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Development of Instructional Material in Electronic Products Servicing

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Abstract

Developing instructional material is crucial as it provides clear, hands-on guidance that helps learners develop practical skills, and connect theory with real-world applications. This research developed instructional material to improve skill transfer and enhance learning material for servicing electronic products. It employed a combination of descriptive and experimental research methods. The instructional material focused on key skills, such as assembling electronic products, servicing consumer electronics, and working with industrial electronic modules. Results from pre-test and post-test evaluations showed a significant improvement in the performance of those who used the instructional material compared to those who followed traditional methods. The research concludes that instructional materials effectively improve technical skills and understanding, specifically in electronics technology. It is recommended for integration into electronic products assembly and servicing courses, for use in skill development, and as a guide for instructional design. Further research may explore the integration of digital simulations to enhance its role in education and skills training.

Keywords: Instructional Material, Instructional Design, Experimental Research

1. Introduction

The fast growth of technology, especially in electronics and communication, has greatly affected daily life and work. In education, technology makes tasks more manageable and opens new opportunities for improving teaching and learning delivery. Using instructional technology makes lessons more practical, easier to understand, and accessible to more people. As learning becomes more focused on skills, it is important to consider learners, their environment, and the tools that support their growth. This has led to better ways of teaching by combining instructional material, hardware, and software to make learning more effective.

Instructional technology helps create and share information. As technology continues to improve, new learning systems emerge, offering innovative ways to teach and learn. Today, it is used in schools and various industries, reflecting the increasing dependence on technology for teaching. (Walter Dick, et al. 2015) categorized instructional systems into three main functions: identifying the outcomes of the instruction, developing the instruction, and evaluate the effectiveness of the instruction. These functions form the basis for developing successful teaching methods in technology-driven learning environments. To improve the learning experience, it is crucial to promote the use of instructional materials. Tools like manuals, multimedia, and digital resources are essential in supporting quality education. These resources provide clear explanations, hands-on opportunities, and practical knowledge, helping learners better

understand complex topics. Using instructional materials in education creates a more engaging environment and encourages students to become more independent in their learning.

In the Philippines, the government has taken steps to improve technical-vocational education. The Commission on Higher Education (CHED) set standards for the Bachelor of Technical-Vocational Teacher Education (BTVTEd) program, which prepares future teachers for Technology and Livelihood Education (TLE) courses. With the shift to the kindergarten to 12th-grade (K to 12) system, new programs were introduced to meet job market needs, while the Technical Education and Skills Development Authority (TESDA) provides hands-on training, especially in electronics technology. To support theory and practice, laboratory manuals were developed to help learners gain industry-relevant skills.

The global disruption caused by health and weather challenges accelerated the integration of technology in education. Instructional materials and learning management systems became essential, providing a way to continue education remotely. These learning platforms helped maintain student engagement and facilitate learning at home. This shift highlighted the importance of instructional materials in education, especially during crises.

Science and technology are essential for national development and progress in adopting technology, as outlined in the 1987 Philippine Constitution, this study aims to develop instructional material to improve troubleshooting skills in electronics technology. It will evaluate how effective these materials are for learners, particularly in distance learning. The research explores how technology acceptance affects the development of instructional tools to improve students' practical skills in electronics servicing, with the goal of enhancing the quality of education in electronics technology.

2. Objectives of the Study

This study aims to develop instructional material for Bachelor of Technical-Vocational Teacher Education Electronics Technology students in electronic products servicing. Specifically, the researcher sought answers to the following questions:

1. What is the competency level of the students in terms of assembling electronic product, servicing consumer electronic product, and servicing industrial electronic module?
2. What is the instructional design of the instructional material for electronic product servicing?
3. What is the effectiveness of the instructional material for electronic product servicing?

3. Scope of the Study

This study aimed to determine the competency of the Bachelor of Technical-Vocational Teacher Education electronics technology 1st-year students who have no prior experience in electronic products assembly and servicing. Competency covers assembling electronic product, servicing consumer electronic product, and servicing industrial electronic module. The design and content of the instructional material are based on the results of the competency of the respondents. Other allied courses and students who belonged to the electrical courses were not included as respondents of the study. Furthermore, learning management systems and electronic circuit simulators were also delimited in this study.

4. Review of Literature and Related Studies

In an instructional design principle, to design instruction systematically, one must first establish a ratio-

nale for what is to be learned. This instruction requires going back to the primary sources that have given rise to the idea of employing instruction to meet a recognized need. With this information showing the instruction must be undertaken with suitable attention to the conditions under which learning occurs, both external and internal to the learner. As noted in an article by Mariam Aly (2018), the key to a happy lab life is in the manual, wherein a set of guidelines and advice can save time, reassure trainees, and promote a positive lab culture. Electronics technology, like any other discipline of science, is based on experimental and hands-on work and, therefore, usable forms in an integral part of learning.

