Emerging Technologies and Pedagogy of Electrical Electronic Technology as Correlates of Skill Acquisition and Employment Opportunities of Students of Tertiary Institutions in Plateau State, Nigeria

by
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Abstract
The study determined the relationship among emerging technologies, pedagogy of Electrical/Electronic Technology, skill acquisition, and employment opportunities for Students of Tertiary institutions in Plateau State, Nigeria. Three research questions guided the study and three hypotheses were tested at 0.05 level of significance. The study adopted correlational research design. The population for the study was 109 electrical/electronic technology education students of tertiary institutions. The entire population was studied. A Structured questionnaire titled Relationship between Emerging Technologies and Pedagogy of Electrical/Electronic Technology Education Questionnaire (RETPEETEQ) was used as instrument for data collection. The instrument was validated by three experts, and a reliability coefficient of 0.89 was obtained using Cronbach's Alpha reliability method. The data collected were analyzed using Pearson Moment Product correlation method to answer research questions while simple regression analysis was conducted to test the nullhypotheses at 0.05 level of significance. The findings on research questions revealed that: (i) moderate relationship exists between emerging technologies and skill acquisition of students of electrical electronic technology students of tertiary institution, (ii) relationship exists between emerging technologies and employment opportunities of electrical electronic technology students of tertiary institution, (iii) relationship also exists between skill acquisition and employment opportunities of students of electrical electronic technology students of tertiary institutions in Plateau State. The findings of the study on hypotheses revealed that: (i) there was a significant relationship between emerging technologies and skill acquisition of electrical electronic technology students of tertiary institution in Plateau State, (ii) there was a significant relationship between emerging technologies and employment opportunities of electrical electronic technology students of tertiary institutions, and (iii) there was a significant relationship between skill acquisition and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State. Based on these findings, the study recommended that: (i) relevant emerging technologies should be used by lecturers of tertiary institutions in the study area to teach all students of electrical/electronic technology students so that they can acquire relevant skills for employment after graduation, and (ii) administrators of the tertiary institutions should make emerging technologies more available for the teaching of electrical/electronic technology students.

Keywords: pedagogy, emerging technologies, employment, skill acquisition, electrical and electronic technology

Introduction

Emerging technologies refer to new and innovative technologies that are currently being developed or will be developed within the next few years (Heo et al., 2017). These technologies often have the potential to significantly alter industries, economies, and societies. Examples include artificial intelligence (AI), machine learning, robotics, blockchain, and advanced manufacturing technologies. These technologies are characterized by their rapid evolution and the potential to create new markets and disrupt existing ones. Emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and automation are transforming traditional job roles in the electrical and electronic sectors. While some routine jobs

may be automated, new roles that require advanced technical skills and creativity are emerging(Tugce et al., 2020, Dec et al., 2022, Trenerry et al., 2021, & Alotaibi, 2023). This shift creates opportunities for students who are equipped with the necessary knowledge and skills acquired to adapt to these changes.

Skill acquisition is the ability to do things practically through experience. Oladeji (2019) views it as a well-designed procedure for acquiring new ways and methods of carrying out focused occupations. It can also be described as the form of training by individuals or a group of individuals that can lead to the acquisition of practical knowledge for self-sustenance. Accordingly, Edem2018 in Fakokunde, & Oyinlola, (2021).) postulated skill acquisition as the accumulation of different skills that enhance task performance through the integration of both theoretical and practical forms of knowledge. As the industry evolves, there is a growing demand for competencies that go beyond traditional technical skills in electrical electronic technology. Electrical/electronic technology education prepares students for teaching employment in secondary schools, tertiary institutions or working in the industries (James 2015). Students are trained in electrical/electronic technology to design, develop, construct, maintain and repair electrical/electronic gadgets, appliances (Federal Republic of Nigeria, FRN, 2013; Ogbuanya & Chukwuedo, 2017). It is aimed at providing students with adequate skills knowledge, and attitude for employability. This can only be achieved through a conducive learning environment through the teacher's effective pedagogy.

