Perception of Teachers on the Integration of Variable Flux Machines Technology for Teaching and Learning of Electrical/Electronic Technology and Automobile Technology in TVET Institutions in Nigeria

by

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Abstract

The study investigated the perception of teachers on integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria. A descriptive survey research design was adopted for the study. It was conducted in three TVET institutions in South East, Nigeria. The population of the study was 61 subjects, comprising of 25 lecturers and 36 workshop technologists from the three departments. Due to the manageable size of the population, there was no sampling as the entire population was used for the study. A 32 item questionnaire was used as instrument for data collection. The questionnaire was face validated by three experts in the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. Cronbach alpha reliability method was used to determine internal consistency of the instrument, a reliability coefficient of 0.85 was obtained. Data collected from the study were analyzed using mean and standard deviation to answer research questions while t-test was used for testing the null hypotheses at 0.05 level of significance and relevant degree of freedom. The study revealed that TVET teachers had a positive perception about the use of VFM for teaching and learning electrical/electronic technology and automobile technology. The study also revealed some of the barriers to the integration of VFM in TVET institutions and the solutions to the barriers. Recommendations include that tvet teachers should be encouraged to make use of VFM for teaching and learning electrical/electronic technology and automobile technology

Keywords: Technical and Vocational Education and Training (TVET), Automobile Technology, Electrical/Electronic Technology and Variable Flux Machines.

Introduction

Technical and vocational education and training (TVET) refers to educational and training programs that focus on providing students with practical skills and knowledge that are relevant to specific trades, occupations, or vocations. UNESCO (2009) defined TVET as all forms and aspects of education that are technical and vocational in nature, provided either in educational institutions or under their authority, by public authorities, the private sector or through other forms of organized education, formal or non-formal, aiming to ensure that all members of the community have access to the pathways of lifelong learning. According to Akanbi, (2017) TVET programs typically include a mix of classroom instruction, hands-on training, and experiential learning

opportunities which may be offered at the secondary, post-secondary, or higher education level. These programs are designed to prepare students for careers in a wide range of fields, including manufacturing, construction, engineering, and healthcare, hospitality, and information technology Kanwar, Balasubramanian and Carr, (2019). TVET programs are often seen as an important means of providing individuals with the skills and knowledge they need to enter the workforce and succeed in their chosen careers.

Technical and vocational education and training (TVET) plays a crucial role in promoting economic development and sustainable development. According to Kibet and Kibet, (2019) the few ways in which TVET can contribute to promoting economic development and sustainable development goals in the society include: i) TVET provides individuals with the skills and knowledge they need to enter the workforce and be productive members of society. This helps to increase labour productivity and competitiveness, which can drive economic growth and development. ii) TVET programs can help to address skills shortages and mismatches in the labour market, which can lead to increased employment and economic opportunities for individuals and communities. iii) TVET can help to improve social mobility and reduce poverty by providing disadvantaged individuals with the skills and knowledge they need to access better-paying jobs and improve their economic prospects. iv) TVET programs can also contribute to sustainable development by helping to train individuals in trades and occupations that are in demand in the green economy, such as renewable energy and sustainable agriculture. This can help to reduce reliance on fossil fuels and promote environmentally-sustainable practices. v) TVET can also promote gender equality by providing women and men with equal access to education and training opportunities, which can help to reduce gender-based barriers to employment and improve economic opportunities for all. Similarly, in line with its goal to promote economic development and sustainable development in the society in, many tertiary institutions in Nigeria are offering a series of TVET courses for their students. Some of these courses include; metal work technology, woodwork technology, building technology, automobile technology, electrical and electronic technology among others.

One of the components of TVET is electrical/electronic technology. Electrical and Electronic Technology is the branch of engineering concerned with the practical application of electricity in all forms of human endeavour (Frank & Ryder, 2018). According to Ajayi, (2018), electrical and electronic technology is a field of study that provides both theoretical and hands-on knowledge of current electrical and electronics devices and circuits. Hence, electrical and electronic syllabus in Nigerian universities is designed to provide the essential fundamental knowledge and the analytical, practical and experimental skills necessary for a lifelong career in the field of electrical and electronic technology. It also provides students with the fundamental knowledge and skills for workplace and professional pedagogy skills in electrical and electronics field. Electrical/Electronic technology provides technical knowledge needed as well as the essential hands-on skills that meet the condition for achieving success in the electrical field. Another integral component of TVET in Nigerian universities is automobile technology.

