Strategies for Improving Students' Skills in Building Electronics Systems in Universities in Rivers State

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Abstract

The study was necessitated by the need to improve students' skills in building electronic systems in universities in Rivers State. Two research questions guided the study, while two hypotheses were tested at a .05 significance level. The study adopted a descriptive survey research design. The entire population of 32 electronics engineering and technology lecturers from three universities in Rivers State was studied without sampling. A structured questionnaire validated by experts was used for data collection. The Cronbach Alpha reliability method was used to establish the internal consistency of the items, which yielded an overall coefficient of 0.89. Data collected were analyzed using mean and standard deviation to answer the research questions, while a t-test was used to test the hypotheses at a .05 significance level. Findings revealed that the lecturers rated audiovisual materials and scaffolding teaching technique strategies as highly effective in improving students' skills in building electronics systems, and their opinions were not significantly influenced by years of experience and ownership of the institution. It concluded that the adoption of these strategies will improve students' skills in building electronic systems. The study recommended among others that, the Ministry of Education in partnership with the National Universities Commission and Tertiary Education Trust Fund should provide updated audiovisual materials to lectures teaching electronics subjects; scaffolding teaching techniques should be advocated and practiced among electronics engineering and technology lecturers especially when students embark on projects that involve the building of electronics systems.

Keywords: Strategies, Electronics, System, Tertiary, Institutions, Scaffolding.

Introduction

Electronics have assumed centre stage in all human endeavours. It has led to the political, social, economic, and educational development of all nations of the world. Electronics have also affected, modified, and shaped the lives of individuals, families, and institutions. Electronics according to Das (2021) is the branch of science that deals with the study of flow and control of electrons (*electricity*) and the study of their behaviour and effects

in vacuums, gases, and semiconductors, and with devices using such electrons. This control of electrons is accomplished by devices that resist, carry, select, steer, switch, store, manipulate, and exploit the electron. Electronics deals with the flow of charge (*electrons*) through non-metal conductors (*semiconductors*).

The field of electronics is a branch of physics and electrical engineering that deals with the emission, behaviour, and effects of electrons using electronic devices. Electronics uses active devices to control electron flow by amplification and rectification, which distinguishes it from classical electrical engineering, which only uses passive effects such as resistance, capacitance, and inductance to control electric current flow.

Electronics systems in recent times has principal branches that include digital electronics, analogue electronics, microelectronics, circuit design, integrated circuits, power electronics, optoelectronics, semiconductor devices, embedded systems, audio electronics, telecommunications, nanoelectronics, and bioelectronics. The design and building of those circuits require improved skills in the field of electronics.

Educational institutions prepare students for real life by equipping them with up-to-date information and necessary skills (Eze & Azu, 2017). Hence, educational institutions offering electronics engineering and technology should map out strategies to improve students' skills in building electronic systems. The strategies include the use of audiovisual materials, posters, excursions, project teaching techniques, and reflective teaching methods among others.

Since the acquisition of skills necessary for building electronics systems is supposed to be dynamic, practical-oriented, and activity-based through the application of different active or students-entered Instructional strategies. The use of audiovisual materials and scaffolding among others could be effective Instructional strategies (Eze & Azur), 2017).

Audiovisual material is defined as material that utilizes an audiovisual combination of various digital media types such as text, images, sound, and video, into an integrated multisensory interactive application or presentation to convey a message or information to an audience. In other words, audiovisual means “an individual or a small group using a computer to interact with information that is represented in several media, by repeatedly selecting what to see and hear (Agnew, Kellerman, & Meyer 1996).

The concept of audiovisual aids is not new and can be traced back to the seventeenth century when John Amos Comenius (1592–1670), a Bohemian educator, introduced pictures as teaching aids in his book Orbis Sensualium Pictus ("Picture of the Sensual World”) that

was illustrated with 150 drawings of everyday life (Aggarwal, 2009). The goal of audiovisual aids is to enhance the teacher's ability to present the lesson in a simple, effective, and easy to understand for the students. Audiovisual materials make learning more permanent since students use more than one sense. In addition, studies have shown that there is a significant difference between the use and non-use of audiovisual material in teaching and learning. The objectives of the use of audiovisual materials include:

1. to strengthen teachers' skills in making the teaching-learning process more effective
2. to attract and retain learners' attention
3. to generate interest across different levels of students
4. to develop lesson plans that are simple and easy to follow
5. to make the class more interactive and interesting
6. to focus on a student-centred approach

Today, the use of audiovisual tools can improve the acquisition skill process. The most common audiovisual materials used in teaching and learning range from filmstrips, microforms, slides, projected opaque materials, tape recording, and flashcards. In the current digital world, audiovisual aids have grown exponentially with several multimedia such as educational DVDs, PowerPoint, television educational series, and YouTube among others (DeBernardes & Olsen, 1948).

