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INSTRUCTIONAL GUIDE FOR ELECTRONICS TECHNOLOGY INSTRUCTION USING THE FABRICATED TIME VOLTAGE DELAY DEVICE

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Abstract
The study used a pre-post design in order to assess the efficacy of the instructional guide using the fabricated voltage time delay device. Pretests and posttests were conducted to evaluate the performance of the students before and after the discussion and demonstration. The reliability of the pre-test result showed doubt because this was attributed to the prior knowledge of the students. The students were not able to study the topic yet. Right after the pretest, using the device for instruction the result of the reliability of the post-test was 0.75 with the interpretation of good. This means that the test instrument was good for a classroom test, though, there were probably a few items that could be improved. For the test, significance using the t-test the computed value was 3.689 which was bigger compared to the table value at 0.01 and 0.05 levels of significance therefore the decision was significant. This means that the null hypothesis of no significant correlation was rejected. The researcher failed to provide sufficient evidence to accept the null hypothesis that there was no significant correlation between the pretest and posttest given to students using the lesson guide. It was established that the lesson guide using a voltage-time delay device was valuable for electronics instruction. This guide helps the students to understand and fabricate a device that can protect against electrical surges or spikes for the different electronics and electrical-consuming devices. This equipped or enhanced their knowledge and skills in both electronics and electricity they need when they will graduate from their course. Therefore, was safe to recommend the use of the guide for instruction.
Keywords: Lesson Guide, Electronics Technology, Pre-Post design, Voltage Time Delay

Introduction

Instructional guides or instructional material is an essential requirement in the field of the teaching process. Learners' evolutionary aspects need the visual or actual appearance of the things embedded in their growing knowledge of what is vested in the curriculum. Enough instructional guides could provide learners with quality education to develop and maintain the curriculum. A laboratory manual, instructional manual, and modules are the primary materials used in teaching which are provided and created by the teachers with the purpose to develop the needs of the learners. PowerPoint in computers, electronic dictionaries, and traditional visual aids, provides learners to find out their needs and directions as they grow older in a heterogeneous society.

Resources in the instruction are limited due to so many reasons that reflect to the moving quality education. Instructors and professors enhanced the supplies of textbooks to augment the needs of the students which aims for quality education outcomes. Multimedia, computers, and internet resources may be used to support learning for the students and these tools are normally used as support to the curriculum rather than as a planted tool for curriculum implementation. Studies showed that it is easier for designers to process complex ideas with visual prototypes rather than relying on working memory (Cash, StankoviÄ‡, & Štorga, 2014). Several schools do not have adequate funding to purchase those materials to support the needs of the students. Learners in those schools have insufficient choices that can be used to support their learning methods and needs as introduced by the changing curriculum.

Universal Design for Learning (UDL) is a way of thinking about teaching and learning that helps give all students an equal opportunity to succeed. This approach offers flexibility in the ways students access material, engage with it, and show what they know. Developing lesson plans this way helps all learners, but it may be especially helpful for learners with learning and attention issues (Morin, 2018). UDL principles help instructors to create classrooms where learners can use technologies to move beyond being academic observers. These principles give a model for self-actuated learning and universal access for all learners, regardless of students' disabilities or differentiated learning styles and ethnicity, every student needs and have the right to access the provided curriculum and learning environment.

Classroom resources should be planned, providing students with several activities that enhance their multiple knowledge and skills. It is vital to choose materials that help learners' retention of the information presented in the lesson because learning is useless if learners forget what they have learned. Teachers no longer need to compete with digital tools of the current age. Instead, the tools can be used to enhance instruction and promote learning" (Johns, et. al, 2017). However, it contributes differently than other visuals. It allows designers to experience, discuss, and evaluate their ideas in context, and helps designers to understand how the settings in which a design is used can affect its intended use (Smith, 2014).

Technology is a broad concept that deals with the application and knowledge of tools, gadgets, equipment, and crafts and, how it affects the ability to organize and adjust to the changing environment (4HLNET, 2019). In modern civilization, it is important that science and technology are intertwined for development. People's use of technology commences with the conversion of natural resources into simple and complicated tools to substitute the activities made by humans. In society, technology has helped to increase and develop more complex activities in the field of economy that changes the lives of the people.