Pedagogy is any activity consciously designed by a teacher to bring about effective learning in the students, with the aim of motivating and making the student's journey successful and productive throughout life in the 21st century (Wlodkowski, & Ginsberg, 2017). This therefore underscores the importance of adopting active pedagogies by establishing learner-centred approaches that will encourage learners to be in control of their learning. Recently a new phenomenon has emerged to further support teaching in the 21st century classroom, it is called fifth Generation of wireless technology (5G). Alexis and Erica (2018) posited that a 5G-enabled classroom could include: A holographic teacher who can beam in to lead discussions on specialized topics; seamless virtual reality experiences that can help students with diverse learning needs before engagement, or connected devices that could help close gaps in education for students. According to Mormah, & Bassey, (2021), Zhi Hao Chung a spark team's founder came up with mobile AR platform that allows educator to search for and upload lesson plan which can then be turned into interactive and multi sensing learning experiences for students. As the students learn, the platform uses technology to listen in on students' progress and provide comprehensive feedback for teacher which can improve future lessons. Experts in the field of communication technology are making efforts to apply Artificial Intelligence (AI) to support teaching process.5G technology necessitates skills in network design, RF engineering, and data traffic management. Understanding the intricacies of 5G protocols, network architecture, and signal processing is essential (Miller, 2022). In the teaching-learning environment, technology provides opportunities for teachers and students to fit in the globalized digital age (Timotheou et al., 2022). In the 21st-century, students and teachers expect information to be accessible, instant, and multi-dimensional (Ng, et al., 2023). The researchers argue that technology integration in instruction (digital skills) is among the competencies of a 21st Century teacher, especially the implementation of technology-enhanced classrooms (Mohammod & Md., 2024; Saltos-Rivas et al., 2023; Ng, et

al., 2023). Technological knowledge has become increasingly important as it helps increase students understanding of complex concepts and encourages collaboration among peers (Cipto, Wardoyo, Yogi et al., 2021). Consequently, it is expected that teachers in the current educational practice should use some form of technology in the classrooms. Teachers need access to professional development on new technologies. If they lack such opportunities, the full potential of transferring knowledge using technologies in classrooms will not be realized (Ng, Lok, et al., 2023). The researchers pointed out that technology is constantly changing; teachers must stay up-to-date by getting additional training to keep their technological expertise current. Emerging pedagogy equip students with relevant knowledge, marketable skills.Thus helping to close the skills gap/ mismatches experienced in youth transition from education to employment (Venkatraman, et al., 2018). When students acquire relevant skills through effective teaching methods, they become more employable, hence, creating employment opportunities.

Employment opportunities referto the chances available for individuals to secure jobs in specific field or industry. Employers are looking for graduates who possess a combination of technical expertise, problem-solving abilities, and soft skills such as communication and teamwork(electrical/electronic inclusive)(Poláková et al., 2023, &Veerapornet al., 2019). Tertiary institutions need to align their curricula with these emerging requirements to prepare students effectively for the job market. With the increasing emphasis on innovation, students can leverage their skills to create new products and services, contributing to job creation and economic growth (Meganck, &Jeanine 2020, Tushar &Nanta 2023; Dumitru & Halpern, 2023). Emerging technologies are not confined to local markets; they open up global employment opportunities. Students with expertise in cutting-edge technologies can find roles in multinational companies or even remote work opportunities, expanding their career prospects beyond their immediate geographical location (Malik, 2020; Owolabi et al., 2020; &Borger et al., 2023). The rapid pace of technological advancement necessitates a commitment to lifelong learning. Students must be prepared to continuously update their skills and knowledge to remain relevant in the job market. Tertiary institutions can play a crucial role by providing access to ongoing education and training programs (Trenerry et al., 2021), Sharkiya & OhanaIrit, 2024; Keese et al., 2023).

