NAU Journal of Technology and Vocational Education
Volume 10, No. 2, September 2025

INTEGRATING INNOVATIVE METHODS OF TEACHING AND LEARNING ELECTRONICS IN TECHNICAL VOCATIONAL EDUCATION (TVE) FOR SUSTAINABLE DEVELOPMENT IN IMO STATE

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Abstract
The study investigated the integration of innovative methods of teaching and learning Electronics in Technical Vocational Education for sustainable development in Imo state. Descriptive survey design was adopted for the study. The population of study comprised of 35 respondents. Intact class was and census sampling were used because of the smallest of the numbers. A 20-item questionnaire tagged "Innovative Method of Teaching and Learning Electronics (IMTLE)" was used for data collection, which was validated by three experts and trial tested outside the area of study. The questionnaire items were generated from the review of the related literature. All the 35 copies of the questionnaire administered were returned. Mean and standard deviation were used to answer the research questions while T-test statistic was used to analyze the hypothesis. Mean of 3.50 were considered needed. The reliability coefficient was 0.81, established using Cronbach alpha to analyze the hypothesis. The result of the study revealed that 10 innovative methods were needed to be integrated in the teaching and learning electronics. The results also showed that electronics lecturers/educators were not sufficiently integrating the innovative methods in teaching and learning. The researcher among others recommends that electronics lecturers/educators should be encouraged to update their knowledge in the use of innovative teaching and learning by attending conferences and workshops, in service training and other continuous education opportunities.
Keywords: Technical Vocational Education, Sustainable Development, Electronics, Innovation

Introduction

TVE is an aspect of educational processes that seeks to educate learners to think creatively and transform knowledge through technological process into broader economic base. Basically, the purpose of TVE is to equip people with the technical and professional skills needed for socio economic and industrial development in the country. It encompasses training of craftsmen, as well as highly skilled technicians, technologist and technical educators. Therefore, TVE programme of studies are offered in technical colleges, polytechnics, College of Education and Universities. It is an aspect of educational processes that comprises of general education technological and related science and acquisition of practical skills, attitudes, understanding and knowledge relating to occupation and various sectors of the economy and social life (Federal Republic of Nigeria, FRN, 2013). Therefore, the goal of TVE is to inculcate thinking for creativity and entrepreneurship through learning and practicing of skills for sustainable development.

Sustainable development is the development that meets the needs of the present generation without compromising the ability of the future generation to meet their needs (Rao & Jain, 2009). Therefore, education system that deals with the impartation of appropriate technical skills is highly sustainable, for it is based on acquisition of solution-oriented skills and empowerment, solving the present needs of the society and capable of solving the future needs. Electronics serves this purpose.

Electronics is a course of study in TVE, through which needed skilled workforce are generated for economic growth. It is practically oriented, based on the study of science and technology in relation

to flow of electrons in semi-conductors, gas or vacuum (Mehta & Mehta, 2019). It is a household name that mirrors the reflections of telecommunication equipment /gadgets such as television, audio and video machine, radio, camera, computer, amplifier, woofer, projectors. Others are speakers, telephone, digital watches, mobile phone, satellite among others. Electronics has gained more importance due to its limitless applications in industries; such as medical, instrumentation, automotive, avionics, consumer and industrial electronics among others (Schuler, 2012). Despite the widely known importance of Electronics and its application, most of the graduate of this course are good in the theoretical knowledge while performance level in practical is extremely low (Attah, Nwahunanya, and Ujevbe, 2020). But, the graduates of Electronics are prepared to service and maintain electronics gadgets and system design; and construct circuit producing electronic equipment among others. One wonders how students were prepared. According to Ogwa (2010), teachers are meant to draw out potentials from learners for all round skill development through proper delivery mode and not talk and chalk method that is based on factual knowledge. Teaching electronics technology in higher institution involves the use of teaching methods in impartation of skills, attitude and knowledge. The Electronics Engineering Technology Lecturers and Electronics Educators in Polytechnics and Colleges of Education respectively can differentiates traditional methods of teaching from the innovative methods of teaching, since they are in educational system and are working towards pursuing the goal of acquisition of skill, knowledge in the same field of study (TVE)..Holistic teaching is intimately tie to learning of targeted curriculum through innovative methods.