In Electronics technology there is a need to update instructional materials because of the premise that electronics is a changing and continuing knowledge to which schools should provide enough instructional guides to enhance the learning of the students to produce quality outcome. Wiley and Hilton (2018) stated that once the instructional designer believes they have identified the problems (i.e., they have a new hypothesis about how to better support student learning), new or existing instructional materials and assessments can be created, adapted, or modified. Students can also be powerful partners and collaborators in creating improvements to instructional materials. Technology in the classroom allows students to gain a deeper understanding of topics that interest them, collaborate with each other, and direct their learning (Martin & Bolliger, 2018). Another study found that "the course's level of interpersonal interaction was the most important factor in predicting student grades; students in lowinteraction courses earned nearly one letter grade lower than students in high-interaction courses" (Jaggars, Edgecombe, & Stacey, 2013).

The voltage-time delay device was used for electronics instruction where the performance of the students was improved based on the pretest and post-test scores (Dalaguit, A.B. & Dalaguit, M.L. 2017). It is in this argument that the voltage-time delay device created was used in instruction.

Objectives:

The main purpose of this study is to establish the effectiveness of a lesson guide using a voltage-time delay device for electronics technology instruction, specifically,

1. enhance and develop the skills of the students in electronics which is important for the students as a part of their growing knowledge and skills which is very useful during the time that they enter the field of their specialization.
2. help the students understand the effect of electrical spikes or surges in the different electrical-consuming devices.
3. guide the students in the fabrication of the device.

Materials and Methods

The study used a pre-post design in order to assess the efficacy of the instructional guide using the fabricated voltage time delay device. Pretest and posttests were conducted to evaluate the performance of the students before and after the discussion and demonstration.

Lesson guide

Lesson 1. Functions of the Different Components
Lesson 2. Rectifier and Relay Circuit Fabrication
Lesson 3. Wiring Connection
Lesson 4. Testing the Device

Intended Learning Outcome	Activity	Time
Lesson 1. Functions of the Different Components At the end of the lesson the students must have: **A.** Conceptualized the different part and functions of the components.	A. Conceptualizing the different part and functions of the components	2 hours
Lesson 2. Rectifier and Relay Circuit Fabrication At the end of the lesson the student must have: **A.** Explained the preparation of the Printed	A. 1. Preparing a full-scale foil pattern layout of the circuit as 2" X 3".	

Circuit Board.	2. Cutting the copper-clad board to the desired size with a hacksaw and washing the copper side with any cleaning detergent or laundry soap to remove surface dirt. 3. Covering the copper-clad board with masking tape and trace the layout pattern using carbon paper on the copper side of the board. 4. Cutting the layout pattern and remove the unnecessary portion covered with masking tape.	4 hours
	5. Immersing the board in an etching solution and place the plastic side of the board down so that the copper side will not touch the bottom of the tray. 6. Removing the board from the solution as soon as the copper foil is completely washed away. 7. Removing the masking tape or the resist with cotton or soft cloth dipped in lacquer thinner. 8. Cleaning the PCB with water and let it dry. 9. Marking and drilling the required component lead holes on the copper side.	4 hours
B. Demonstrated in Mounting the Different Components in the Printed Circuit Board.	B. 1. Cleaning the printed circuit board leads holes and the leads of the components with the use of a sand paper. Because when the surface is dirty, the solder will not stick to the copper. 2. Using the preferred solder in electronics work, the 60% tin and 40% lead. 3. Checking the power of the soldering iron, the power of the soldering iron used in electronics activity is 30 to 40 or 60 watts if needed. 4. Cleaning the tip of the soldering iron by wiping it with a sponge. A dry sponge will not clean the tip efficiently, and in case it is	4 hours

	too wet this will lower the temperature of the tip making for an ineffective solder joint. 5. Wiping the tip on the moist sponge until it is clean. Continue wiping the tip while soldering a circuit board. 6. Bending the lead of the component using fine pliers so that it is easily slides into the holes of the printed circuit board.	
	7. Inserting the components to be soldered into the circuit board and bend the leads protruding from the bottom of the circuit board at an angle of approximately 45^0. 8. Holding the soldering iron at a 45^0 angle and heat both the lead and the copper simultaneously, touch the wire in the space between the iron tip and the lead terminal of the component in the copper board. 9. Keeping in touch with the soldering iron tip while moving the solder around the joint as it melts. 10. Removing the solder wire first and soldering iron next to avoid fitting in between the copper board and the solder wire. 11. Cleaning the board with lacquer thinner using a brush to remove the flux residue and other contaminants. 12. Inspecting for a good solder connection, solder joint should be clean, smooth and shiny.	