Emerging technologies are the ones whose development and application areas are still expanding fast, and their technical and value potential is still largely unrealized (Küfeoğlu, 2022). The author highlight some emerging technologies as 3D printing, 5G, advanced materials, artifcial intelligence, autonomous things, big data, biometrics, bioplastics, biotech and biomanufacturing, blockchain, carbon capture and storage, cellular agriculture, cloud computing, crowdfunding, cybersecurity, datahubs, digital twins, distributed computing, drones, edge computing, energy storage, fexible electronics and wearables, healthcare analytics, hydrogen, Internet of Behaviours, Internet of Things, natural language processing, quantum computing, recycling, robotic process automation, robotics, soilless farming, spatial computing and wireless power transfer. These technologies often have the potential to significantly alter industries, economies, and societies. These technologies are characterized by their rapid evolution and the potential to create new markets and disrupt existing ones.

The integration of emerging technologies into educational programs influences the development of relevant skills among students in Nigerian tertiary

institutions (AfolakemiSimboOgunbanwo et al., 2019; Islam et al., 2024). Emerging technologies such as automation, the Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), and advanced semiconductor technologies significantly impact the skills needed in electrical and electronic technology. As these technologies evolve, they redefine industry standards and job roles, necessitating new skills and competencies for professionals in the field. Automation and robotics require knowledge of control systems, programming, and integration of automated systems. Skills in robotics programming, sensor integration, and machine learning are increasingly essential (Harris, 2020). Industrial robots used in automotive manufacturing require expertise in programming using languages like Python or C++ (Gibson, 2020).

Internet of Things (IoT), which involves connecting physical devices to the internet, enabling smart systems and data exchange, which requires skills in sensor technology, data analysis, and network security, (Bandyopadhyay & Sen, 2021). Artificial Intelligence (AI) and Machine Learning technologies are increasingly being integrated into electrical systems for automation, predictive maintenance, and system optimization. Skills in AI programming, algorithm development, and data handling are essential (Shalev-Shwartz, & Ben-David, 2023). Electrical/electronic technology students are expected to analyze historical data to train machine learning models that predict equipment failures (Smith, 2022).

Advanced semiconductor technology requires knowledge in materials science, fabrication processes, and electronic circuit design. Skills in working with new materials like gallium nitride (GaN) and silicon carbide (SiC) are increasingly important (Taylor, 2021, Lee, 2022).According to Mousazadeh, &Shafiee, (2022) electrical electronic technology students should be skillful in Renewable Energy Technologies which involve Advances in solar, wind, and energy storage systems design, implementation, and management. To prepare students for the evolving job market, curricula need to incorporate emerging technologies to update course content, integrating hands-on labs, and using simulation tools, (Choi, &Ko, 2023). Hands-on experience is crucial for skill acquisition. Institutions are increasingly using modern laboratories equipped with the latest technology to provide practical training in areas like IoT, AI, and renewable energy (John & Olaniyan, 2023). Emerging technologies create new job roles and transform existing ones, emphasizing the need for skills in areas like data analytics, network management, and renewable energy systems (World Economic Forum, 2023). Incorporating emerging technologies ensure that students learn about the latest advancements and gain relevant skills. For example, integrating modules on AI and ML into electrical engineering programs helps students acquire skills that are increasingly demanded by employers (Brown, 2021). Partnerships with industry provide students with exposure to current technologies and practical experience through internships and collaborative projects. These partnerships help align academic learning with industry needs and enhance employability (Smith, 2022).

However, smooth and effective integration of new technologies in education has been challenging for teachers due to barriers related to cost and access to technological tools, time, and lack of knowledge on how technology can be used for students' benefit across diverse subjects (Akram, et al., 2022). Many institutions in Nigeria struggle with inadequate infrastructure and resources (materials and human resources) to support the latest technologies, which reduces their ability to offer up-to-date training and education (Abubakar, &

Ibrahim,2024). There is often a mismatch between the skills that graduates possess and those demanded by employers, indicating the need for curriculum adjustments and enhanced training programs (Bessen, 2022). It was pointed out that teachers need technical support from skilled personnel in operating and troubleshooting hardware and software(JérémieLaydevant, et al., 2024). Besides, adopting new technology could be time-consuming if teachers get inadequate technical support(Kairit, et al., 2023; Musa, et al., 2022). Most institutions lack collaboration with industry which can help institutions stay current with technological advancements and provide students with relevant, real-world experience (Olaniyan, &Ojo, 2024). To effectively teach emerging technologies, educators themselves need continuous professional development to stay abreast of new trends and tools (Nwokocha&Agwu, 2024).