Automobile technology involves the application of scientific knowledge in the design, selection of materials, construction, operation and maintenance of the motor vehicle (Kanife & Okanya, 2022). Automobile according to Wahab (2015) means vehicles particularly one for passengers, carrying its own power-generating and propelling mechanism, for travel on ordinary road. Mechanism means any mechanical means for the conversion of control of motion or the transmission or control

of vehicle. It is the structure or arrangement of parts of a machines or similar device or of anything analogous. The automobile services field offers many career opportunities for anyone who is mechanically inclined and has the educational background. This background includes: servicing of injector, vulcanizing, engine repair, gear repair, refrigeration and painting, body build and repair. However, the teacher plays a pivotal role in imparting the necessary knowledge and skills for students of automobile technology.

The lecturers and lab/workshop-technologists are the two main categories of teachers in most Nigerian universities. They engage the students in teaching and learning process through two prominent methods: lecturers engage the students in theoretical aspect of the courses while the lab/workshop technologists engage the students in practical skill activities. Kaino, (2017) stated that teaching involves in active learning because it involves engaging students in an active exchange in which students are not passively listening and making notes but actively contributing their thoughts and ideas to a relevant collaborative discussions. It is also an activity which is guided by the instructor or the teacher, Al-Hariri and Al-Hattami, (2017) sees teaching as a process whereby the teacher is more of an equal, who takes account of the learner's experience and even learns from the learner. It is viewed as a process of student-teacher interaction whereby the teacher facilitates the learning while the students are also considered as participants in the process. Therefore, the centres of educational development are the teachers, the student and the content of instruction. For proper mechanism of automobile, electrical and electronic technology, the teachers requires conventional skills and modern technology in order to impart or convey the required saleable practical skills to electrical/electronic technology and automobile technology graduates. That is, the electrical/electronic technology and automobile technology teachers need to improve themselves with the currents ways, methods and procedures or producing cars, designing, servicing, and repairing an overhauling of vehicles and electrical/electronic devices. The teacher is supposed to demonstrate and understanding of electrical/electronic technology and automobile technology content and proficiency with the use of appropriate tools, technology and techniques to solve biology problems. Teachers should be able to use these tools and technique to gather, manage, analyze and interpret data in order to enhance student learning opportunities.

However, several studies conducted all revealed that the products of most automobile technology programmes lacked the basic skills needed for gainful employment in today's automobile industry (Asogwa, Okanya, Eze, & Edozie, 2020; Howell, 2018). Most automobile technology graduates cannot use auto-diagnostic tools and equipment to read or clear fault codes in modern vehicles despite their years of training (Akanbi, 2017; Okwelle, Beako & Ajie, 2017). Most of these problems has be attributed to poor teaching strategy from teachers. Most teachers lacked the ability to utilize instructional materials for teaching and learning while some were not competent enough to impact the practical skills on students. The curriculum was also blamed for not being adequate and relevant to offer enough of the skills needed to meet the challenges that are involved in the maintenance of modern automobiles on Nigerian roads. Similarly, the incorporation of new technologies with new subsystems and system components into modern automobiles have changed their configurations and made their maintenance a more complex task, even though some of the new systems make them easier to maintain (Thomas, Ugoji & Idibia, 2022). The curriculum of automobile technology programmes that train the service personnel for maintaining these vehicles has however, remained rigid (Thomas, & Amaechi, 2016).

The gaps created between the curriculum and the new technological innovations have made the needed skills for effective maintenance of these new breed automobiles to continue to elude the products of these programmes. The result has being that, the graduates of these programmes are often unemployable or underemployed while most automobiles with these new innovations either suffer disrepair or have the new systems replaced by the classical substitute systems that the new ones were meant to improve upon. Yet some are even completely grounded just barely into their expected service lives because of lack of competent personnel for their effective maintenance (Chitewere, 2017).