Scaffolding is another Instructional strategy that enhances students' ability to acquire practical skills in their chosen endeavours. Scaffolding as an Instructional strategy according to Eze and Azu (2017) is the principle of setting a task that is currently beyond students' expertise and then providing support in the form of modelling, guidance, hints, or clues among others. This is so that the learner can achieve the goal of setting that task. Scaffolding is a technique that teachers use to assist students bridge the cognitive gap in the course of learning they previously were to accomplish (Van del Pol, Janneke, Volman, Monique & Beishuizen, 2010).

According to Firestone (2015), scaffolding Instructional strategy refers to a process in which teachers demonstrate how to solve a problem, and then step back, offering support as the need arises. Potential job skills embedded in scaffolding Instructional strategy include problem-solving skills, critical thinking skills, manipulative skills, social skills, and reasoning skills which students can use to perform workplace duties independently (Eze & Azu, 2017). The teacher's is to offer support; and then gradually fade as the student masters the task.

However, the selection of effective strategies for improving students' skills in their fields of study sometimes depends on the teacher's years of experience. Adams (2018) posited that most experienced teachers discern and make use of appropriate and relevant strategies in helping the students to competent skills in their areas of study than the less experienced ones. Also, Philip (2028) noted that the type of educational institution and their policies have a bearing on the use of strategies to assist students in improving on the skills they need to acquire. A closer examination at tertiary institutions in Nigeria indicates that most technology and engineering teachers still depend on the traditional Instructional method of chalk and talk approach, which has not shown much improvement in the acquisition of skills. Traditional Instructional strategies are no longer adequate in helping students to meet the new challenges the innovation in electronics systems poses on them as future technicians.

Statement of the Problem

The advancement in the field of electronics requires improvement in the teaching and strategies employed in inculcating relevant skills in students in building electronic systems. The situation requires teachers who are skilful and well-equipped with effective Instructional strategies. The absence of a practical approach to the learning of skills in building electronics systems in tertiary institutions in Nigeria, especially in Rivers State. This is one of the missing links responsible for the inability of graduates to gain employment or excel in the workplace. Emeasoba and Igwe (2016) observed that the teaching and learning strategies adopted by most engineering and technology teachers are of theory rather than practice and inquiry, and therefore, no longer relevant for teaching and learning in the present information technology era. It is expected that appropriate and relevant strategies should be adopted and implemented for students to be more skilful in building electronic systems. This will help to curtail the alarming rate of unemployment, underemployment, loss of jobs, and lack of job satisfaction among graduates of electronics engineering and technology. The study, therefore, seeks to examine the impact of audiovisual materials and scaffolding Instructional strategies on improving students skills in building electronics system in universities in Rivers State.

Purpose of the Study

The purpose of this study is to determine the effective strategies for improving students' skills in building electronics systems in Universities in Rivers State. Specifically, the study sought to determine whether teachers consider:

1. use of audiovisual materials as an effective strategy for improving students' skills in building electronics systems in universities in Rivers State.

2. the use of scaffolding teaching technique as an effective strategy for improving students' skills in building electronics systems in universities in Rivers State.

Research Questions

The following research questions guided the study:

1 how effective is the use of audiovisual materials in improving students' skills in building electronic systems.

2 how effective is the use of scaffolding technique in improving students' skills in building electronics system.

Hypotheses

The following null hypotheses were tested at a .05 level of significance:

1 there is no significant difference in the mean ratings of respondents on the use of audiovisual materials to improve students' skills in building electronics systems based on years of experience (0 – 10 years and 11 years – above)

2 there is no significant difference in the mean ratings of respondents on the use of scaffolding teaching techniques to improve students' skills in building electronics systems based on years of experience (0 – 10 years and 11 years – above).

Method

The descriptive survey research design was adopted for the study. The population of the study comprised 32 electronics lecturers in three universities (12 in federal universities and 20 in State universities) in Rivers State. Sampling was not done since the population is not too large and is manageable. The instrument for data collection was a structured questionnaire designed by the researcher. The questionnaire was structured on a five-point scale of Very High Effective (VHE), High Effective (HE), Moderate Effective (ME), Slightly Effective (SE), and Ineffective (I). Three experts in the Technical Department of Ignatius Ajuru of Education validated the instrument. Cronbach's Alpha was used to ascertain the internal consistency of the instrument. This yielded an overall reliability coefficient of .89. The researcher administered 32; copies of the questionnaire with the help of three research assistants. All copies of the questionnaire distributed were returned and used for data analysis. Data collected for the study were analyzed using mean to answer the research questions and standard deviation to determine the homogeneity or otherwise of the respondent's views. A T-test was used to test the null hypotheses at a .05 significance level. Where the p-value is less than or equal to .05, the null hypothesis is rejected, but if the p-value is greater than .05, the null hypothesis is retained.

