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Relative Effectiveness of Demonstration and Project-Based Teaching Methods in Developing Students' Psychomotor Skill and Interest in Electrical Installation and Maintenance Work

J. I. Ezenwafor
Professor, Department of Technology and Vocational Education
Nnamdi Azikiwe University Awka Anambra State Nigeria
K. R. E. Okoye
Professor, Department of Technology and Vocational Education,
Nnamdi Azikiwe University Awka Anambra State Nigeria
C.O.C OBI
Lecturer, Department of Electrical/Electronics Technology Education,
Federal College of Education (Technical), Umunze, Anambra State Nigeria

Abstract:
The need to equip technical education students with psychomotor skills for gainful employment on graduation necessitated the study to determine the relative effectiveness of demonstration and project-based teaching methods in developing students' psychomotor skill and interest in electrical installation and maintenance work in technical colleges in Anambra State. Two research questions and two null hypotheses guided the study. The quasi-experimental, specifically, pre-test, post-test non-equivalent research design was adopted for the study. Population comprised 343 National Technical Certificate 11 (NTC) students offering electrical installation and maintenance work in the twelve technical colleges in Anambra State. Purposive sampling technique was used to select a sample size of 80 students from two colleges based on schools that have good number of male and female students. Psychomotor Skill Performance Test in Electrical Installation and Maintenance Work (PSPTEIMW) and Interest Inventory Scale on Electrical Installation and Maintenance (IISEIMW) were used to collect data for the study. The PSPTEIMW has been validated by test developers in the National Business and Technical Examination Board while IISEIMW was face validated by experts in the field of technical education. A pilot study was used to establish the reliability of the instruments by administering them to 30 NTC II students of government technical college Okporo, Orlu in Imo state who were not part of the population of the study. Internal consistency of the instruments was determined using Cronbach Alpha technique and reliability coefficient values of 0.82 and 0.80 respectively were obtained. Data collected from the study were analyzed using arithmetic mean to answer the research questions while the hypotheses were tested using analysis of covariance (ANCOVA) at 0.05 level of significance. The findings revealed that the two methods improved students' psychomotor skill development and interest in electrical installation and maintenance work but project-based teaching method was slightly more effective. There was significant difference in the psychomotor skill development and interest scores of students based on the teaching methods. Based on the findings of the study, it was concluded that use of demonstration and project-based teaching methods by technical teachers will lead to an improvement in students' psychomotor skill development and interest in the trade. It was, therefore, recommended among others that technical teachers should adopt the two methods but use project-based teaching method to enhance students' psychomotor skills development in relevant trades to equip them for gainful employment on graduation.

Keywords: *Technical education, psychomotor skill, electrical/electronic, electrical installation and maintenance work, demonstration, project-based*

1. Introduction

Technical education as a multifaceted, multi-disciplinary and pragmatic field of study is aimed at equipping individuals with requisite skills which will enhance their relevance and functionality in the society (Eze, 2010). Vocational and technical education is aimed at developing not only practical skills, but desirable work habits and attitudes that make the recipient very creative and resourceful. Furthermore, practical skill acquisition entails accumulation of different competencies and abilities that enhance task performance through integration of both theoretical and practical forms of knowledge. It makes provision for adequate training of trainee for self-employment using practical activities to enhance psychomotor skill development and practice in a conducive environment.

Psychomotor skills are those capabilities involved in a task or various tasks that learners are expected to acquire as a result of persistent practice (Ayonmike, 2014). More so, psychomotor skills are those skills or special abilities required by a learner in human activities which can be acquired through learning and constant practice. Additionally, Ayonmike stated that principles that guide psychomotor skill development are necessary in the education process for it to contribute to the development of a nation through effective human capital development to meet employment requirements. Supporting this view, Eze (2010) asserted that psychomotor skill development begins with practice in schools, adding that employment opportunities await graduates who possess relevant skills. However, it is common knowledge that many graduates of Nigerian educational institutions sometime lack psychomotor skills relevant for gainful employment in industries. This could be attributed to the methods of instructional delivery by teachers in technical colleges and technical programmes of colleges of education and universities.