Lesson 3. Wiring Connection At the end of the lesson the student must have: **A.** Demonstrated the Wiring Connection of the Voltage Time Delay Device	A. 1. Connecting line one to the first contact terminal of the relay switch, then the second contact terminal of the relay switch to terminal two of the timer and terminal A of the holding coil of the magnetic contactor. 2. Connecting line two to terminal 95 of the overload relay, then terminal 96 of the overload relay to terminal 8 and 7 to the timer, and terminal 6 of the timer to terminal B of the holding coil of the magnetic contactor. (Note: Code of the holding coil is not uniform)	2 hours
B. Demonstrated the Routing the Routing of the Magnetic Contactor	B. 1. Connecting the source and the load side of the magnetic contactor base on the manufacturer's code. 2. Using a screwdriver to loosen the holding screws in the contact terminals for the wire. 3. Inserting the wires but note there should be no insulation is pushed into the contact terminals for the wires. 4. Making sure that no strands are protruding out from the contact terminals. 5. Tightening the screws on the contact terminals.	2 hours
Lesson 4. Testing the Device At the end of the students must have: **A.** Tested their Finished Output	A. 1. Testing the function and the voltage output using a multi tester. 2. Testing with a load of an incandescent lamp.	1 hour

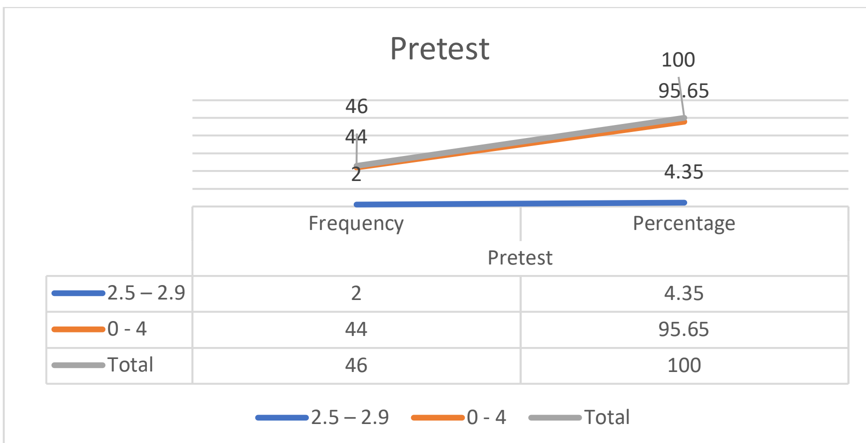
Result and Discussion:

Students' academic performance involves meeting goals, achievements, and objectives set in the program or course that a student attends. These are expressed through grades which are the result of an assessment that involves passing or not the tests. The pretest was given to determine how much the students already learned before instruction while the posttest was to determine how much the students have learned after the instruction was made. The test consists of fifty items.

Pretest Performance

Pretest is a test given to students to determine if they are satisfactorily prepared to start a new lesson. In short, pretests are non-graded assessments where a teacher determines each student's knowledge of and proficiency in the subject matter. This will give teachers a way to measure student knowledge, prepare students for future content and, in the end, measure student growth. At every grade level and in every discipline, teachers must know what their learners know before beginning a new unit of study. One way to make this determination is to use a pretest that assesses student proficiency in the skills that are going to be taught (Kelly, 2019).
Figure 1 shows the pretest result of the student performance before using the teaching guide for electronics instruction.