Educational Technology Laboratory under the Commission on Higher Education Memorandum No. 79 series of 2017, the technology education institution should have access to an educational technology laboratory with appropriate equipment and software as indicated in the course specifications. Furthermore, the same laboratory shall allow preparation, presentation, and viewing of audio-visual materials to support instruction. Also, as noted on the training regulation issued in the Electronic Products Assembly and Servicing National Certificate, it consists of competencies that a person must achieve to assemble electronic products, prepare (PCB) printed circuit board modules, and install and service consumer and industrial electronic products and systems. These competencies are needed by the learner through activities such as demonstration and return demonstration to pass the course. Hence, providing a laboratory manual for these competencies made the tasks easier for educators and learners.

Technology teacher education program equips future educators to be globally competent and committed in their areas of expertise. Therefore, graduates in this discipline are considered to have satisfied the Technical Education and Skills Development Authority (TESDA) competency standards. With this information presented, there is a need to conduct a study on the competency aligned with the training regulations. Hence, enhancement programs should be implemented to improve the students' and teachers' skills. Moreover, it motivates researchers to develop and validate instructional material in electronics technology in accordance with the competency requirement. As noted by the Commission on Higher Education, the program equips individuals with the knowledge, industry-relevant skills, right attitude, and experience essential for becoming competent technology educators.

Basic instructional modules, like technology, have expanded in importance as a teaching tool. The internet and online learning have progressed in the twenty-first century, causing pedagogical shifts in higher education. One of the key reasons is that there is more access to education in comparison to traditional methods of teaching. In addition, students can learn anywhere, at any time, which is especially beneficial for working and studying part-time. There are three reasons why module education is efficient and effective, according to Issa et al. (1999). It is self-paced learning, which allows students to learn at their own pace; it includes video/audio production, which improves the learner's interaction with the materials; and it provides autonomy in the learning process, which shifts the instructor's regulated sense of responsibility to the students.

A previous study by Aldoobie (2015) investigated the incorporation of educational design wherein step-by-step process used to create effective and engaging learning materials. The study aimed to identify areas for improvement by reviewing how instructional designers should incorporate learning models in lessons, manage classrooms, apply different teaching strategies, and conduct assessments. This study highlights the importance of continuously improving instructional models to help teachers deliver high-quality education while adapting to students' evolving needs using the ADDIE model. It is a procedural method for designing effective instructional materials and training programs. It has five main stages: analysis, design, development, implementation, and evaluation. It is also one of the most common

models in instructional design. Hence, this instructional model is an approach that guides instructional designers, content developers, or even teachers to create an efficient and effective teaching delivery.

In the study of Moreno (2014) focused on checking how skilled National Certificate passers in Western Visayas were. This was done to make sure they met the standards required by industries and companies. The study's findings were also used to help improve training programs in the region. Based on the results, a new training plan was suggested to make the program better and ensure that those who complete it have the right skills for the job market. Moreover, the study of Valladolid (2015), set a progress monitoring of assessment procedures to determine how students benefit from classroom instruction and monitor the curriculum's effectiveness. In addition, this study aimed to develop and validate a set of curriculum-based measurement tools to identify students at risk of reading difficulty. The mentioned study focuses on developing the curriculum and enhancing the students' reading skills. The study is related to the present study as it used instructional material development. Hence, it identifies students' troubleshooting difficulties with electronic devices and provides a laboratory manual practical solution.

The effectiveness and acceptability of the developed trainer of Bermundo (2022) focuses on improving learners to develop skills in audio amplifier servicing, an important part or section in electronic product assembly and repair. Many learners struggle with troubleshooting audio amplifiers due to a lack of hands-on learning materials. To address this, the researcher designed and developed an audio amplifier trainer to simulate basic man-made trouble and service transistorized audio amplifier circuit. The study followed an exploratory sequential approach to evaluate how useful and effective the trainer is as a learning tool. Findings also showed a clear difference in performance between learners who used the trainer and those who did not. This confirms that the instructional trainer is an effective instructional tool for improving technical skills in the field of electronics technology.

The study of Raju (2022) examines the effectiveness of self-instructional for learners without a formal background, including those admitted through an eligibility test. The findings show that the reference group (students with formal education) performed better in three out of five tests, while the experimental group (students using the self-instructional material) performed better in two tests. The study confirms that the developed course content is valid and effective. The study further confirms that the course content developed for the self-instructional program is valid and effective. This is supported by the fact that the learners' post-test scores after using the self-instructional materials were higher than their pre-test scores, demonstrating that the course led to real improvement in their knowledge. This suggests that the course content is well-structured and supports effective learning.

In parallel with the study of Farzana (2023) examined innovative approaches like Content-Based Instruction focuses on improving education and responsive well-interests for Rohingya refugees in Cox's Bazar, Bangladesh. The country hosts refugees, making it the largest shelter site globally. In response, the Bangladesh government, in partnership with UNICEF, launched the Myanmar Curriculum Pilot to provide formal education and skill training. Children and adolescents attend the learning centers, with over 70% supported by UNICEF. However, the study highlights that traditional teaching methods are ineffective in achieving learning goals. It suggests that Content-Based Instruction (CBI) is a more effective approach. The instruction helps learners acquire basic skills by using them in real-world applications, making learning more practical and engaging. Teaching skills through CBI can enhance skill development and resilience among Rohingya refugees, better preparing them for future opportunities.

