DOI: https://doi.org/10.53555/nnel.v9i3.1597 Publication URL: https://nnpub.org/index.php/EL/article/view/1597

EFFECT OF PC SIMULATION PROGRAM WITH INTEGRATED CIRCUIT EMPHASIS (PSPICE) ON STUDENT'S INTEREST IN CIRCUIT DESIGN IN FEDERAL COLLEGE OF EDUCATION, TECHNICAL OMOKU, RIVER STATE, NIGERIA

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Abstract

The present study examined the effect of a PC simulation program with integrated circuit emphasis (PSPICE) on students' interest in Circuit Design at Federal College of Education, Technical Omoku, River State, Nigeria. One hundred and eighty-seven (n = 187) students enrolled in the engineering departments of the Federal College of Education, Technical Omoku, River State, Nigeria, comprising males and females between the ages of 23 and 31 years with a mean age of (M=9.14) and (SD= 1.24) were randomly selected as the study participants. They were assigned two conditions, with group A as the experimental condition. On the other hand, group B represents the control condition. A t-test analysis was performed on the data to answer the research question of whether the PSPICE simulation software would increase students' interest in circuit design. The analysis established a significant difference between the experimental and control conditions on interest in circuit design MD = 5.08, t (185) = 7.328, p = .000. Thus, the result provided the answer to the research question and suggested that the PSPICE software might be used to improve student's interest in circuit design. The practical implications and recommendations are discussed.

Keywords*: PSPICE, circuit design, students, interest*

INTRODUCTION

Due to recent advancements in computer technology, the fields of science and engineering have recently become very dynamic. Computers have been used in education in many ways since their history. Computer simulations contain visual features for representing authentic systems or phenomena and have been recognized as an effective tool for teaching and learning in science (Duangngoen & Srisawasdi, 2016). Virtual reality simulators are becoming essential to modern education (Roy et al., 2017). Numerous computer programs to solve common and uncommon problems have been produced due to these advancements. These programs help plan, create, and manage complex systems using the computer's enhanced computational capabilities. Various teaching methods are emerging, and virtual simulation technology as a new teaching media has begun appearing in education and teaching (Yu & Chen, 2022). The use of virtual simulation technology to help students visualize the landscape space in front of students is of great help to students' spatial cognitive learning (Zhang & Ma, 2022). Virtual learning simulations are increasingly being used in diverse educational and training contexts as a supplement to traditional educational methods (Badowski & Wells-Beede, 2022; Behmadi et al., 2022; de Vries & May 2019; Foronda et al., 2020; Garmaise-Yee et al., 2022; McGarr, 2020; Moscato & Altschuller, 2019; Nassar & Tekian, 2020; Padilha et al., 2019; Perez et al., 2022; Qiao et al., 2021). Similarly, previous research has underscored its educational benefits (Dyrberg et al., 2017; Khan et al., 2018; Soraya et al., 2022; Wertz, 2022).

It has been argued that students' understanding of scientific ideas and concepts is based on their engagement in science and engineering practices (Papakonstantinou & Skoumios, 2021). Computer simulations allow students to quickly grapple with realistic scenarios that may not be possible to experience in real life because they may be too dangerous or only occur rarely (Wang et al., 2014). Literature suggests that virtual learning simulations allow students to observe supposedly unobservable phenomena, reduce the time commitment of experiments that would take a very long time if they were carried out physically, and provide guidance that is both online and dynamic (De Jong et al., 2013). Virtual learning simulations can promote learning in a novel way by assisting students in building an understanding of concepts and processes through inquiry-based learning and participation in realistic investigations with continuous feedback. (Bonde et al., 2014; Furtak et al., 2012). In particular, learning simulations make an excellent platform for inquiry-based learning because they allow students to acquire conceptual knowledge while independently investigating a scientific issue using the appropriate methodology in the field. Furthermore, students are motivated by these simulations because they provide them with challenges coupled with continuous feedback in a learning environment better suited to their specific needs and interests.

Modeling with a computer simulation in designing electrical and electronic circuits is important because it is a reliable and affordable method to assess the circuit's performance. It has been discovered that computer-aided simulation can be a handy tool, with simulation serving as a medium through which students can make connections between theoretical concepts and experimental electronic processes. In order to simulate the operation of an electronic device or circuit, simulation software employs mathematical models. It is essentially software that can transform a computer into an electronic lab. Numerous simulation modules support basic electronic practices based on virtual laboratories. For example, several studies have employed Proteus (Waluyo et al., 2021), Multisim (Djalal & HR, 2019), MatLab (Benotsmane et al., 2020) LabView (Korgin et al., 2019), and PSPICE (Muchlas & Budiastuti, 2020) software as a virtual laboratory on basic electronics subjects. The present study aimed to strengthen interest in circuit design using PSPICE simulation software.

An exceptional simulation software program that can effectively solve simple and complex circuit designs is the PC simulation program with integrated circuit emphasis (PSPICE). PSPICE is the SPICE software version created by MicroSim Company. It allows users to build a virtual circuit using a schematic, simulate it using different problem-solving strategies, and evaluate the results using the software. A circuit can be simulated in five main steps. In order to create a circuit, different parts from the directory are first inserted, then the parts are arranged, and then wires are connected between them. The names, values, and other part attributes are then changed. After saving, the schematic file is checked for errors. The outputs are then viewed and analyzed

Computer-aided simulation allows the designed system to be simulated to verify the expected circuit behavior under specific operating conditions. Any design error can be identified, and fine-tuning relevant parts of the design can modify the system's performance. This visual and interactive mode of operation is very helpful in understanding the subject in detail. Also, mistakes can be avoided well before the final hardware implementation of the circuit. Although virtual learning simulations have shown great promise, many unanswered questions regarding their potential exist. For instance, few studies have investigated the non-cognitive outcomes of using virtual learning simulations in high school populations. Furthermore, little is known about how virtual learning simulations can influence students' interest in science, technology, engineering, and mathematics (STEM) fields. Therefore, the present study fills this gap by comparing the effect of simulations and traditional lessons on interest in circuit design.

