



Extent of Utilization of Tools in Teaching and Learning of Direct-on-line and Star/Delta Starters in Technical Colleges in Delta State

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Abstract

This study adopted a descriptive research design. The population comprises of 36 respondents, 27 Electrical electronic teachers and 9 workshop technicians. No sample was used due to small population size. Two research questions to guide the study while two null hypotheses was formulated and tested at 0.05 level of significance and 100 degrees of freedom. The instrument for data collection was a structured questionnaire which contains 40 items. The reliability of the instrument was determined using Cronbach Alpha method and coefficient of 0.08 was obtained. Mean and Standard deviation were used to answer the research questions while t-test was used to test and analyzed the null hypotheses. The findings on hypotheses revealed that there was no significant difference in the mean ratings of the two groups of respondents on the use of tools in teaching and learning of direct-on-line and star/delta starters in technical colleges in Delta State. It was therefore recommended that, technical college teachers should be trained and re-trained in order to prepare students for the industry.

Keywords: Contactor; Overload; Star/Delta; Direct-On-Line.



Introduction

Education is the manner of assisting learning or the acquisition of knowledge, skills, values, beliefs, habits, and individual development. It originated as transmission of traditional heritage from one generation to the next. According to Okoro (2010), Technical colleges are institutions established with the aim of training individuals to acquire appropriate vocational skills, knowledge, attitudes, habits of thoughts and qualities of characters that enable them to develop their intellectual capabilities in becoming self-reliant and contribute to the growth and development of the nation.

Technical colleges are quite different from normal secondary schools, the reason is that it places emphasis on vocational education and skills acquisition rather than how to read and write (Okolie, 2014). Okolie continued that technical colleges are training centers for individuals to acquire technical awareness and useful skills necessary for mastering a particular trade. Students with first school leaving certificate and junior WAEC (West Africa Examination Council) are often admitted into technical colleges for six and three years of vocational and technical training.

The vocational and technical subject offered in technical colleges includes; furniture making, painting and decoration, agricultural mechanization, automobile mechanics, electrical installation and maintenance works, electronic works, welding and fabrication, plumbing, etc. in addition, all the vocational and technical subjects offered in technical colleges are transferred by trained and experienced teachers. Technical teachers are personnel trained in colleges of education, polytechnics, and universities who specialized in one of the trades and use variety of teaching methods to help students develop skills related to a specific field of study (Okoro, 2010). The practical aspect of the trades is performed in the workshop. Workshop is a workplace where practical is demonstrated for students understanding. Practical teaching and learning in the workshop increase the level of confidence in student's practical ability.

Teaching is a process where the teacher transfers his own knowledge to the learners in order to achieve a specific skill or have change in behavior. Teaching and learning cannot be effective without having facilities on ground for practical exercise. These facilities that are available must be utilized by technical teachers for teaching and maintained for further use especially in technical colleges where the three domains of learning (cognitive, affective, and psychomotor) are completely emphasized. Teaching according to (Chukwuma, 2022), is the practice implemented by a teacher aimed at transmitting skills, knowledge, and know-how to a learner in the context of educational institution. Teaching in totality is closely related to learning.

Learning is lifelong process of transferring information and experience into knowledge, skills and attitude. In addition, education is just one approach to learning. It's a process where a society passes on the knowledge, values, and skills from one generation to another, (Chukwuma & Okwelle, 2021). In teaching and learning of direct-on-line and star/delta starters certain tools are required in the layout, wiring, and the functionality of motor operations. The following are tools used in the construction and wiring of motor starters; contactors, start/stop push button, overload relay, power supply and circuit breaker.

Direct-On-Line Starter

A direct-on-line (DOL) starter is a simple and common method of starting electric motors particularly three phase induction motors. Basic components used are, contactors,

start/stop push button, overload relay, power supply and circuit breaker. When the start button is pressed the following sequence occurs: the contactor coil will be energized closing the main contacts, this directly connects the motor to the full supply voltage, the motor starts immediately by drawing a high inrush current and then accelerates quickly to its full speed, the motor draws its normal operating current when running, while the overload relay monitors the current flowing to the electric motor. If overload occurs it trips and opens the contactor which will stop the electric motor to prevent damage.