Statement of the Problem

The integration of emerging technologies into electrical and electronic engineering education in Nigerian tertiary institutions is essential for aligning academic programs with industry needs. This integration influences skill acquisition by updating curricula, enhancing practical training, and addressing infrastructure challenges. While there are significant opportunities for improving skill development and employment outcomes, there are also challenges that institutions must overcome to fully capitalize on the benefits of these technological advancements.

Literature revealed that most institutions struggle with inadequate infrastructure and resources (materials and human resources) to support the latest technologies. There is often a mismatch between the skills that graduates possess and those demanded by employers. No curriculum adjustments by integrating emerging technologies to enhanced training programs. Most institutions lack collaboration with industry and lack of teachers' level of skill proficiency in emerging technologies. Therefore, it has become necessary to examine the level of Emerging technologies and pedagogy of electrical electronic technology as correlate of skill acquisition and employment opportunity for tertiary institution in Plateau State, Nigeria. Particularly to examine relationship between emerging technologies and skill acquisition, relationship between emerging technologies and employment opportunities and Pedagogy as correlate of skill acquisition and employment opportunities.

Purpose of the Study

The general purpose of the study was to investigate the relationship among Emerging technologies, pedagogy use in electrical electronic technology, skill acquisition and employment opportunities of students of tertiary institutions in Plateau State, Nigeria. Specifically, the study sought to determine the relationship between:

1. emerging technologies and skill acquisition of students of electrical electronic technology students of tertiary institution in Plateau State
2. emerging technologies and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State skill acquisition and employment opportunities of students of electrical electronic technology students of tertiary institution in Plateau State

Research Questions

The following research questions guided the study:

3. What is the relationship between emerging technologies and skill acquisition of electrical electronic technology students of tertiary institutions in Plateau State?
4. What is the relationship between emerging technologies and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State?

5. What is the relationship between skill acquisition and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant relationship between emerging technologies and skill acquisition of electrical electronic technology students of tertiary institution in Plateau State.
2. There is no significant relationship between emerging technologies and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State.
3. There is no significant relationship between skill acquisition and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State.

Methodology

The study adopted a correlational research design. The study was conducted in plateau state. The population for the study was 109 electrical/electronic technology education students of tertiary institutions in Plateau State. There was no sampling, the entire population was studied because of their manageable size. The instrument for data collection was a structured questionnaire titledRelationship Between Emerging Technologies and Pedagogy of Electrical/Electronic Technology Education Questionnaire (RETPEETEQ). The instrument was validated by three Experts and a reliability coefficient value of 0.89 was obtained using Cronbach's Alpha reliability method. The data collected were analyzed using Pearson Moment Product correlation method to answer research questions while simple regression analysis was conducted to test the null hypotheses at 0.05 level of significance.

Results

Table 1: Correlation Between Emerging Technology and Practical Skill Acquisition of electrical electronic technology students of tertiary institutions in Plateau State, Nigeria.

Correlations

		Emerging Technology	SkillAcquisition
Emerging Technology	Pearson Correlation	1	.395**
	Sig. (2-tailed)		.000
	N	109	109
SkillAcquisition	Pearson Correlation	.395**	1
	Sig. (2-tailed)	.000	
	N	109	109

**. Correlation is significant at the 0.01 level (2-tailed).

The results presented in Table 1 show the relationship between emerging technology and practical skill acquisition of electrical electronic technology students of tertiary institutions in Plateau State, Nigeria. It can be observed that there is a positive relationship between emerging technologies and practical skill acquisition of electrical electronic technology students (.395), this shows that the correlation between emerging technologies and practical skill acquisition of electrical electronic technology students is a moderate correlation. The positive relationship indicates that the two variables move in the same direction.

Table 1 also revealed that P<0.000 is less than alpha value of 0.05 level of significant, hence there is a statistically significant relationship between emerging technology and skill acquisition of electrical electronic technology students. Therefore, the null hypothesis was rejected. Hence, the assumption that there is no significant relationship between emerging technologies and skill acquisition was not true.