Research question: Will PSPICE simulation software increase interest in circuit design among students of Federal College of Education, Technical Omoku, River State, Nigeria

Method

The present study employed a quasi-experimental design with pre-test and post-tests and two groups (experimental and control conditions). One hundred and eighty-seven (n = 187) students enrolled in the electronics engineering departments

of the Federal College of Education, Technical Omoku, River State, Nigeria, comprising males and females between the ages of 23 and 31 years with a mean age of (*M*=9.14) and (*SD*= 1.24) were randomly selected as the study participants. They were assigned two conditions, with group A as the experimental condition. On the other hand, group B represents the control condition.

Procedure

Authorization was duly obtained from the school authority. Thus, reliable corporation was established between the researcher and the participants. Before the commencement of the experiment, a questionnaire was administered to the students as a pre-test study. The pre-test determined the student's overall knowledge and interest in circuit design. On concluding the pre-test, the research assistants collected the questionnaires and recorded the scores before handing them to the researcher for further analysis. The primary study resumed with the experimental conditions being taught circuit design with the virtual simulation software. In contrast, the control conditions were taught the same lesson using the conventional method. Finally, the post-test study was conducted similarly to the pre-test, except the questions were reshuffled. The data from the pre-test and post-test were subjected to data analysis.

Result

Table 1: shows the mean and standard deviation scores for group.

		Pre-test		Post-test		
Group	N	Mean	Standard Deviation	Mean	Standard Deviation	Mean Gain
Experimental	98	43.1	10.54	50.19	13.68	7.02
Control	8	42.29	11.29	44.39	13.38	2.01
MD		0.88		5.08		

Table 1 shows that the mean in the pre-test study for experimental conditions is 43.17 while the mean in the pre-test for control conditions is 42.29 giving the pre-test mean difference of 0.88. The finding indicates no significant difference in the participants' mean scores on their level of interest in circuit design. On the other hand, the post-test study reveals a mean of 50.19 for the experimental conditions and 44.39 for the control condition, with a mean difference of 5.08. The gain score for the two conditions was 7.02 and 2.01, respectively. Thus, the result shows that the experimental conditions improved interest in circuit design due to their exposure to the PSPICE software.

Table 2: shows a t-test comparison.

Source of variation	N	Mean	SD	df	*t*	Sig
Experimental	98	50.19	13.68			
Control	89	44.39	13.38	185	7.328	000

A t-test analysis was performed on the data to answer the research question of whether the PSPICE simulation software would increase students' interest in circuit design. The analysis established a significant difference between the experimental and control conditions on interest in circuit design *MD* = 5.08, t (185) = 7.328, p = .000. Thus, the result provided the answer to the research question and suggested that the PSPICE software might be used to improve student's interest in circuit design.

Discussion

This study was conducted to determine whether PSPICE as a PC simulation software would increase interest in circuit design among students of the Federal college of education, Omoku. The result showed a significant difference between the students taught with the simulation software and those prepared with conventional methods in circuit design. For the pre-test and the post-test study conducted, the mean and standard deviation scores showed that exposing the students to a virtual simulation teaching significantly influenced their motivation for circuit design in the post-test study (*M* = 50.19, *SD* = 13.68) compared to the control group (*M* = 44.39, *SD* = 13.38). This finding is important because it suggests that simulations can be at least as capable, if not more so, of enhancing learning compared to traditional lessons. This means that teachers can use the simulations to supplement their lessons, knowing they will not compromise the student's learning outcomes.

Furthermore, the findings back up the current trend toward learning strategies that rely more heavily on technology (Cristol et al., 2015) and add to the existing empirical evidence demonstrating the benefits of educational simulations in learning (Akselbo et al., 2020; Davis, 2019; R. Khan et al., 2019; Makransky & Petersen, 2019; McCoy et al., 2016; Scahill et al., 2021). In addition to the confirmatory results regarding learning, the present study also showed exciting changes in the learning approach. The simulation led to a significant increase in interest.

The implication of the study

The research findings have some implications for the teachers, students, school authorities, and curriculum planners. Indeed, the finding implicates the virtual simulation as an effective strategy to enhance students' interest in learning. Also, this has implications for all the stakeholders in education with inclusive students. More so, it implies that the teachers'

continuous use of the conventional method in circuit design might slow learning capabilities. It equally means that if school authorities and curriculum planners do not try to enforce the use of simulation software, interest may be dampened.

Conclusion

The present research investigated whether PSPICE simulation software will enhance students' interest in circuit design. The research established a positive difference between the two conditions on interest in circuit design in the post-test study. Thus, the study concludes that the PSPICE simulation software is an essential technological tool that could improve students' overall interest in learning. Therefore, the study contributes to the literature by supporting previous research that promotes the integration of virtual simulations in the classroom. Nevertheless, the sample size used in the study may pose a significant challenge for generalizing this result. Future researchers should include more representative samples and explore other moderating variables that could broaden our understanding of this outcome. However, the study recommends fully integrating computer resources in the classroom and consistently training instructors in this direction.

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