Star/Delta Starter

A star/delta starter is a method used to start large three phase induction motors to reduce the initial in-rush current and starting torque. Motor windings are connected in star (Y) configuration; this is during starting operation. After the motor has reached about 80% of full speed, windings switched to delta (Δ) configuration. Components for this operation are; contactors overload relay, timer, and circuit breakers. On the process of star operation, the apply voltage reduce to 58% of line voltage. In the transition period the timer-controlled switch from star to delta. During the delta operation stage full line voltage will be applied for normal running. This starter lowers starting current to about 1/3 of direct-on-line starting current and also reduces mechanical stress.

Federal Republic of Nigeria in her National Policy on Education (2013) stated that technical education should provide training and impart the necessary skills and knowledge to individuals to become self-reliant. However, technical college graduates who are trained to be job creators and employers of labour are now job seekers (Ehimen & Ezeora, 2018). This negates the objectives of technical education as there are cases where some technical college graduates lack industrial and occupational skills which has stalled job creation and economic self-reliance (Akiri, et al., 2016).

Most electrical electronic technology graduates roam the street unemployed because they do not have the basic skills required in the industry. This may be as a result of not having enough practical demonstration with tools such as contactors, overload relay, start/stop push buttons used in the construction and wiring of direct-on-line and star/delta starters in technical colleges in Delta state. Hence, there is need for identification and integration of the practical demonstration in the teaching of direct-on-line and star/delta starters with tools in technical colleges.

Research Questions

The following research questions guided the study;

1. What is the extent of tools utilization in teaching of direct-on-line starter in technical colleges in Delta State?
2. What is the extent of tools utilization in teaching of star/delta starter in technical colleges in Delta State?



Hypotheses

The following null hypotheses were formulated and tested at 0.05 level significance.

HO₁: There is no significant difference in the mean ratings of electrical electronic teachers and industrial technicians on the extent tools are utilized in teaching of direct-on-line starter in technical colleges in Delta State

HO₂: There is no significant difference in the mean ratings of electrical electronic teachers and industrial technicians on the extent tools are utilized in teaching of star/delta starter in technical colleges in Delta State

Methods

The study adopted a descriptive survey design. The study was conducted in nine technical colleges in Delta State. The population of the study is 36 comprises of 27 teachers in technical colleges and 9 industrial technicians all in Delta State. Due to the small population size there was no sampling, hence the entire population was used for the study. Data was collected using structured questionnaire, four-point rating scale of Very High Extent (VHE), High Extent (HE), Low Extent (LE), and Very Low Extent (VLE) with numerical value of 4, 3, 2, and 1 respectively. The instrument was tried in Afuze technical college in Edo state and a reliability coefficient of 0.08 was established using Cronbach Alpha. Data collected from the research questions were analyzed using mean and standard deviation. Items with mean value of 2.50 and above were accepted while mean value of 2.49 and below was rejected. The hypotheses were tested at 0.05 level of significance using t-test statistics. The calculated value of t-cal less than the critical value t-crit, the hypotheses was accepted but for t-cal equal to or greater than t-crit the hypotheses was rejected.

Results

Research Question 1: What is the extent of tools utilization in teaching of direct-on-line starter in technical colleges in Delta State?

The Data for answering and analyzing question 1 are in Table 1.

Table 1: Mean and standard deviation of the extent of tools utilization in teaching of direct-on-line starter in technical colleges in Delta State

S/N	Item Statement	$\bar{x}_1$	SD	Rmk	X2	SD2	Rmk
1.	Identifying contactor terminals with multimeter	3.26	0.78	VHE	3.57	0.67	HE
2.	Connecting circuit breakers with pliers	3.11	1.01	HE	3.49	0.70	HE
3.	Preparing cables with long-nose pliers	3.29	0.85	VHE	3.57	0.60	HE
4.	Use cutters in tagging of cables numbers	3.21	0.79	HE	3.82	0.38	VHE
5.	Using screw driver to fix terminal blocks	3.39	0.79	VHE	3.76	0.42	HE
6.	using spirit level for layout	3.00	0.83	VHE	3.31	0.83	VHE



7. Connection of power cables	3.15	0.84	HE	3.37	0.63	HE
8. Terminating control circuit With tester	2.92	0.85	HE	3.29	0.80	HE
9. Use magnet to check poles of contactors	3.37	0.83	VHE	3.51	0.64	HE
10. Testing of overload Relay with multimeter	3.10	0.82	HE	3.45	0.70	HE
11. Connection of self-holding Contact	3.05	0.89	HE	3.65	0.55	HE
12. Normally open contact termination	3.20	0.43	HE	3.53	0.29	VHE
13. Servicing of contactors with hand brush	3.48	0.76	VHE	3.11	0.94	VHE
14. tester for loop test	3.31	0.71	HE	3.34	0.72	LE
15. Terminating push buttons	3.37	0.92	VHE	2.85	0.76	HE
16. Brush to clean contactor terminals	3.29	0.73	HE	2.76	0.66	HE
17. Use of cable strippers	3.15	0.90	LE	3.57	0.57	HE
18. Ammeter to monitor electrical controls	3.42	0.78	HE	3.59	0.53	HE
19. Disconnecting contactor with tester screw driver	3.29	0.83	HE	3.53	0.61	HE
20. Tester to trace Electrical diagram	3.21	0.70	HE	3.64	0.66	VHE
Grand Mean	3.23	0.82		3.48	0.65	