Technical education at all levels of the education system emphasizes acquisition of psychomotor skills. Uwaifo (2010) viewed technical education as education and training which encompasses knowledge, skills, competencies and structural experiences for securing jobs in various sectors of the economy and even enabling an individual to become self-dependent by being a job creator. The author further stressed that if technical education instruction is delivered appropriately to facilitate acquisition of psychomotor skills, individuals could explore their environment and harness the resources which could serve them and create wealth for the society. In view of this, Dokubo and Dokubo (2013) asserted that psychomotor skill is the major distinguishing aspect of technical education which makes it outstanding from liberal arts. The authors further stressed that in teaching technical trades (electrical installation and maintenance work inclusive) instructors should adopt teaching methods which can increase interest and motivate students to improve on their academic achievement. Supporting Dukubo, et al, Okoye, (2016) explained that teaching methods employed in electrical/ electronics should be to match the programme objectives.

Electrical/Electronic is an option in technical education programme and it is one of the trades in technical colleges which provide students the necessary skills to be self-reliant economically. The option covers electrical installation and maintenance work, appliance and repairs as well as radio and television services, including general electronic work (NBTE, 2013; UNESCO, 2016). Electrical/Electronic students of technical colleges are expected to secure employment either on completion of the entire programme or after completing one or more modules. It is also expected that they should be able to set up their own businesses, become self-employed and able to employ others (FGN, 2014). To fully achieve the objectives of the programme as highlighted above, teachers should adopt effective instructional methods to adequately equip students to be self-reliant and thus reduce unemployment and poverty. In furtherance, Okoye (2016) affirmed that electrical/electronic option of the technical education programme should equip students with salable skills and competencies to enhance their development of self-reliance initiatives.

In technical colleges, electrical installation and maintenance work is a trade in electrical/electronic option and provides learners with practical skills and knowledge required for effective electrical/electronic technicians. Such persons are needed for employment in organizations like Electricity Distribution Company (EDC), manufacturing, mining, oil and gas industries. Electrical installation and maintenance work comprise three modules namely; domestic and industrial installation, cable jointing and battery charging and winding of electrical machine, (NABTEB 2010). Additionally, graduates of this programme are expected to develop psychomotor skills in installing, operating, maintaining and repairing of electrically energized systems such as residential, commercial and industrial building. Electrical installation and maintenance work ought to be taught effectively, as anything less would not only wreak havoc to the lives of electricity users but will also worsen unemployment and poverty to the trainees (Ogbuanya and Akinduro, 2017). The authors affirmed that students can only be proficient in handling the above stated tasks in installation when teachers employ appropriate teaching methods.

Regarding the issue of appropriate teaching methods in technical colleges, Okoye (2016) asserted that since technical education programme is skill-based, teaching methods should be able to facilitate psychomotor skill in order to develop the capability and capacity of the individual to design, produce and use technological products and systems as well as assess the appropriateness of technological action. Consequently, Okoye emphasized that there should be adjustment in the programme of technical colleges. In the same vein, Eze and Osuyi (2018) asserted that adjustment in technical education programme will affect the curricular implementation processes which are prosecuted through different learning experiences and contents. Similarly, FGN (2014) recommended that modern educational instructional methods should be increasingly used and improved upon at all levels of education system.

Additionally, the implication of the recommendation of FGN (2014) is that educators must be in constant search of teaching methods and techniques that could improve their practice, encourage learners to participate actively in the learning process and adapt more perfectly to a particular classroom situation geared towards meeting the societal and industrial needs. Several teaching methods have been documented as being effective in teaching psychomotor skills, improving students' performance and interest in technical education programmes especially electrical installation and maintenance work. These methods include discussion, demonstration, guided discovery, project-based methods, problem-solving, and field trips among others. While many instructors are aware of the existence of these instructional methods and techniques, most technical teachers simply opt to utilize the conventional (chalk-talk) method.