Results

The findings of the study were obtained based on the results of data analysis.

Research Question 1: How effective is the use of audiovisual materials in improving students' skills in building electronic systems.

Data collected in respect of research question 1 were analyzed and presented in Table 1.

Table 1: Respondents mean ratings on the effect of the use of audiovisual materials in improving students' skills in building electronics systems.

S/No	Audiovisual Materials	Mean	SD	Remarks
1	Empower students to develop drafting skills	4.30	0.46	HE
2	Empower students to develop drawing skills	4.49	0.51	VHE
3	Empower students to recognize electronic symbols	4.27	0.45	HE
4	Empower students to recognize electronic tools and equipment	4.07	0.54	HE
5	Empower students to make use of appropriate tools and equipment	4.23	0.61	HE
6	Enable students to develop design skills	4.20	0.43	HE
7	Enable students to develop construction skills	4.40	0.53	HE
8	Facilities of learning and retention	4.39	0.56	HE
9	Provides bases for self-evaluation	4.43	0.51	HE
10	Provides bases for individuals' progress	4.21	0.62	HE
11	Empower students to read, interpret and understand electronic drawing	4.50	0.51	VHE
12	Empower students to follow step-by-step process in drafting, designing, building, coupling, and testing electronic systems	4.56	0.49	VHE
	Cluster Mean	**4.34**	**0.52**	**HE**

Table 1 shows that all the items have a cluster mean of 4.34, which means that electronics engineering and technology lecturers considered the use of audiovisual materials as highly effective in improving students' skills in building electronics systems. The standard deviation of 0.52 shows that the respondents are homogenous in their responses.

Research Question 2: How effective is the use of scaffolding technique in improving students' skills in building electronics system.

Data collected in respect of research question 1 were analyzed and presented in Table 1.

Table 2: Respondents' mean ratings on the effect of the use of scaffolding technique in improving students' skills in building electronic systems

S/No	Audiovisual Materials	Mean	SD	Remarks
1	Enables students to draft and design electronic systems with minimal supervision	4.51	0.56	VHE
2	Facilitates students' mastery and competency in building electronics systems procedures	4.50	0.50	VHE
3	Help students break down complex design and construction tasks into manageable bits	4.59	0.49	VHE
4	Motivate students to compete in building electronics systems independently	4.51	0.54	VHE
5	Empower students to organize and assemble appropriate materials and tools required in building electronic systems	4.61	0.41	VHE
6	Enable students to develop reasoning and improvisation skills while building an electronic system	4.23	0.47	HE
7	Creates opportunities for students to develop analytic skills while building electronics	4.50	0.53	VHE
8	Facilities of learning and retention	4.32	0.57	HE
9	Provides bases for self-evaluation	4.68	0.41	VHE
10	Provides bases for monitoring students' progress	4.31	0.53	HE
11	Creates opportunities for students to develop critical thinking skills while designing and building electronic systems	4.20	0.61	HE
12	Empower students to recognize and follow step-by-step processes in drafting, designing, building, coupling, and testing electronic systems	4.62	0.49	VHE
	Cluster Mean	**4.46**	**0.52**	**VHE**

Table 2 shows that all the items have a cluster mean of 4.46, which means that electronics engineering and technology lecturers considered the use of scaffolding teaching technique as very highly effective in improving students' skills in building electronics systems. The standard deviation of 0.52 shows that the respondents are homogenous in their responses.

Hypothesis 1: There is no significant difference in the mean ratings of respondents on the use of audiovisual materials to improve students' skills in building electronics systems based on years of experience (0 – 10 years and 11 years – above)

Data obtained in respect of hypothesis 1 were analyzed and presented in Table 3.

Table 3: Summary of t-test comparison of the mean ratings of electronics engineering and technology teachers on the use of audio-visual materials to improve students' skills

Lecturer Years of Experience	n	$\bar{X}$	SD	α	df	t-cal	p-value	Decision
0 – 10	15	3.49	.11	0.05	30	0.41	.061	Not Significant
11 - above	17	3. 51	.12					

Data in Table 3 show that respondents do not differ significantly in their mean ratings on the use of audiovisual materials to improve students' skills in building electronics systems based on years of experience, with mean scores of 3.49 and 3. 51 while the corresponding standard deviations are .11 and .12. The Table indicated a t-value of 0.41, at degree of freedom of 30 and a p-value of .061. Testing at an alpha level of 0.05, the p-value is not significant since the p-value is greater than the alpha value (0.05). Therefore, the null hypothesis is not rejected. Hence, there is no significant difference in the mean ratings of respondents on the use of audiovisual materials to improve students' skills in building electronic systems based on years of experience.