Figure 1
Pretest Results of Students Performance
n=46



	Frequency	Percentage
2.5 – 2.9	2	4.35
0 - 4	44	95.65
Total	46	100

Legend:
40 - 50 – Superior 30 - 34 – Good
35 - 39 - Very Good 2.5 - 29 – Fair 0 - 24 – Poor

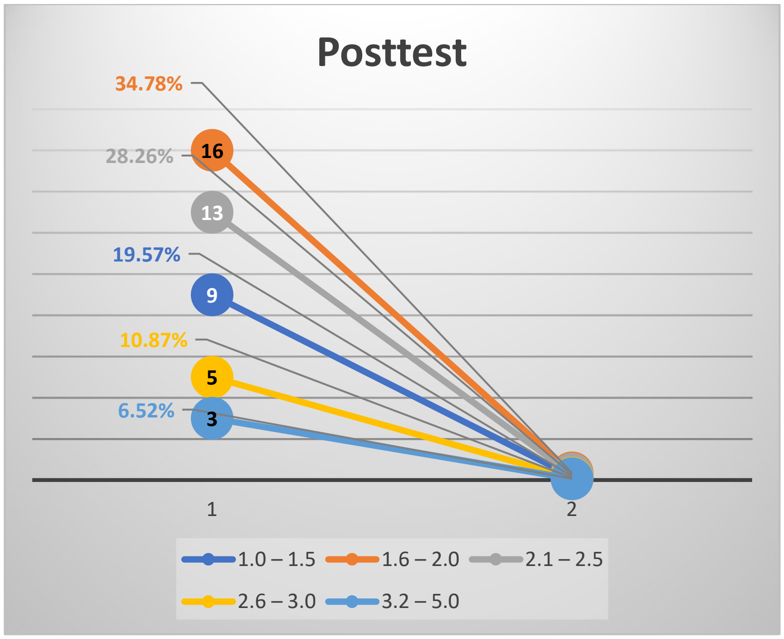
This figure revealed the pretest results of 46 students. As shown only 2 students or 4.35% were able to get a fair score, while, almost all or 95.65% got a failing score in the pre-test. This implies that the students have no prior knowledge about the functions of the different components of the device, materials, and methods of constructing the device as well.

Posttest Performance

Posttest is the test given to students after completion of the lesson guide used in conjunction with a pretest to measure their achievement and the effectiveness of the lesson guide. This shows whether a student gained the knowledge required to successfully complete the course. And this reveals how much each student's knowledge grew and how much students improved during the course.

Figure 2 displays the results of students' post-test performance after using the teaching guide for electronics instruction.

Figure 2
Post Test Results of Students Performance
n=46



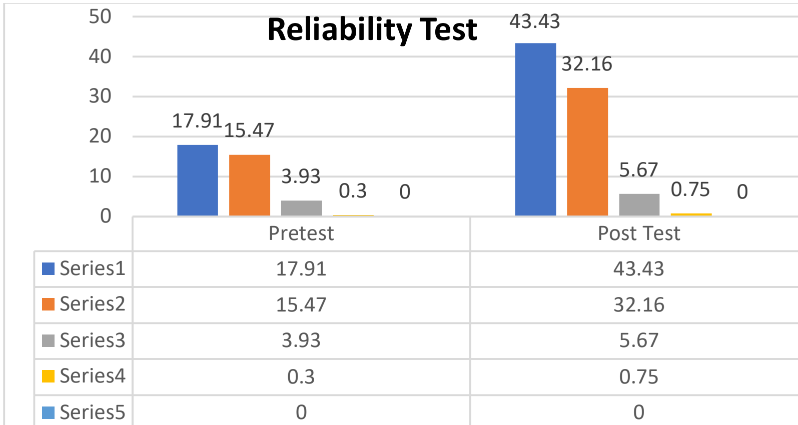
As reflected in figure 2, the post test results of 46 electronics technology students during the assessment after using the lesson guide for the voltage-time delay device. For the posttest under the range of 1.0 – 1.5, the frequency was 9 and the percentage was 19.565. As to the range of 1.6 – 2.0, the frequency was 16 and the percentage was 34.783 respectively. Another 13 for frequency and 28.26 percent for the range 2.1 – 2.5. For the range 2.6 – 3.0, the frequency was 5 and the percentage was 10.87. As to the last range, the range was 3.2 – 5.0 the frequency was 3 and the percentage was 6.522. As presented in this table, out of 46 students taking the posttest evaluation, there were 43 students got a passing score, and there only 3 students got a failing score. This implies that using the device as instructional material can greatly help improve the performance of the students in acquiring the knowledge and skills needed.

Reliability Result

Reliability is defined as the probability that a lesson guide will perform its intended function adequately for a specified period of time, or will operate in a defined environment without failure. The goal of reliability theory is to estimate errors in measurement and suggest ways of improving lesson guides so that errors are minimized.

Figure 3 presents the results of the reliability of the test base on the performance of the students using the voltage-time delay device for electronics instruction.