Demonstration method is a teaching technique that combines oral explanation with "doing" to communicate processes, concepts and facts. It is particularly effective in teaching a skill that can be observed. Demonstration in this study will involve the teacher and student (teacher-student demonstration performance). This is because the technical teacher is expected to demonstrate the skill to the students and observe them display what they have learnt. Demonstration method of teaching allows students to make use of all their senses- sight, smell, taste, hearing and touch

(Omeje and Onaga, 2015). Students learn physical or mental skills by actually performing those skills under supervision (Edu, Ayang, Idaka, 2012) However, Edu stated that in using demonstration teaching method, giving students assignments/projects is inevitable for their better acquisition of needed skills.

Project-based method of teaching is one of the instructional methods used by technical instructors as it enables students' participation. According to Omeje and Onaga (2015), project-based teaching method involves units of activities carried out by the students in a spirit of purpose to accomplish a defined, attractive and seemingly attained predetermined goals based on their background knowledge and experience. The authors further explained that project-based teaching method is like assignment method in which a task is given to students or a number of tasks are shared to students to carry out practical's allowing a great deal of students involvement right from the planning stage, the sketching of the project, the steps of executing it, the tools, equipment and materials to be used in the project. This will enable students to conceptualize the content and put the task into practice repeatedly in order to improve their psychomotor skill development and interest for the benefit of the society.

Researchers such as Omeje, (2011), Edu, Ayang, Idaka, (2012), Udofia, Udofia, (2013) Ayonmike, (2011), and Amaechi, Thoman (2016) recommended that demonstration and project-based teaching methods could be effective methods for teaching psychomotor skill in technical education because they encourage active participation of students in the teaching and learning process and as well enhance their psychomotor skill development and interest. It is therefore, necessary also to investigate the relative effectiveness of demonstration and project-based teaching methods in developing students psychomotor skill in electrical installation and maintenance work because when students understand the principles of a subject, they can construct knowledge of the subject, retain the knowledge and apply it practically in given situations.

1.1. Statement of the Problem

Skill development in different trades is critical for sustainable economic growth. Psychomotor skills and interest in the study of electrical installation and maintenance work among students in technical colleges have been dwindling over the years. Hassan and Babawuro (2013) reported that most of the products of vocational and technical education programmes in tertiary institutions in Nigeria are half-baked as they lack psychomotor skills and therefore are unable to function effectively in the world of work after schooling. This ugly trend could be attributed to instructional method used by teachers since the use of instructional methods that match the programme objectives of technical education will increase students' interest in the study as well as quip and empower them with skills to fit into jobs in the society. This is why they are unable to exhibit the technical skills required to become self-dependent after their training especially as they lack clear understanding of the theories and principles of electrical installation and maintenance work. The goal of electrical installation and maintenance work in technical colleges is to produce skilled craftsmen with good knowledge of working principle of domestic and industrial installation and safety practices involved in its maintenance. This could be as a result of the instructional methods adopted by the teachers among other causes.

The problem of this study is that the performance in theory and principles of electrical installation and maintenance work of students in technical colleges in psychomotor skill test in NABTEB examinations has consistently been poor in recent times. Although such other factors like parental and societal influence can be implicated for the ugly trend, instructional methods used by teachers could be a key factor (Eze and Osuyi, 2018). The instructional methods used in technical colleges may have neglected the psychomotor development which is the main focus of technical education programme. It becomes necessary to ascertain other methods of instruction that will sufficiently equip technical college students with psychomotor skills for excellent performance after leaving school. This prompted the study on the relative effectiveness of demonstration and project-based teaching methods in developing students' psychomotor skill and interest in electrical installation and maintenance work in technical colleges in Anambra State to provide relevant stakeholders empirical for objective remedial actions.