5. Research Methodology

This study evaluated the effectiveness of instructional material in electronic product servicing for Bachelor of Technical-Vocational Teacher Education Electronics Technology students. It used descriptive and experimental research methods to assess their skills in assembling electronic product, servicing consumer electronic product, and industrial electronic module. Learners were observed while performing tasks, and their performance was measured using a performance rating sheet.

The instructional material was designed based on the learners' competencies, including performance objectives, instructional strategies, and assessment tools. To test its effectiveness, the study compared two groups: one using traditional teaching methods and the other using the developed instructional material. Their skills were assessed in assembling electronic product, servicing consumer electronic product, and industrial electronic module. Percentage technique was used in this evaluation. The results, analyzed through statistical techniques, showed whether the instructional material helped improve learners' competencies.

6. Results and Discussion

Table 1. Competency of Bachelor of Technical-Vocational Teacher Education Electronics Technology Students

Competency	Competent	Not Yet Competent
Assembling Electronic Product	0%	100%
Servicing Consumer Electronic Product	0%	100%
Servicing Industrial Electronic Module	0%	100%

Table 1 shows the competency level of the students, which was assessed in the task observation using the performance rating sheet. It can be gleaned on the table that the respondents were not yet competent in the presented competencies for assembling electronic product, servicing consumer electronic product, and servicing industrial electronic module. During the assembly and servicing, the respondents were considered for up to three (3) attempts to satisfy the requirements. However, the requirement was not met, and due to this performance, they could not perform the remaining task. This implies that they have not yet possessed the skills required to assemble and service electronic product aligned to the training regulations.

In designing the instructional material, the result from Table 1 serves as a crucial reference. Therefore, the instructional design should be aligned and catered to provide skills development along with the following competencies: assembling electronic product, servicing consumer electronic product, and servicing industrial electronic module. Thus, this instructional material follows five steps: analysis, design, development, implementation, and evaluation or so-called ADDIE model. The instructional material includes the course duration, delivery methods, and assessment approaches. Safety rules during laboratory activities are emphasized to ensure a safe learning environment. The main section outlines the objectives and topics of each lesson. The core content of the manual focuses on practical skills like assembling electronic products, repairing systems, and constructing circuits. Self-evaluation tests and

job sheets are included for students to assess their understanding. Also, a Teacher's Manual for teachers or facilitators that guides them on how to deliver the lesson effectively.

Table 2. Effectiveness of the Instructional Material

Competency	**Control Group**		**Experimental Group**		**Competent Rate Difference**
	Competent	Not Yet Competent	Competent	Not Yet Competent	
Assembling Electronic Product	10.77%	89.23%	98.46%	1.54%	87.69%
Servicing Consumer Electronic Product	6.15%	93.85%	76.92%	23.08%	70.77%
Servicing Industrial Electronic Module	6.15%	93.85%	100%	0%	93.85%
Average					**84.10%**

Table 6 shows the result of the test of the difference in performance between the control and experimental groups. The researcher had two groups of respondents, each with thirteen (13) students: the control and experimental groups. In order to determine the rate difference, the rate (percent) of the Competent in the control group was subtracted from the rate (percent) of the Competent in the experimental group. As revealed from the result, the experimental group earned an 84.10% rate difference, implying that learners who fully comprehend and understand a particular task could efficiently perform the activities. Further, the performance of the students taught using the instructional material was significantly higher, and their practical skills in electronic product servicing were effectively improved compared to those of the control group. Hence, the result of the study showed that the instructional material could help students transfer knowledge and skills more easily and was regarded as a teaching resource.

7. Recommendations

To enhance the effectiveness and applicability of the instructional material. First, the electronics technology course should utilize instructional material to improve performance and align with the required skills components. Its structured approach will help reinforce competencies essential for electronics technology students and beginner technicians, thereby increasing proficiency in practical applications. Furthermore, it can serve as a valuable reference in developing instructional designs, contributing to the enhancement of learning materials that improve technical capabilities. Future researchers interested in this field may explore ways to address the instructional material's limitations, particularly in simulation integration, web application, and digital circuit design. Enhancing these

aspects will make the instructional material more adaptable to technological advancements and accessible to a broader range of learners. By implementing these recommendations, it can become a more effective tool in technical education, supporting skill development and innovation in electronic products assembly and servicing courses.

8. Conclusion

Based on the findings, the following conclusions have been drawn regarding the use and effectiveness of the instructional materials. First, first-year Electronics Technology students were assessed as not yet competent, showing that they need helpful materials to support their learning and improve their abilities. The instructional material was well-organized, with clear instructions and easy-to-follow content, making it easier for students to understand the goals and steps for lab activities as it is aligned with the training standard. Also, the instructional material played an important role in helping students improve their skills and perform better, especially for those in the experimental group. The evaluation from respondents further confirmed the effectiveness of the instructional material, which facilitates positive learning transfer and keeps learners engaged in acquiring and refining their technical skills. These findings underscore the importance of continuously enhancing instructional materials to meet the evolving needs of learners and ensure the development of necessary competencies in the field of electronics technology.

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