Figure 3
Reliability Test as to the Performance of the Students
n = 50



This figure specifies the reliability test as to pretest and posttest evaluation of students using the voltage-time delay device for electronics instruction. The average based on 50 items was 17.91 for the pretest while the post-test was 43.43. For variance, 15.47 for the pretest and 32.16 for the post-test. As to the standard deviation, 3.93 for the pretest and 5.67 for the posttest. The reliability of the pre-test result showed doubt because this was attributed to the prior knowledge of the students. The students were not able to study the topic yet. Right after the pretest, using the device for instruction the result of the reliability of the post-test was 0.75 with the interpretation of good. This means that the test instrument was good for a classroom test, though, there were probably few items that could be improved.

Correlation Coefficient

Correlation coefficients are used to find how strong a relationship is between data. The formulas return a value between -1 and +1, where: +1 indicates a strong positive relationship. -1 indicates a strong negative relationship. A result of zero indicates no relationship at all. There are several types of correlation coefficient, but the most popular is Pearson's. **Pearson's correlation** (also called Pearson's *R*) is a **correlation coefficient** commonly used in linear regression (Rosner,2017).

Pearson's Correlation Coefficient is a linear correlation coefficient that returns a value of between -1 and +1. A -1 means there is a strong negative correlation and +1 means that there is a strong positive correlation. A 0 means that there is no correlation (this is also called zero correlation).

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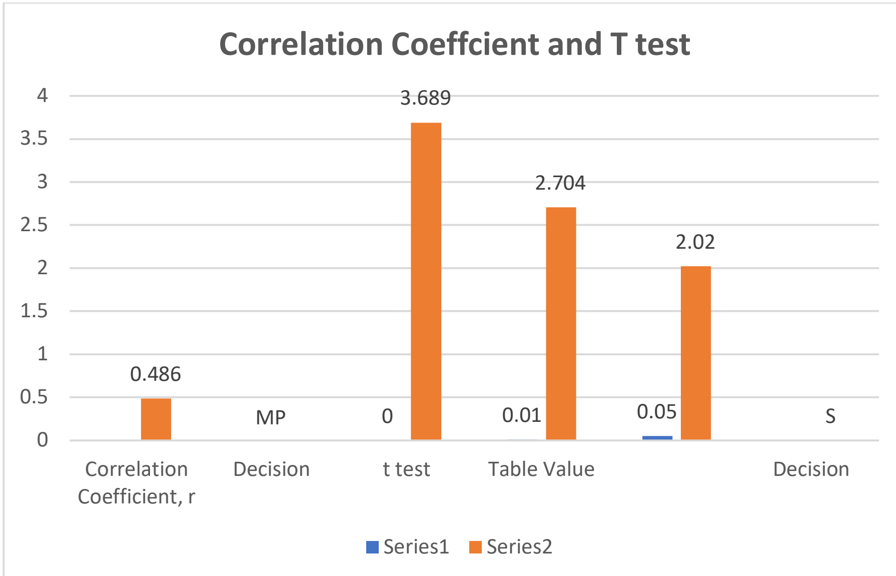
Figure 4 presents the results of the correlation coefficient as to the performance of the students using the voltage-time delay device for electronics instruction.

Figure 5
Correlation Coefficient and T- Test as to the Performance of the Students



This figure showed the correlation coefficient and t-test as to the performance of the students during pretest and posttest evaluation. As to the correlation coefficient with value of 0.486 the decision was moderate positive based on the equivalent range which 0.3 to 0.5 coefficient. For the test significance using the t-test the computed value was 3.689 which was bigger compared to the table value at 0.01 which was 2.704 and 0.05 which was 2.02 levels of significance, therefore the decision was significant. This means that the null hypothesis of no significant correlation was rejected. The researcher failed to provide sufficient evidence to accept the null hypothesis that there was no significant correlation between the pretest and posttest given to students using the lesson guide.

Conclusion

It was established that the lesson guide using voltage time delay device was valuable for electronics instruction. This guide helped the students to understand and fabricate a device that can protect electrical surge or spikes for the different electronics and electrical-consuming devices. This equipped or enhanced their knowledge and skills in both electronics and electricity they need when they will graduate from their course. Therefore, it was safe to recommend the use of the guide for instruction.

Citation

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