Table 2: Correlation Between Emerging Technology and Employment Opportunities of Electrical/Electronic Technology Students of Tertiary Institutions in Plateau State, Nigeria.

Correlations

		Emerging Technology	Employment opportunity
Emerging Technology	Pearson Correlation	1	-.237*
	Sig. (2-tailed)		.013
	N	109	109
Employment Opportunity	Pearson Correlation	-.237*	1
	Sig. (2-tailed)	.013	
	N	109	109

*. Correlation is significant at the 0.05 level (2-tailed).

The results presented in Table 2 show the relationship between emerging technology and employment opportunities of electrical electronic technology students of tertiary institutions in Plateau State, Nigeria. It can be observed that there is a negative relationship between emerging technologies and employment opportunities of electrical electronic technology students (-.237), this shows that the correlation between emerging technologies and employment opportunities of electrical electronic technology students is a low correlation. The negative relationship indicates that the two variables move in opposite direction.

The significant level (Sig. 2-tailed) for this correlation is p< 0.013, which is below the conventional alpha value of 0.05 level of significant, indicating that the correlation between the variables is statistically significant. Therefore, there was a significant relationship between emerging technologies and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State. Therefore, the null hypothesis was rejected. Hence, the assumption that there is no significant relationship between emerging technologies and employment opportunities was not true.

Table 3: Correlation Between Skill Acquisition and Employment Opportunities of Electrical/Electronic Technology Students of Tertiary Institutions in Plateau State, Nigeria

Correlations

		Skill Acquisition	Employment opportunity
Skill Acquisition	Pearson Correlation	1	-.228*
	Sig. (2-tailed)		.017
	N	109	109
Employment opportunity	Pearson Correlation	-.228*	1
	Sig. (2-tailed)	.017	
	N	109	109

*. Correlation is significant at the 0.05 level (2-tailed).

Data in Table 3 showed the relationship between skill acquisition and employment opportunity of electrical/electronic technology students of tertiary institutions in Plateau State using Pearson product moment correlation method. The data indicates low relationship and in a negative direction as shown by r= -.228. Thus, this implies that the more students do not have skill acquisition the more likely are they not to have employment opportunity. The negative relationship indicates that the two variables move in opposite direction. The table indicated that there was a significant relationship between skill acquisition and employment opportunities of electrical/electronic technology students as shown by p value=.017 which is below the statistically p value of 0.05 level. This means that there was significant relationship between skill acquisition and employment opportunities of electrical electronic technology students of tertiary institution in Plateau State. Therefore, the null hypothesis was rejected. Hence, the assumption that there is no significant relationship between skill acquisition and employment opportunities was not true.

Discussion

Result in Table 1 revealed that there is moderate relationship between emerging technologies and skill acquisition of electrical/electronic technology students of tertiary institutions in Plateau State. The relationship suggests that practical skills acquisition is a crucial factor that correlates with the use of emerging technology in electrical/electronic technology students. This revealed that P<0.000 is less than alpha value of 0.05 level of significant, hence there is a statistically significant difference in the relationship between emerging technology and skill acquisition of electrical electronic technology students. Therefore, the null hypothesis was rejected. Hence, the assumption that there is no significant difference between emerging technologies and skill acquisition was not true. This study is in line with Abubakar, & Ibrahim, (2024), which stated that many institutions in Nigeria struggle with inadequate infrastructure and resources (materials and human resources) to support the latest technologies, which reduces their ability to offer up-to-date training and education. Hands-on experience is crucial for skill acquisition. Institutions are increasingly

using modern laboratories equipped with the latest technology to provide practical training in areas like IoT, AI, and renewable energy (John, & Olaniyan, 2023).

Incorporating emerging technologies ensure that students learn about the latest advancements and gain relevant skills. For example, integrating modules on AI and ML into electrical engineering programs helps students acquire skills that are increasingly demanded by employers (Brown, 2021). Partnerships with industry provide students with exposure to current technologies and practical experience through internships and collaborative projects.Technological knowledge has become increasingly important as it helps increase students understanding of complex concepts and encourages collaboration among peers (CiptoWardoyo, et al., 2021).