Furthermore, electrical/electronic technology program is expected to help learners develop abilities in the design, development, diagnosis and repairs of electrical components, equipment and machines (Olumuyiwa Kazeem, & Yusuff, 2014). This professional field requires learning of multiple abstract contents ranging from structures of matter to electricity, semi-conductor devices and thermionic emissions, electromagnetism, oscillators and oscillation, radio frequencies and audio signals, radio waves and modulations, circuit theories, electronic amplifiers and transistors with some others (Okorafor, & Nnajiofor, 2017). Also, students studying electrical/electronic technology are required to be versatile in handling complex calculations such as present in circuit theorem and Boolean algebra. Naturally, students on this program of study requires higher order thinking to comprehend the concepts, however, the poor teaching practice with lack of good environment for facilitative learning have contributed to students poor understanding and performances (Ayonmike, & Okeke, 2016). There is lack of evidenced based teaching and active involvement in the knowledge construction, which results in students facing challenges with comprehension, retention and academic performance in electrical/electronic technology (Chibabi, et al., 2018). Most electrical/electronic technology graduates are not employable after graduation while many are not self-reliant. Al-Hariri and Al-Hattami (2017) laid credence to this fact in that students tends to learn better with use of images, videos, animation among other learning enrichment properties of technology-enhanced learning facilitation compared to traditional lecture method. Teachers need to employ effective techniques which will go beyond mere passing of information but enhance retention (Raleigh, et al., 2018).

Such technique are effective in developing high level thinking process, perceptual and manipulative skills, real and permanent learning and superior knowledge retention. Sustainable measures are needed to keep electrical/electronic and automobile technology students in tune with the knowledge and skills needed in the world of work. The school courses and curricula must be reviewed, enriched and updated regularly in line with changes that are taking place in the electrical/electronic and automobile technology industries. Noesgaard and Orngreen (2015) suggested that students' poor understanding of scientific concepts and overall academic performance can be better corrected with integration of Variable Flux Machine (VFM) technology into electrical/electronic and automobile technology programs in Nigerian universities. Variable flux machines (VFMs) are a relatively new class of machine that affords one the ability to actively change a motor from a high torque/low speed range to low torque/high speed range through the online control with a reduced rare-earth magnets (Fernandez, Reigosa, Guerrero,. Zhu, Suarez, & Briz, 2018). Athavale, Sasaki, Kato, and Lorenz, (2017) stated that variable-flux machines (VFM) are those which include some means of adjusting the level of permanent magnet flux and are of interest today as they allow flexibility in terms of optimizing efficiency across a machine operation cycle. Variable flux machines (VFMs) are extensively utilized in

several domains such as Electric Vehicles, robotics, industrial automation, renewable energy, and others. This is primarily due to their exceptional power density, high torque, accurate control, and superior efficiency. VFM are also increasingly used in industrial applications that include power generation, transportation, and manufacturing. Recent technological advancements in electric vehicles, railway traction, ship propulsion, and electromobility are few key areas of application that have adopted VFM technology in recent years (Gagas, Sasaki, Athavale, Kato, & Lorenz, 2017).

In recent decades, the rapid increase in the amount of vehicles in use has seriously impacted on worldwide energy consumption and environment. Compared to the internal combustion engine vehicles (ICEV), electric vehicles (EVs) contribute significantly to the energy saving and environmental protection, and on account of these benefits, they constitute today's direction for the automotive industry. EVs are vehicles wholly- or partially-driven by electricity; specifically, they are battery-powered electric vehicles (BEVs), fuel cell electric vehicles (FEVs) and hybrid electric vehicles (HEVs) (Takbash & Pillay, 2018). In a globalized automotive market, the major vehicle manufactures have launched their own commercial EV products, such as Toyota Prius, Toyota Mirai, GM Volt, Nissan Leaf, and so on. In addition, non-traditional vehicle companies, such as Tesla and Google, have also entered into the EV market and have launched a series of distinctive EV products (Zhu, Yang, Xiang, & Quan, 2018). Different from the ICE vehicles, EVs have an electric motor embedded in the powertrain. Since the efficiency in the energy conversion of an electric motor together with the associated power electronics supply is much higher than ICEs, EVs need less energy to move. EVs are convenient, not only for increasing the efficiency in the energy utilization, but also for cutting out environmental pollution in an equal proportion. Batteries, electric machines, electric drive systems and individual mechanical devices are the key technologies of an EV/HEV power train (Yang, Zhu, Lin, Xu, Zhan, Fang, & Huang, 2017). In particular, the electric drive systems propelling the vehicles are the heart of any EV, and their operation directly affects the overall EV performance. Due to the availability of a fixed magnetic field, variable flux machines are designed for high torque and power density, high efficiency and lower heat production in the rotor compared with other types of electrical machines. Thus, it is imperative to investigate the new technological innovations in automobiles and electrical/electronic technology with the view to identifying the perception of teachers on its integration and its benefit to TVET programmes. This study was therefore designed to identify the perception of teachers on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Statement of the Problem

Technical Vocational Education and Training (TVET) programs include a mix of classroom instruction, hands-on training, and experiential learning opportunities which are offered at the secondary, post-secondary, or higher education level. One of the components of TVET, electrical/electronic technology provides students with the fundamental knowledge and skills for workplace and professional pedagogy skills in electrical and electronics field. Electrical/Electronic technology provides technical knowledge needed as well as the essential hands-on skills that meet the condition for achieving success in the electrical field. Another integral component of TVET in Nigerian universities, automobile technology offers many career opportunities for anyone who is mechanically inclined and has the educational background. This background includes: servicing of injector, vulcanizing,

engine repair, gear repair, refrigeration and painting, body build and repair.