1.2. Research Questions

- What is the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?
- What is the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

1.3. Null Hypotheses

- There is no significant difference in the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
- There is no significant difference in the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

2. Method

Quasi experimental design was adopted for the study, specifically pre-test, post-test, non-equivalent control no randomization. This design was adopted because it is not possible for the researchers to randomly sample the subjects and assign them to groups without disrupting the academic progrmme and time table of the technical college involve in the

study. The study was carried out in Anambra State of the south- Eastern geopolitical zone of Nigeria. Population of the study was 343 National Technical Certificate11 (NTC11) electrical installation and maintenance work students (235 males and 108 females) of 2018/2019 session in electrical installation and maintenance work in all the twelve technical colleges in Anambra State. A purposive sampling technique was used to select two intact classes of 80 (50 males and 30 females) NTC11 students in electrical installation and maintenance work from two technical colleges for the study. The two technical colleges were selected based on the number of male and female students and availability of facilities for practical activities. Toss of a coin was used to assign one intact class to experimental group 1 (demonstration teaching method) and the other to experimental group 2 Purposive sampling technique was used to select a sample size of 80 students. Instruments for data collection were the Psychomotor Skill Performance Test in Electrical Installation and Maintenance Work (PSPTEIMW) and Interest Inventory Scale in Electrical Installation and Maintenance Work (IISEIMW). The instruments were validated by three experts (two from Technology and Vocational Education Department and one from Measurement and Evaluation Unit of Educational Foundation Department), all in Nnamdi Azikiwe University Awka. The reliability coefficient of PSPTEIMW and IISEIMW were established using Cronbach Alpha and the reliability coefficient value of 0.82 and 0.80 were obtained respectively. Arithmetic mean and standard deviation were used to analyze data relating to the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.

3. Results

3.1. Research Question 1

What is the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

Teaching Method	Pre-test			Post-test		Mean Gain
	Mean		SD	Mean	SD	
Demonstration Teaching	42	7.15	2.33	12.4	3.14	5.25
Project-based Teaching	38	7.77	2.24	17.2	2.61	9.42

Table1: Mean and Standard Deviation of Academic Achievement Mean Scores of Psychomotor Skills of Students Taught Using Demonstration Teaching Method and Those Taught Using Project-Based Teaching Method

Table 1 shows that pre-test and post-test academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method were 7.15 and 12.40 with mean gain of 5.25. Those taught with project-based teaching method had 7.77 and 17.20 with mean gain of 9.42 However, for each of the groups, the post-test means were greater than the pre-test means with the group taught using project-based teaching method having a higher mean gain. This shows that project-based teaching method has more effect on students' psychomotor development skill in electrical installation and maintenance work than demonstration teaching method.

3.2. Research Question 2

What is the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

Teaching Method	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Demonstration Teaching method	42	2.75	.98	3.62	.376	0.87
Project-based Teaching method	38	2.62	.89	3.68	.355	1.06

Table 2: Mean and Standard Deviation of Interest Mean Scores of Students Taught Using Demonstration Teaching Method and of Those Taught Using Project-Based Teaching Method

Table 2 shows the pre-test and post-test interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method were 2.75 and 3.62 with mean gain of 0.87. Those taught with project-based teaching method had 2.62 and 3.68 with mean gain of 1.06. However, for each of the groups, the post-test means were greater than the pre-test means. This shows that both teaching methods have relative effects on students' interest in electrical installation and maintenance work.

3.3. Null Hypotheses 1

There is no significant difference in the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

Source of Variation	Sum of Squares	Df	Mean Square	F	Sign.
Corrected Model	4.72726	2	236.138	28.387	.000
Intercept	1736.664	1	1737.664	208.771	.000
Pre-test	11.476	1	11.476	1.380	.244
Method	472.099	1	472.099	56.753	.000
Error	640.524	77	8.318		
Total	18636.000	80			
Corrected Total	112.800	79			

Table 3: Summary of Analysis of Covariance (ANCOVA) of Academic Achievement Mean Scores of Psychomotor Skills of Students Taught with Demonstration and Those Taught Using Project-Based Teaching Methods

Table 3 shows the probability value associated with the calculated value of F (56.753) is 0.000. Since this value 0.000 is less than the 0.05 level of significance, the null hypothesis is rejected. It means that there is significant difference in the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method. The null hypothesis was, therefore, rejected. However, the direction of the difference is in favour of the project-based teaching method which had a higher post-test mean achievement score as shown in Table 1.