Hypothesis 2: There is no significant difference in the mean ratings of respondents on the use of scaffolding teaching techniques t improve students' skills in building electronics systems based on years of experience (0 – 10 years and 11 years – above).

Data obtained with respect to hypothesis 3 were analyzed and presented in Table 4

Table 4: Summary of t-test comparison of the mean ratings of electronics engineering and technology teachers on the use of scaffolding teaching technique to improve students' skills.

Years of Experience	n	$\overline{X}$	SD	α	df	t-cal	p-value	Decision
0 – 10	15	2.05	.12	0.05	30	1.54	.063	Not Significant
11 - above	27	2. 13	.14					

Data in Table 4 show that respondents do not differ significantly in their mean ratings on the use of scaffolding teaching techniques to improve students' skills in building electronics systems based on years of experience, with mean scores of 2.05 and 2.13. The corresponding standard deviation is.12 and.13. .14. The Table indicated a t-value of 1.54, at degree of freedom of 30 and a p-value of .063. Testing at an alpha level of 0.05, the p-value is not significant, since the p-value is greater than the alpha value (0.05). Therefore, the null hypothesis is not rejected; hence, there is no significant difference in the mean ratings of respondents on the use of scaffolding teaching technique to improve students skills in building electronics systems based on years of experience

Discussion

The findings of the study reveal that lecturers in electronics engineering and technology consider the use of audiovisual materials as a highly effective strategy for improving students' skills in building electronic systems in universities in Rivers State. This finding aligns with that of Adamu; Ibrahim; Adamu and Ibrahim (2018) who noted that a lecture that integrates pictures or video images can help an individual learn and retain information much more effectively. The finding also tallies with that of Neo & Neo (2000) who stated that the evolution of audiovisual aids has made it very possible for learners to become more involved in learning activities. With audiovisual technologies, learners can create audiovisual applications as part of learning project requirements. This would make the

learners active participants in the learning process, instead of just being passive learners of the educational content.

The t-test analysis indicates that there is no significant difference in the mean ratings of respondents on the use of audiovisual materials to improve students' skills in building electronics systems. This is based on years of experience from 0 to 10 years and 11 years - above in universities in Rivers State. This finding is in agreement with that of Olisa (2009) who reported that lecturers irrespective of their year of experience make use of audiovisual materials that help students acquire practical skills. The study is in disagreement with that of Adams (2018) who posited that most experienced teachers discern and make use of appropriate and relevant strategies in helping students to competent skills in their areas of study than the less experienced ones. It is also in disagreement with Philip (2018) who noted that the type of educational institution and their policies have a bearing on the use of strategies to assist students in improving the skills they need to acquire.

Results of the study showed that electronics engineering and technology lecturers considered the use of scaffolding teaching technique as a very highly effective strategy in improving students' skills in building electronics systems in Rivers State. The findings are in line with that of Firestone (2015) who stated that scaffolding Instructional strategy refers to a process in which teachers demonstrate how to solve a problem, and then step back, offering support as the need arises. The objective of teachers in using the scaffolding teaching technique is to provide assistance that guides the learner towards independence and self-reliance.

The findings of the analysis of the hypothesis indicate that there is no significant difference in the mean ratings of respondents on the use of scaffolding teaching technique to improve students' skills in building electronics systems. This is based on years of experience from 0 to 10 years and 11 year – above in universities in Rivers State. This is in disagreement with Jimoh-Kadiri (2012) who opined that less experienced teachers might not be more competent in using some Instructional techniques. The study agrees with that of Ngetcha and Ndege (2011) who stated that scaffolding teaching techniques can facilitate the attainment of teaching and learning objectives irrespective of university.

Conclusion

Audiovisual and scaffolding teaching techniques are important strategies for improving students' skills in building electronic systems. While audiovisual materials help the teacher to present the lesson effectively and students learn and retain the concepts better

and for longer duration; improve student's critical and analytical thinking; and remove abstract concepts through visual presentation, scaffolding teaching technique promotes self-confidence, self-reliant and independence to students as they apply occupational skills.

Recommendations

Based on the findings and conclusion of the study, the following recommendations were made:

1 Lecturers in universities should be encouraged to make use of relevant, appropriate, and instructive audiovisual materials during electronics courses.

2 Ministry of Education in partnership with the National Universities Commission and Tertiary Education Trust Fund should provide updated audiovisual materials to lectures teaching electronic subjects.

3 Scaffolding teaching techniques should be advocated and practiced among electronics engineering and technology lecturers, especially when students embark on projects that involve building electronics systems.

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