However, several studies conducted all revealed that the products of most automobile technology programmes lacked the basic skills needed for gainful employment in today's automobile industry. Accordingly, most automobile technology graduates cannot use auto-diagnostic tools and equipment to read or clear fault codes in modern vehicles despite their years of training. Most of these problems were attributed to poor teaching strategy from teachers as most teachers lacked the ability to utilize instructional materials for teaching and learning while some were not competent enough to impact the practical skills on students. The curriculum was also blamed for not being adequate and relevant to offer enough of the skills needed to meet the challenges that are involved in the maintenance of modern automobiles on Nigerian roads. Similarly, the incorporation of new technologies with new subsystems and system components into modern automobiles have changed their configurations and made their maintenance a more complex task. The curriculum of automobile technology programmes that train the service personnel for maintaining these vehicles has however remained rigid. The gaps created between the curriculum and the new technological innovations have made the needed skills for effective maintenance of these new breed automobiles to continue to elude the products of these programmes.

The result has being that, the graduates of these programmes are often unemployable or underemployed while most automobiles with these new innovations either suffer disrepair or have the new systems replaced by the classical substitute systems that the new ones were meant to improve upon. Similarly, the poor teaching practice with lack of good environment for facilitative learning have contributed to students' poor understanding and performances in electrical/electronic technology. Report show a lack of evidenced based teaching and active involvement in the knowledge construction, which results in students facing challenges with comprehension, retention and academic performance in electrical/electronic technology. As a result, most electrical/electronic technology graduates are not employable after graduation while many are not self-reliant. Scholars have suggested the integration of variable flux machines technology into the electrical/electronic technology and automobile technology programmes in TVET Institutions so as to improve the quality of the graduates. It is on this premise that the present study seeks to ascertain the perception of teachers on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Purpose of the study

The main purpose of the study was to determine perception of teachers on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria. Specifically, the paper sought to:

1. Find out the teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.
2. Examine the barriers hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.
3. Determine the solutions to the challenges hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Research Questions

What are the teachers' perception on the integration of variable flux machines technology for teaching and learning of

electrical/electronic technology and automobile technology in TVET Institutions in Nigeria?

2. What are the barriers hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria?
3. What are the solutions to the challenges hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria?

Hypotheses

The following hypotheses guided the study:

1. There is no significant difference in the mean response of lecturers and technologists on teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Methodology

A descriptive survey research design was adopted for the study. It was conducted in three TVET institutions in South East, Nigeria. These TVET institutions include: Department of Industrial Technical Education University of Nigeria Nsukka, Department of Technology and Vocational Education Nnamdi Azikiwe University Awka and Department of Industrial Technology Education Michael Okpara University of Agriculture Umudike. The population of the study is 61 subjects, comprising of 25 lectures and 36 workshop technologists from the three departments. Due to the manageable size of the population, there was no sampling as the entire population was used for the study. A 32 item questionnaire was developed from literature to obtain data for the study. A 5-point Likart scale was used to develop the questionnaire. The scale for the questionnaire was Strongly Agree (SA) - 5, Agree (A) - 4, Undecided (UD) – 3, Disagree (D) - 2 and Strongly Disagree (SD) - 1. The questionnaire was face validated by three experts from the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. Their suggestions and recommendation were integrated into the final copy of the questionnaire. The questionnaire was administered to the 61 respondents. The data collected was analyzed using mean, standard deviation and t-test statistics. The mean and standard deviation were used to answer the research questions, while the Cranach alpha was used to determine internal consistency of the instrument, a reliability coefficient of 0.85 was obtained. Data collected from the study were analyzed using mean and standard deviation for answering the research questions. Arithmetic mean of 3.50 was used to interpret the analyzed data, any item with a mean of 3.50 and above was accepted, while items having their mean below 3.50 were rejected. The t-test was used for testing the null hypothesis at probability of 0.05 level of significance and relevant degree of freedom.

Results:

Research Question One: What are the teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria?