Innovation in teaching is a creative method in education which combines convectional lecture method with other strategies allowing students to improve their learning abilities by exploring their potential. It is geared towards learner centered for solving problems. According to Kumar (2020), the use of innovative methods, in education has the potential not only to improve education but also to empower people, strengthen and galvanize the effort to achieve the human development goals for the country. The objective of innovation in teaching and learning electronics is to develop a holistic approach to key concepts in electronics components application in circuits, circuit design and construction for realization of product of technology. In the word of Kumar (2020), Innovative teaching methods are collaborative learning, display of working models, facilitating through group learning, teaching through value added course. In addition to providing experiential learning, invitation of guest lecturers/ industrial visits, field trips, project/product-based learning and through display of video animation link to internet.

In agreement with Kumar (2020), Lamidi and Efuwape (2019) opined that appropriate teaching models, collaborative learning and assigning students projects/work in group are, means of acquiring saleable skills in electronics technology. Project based learning is an innovative teaching method that ignites creativity and productivity, Law-Obi and Ogbuanya (2017) asserted that to inspire task performance in electrical work, teacher can assign students project for instance, on the construction of power circuit without providing the components to use and their ratings, since they have learnt characterization and functions of semiconductor materials, and necessary electric circuit laws necessary for modeling the circuit. They will end up getting different wattages of the power circuit. Traditional experiments in laboratories cannot be taken as project-based learning rather laboratories lend themselves to methodological innovation known as project-based learning were students are the actors as pointed (Juan, Martinze-Viviente and rUz-Merino, 2020). The assertion of Kumar (2020) corroborated with Sahari (2020) who opined that using animated video improves understanding and application in electronics, for instance modulation techniques can be understood in a better way if animated video that are available in internet is utilized. Leve-Doff and McDonald (2008) in an agreement pointed out that, many topics are in the internet that displayed techniques of understanding abstract topic using animated video. More so, students gain confidence as they do project on their own with the help of their seniors studying the same course. Through this means, peer learning can be achieved. Organizations of workshop for students in cooperation with known electronics company, who will be guest speaker for educating students on hands-on experience such as printed circuit board design, switching circuit and logic design gives students industrial skill (Lily nova, 2019). Also added to that is, the use of software environment-simulation software; such as Mutism, P-spice, Proteus, Electronic Work Bench are not left out in producing prototype coupled with the real production by

demonstrating with listed industrial standard simulation packages. In the same vein, Chaitanya (2019) stated that project-based teaching/learning coupled with demonstration using industrial standard simulation software in electronics coupled with teaching through research papers are innovative practices, that bridges the disconnect between theory and practice of acquisition of skill development for self-reliance. Field trip provide the most realistic means study of reality in processes and product manufacturing in their actual environment setting (Mbakwe, 2007). A teaching method involving the explanation of concepts, principles and theories while students are taking notes, remain passive and exam taken at the end semester is an oldest method of teaching that have been in use for ages. According to Open University (2013), lecture, demonstration and project are teaching methods in equipment maintenance training.

Statement of Problem

Electronics is an arm of Electrical / Electronic course in TVE, through which the pursuit of mandate of acquisition of skills, self-reliance and sustainable development of Nigerian economy will be achieved, but the traditional method presently employed in the delivery of the subject matter may enforce students to learn the concept through abstract thinking, reasoning and imagination which may lead to not realizing the expected outcome. They may end up losing interest in the holistic view of the learned content and its relevance in relation to real life practical situation, thereby displaying inability in solving problem that negates the goal of studying the course. Therefore, it is necessary to identify the innovative methods needed to be integrated into teaching and learning, since not all competencies can be acquired through the methodology of normal classroom setting. Specifically, the study sought to determine:

1. The needed innovative methods to be integrated into teaching and learning Electronics in higher institution in Imo State.
2. The needed innovative methods already integrated into teaching and learning Electronics higher institution in Imo State.