Data presented in Table 1 revealed that the electrical and electronic teachers had mean ranging from 2.92 to 3.48, while the industrial technicians had mean ranging from 2.76 to 3.82. since the mean value are above the cut-off point of 2.50 it indicates that both respondents accepted that tools are highly useful in the teaching and learning of direct-on-line starter as in preparing technical college graduates for employment. In essence, the electrical electronic teachers had standard deviation ranging from 0.07 to 1.01, while the industrial technicians had the standard deviation ranging from 0.29 to 0.94 which revealed that the respondent's opinions were similar.

Research Question 2: What is the extent of tools utilization in the teaching of star/delta starter in technical colleges in Delta State?

The Data for answering and analyzing question 2 are in Table 2.



Table 2: Mean and standard deviation of the extent of tools utilization in the teaching of star/delta starter in technical colleges in Delta State

S/N	Item Statement	$\bar{x}_1$	SD1	Rmk	$\bar{x}_2$	SD2	Rmk
1.	Testing of contacts with multimeter	3.06	0.68	VHE	3.37	0.65	HE
2.	Use of meter to select circuit breakers	3.11	0.99	V HE	3.49	0.70	HE
3.	Fixing of contactors with din-rail	3.29	0.85	VHE	3.57	0.60	HE
4.	Tagging of cables numbers	3.21	0.79	VHE	3.86	0.38	HE
5.	Timing of contactor with screw driver	3.39	0.79	HE	3.76	0.42	HE
6.	Fixing of lamps with hole-cutter	3.00	0.83	VHE	3.31	0.83	VHE
7.	Fixing of control Cables with tester	3.15	0.84	HE	3.37	0.63	HE
8.	Connection of Control circuit with screw drivers	2.93	0.85	VHE	3.29	0.80	HE
9.	Use of tester to measure current in contactor	3.27	0.73	LE	3.41	0.60	HE
10.	Removing of insulation with cable striper	3.00	0.72	HE	3.05	0.60	HE
11.	Use of lugging tool in motor connection	3.05	0.89	VHE	3.65	0.55	HE
12.	Terminating contacts with allen key	3.20	0.43	VHE	3.53	0.29	HE
13.	Setting of contactors with filler guage	3.38	0.79	HE	3.21	0.64	LE
14.	Use of tester to test coil	3.31	0.71	HE	3.34	0.72	HE
15.	Clamp tester for in-rush current	3.37	0.92	VHE	2.85	0.76	HE
16.	Brush for cleaning contactor terminal	3.29	0.73	HE	2.75	0.66	HE
17.	Using clamp meter to check current	3.15	0.90	HE	3.57	0.57	HE
18.	Using screw driver to fix motor panel	3.42	0.78	LE	3.59	0.53	LE
19.	Using multimeter to check timers	3.39	0.85	HE	3.50	0.50	HE
20.	Interpreting of electrical drawing	3.21	0.80	HE	3.64	0.66	VHE
Grand Mean		3.21	0.78		3.40	0.60	

Data presented in Table 2 revealed that the electrical and electronic teachers had mean ranging from 2.93 to 3.42, while the industrial technicians had mean ranging from 2.75 to 3.86.

Since the mean value are above the cut-off point of 2.50, it clearly indicates that both respondents accepted that tools are highly needed in the teaching and learning of direct-on-line starter as in preparing technical college graduates for employment. In essence, the electrical electronic teachers had standard deviation ranging from 0.08 to 0.99, while the industrial technicians had the standard deviation ranging from 0.29 to 0.83 which revealed that the respondent's opinions were similar.

HO₁: There is no significance difference in the mean rating of electrical electronic work teachers and industrial technicians on the extent of tools utilization in the teaching of direct-on-line starter in technical colleges in delta state

Table 3. T-test analysis on the extent of tools utilization in the teaching of direct-on-line starter in technical colleges in Delta State.

