USE OF ELECTRICAL WIRING BOARD IN IMPROVING THEACADEMIC PERFORMANCE OF GRADE 8 IN ELECTRICAL INSTALLATION AND MAINTENANCE

LARRY DINU SOMERA

Modified Title: Use of an Electrical Wiring Board to Improve the Academic Performance of Grade 8 Students in Electrical Installation and Maintenance

---

Abstract

This study determined the effectiveness of a teacher-developed electrical wiring board (circuit trainer) in improving the academic performance of Grade 8 students in Electrical Installation and Maintenance (EIM) at Dupax Del Sur National High School. Specifically, it compared the academic performance of students taught using the electrical wiring board with those taught through the conventional method of instruction. The study employed a quantitative approach using a quasi-experimental pretest–posttest control group design involving 60 Grade 8 students randomly assigned to either the control or experimental group. A researcher-developed and validated 75-item achievement test was administered before and after the intervention to measure students' learning outcomes. Data were analyzed using mean, standard deviation, independent samples t-test, and paired samples t-test at the 0.05 level of significance. Results revealed that both groups initially demonstrated low mastery of EIM competencies, with no significant difference in their pretest scores. Following the intervention, both groups improved to an average level of mastery; however, the experimental group obtained significantly higher posttest scores than the control group. Significant learning gains were likewise observed between the pretest and posttest scores of both groups, with greater improvement recorded among students exposed to the electrical wiring board. The findings demonstrate that the use of the electrical wiring board is an effective instructional innovation that enhances students' academic performance, promotes hands-on learning, and improves the mastery of practical competencies in Electrical Installation and Maintenance.

Keywords: electrical wiring board, circuit trainer, Electrical Installation and Maintenance (EIM), academic performance, Grade 8 students, instructional innovation, hands-on learning, Technology and Livelihood Education, quasi-experimental design, technical-vocational education

Introduction

During the past four years of teaching at Dupax Del Sur National High School, the researcher encountered numerous challenges, including adapting to new systems, instructional materials, and teaching strategies, as well as gaining an understanding of classroom structure and regimentation through professional experience. Among these challenges, identifying appropriate instructional materials that effectively facilitate teaching and learning in the classroom proved to be the most difficult. Through a process of trial and error, the researcher gradually developed strategies to enhance classroom management, minimize disruptions, and improve student engagement. These experiences led to the development of an instructional innovation known as the **Electrical Wiring Board**, also called a **Circuit Trainer**.

The Philippine government, through the establishment of the **Technical Education and Skills Development Authority (TESDA)**, has prioritized workforce development as a key driver of economic growth. TESDA plays a significant role in advancing **Technical Vocational Education and Training (TVET)** by encouraging research-based innovations that improve instructional delivery. Research findings and recommendations serve as foundations for policy formulation aimed at enhancing students' academic performance while developing competent, productive, and globally competitive workers (TESDA, 2010).

In support of this mandate, TESDA formulated the **National Technical Education and Skills Development Plan (NTESDP)**, which envisions a vibrant and high-quality TVET system that promotes decent work and sustainable inclusive growth. The plan is guided by three strategic thrusts: **TVET for Global Competitiveness and Workforce Readiness**, **TVET for Social Equity and Workforce Inclusion**, and **TVET for Poverty Reduction** (TESDA, 2010).

The first thrust, TVET for Global Competitiveness, emphasizes the development of skills, knowledge, and technologies essential for industrial productivity. Productivity is widely recognized as a cornerstone of sustainable economic development and wealth generation (TESDA, 2011). To remain globally competitive, TVET institutions must adopt internationally recognized standards, continuously integrate emerging technologies and innovations, align training programs with industry demands, and strengthen partnerships between public and private sectors. These efforts aim to equip learners with adaptable and industry-relevant skills responsive to technological advancements (TESDA, 2011).

Global competitiveness has become increasingly urgent due to trade liberalization and investment facilitation, which allow the free movement of goods, services, and labor across national borders. In response, TESDA promotes structured training delivery systems implemented through schools, training centers, and enterprises. These systems cater to wage and self-employed workers, future industry practitioners, educators, vocational and higher education graduates, and workers in emerging industries. Core initiatives include competency standards development, training regulation, program accreditation, competency assessment and certification, scholarship programs, skills competitions, and the establishment of centers of excellence.

The second thrust, TVET for Social Equity, underscores inclusive workforce development by addressing the needs of marginalized sectors, such as informal workers, farmers, fisherfolk, indigenous peoples, overseas Filipino workers, women, persons with disabilities, and other socially disadvantaged groups. From 2018 to 2022, TESDA identified three key employment generators: rapidly growing industries such as tourism, construction, and transportation; traditional sectors with large employment bases but slow growth such as agriculture and manufacturing; and high-growth service industries including health, wellness, and social services.

Despite these initiatives, TESDA identified several challenges confronting the TVET sector. These include rapid technological advancements associated with the **Fourth Industrial Revolution (4IR)**, evolving workforce competency requirements, and the persistent issue of low employability among some TVET graduates. Additionally, the country faces a significant labor outflow, with millions of skilled Filipino workers employed overseas, resulting in a depletion of highly skilled labor domestically (TESDA, 2013). To address these challenges, TESDA established five strategic objectives focused on improving skills development, employability, innovation, and workforce competitiveness.