Table 1: Teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology

S/N	Items	SA	A	UD	D	SD	Mean
1	I think Students will learn more when using variable flux machines (VFM) technology.	7	8	0	1	1	3.61
2	I think the use of VFM will help to develops students' problem-solving.	9	6	0	1	0	3.55
3	I think VFM will enable teachers to simplify difficult topics while teaching.	8	10	0	2	0	3.52

4	The use of VFM will boosts students' creative abilities	9	8	0	1	1	3.66
5	The use of VFM will facilitate teachers' better management of classroom while teaching.	4	11	0	1	0	3.60
6	The use of VFM can provide me with opportunities to integrate effective pedagogy.	7	9	0	1	1	3.57
7	The use of VFM tools will enable teachers to make their teaching effective by conveying specific contents to the learners in a better way.	8	8	1	1	1	3.71
8	The use of VFM could facilitate the clear and elaborate presentation of concepts to students by enhancing the showing of numerous and complex examples	9	9	0	1	1	3.63
9	The use of VFM could enhance the engagement/attention of students	5	10	1	0	0	3.58
10	The use of VFM could encourage student-student interaction while learning basic concepts	9	11	0	0	0	3.54
11	The use of VFM could encourage student-teacher interaction during lessons and practical sessions.	10	7	1	1	1	3.62
12	Training on the use VFM technology could help teachers to improve teaching with more updated materials.	11	8	2	1	0	3.72
13	The use of VFM could gives teachers opportunity to be learning facilitators instead of information providers	8	7	1	1	1	3.65

Table I above shows that all the mean score for both lecturers and lab technologists was above 3.50. This is an indication that the respondents agreed that all the 13 items are the teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Hypothesis 1: There is no significance difference in the mean response of lecturers and technologists on teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Table 2: Independent Samples t-test statistics of Mean Responses of lecturers and technologists on teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology

Group	N	Mean	SD	DF	T	Sig.	Alpha
Lecturers	25	3.96	.25	73	1.05	0.17	0.05
Technologists	36	3.77	.24				

As shown in Table 2, lecturers had a relatively higher mean score of 3.96 than workshop technologists with a mean of 3.77. There was no significance difference in the mean response of lecturers and technologists on teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology ($t=1.05 > .05$). With this result, the null hypothesis of no significant difference was accepted at 0.05% level of significance.

Research Question Two: What are the barriers hindering effective integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria?

Table 3: Teachers' perception on the barriers hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology

S/N	Items	SA	A	UD	D	SD	Mean
1	Lack of curriculum provision for teaching of VFM in electrical/electronic and automobile technology	12	8	0	0	0	3.87
2	Lack of laboratories/workshop fitted with variable flux machine technology in TVET schools.	7	8	0	1	1	3.61
3	Lack of basic skills/knowledge by teachers on how to operate variable flux machines	9	6	0	1	0	3.55
4	Lack of in-service training of teachers on how to use variable flux machines for teaching	8	10	0	2	0	3.52
5	Lack of basic skills on the use of VFM by students	9	8	0	1	1	3.66
6	Insufficient time allotted to the teaching of automobile and electrical/electronic technology using VFM facilities	4	11	0	1	0	3.60
7	VFM use is good only for students who are mathematically inclined	7	9	0	1	1	3.57
8	School does not receive sufficient support from government as far as adoption of VFM is concerned	8	8	1	1	1	3.71
9	Many teachers cannot use VFM in teaching because they are not computer literate and see computer as waste of time	9	9	0	1	1	3.63
10	Most teachers lack the motivation to adopt to new way of instruction using VFM	5	10	1	0	0	3.58

Table 3 above shows that all the mean score for both lecturers and lab technologists was above 3.50. This is an indication that the respondents agreed that all the 10 items are teachers' perception on the barriers hindering effective integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Research Question Three: What are the solutions to the challenges hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria?