Group	N	Mean	SD	p-vl	Df	t-cal	t-crit	Remark
Teachers	27	3.23	0.82	0.05	214	1.25	1.69	no sign
Industrial technicians	9	3.48	0.65					

Result in Table 3 revealed that t-cal (1.25) is less than t-crit (1.69) which indicates that the hypothesis stated above was highly needed in the teaching and learning of direct-on-line starter in technical colleges in Delta State. Therefore, there is no significant difference in the mean rating of electrical electronic teachers and industrial technicians on the extent of tools utilization in the teaching of direct-on-line starter in technical colleges in Delta State.

HO₂: There is no significance difference in the mean rating of Electrical electronic work teachers and industrial technicians on the extent of tools utilization in the teaching of star/delta starter in technical colleges in Delta State.

Table 4: T-test analysis on the extent of tools utilization in the teaching of Star/Delta starter in technical colleges in Delta State

Group	N	Mean	SD	p-vl	Df	t-cal	t-crit	Remark
Teachers	27	3.21	0.79	0.05	214	1.23	1.66	no sign.
Industrial Technicians	9		3.40					

Result in Table 4, revealed that t-cal (1.23) is less than t-crit (1.66) which indicates that the hypothesis stated above was highly required in the teaching and learning of star/delta starter in technical colleges in Delta State. Therefore, there is no significant difference in the mean rating of electrical electronic teachers and industrial technicians on the extent of tools utilization in the teaching of star/delta starter in technical colleges in Delta State.

Discussions

Data presented in Table 1, revealed that the electrical electronic teachers had mean ranging from 2.92 to 3.48, while the industrial technicians had the mean ranging from 2.76 to 3.82. In essence, the standard deviation for electrical electronic teachers ranged from 0.07 to 1.01, while the standard deviation of industrial technicians ranged from 0.29 to 0.94 which revealed that the respondents were similar in their opinions. However, Table 1 shown also that

both the teachers and industrial technicians highly supported that tools are highly needed in the teaching and learning of direct-on-line and star/delta starters which will help to impact more knowledge and prepares individuals for employments. These findings are in agreement with NBTE (2011), which opined that technical college students upon graduation should be able to set up their own work place and also be employed in the industries as technicians.

Results in Table 3, revealed that $t\text{-cal}$ (1.25) is less than $t\text{-crit}$ (1.69) which shown that the hypothesis was highly extent accepted. Therefore, there is no significant difference in the mean ratings of electrical electronic teachers and industrial technicians on the extent of tools utilization in the teaching of direct-on-line starter, which proved that technical college graduates will be fit for industrial opportunities or be self-employed in Delta state.

Data presented in Table 2 revealed that the electrical electronic teachers had mean ranging from 2.93 to 3.42, while the industrial technicians had the mean ranging from 2.75 to 3.86. In essence, the standard deviation for electrical electronic teachers ranged from 0.29 to 0.89, while the standard deviation of industrial technicians ranged from 0.29 to 0.94 which revealed that the respondents were close in their opinions. However, Table 2 shown also that, both the teachers and industrial technicians highly supported the use of tools in the teaching and learning of direct-on-line and star/delta starters. This helped to elevates individual's skill and knowledge and also prepare them for employments.

These findings are in agreement with NBTE (2011), which opined that technical college graduates should be able to work on both direct-on-line and star/delta starters confidently and be employed in the industries as technicians. Results in Table 4, revealed that $t\text{-cal}$ (1.23) is less than $t\text{-crit}$ (1.66) which shown that the hypothesis was highly accepted.

Therefore, there is no significant difference in the mean ratings of electrical electronic teachers and industrial technicians on the extent of tools utilization in the teaching of direct-on-line starter and the functions of tools, which proved that graduates from technical college are fit for industrial opportunities or be self-employed in Delta State.

Conclusion

The study conducted on the extent of utilization of tools in the teaching and learning of direct-on-line and star/delta starters in technical colleges in Delta state. Data analyzed and tested revealed that adequate knowledge of contactor logics, overload relay and start/stop push buttons are very crucial for industrial employment. The ability to work in the industry as technicians requires the wiring knowledge of electric motor starters. This clearly indicates that technical college graduates need to be prepared practically for employability

Recommendations

1. Government agency and private school owners should organize seminars and workshops regularly for industrial exposures
2. Technical college teachers should be trained and re-trained to enable them inculcate the required skills and knowledge to students
3. Adequate provision of electricity should be made available by the Government for sustainability.



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