Research Questions in

The study answered the following research questions;

1. What are the innovative methods needed to be integrated into teaching and learning Electronics in higher institution in Imo State?
2. What are the innovative methods already integrated into teaching and learning Electronics in higher institution in Imo State?

Hypothesis

The null hypothesis was tested at 0.05 level of significant.

1. There was no significant difference on the mean rating of Lecturers from Polytechnics and Educators from College of Education on the innovative teaching methods of delivery of Electronics

Methodology

The study adopted survey research design to determine the needed innovative methods and its level of integration in the teaching-learning Electronics in Imo State, the population of study was 35 respondents comprising of 14 Electronics Educators and 21 Electronics Engineering Lecturers. intact class and census sampling techniques were utilized for the study. The questionnaire titled “Innovative methods of teaching and learning Electronics Technology (IMTLE)” was used for data collection. The reliability of the instrument was 0.81 established using Cronbach Alpha. The questionnaire items were generated from the review of the related literature, which consisted of three sections, A to C. Section A solicited for information on the personal data of the respondents. Section B, sourced for data on the needed innovative methods to be integrated into teaching and learning of electronic technology institution in Imo State. while section C centered on the needed innovative methods already integrated into teaching and learning electronic technology in higher institution in Imo State. The instrument

made use of the five-point Likert scale – Highly Needed (HN), Needed (N), Barely Needed (BN), Not Needed (NN), Highly Not needed (HNN) for section A while in section B, needed was replaced with Integrated in the same order. The response category values were assigned 5, 4, 3, 2, and 1 respectively. The instruments were validated by 3 experts from Engineering and Technical Education Department, outside the area of the study; mean and standard deviation were used to answer each of the two research questions while T-test statistic was used to answer the hypothesis and any item with a mean of 3.50 or above was considered needed or integrated. The hypothesis was tested at 0.05 level of significance. All the questionnaires administered were completed and returned. *X* Mean, SD Standard Deviation

Table 1: Respondents' Mean Rating of Innovative methods needed to be integrated into teaching-learning Electronics Technology in higher institution. **N=35**

S/N	Item	Mean	SD	Remark
1	Flipped Classroom	3.66	0.75	Needed
2	Industrial Standard simulation	4.56	0.78	Needed
3	Displaying of working model	3.86	0.76	Needed
4	Guest lecturers from industries	4.66	0.88	Needed
5	Real time field experience	4.77	0.86	Needed
6	Workshop and seminar	4.68	0.84	Needed
7	Teaching through research paper	4.76	0.81	Needed
8	Animated video links to internet on abstract topics	4.75	0.86	Needed
9	Artificial Intelligent Model	3.92	0.83	Needed
10	Appropriate teaching model	3.55	0.72	Needed
Average Mean		**4.32**		**Needed**

The data presented in table 1 revealed that 10 items had mean range of 3.55 to 4.77 with average mean of 4.32. All the 10 items had mean above the rated minimum cut off point of 3.50. Therefore, the items are the needed innovative methods meant for integration into teaching and learning electronics for sustainable development in Imo State. Nigeria.

Table 2: Respondents mean rating of the innovative methods already integrated in teaching-learning electronics in higher institution. **N= 35**

S/N	Item	Mean	SD	Remark
1	Collaborative Learning / group work	3.47	0.75	Not Needed
2	Project based learning	3.45	0.61	Not Needed
3	Lesson plan	2.46	0.67	Not Needed
4	Text book centered method	2.55	0.65	Not Needed
5	Demonstration method	3.33	0.67	Not Needed
6	Experimentation/ Practical lab Work	3.00	0.79	Not Needed
7	Chalk and Talk	3.45	0.73	Not Needed
8	Leaning Passive and Exam Centered	2.46	0.65	Not Needed
9	Lecture Method	3.24	0.74	Not Needed
10	Students' Listen and Take note	2.45	0.67	Not Needed
Average Mean		**2.99**		**Not Needed**

The data presented in table 2 above revealed that 10 items had mean range of 2.45 to 3.47 with an average mean of 2.99. There is an indication from the table that all the 10 items had mean scores less than minimum cut off point of 3.50. These results derived from the items had indicated that the above methods of teaching have been integrated as the traditional methods of teaching electronics and therefore not needed to be integrated.