TESDA emphasizes the need for research-driven, innovative, and adaptive instructional strategies to prepare learners for the demands of the modern labor market. As highlighted by TESDA Deputy Director General Rosanna Urdaneta, academic institutions, researchers, employers, and government agencies must collaborate to ensure global competitiveness. Research findings and recommendations are encouraged to inform policies and strengthen TVET delivery systems nationwide.

Similarly, the **Asia-Pacific Economic Cooperation (APEC)** recognizes that human capital is a critical resource for economic growth. APEC has expressed concern over the mismatch between industry skill requirements and the competencies produced by educational institutions. Studies conducted by APEC highlight the importance of aligning education and training programs with global industry standards to address skills shortages and workforce gaps.

At the school level, **Technology and Livelihood Education (TLE)** plays a crucial role in preparing learners for career pathways by equipping them with practical knowledge, skills, work values, and problem-solving abilities, particularly in the field of Industrial Arts. The effective implementation of the **K to 12 Basic Education Curriculum** further emphasizes the development of 21st-century skills through relevant, experiential, and skills-based learning. However, the successful delivery of these objectives depends largely on the availability of appropriate instructional materials, tools, and equipment.

The researcher, currently employed as a **Teacher III** specializing in **Electrical Installation and Maintenance (EIM)**, has taught the subject for over ten years. Throughout this period, the researcher observed persistent difficulties in teaching practical skills due to the lack of adequate instructional materials. In response, the researcher designed and developed a **teacher-constructed electrical circuit trainer** to enhance instruction and assess its effectiveness in improving the academic performance of Grade 8 students at Dupax Del Sur National High School.

The electrical circuit trainer consists of a movable instructional board measuring approximately 198 centimeters in height and 87 centimeters in width. It includes multiple circuit panels equipped with light-emitting diode (LED) bulbs, a fluorescent lamp, single-pole switches, three-way switches, and convenience outlets. This equipment allows students to perform hands-on activities simulating real-life electrical installations.

The use of the electrical circuit trainer provides meaningful opportunities for experiential learning, supplementing traditional teaching methods such as board-and-chalk instruction. It enhances students' knowledge, skills, and attitudes by promoting active engagement, practical application, and skill mastery. Ultimately, this instructional innovation supports the development of globally competitive, skilled, and productive learners aligned with the goals of TESDA and the national education system.

Keywords: Electrical Wiring Board; Circuit Trainer; Electrical Installation and Maintenance (EIM); Academic Performance; Grade 8 Students; Technical Vocational Education and Training (TVET); Instructional Materials; Hands-on Learning; Skills Development; Technology and Livelihood Education (TLE)

Methods

Research Design

This study employed a quantitative research approach using a quasi-experimental pretest–posttest control group design. Quantitative research involves the collection and analysis of numerical data to describe, compare, and explain phenomena through statistical procedures. This approach enables objective measurement of students' academic performance and the determination of the effectiveness of instructional interventions.

Two comparable groups—the control group and the experimental group—were utilized. Both groups were administered a pretest in Electrical Installation and Maintenance (EIM) to determine their entry-level competencies. The experimental group was taught using the teacher-constructed electrical wiring board (circuit trainer), while the control group was exposed to the conventional method of teaching. After the intervention, a posttest parallel to the pretest was administered to both groups to measure learning gains.

The research design is illustrated as follows:

R O_1 X O_2

R O_3 O_4

Where:

R – Random assignment

X – Treatment (use of the electrical wiring board)

O_1 – Experimental group pretest

O_2 – Experimental group posttest

O_3 – Control group pretest

O_4 – Control group posttest

Research Method

The study utilized the quasi-experimental method, which allows the examination of cause-and-effect relationships under controlled conditions without full randomization. The independent variable was the use of the electrical wiring board, while the dependent variable was the academic performance of Grade 8 students in EIM.Both groups underwent pretesting to establish comparability. The control group received instruction through the traditional lecture and demonstration method, while the experimental group received instruction through lectures integrated with hands-on activities using the circuit trainer. The intervention was implemented over a specified instructional period.

Considering the educational nature of the study, the level of significance was set at 5%, which is standard in educational and social science research.

Subjects / Respondents of the Study

The respondents of the study consisted of 60 Grade 8 students, representing 85.99% of the total population of 70 students from two sections at Dupax Del Sur National High School. From the first section with 33 students, 30 students (90.90%) were selected, while 30 students (81.08%) were chosen from the second section with 37 students.

Respondents were selected based on their most recent achievement test results to ensure comparable entry-level performance. Using the fishbowl technique, 30 students were randomly assigned to the control group and 30 to the experimental group. A lottery method determined group assignment.

Table 1. Frequency and Percentage Distribution of Respondents

Group	Population	Sample	Percentage
Control	33	30	90.90%
Experimental	37	30	81.08%
Total	70	60	85.99%

Research Instruments

Electrical Installation and Maintenance Achievement Test

The primary data-gathering instrument was a researcher-developed 75-item multiple-choice test based on the K to 12 EIM Curriculum Guide. The distribution of test items reflected the relative importance of each competency area as specified in the curriculum.