3.4. Hypothesis 2

There is no significant difference in the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and that of those taught using project-based teaching method

Source of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	.358	2	179	1.342	.265
Intercept	189.607	1	189.607	1.4213	.000
Pre-test	.226	1	.226	1.694	.195
Group	.156	1	.156	1.171	.281
Error	18.278	137	.133		
Total	1891.278	140			
Corrected Total	18.636	139			

Table 4: Summary of Analysis of Covariance of Interest Mean Scores of Students Taught Using Demonstration and Those Taught Using Project-Based Teaching Method

Table 4 shows the probability value associated with the calculated value of F (1.171) is 0.281. Since this value 0.281 is greater than the 0.05 level of significance, the null hypothesis is accepted. It means that there are no significant differences in the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method. This means that both demonstration and project-based promotes students' interest as shown in table 2.

4. Discussion and Findings

Findings of the study indicate that project-based teaching method is more effective in developing students' psychomotor skills in electrical installation and maintenance work in technical colleges in Anambra State than demonstration teaching method. This finding is in line with that of Omeje (2011) that project-based teaching method enhanced the academic achievement, interest and retention of low ability students in carpentry and joinery in technical colleges. This superiority of project-based teaching method over demonstration could be due to the interaction among students which enabled them to gain competence in psychomotor skill during the treatment. The finding also agrees with that of Udofia and Udofia (2013) which showed that technical college students taught electrical installation and maintenance work using project-based teaching method showed evidence of greater performance in skill acquisition than those exposed to e-learning. Udofia and Udofia suggested that this could be due to the social interaction and friendliness that project-based teaching method provides for the students. Similarly, the probability value associated with calculated F-value was less than the significance level of 0.05 which indicates that there was significant difference in the relative effectiveness of demonstration and project-based teaching methods in psychomotor development skills of students in electrical installation and maintenance work in favour of the project-based teaching method.

Furthermore, findings of the study show that demonstration and project-based teaching methods promote students' interest in electrical installation and maintenance work but the latter is slightly more effective. This finding agrees with Okoro (2013) who conducted a study on the effect of project-based teaching method on secondary school students' academic achievement, interest and retention in home economics in Enugu State and found that the method

improved students' achievement and interest in the field of study. This could be as a result of the fact that the method facilitates active participation of students in the teaching-learning process which improved their level of skill development and interest in the subjects. This is understandable because demonstration and project-based teaching methods encourage students to be deeply involved in different activities in the teaching-learning process which enhances their interest in the study or subject matter. Similarly, the probability value associated with calculated F-value is greater than the significance level of 0.05 which indicates that there was no significant difference in the relative effectiveness of demonstration and project-based teaching methods on students' interest in electrical installation and maintenance work in technical colleges in Anambra State.

5. Conclusion

Based on the findings of the study, it was concluded that the use of demonstration and project-based teaching methods for electrical installation and maintenance work by technical teachers in technical colleges will lead to an improvement in students' psychomotor skill development and interest in the trade.

6. Recommendation

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

- Teachers in technical colleges should use project-based teaching method more in order to facilitate development of psychomotor skills in learners and equip them for gainful employment on graduation as employees or self-employed and employers of labour in their respective trades.
- Management of technical colleges should provide relevant facilities to enable teachers effectively use project-based and demonstration teaching methods in order to develop students' psychomotor skills and interest in their trades.
- Management of higher education institutions that train technical teachers should ensure that lecturers adequately expose students to different methods of teaching practical skills so they can use them effectively in employment for the benefit of their students.

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