.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%		70%	20%	10%			1.40
Electrical	58%	42%	8%	25%	42%	25%		2.83
Mechanical	95%	5%	39%	39%	22%			1.83
Average	85%	15%	38%	30%	25%	7%		2.03

Majority of students expressed that they felt relaxed when using this instructional tool (68%)

- *I believe it is important for me to know how to use PSPICE.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%				10%	60%	30%	4.2
Electrical	58%	42%			8%	50%	42%	4.33
Mechanical	95%	5%			17%	44%	39%	4.22
Average	85%	15%			12%	50%	38%	4.25

Majority of students know that using PSPICE is very important (88%).

- *I concentrate better when a media-based instruction is used.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%			20%	40%	30%	10%	3.30
Electrical	58%	42%		8%	33%	42%	17%	3.67
Mechanical	95%	5%			39%	44%	17%	3.78
Average	85%	15%		7%	37%	40%	16%	3.63

Majority of students believed that they have concentrated better using this instructional tool (56%). 37% of students had no opinion.

- *Learning PSPICE is faster using media-based instruction compared to traditional methods.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%			10%	10%	70%	10%	3.80
Electrical	58%	42%		16%	25%	17%	42%	3.83
Mechanical	95%	5%		5%	22%	33%	39%	4.06
Average	85%	15%		10%	20%	37%	33%	3.93

Majority of students believed the instructional tool has accelerated the learning process (70%).

- *I can learn more from media-based instruction than from traditional books.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%			10%	50%	10%	30%	3.60
Electrical	58%	42%		8%	33%	42%	17%	3.67
Mechanical	95%	5%			39%	28%	33%	3.94
Average	85%	15%		5%	40%	27%	28%	3.78

Approximately 55% of students believed they learned more using this instructional tool compared to textbooks. 40% had no opinion.

- *Using media-based instruction improved my engagement in the learning process.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%			10%	20%	70%		3.60
Electrical	58%	42%			42%	58%		3.58
Mechanical	95%	5%		5%	17%	67%	11%	3.83
Average	85%	15%		5%	25%	65%	5%	3.70

Majority of students agreed that they have engaged in the learning process (70%).

- *Using media-based instruction motivated me to do more simulation.*

Engineering Major	Male Population	Female Population	Score					Score Average
			1	2	3	4	5	
Computer	100%			30%	30%	30%	10%	3.20
Electrical	58%	42%		17%	75%	8%		2.92
Mechanical	95%	5%		11%	39%	39%	11%	3.50
Average	85%	15%		17%	48%	28%	7%	3.25

Approximately 50% of students had no opinion and 35% believed that the media based instructional tool has motivated them.

2. Students Comments

At the back of the survey sheet, students were asked to write comments regarding this media based instructional tool. The comments of students included the following:

- I like the fact that it shows a step by step procedure of how to set up and simulate a given circuit.
- I think learning PSPICE would be easier using media-based instruction.
- In general, it all depends on how the information is presented. I believe a teacher will be able to teach me better while some stuff would be easier to learn through a media representation.
- I like being able to see visually what is being done rather than reading where you don't see the results as quickly as the media allows.
- I like how we can see the process and method and could do the work along with the instruction.
- The media based tutorial helped clarify a few things, such as where things are located in PSPICE. Also, always being able to access it helps.
- Media based instruction = good.
- I would fully support the use of this tool because I do not like to learn about a software from a book like in our previous course in Auto CAD. It is advantageous to learn by doing.
- I think the idea of media based instruction is a good tool in the learning process, however a hard copy of printed instruction is also nice.
- Media based instruction is less confusing than trying to read through the manuals and learn how to simulate.
- This program would not only save time but also allow for a better understanding. Many times I did not complete PSPICE in the lab so in my dorm I had someone helped me. With this disk, I can learn just as much but on my own time which would be a crucial factor.

Based on the statistical data and the comments obtained from students, the media based instructional tool is proven to be an effective learning tool that has worked for majority of students. Students were satisfied with the instruction, and the access to the tool.

Conclusion

The media based instructional tool was designed to tutor students how to use PSPICE circuit simulation program to analyze electric and electronic circuits. The purpose of this paper was to evaluate the attitudes of college students when that integrated instructional media was used as the method of instruction. The information and data collected from the surveys was analyzed and used for the assessment and evaluation. Students have responded favorably to and expressed their satisfaction in the developed instructional tool. We believe that the media based instructional tool offers some advantages such as it is a completely learner-paced, it can be followed easily, it does not require a great deal of time or effort and the learner does not have to be at a specific time and place to use it. In our course, Circuits 2, it is no longer necessary to devote additional classroom or laboratory time to the instruction of PSPICE.

Finally, since the role of instruction is not to distribute facts but to grant students with ways to assemble knowledge, educators must find favored strategies that build students' confidence and enhanced course relevance. This can be achieved through the continual investigation of appropriate ways to introduce new technologies into the classroom.

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Author Biographies

Dr. Feng Jao obtained her PhD from the University of Toledo in the field of Educational Technology in 2001. Currently she is an assistant professor in the Department of Technological Studies at Ohio Northern University. Her professional interests include integration of instructional technology across curriculum, software training, digital media, and web-based instructional material design and development. Dr. Jao holds several certifications including Microsoft Office XP Word 2002 Expert, Office XP Excel 2002 Expert, Office XP PowerPoint 2002 Comprehensive, Office XP Access 2002 Core and Office XP Outlook 2002 Core. She is an active member in AECT and ITEA professional organizations. Dr. Jao is listed in the International Who's Who of Professional Management.

Dr. Khalid S. Al-Olimat is an associate professor in the Department of Electrical & Computer Engineering and Computer Science at Ohio Northern University. He obtained his BS in Electrical Engineering from Far Eastern University on 1990, the MS in Manufacturing Engineering from Bradley University on 1994 and his PhD in Electrical Engineering from the University of Toledo on 1999. Dr. Al-Olimat has many publications in the area of adaptive control, fuzzy control and machine drives. His areas of interest are power engineering, adaptive, fuzzy and intelligent control. He is a member of ASEE and IEEE where he is serving as the secretary of IEEE-Lima section.