The test instrument underwent face and content validation by five external experts and three panelists in Industrial Technology Education from both secondary and tertiary institutions. The validators assessed clarity, content relevance, appropriateness of language, and alignment with learning objectives.

Pretest

The pretest consisted of 75 multiple-choice items covering selected EIM competencies and was administered before the experimental intervention to determine baseline knowledge and skills.

Posttest

The posttest consisted of 75 parallel items paraphrased from the pretest and was administered after the intervention to assess learning gains.
Electrical Wiring Board (Circuit Trainer)
The electrical wiring board was designed and constructed by the researcher in accordance with the EIM curriculum. It was used as the primary instructional tool for the experimental group to facilitate hands-on and experiential learning.

Data Gathering Procedure

Permission to conduct the study was secured from the school principal of Dupax Del Sur National High School. After approval, the researcher prepared the table of specifications and developed the research instruments, which were subsequently validated by experts.The respondents were then identified and assigned to either the control or experimental group. Both groups were administered the pretest to determine comparability. Upon establishing similar pretest performance, the experimental intervention was conducted.

The control group was taught using the conventional method of instruction, while the experimental group was taught using the electrical wiring board. After the intervention, the posttest was administered to both groups. The collected data were subjected to statistical analysis to answer the research questions.

Statistical Tools Used

The following statistical tools were employed using Microsoft Excel:

- Mean and Standard Deviation – used to describe students' performance in the pretest and posttest.
- Independent Samples t-test – used to determine the significant difference between the mean scores of the control and experimental groups.
- Paired Samples t-test – used to determine the significant difference between pretest and posttest mean scores within each group.

All statistical analyses were interpreted at the 5% level of significance.

Results

 The pretest results revealed that both the control group (M = 18.64) and the experimental group (M = 19.40) demonstrated low mastery in Electrical Installation and Maintenance (EIM). After the intervention, posttest mean scores increased to 48.50 for the control group and 61.30 for the experimental group, both of which were qualitatively described as average mastery.

 All competency areas were identified as least mastered during the pretest for both groups, with overall mean scores falling within the 15.00–34.999 range categorized by the Department of Education as low mastery. Following instruction, mastery levels in all competencies improved to average, as indicated by the posttest mean scores of both groups.

 Statistical analysis showed no significant difference between the pretest mean scores of the control and experimental groups (t = 0.83), as the computed value was lower than the critical value of 2.002 at the 0.05 level of significance with 58 degrees of freedom.

 A significant difference was found between the posttest mean scores of the control and experimental groups ($t = 5.43$), which exceeded the critical value of 2.002 at the 0.05 level of significance, indicating that the use of the electrical wiring board had a positive effect on students' academic performance.

 A significant improvement was observed between the pretest and posttest mean scores of the control group ($t = 15.81$) and the experimental group ($t = 21.53$). Both computed values were greater than the critical value of 2.04 at the 0.05 level of significance, confirming that learning gains occurred in both groups, with greater improvement in the experimental group.

Discussions

1. The findings revealed that both the control and experimental groups initially demonstrated low mastery in Electrical Installation and Maintenance; however, their posttest performance improved to an average level of mastery after instruction.
2. The least mastered competencies in the pretest for both groups were mensuration and calculation, interpretation of technical drawings and plans, occupational health and safety practices,

maintenance of tools and equipment, and preparation of electrical supplies, materials, and tools. In the posttest, mastery levels in these competencies improved to an average level for both groups.

3. There was no significant difference between the pretest mean scores of the control and experimental groups, indicating that the two groups had comparable entry-level competencies before the intervention.
4. A significant difference was observed between the pretest and posttest mean scores of the experimental group, demonstrating the effectiveness of the electrical wiring board in enhancing students' academic performance.
5. A significant difference was likewise found between the pretest and posttest mean scores of both the control and experimental groups, with the experimental group showing greater learning gains than the control group.
6. Electrical wiring boards or circuit trainers should be designed and utilized to specifically address the least mastered competencies in Electrical Installation and Maintenance.
7. EIM teachers are encouraged to integrate the use of electrical wiring boards or circuit trainers into instruction to improve students' academic performance and to help develop globally

competitive, skilled, and productive learners guided by principles of equity.

8. The electrical wiring board or circuit trainer developed in this study may be patented, reproduced, and adopted by both public and private schools offering EIM programs.
9. School administrators should provide adequate funding and institutional support for the development, acquisition, and use of circuit trainers in EIM subjects.
10. The Department of Education (DepEd) may support teachers and researchers in public and private schools by providing the necessary tools, materials, and resources for the development of circuit trainers and similar instructional innovations.
11. The Technical Education and Skills Development Authority (TESDA) may conduct seminars, in-service trainings, and competency assessments at the division level to enhance teachers' skills in developing and utilizing circuit trainers and other instructional devices.
12. TLE/T.H.E. teachers and future researchers are encouraged to conduct similar studies with larger samples and in different settings to further validate and strengthen the findings of this research.

Part II

Academic Articles