Table 3: Test-test Analysis of Electronics Engineering Technology Lecturers from Polytechnics and Electronics Educators on the innovative teaching Method of delivering Electronics

S/N	Group	N	X	SD	T- cal.	T-crit	Sig. Level	Df	Remark

1. Electronic Engineering Technology Lecturers	24	3.67	1.05	1.17	1.96	0.05	896	Accepted
2. Electronics Technology Educators	14	3.77						
Total	**35**							

Table 3 presents t-test analysis of the difference between the mean rating of Electronics Educators and Electronic Engineering Technology Lecturers on the innovative teaching method of delivering electronics. The t-calculated value is 1.17 at 896 degree of freedom of decision (df) and 0.05 level of significance. Due to calculated value is less than the table value of 1.96, the null hypothesis of the study is accepted. Therefore, it can be concluded, that there is no significant difference between the two groups on the innovative teaching methods.

Discussion

It was found out from the first research question that 10 items were innovative methods needed to be integrated into teaching-learning electronics in higher educational institutions as shown in Table1, while in Table 2, 10 items are the already integrated traditional methods that have been in use. The findings were not in agreement that collaborative learning cum group work, and project-based learning are means of innovative delivery mode as asserted (Kumar, 2020) in agreement with Lamido and Efuwape (2019). These two methods, appeared in table 2 as already integrated components but the literature reviewed stated otherwise. One can infer that, they are barely integrated but not fully utilized, for instance project based learning and collaborative learning/ group work are basically utilized only at the end of the course. Teaching models are not used, equally using guest lecturer from industries, real time field experience coupled with workshop and seminar were identified as the innovative methods to be integrated; for, through these means experiential teaching-learning are communicated (Kumar, 2020, Lily nova, 2019). The use of industrial simulation standard, animated video link in the internet for demonstrating abstract topics, working model and teaching with research paper were found to be useful innovative methods of learning electronics (Chaitanya, 2019). Experimentation/laboratory work, lecture, talk and chalk; others are passive learning, demonstration methods among others had been in use and therefore, a traditional means of imparting knowledge indicating that, they are needed not to be integrated as innovative methods. The findings from the second research question indicated that all the items within the mean range of 2.45 to 3.47 are already integrated and sufficiently utilized because all the items had mean ranges below 3.50 and therefore should not be integrated as innovative method of teaching Electronics. There is no significant difference established. indicated that Electronics Technology Engineering Lecturers and Electronics Educators are implementers of curriculum of the course and therefore can identify the innovative methods to be integrated

Conclusion

All the findings of innovative methods should be integrated into teaching of electronics. It is a matter of importance that electronics educators/Lecturers should reflect on the current realities in life, that acquisition of saleable skills and competencies are the goal of TVE for economic sustainability. But not all competencies can be acquired through the methodology of normal classroom setting. It is reasonably that methodological teaching –learning innovation can be integrated with the theoretical lectures. The innovation methodologies prepare windows for the achievement of the proposed competencies in question and these innovations are student centered for impartation of the necessary skills. All the findings of the study should be implemented.

Recommendation

Based on the findings of the study the researcher among others recommends that;

1. Electronics lectures/educators should be encouraged to update their knowledge in the use of innovative methods in teaching, by attending conferences, workshops, in service training and other continuous education opportunities
2. Computers with standard license simulation software should be provided to educators/lecturers of technology
3. Guest lecturers from standard electronics company should be invited to give practical knowledge

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