The result in Table 2 also revealed the table demonstrates a negative correlation between Emerging Technology and Employment Opportunity, with a Pearson coefficient of -.237, which is statistically significant at the 0.05 level (2-tailed). This means that there is negative correlation of employment opportunity on emerging technology of Electrical/Electronic Technology Students of Tertiary Institutions. This negative correlation suggests that as use of emerging technology decreases among Electrical/Electronic Technology Students of Tertiary Institutions Employment Opportunity decreases. The significant level (Sig. 2-tailed) for this correlation is $p< 0.013$, which is below the conventional alpha value of 0.05 level of significant, indicating that the correlation between the variables is statistically significant. The findings indicated that electrical/electronic technology students who have not secured employment opportunities are most likely not to have been exposing to the use of emerging technologies. The results underscored the need for exposure of these students to be engage in emerging technologies during their training before securing employment opportunities. This result was in line with the finding of (Poláková et al., 2023, Veeraporn, et al., 2019, andPerrin 2019), which stated that as the industry evolves, there is a growing demand for competencies that go beyond traditional technical skills. Employers are looking for graduates who possess a combination of technical expertise, problem-solving abilities, and soft skills such as communication and teamwork.

Tertiary institutions need to align their curricula with these emerging requirements to prepare students effectively for the job market. This result is also in line with Brown, (2021), which states that incorporating emerging technologies ensure that students learn about the latest advancements and gain relevant skills. For example, integrating modules on AI and ML into electrical technology programs helps students acquire skills that are increasingly demanded by employers. In addition, Partnerships with industry provide students with exposure to current technologies and practical experience through internships and collaborative projects. These partnerships help align academic learning with industry needs and enhance employability (Smith, 2022).

Result in Table 3 revealed the relationship between skill acquisition and employment opportunity of electrical/electronic technology students of tertiary institutions in Plateau State using Pearson product moment correlation. The data indicates low relationship and in a negative direction as shown by r= -.228. Thus, this implies that the more students do not have skill acquisition the more likely are they not to have employment opportunity. The table indicated that there is a significant difference in the relationship as shown by p value=.017 which is below the statistically p value of 0.05 level. This result is in line with Mousazadeh, &Shafiee, (2022) which stated that electrical

electronic technology students should be skillful in Renewable Energy Technologies which involve Advances in solar, wind, and energy storage systems design, implementation, and management. To prepare students for the evolving job market, curricula need to incorporate emerging technologies to update course content, integrating hands-on labs, and using simulation tools, (Choi, &Ko, 2023). Emerging technologies such as automation, the Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), and advanced semiconductor technologies significantly impact the skills needed in electrical and electronic technology. As these technologies evolve, they redefine industry standards and job roles, necessitating new skills and competencies for professionals in the field. Automation and robotics require knowledge of control systems, programming, and integration of automated systems. Skills in robotics programming, sensor integration, and machine learning are increasingly essential (Harris, 2020). Industrial robots used in automotive manufacturing require expertise in programming using languages like Python or C++ (Gibson, 2020).

Conclusion

Technologies are emerging and upgrading daily, putting the classroom of the 21st century always at alert and engaging is necessary. Teachers today must be prepared to be developed and be relevant in the new classroom, by improving their knowledge, skills and competency in the use of emerging technologies for their teaching processes. Integration of emerging technologies into electrical and electronic engineering education in Nigerian tertiary institutions is essential for aligning academic programs with industry needs. This integration influences skill acquisition by updating curricula, enhancing practical training, and addressing infrastructure challenges. As these technologies evolve, they redefine industry standards and job roles, necessitating new skills and competencies for professionals in the field.

Recommendations

1. Stakeholders can work towards creating a more effective and responsive educational system to improve the skills gap in the workforce and ensuring that graduates are prepared to meet the demands of the evolving job market.
2. Institutions should improve collaboration with industry to stay current with technological advancements and provide students with relevant, real-world experience
3. Educators themselves need continuous professional development to stay abreast of new trends and tools

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