Table 4: Teachers' perception on the solutions to the challenges hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology

S/N	Items	SA	A	UD	D	SD	Mean
1	The NUC should review the university curriculum to make provision for teaching of VFM in electrical/electronic and automobile technology.	9	11	0	1	0	3.57
2	Administrators of TVET institutions should ensure that laboratories are fitted with VFM technology tools and equipments.	7	8	0	1	1	3.51
3	TVET Teachers, students and administrators should ensure regular maintenance of VFM tools and equipment when they are installed in workshops/laboratories.	9	6	0	1	0	3.55
4	TVET administrators should engage in regular training, retraining and in-service training of teachers on how to use VFM for teaching	8	10	0	2	0	3.52
5	TVET teachers should endevour to up-skill so as to acquire	9	8	0	1	1	3.66

	basic skills on the use of VFM for teaching						
6	Administrators of TVET institutions should allocate sufficient time for the teaching of automobile and electrical/electronic technology using VFM facilities	4	11	0	1	0	3.60
7	Government and private sector should support the adoption of VFM in teaching by making provisions for teaching and learning materials.	8	8	1	1	1	3.71
8	TVET institutions should employ only competent and qualified teachers for teaching of automobile and electrical/electronic technology	9	9	0	1	1	3.63
9	Teachers' remuneration and pay should be increased so as to motivate teachers to adapt to new way of instruction using VFM by paying.	7	9	1	0	0	3.57

Table 4 above shows that all the mean score for both lecturers and lab technologists was above 3.50. This is an indication that the respondents agreed that all the 9 items are teachers' perception on the solutions to the challenges hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria.

Discussion of Findings

The findings of the study in Table 1 revealed the teachers' perception on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria. Some of them include that teachers think that the use of VFM could enhance the engagement/attention of students and the use of VFM could encourage student-student interaction while learning basic concepts. The findings are in agreement with Alliance, (2016) found that teachers believe that integration of innovative technologies such as VFM into their work would enhance their work so that students would achieve better. Sagar, (2016) discovered that teachers believe that VFM could be one of the biggest sources of help for them in discharging their duties. Olson, (2018) also supported the findings by stating that teachers believe that students could be more independent, positive and motivated towards learning while receiving lessons and practical skill activities through VFM; it motivate students to be interested and take initiative on participating and involving themselves in the learning process.

The findings of the study in Table 3 shows the barriers hindering effective integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria. Some of these challenges include; lack of curriculum provision for teaching of VFM in electrical/electronic and automobile technology and lack of laboratories/workshop fitted with variable flux machine technology in TVET schools. Supporting the findings of this study, Wyman, (2017) found that teachers are faced with many problems which militate against their integration of innovative technologies such as VFM into their work. These problems range from lack of basic ICT skills by teachers and students to lack of innovative facilities in schools. According to Caves, Ghisletta, Kemper and, Renold, (2021), factors that impede teachers' use of digital tools in teaching can be respectively categorized into two main parts (1) intrinsic barriers: such as teacher confidence, their technology-related knowledge and skills, attitudes and beliefs towards applying technology tools; and (2) extrinsic barriers: such as lack of access to technology resources, training, time, and support from institutions.

Devine, (2020) identified many problems which include insufficient access to computers, running cost, teacher access to ICTs, innovative tools and large class. Also, lack of training and personnel is a major problem militating against the integration of VFM in TVET institutions.

Also, the findings of the study in table 3 indicate the solutions to the challenges hindering integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria. Some of these solutions include; that the NUC should review the university curriculum to make provision for teaching of VFM in electrical/electronic and automobile 1 technology and that administrators of TVET institutions should ensure that laboratories are fitted with VFM technology tools and equipments. Lotz-Sisitka, Shumba, Lupele and Wilmot, (2017) supports the findings of this 2 study by stating that teachers and learners need to undergo continuous in-service professional courses to enhance their skills to help learners use VFM tools and resources. Jan, (2019) also supported the findings of the study by noting that Government should embark on a programme in assisting TVET 3 institutions to have access to VFM technology. Government could also provide scholarships to teachers who wish to support further education in VFM technology based programmes.

Conclusion

The study determined the perception of teachers on the integration of variable flux machines technology for teaching and learning of electrical/electronic technology and automobile technology in TVET Institutions in Nigeria. The study revealed that TVET teachers had a positive perception about the use of VFM for teaching and learning electrical/electronic technology and automobile technology. The study also revealed some of the barriers to the integration of VFM in TVET institutions and the solutions to the barriers.

Recommendation

The following recommendations are made:

1. There should be a review of the electrical/electronic technology and automobile technology curriculum so as to incorporate the teaching of learning of variable flux machines technology.
2. Administrators of TVET institutions should organize regular pre-service and in-service training programmes for all teachers on the integration of VFM in teaching not only in electrical/electronic technology and automobile technology but other related TVET courses.
3. The government, private sector together with the management of TVET institutions should also strive to provide VFM facilities in the electrical/electronic technology and automobile technology laboratories and workshops. This will go a long way in helping the effective integration of VFM in of electrical/electronic technology and automobile technology

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