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Design and Development of Small Engine Mock-up

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Abstract. This study focused on the construction and evaluation of an improvised motorcycle electrical trainer. It is a type of instructional tool that is an electrically powered device that can be used to practice automotive electrical components. The trainer was developed based on the stages of the ADDIE model and was evaluated by three (3) groups of respondents, including industrial technology students, industrial technology teachers, and industry experts from the city of Cabanatuan, Nueva Ecija. They were asked to assess the technical characteristics of an improvised motorcycle electrical trainer in terms of functionality, usability, portability, and level of effectiveness. The researcher analyzed the collected data using a weighted mean. According to the findings of the study, respondents evaluated and agreed with this particular technology. And by utilizing this trainer as an instructional tool, it will provide a deeper understanding of the topic and improve the teaching-learning process.

Keywords: Design, Development, Electrical, Portable Motorcycle Electricity Trainer, Technology,

1. Introduction

The use of instructional materials is important in the teaching-learning process in education and training specifically in automotive students. The advanced development of automotive systems mainly occurs in electrical systems. Most of the systems in automotive field have been controlled electrically. In automotive electrical lectures the majority of students consider this subject very difficult.

The unavailability of shop laboratory equipment or specialized educational materials is one of the main issues faced by both students and teachers. Previous research undertaken by specialists in the area found that using a trainer in the shop laboratory increased student performance far more than teaching

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automotive engine concepts and practices the traditional way. As the Philippines tries to keep up with technological development among industrialized nations, the Technical Education and Skills Development Authority (TESDA) has proposed that our government provide guidelines, policies, programs, and standards for quality technical education and skills development.

According to Pereyras JG (2020) an electrical wiring installation trainer provides the students' learning experience and appreciation of the subject and course and for the professors' demonstrations and evaluation of students' performance during laboratory time. According to Muskhir, M. (2019) the introduction of new technology must be carried out in the lecture process so that students are able to become individuals who are ready to face the challenges of the world in the technological era. The quality of the learning process will affect student learning outcomes. One of the factors that can support the quality of student learning outcomes both in the theoretical or pum practicum study is the availability of learning media

The Improvised Motorcycle Electrical Trainer will provide opportunities and increase the skills of automotive students. The Improvised Motorcycle Electrical Trainer is intended to carry out a variety of motorcycle vehicles electrical circuit experiments. It is important for any automotive student to have a deep understanding of the electrical system in order to improve his troubleshooting and repair skills. The trainer could create opportunities for the institution in terms of research and invention, as well as prospective institutional research output. The device is a piece of equipment that can be utilized as a teaching aid as well as a source of potential institutional research.

The instructional material covers all aspects of auto-electricity, from the fundamentals to the more complex topics. The objective of this teaching aid unit is to give students a thorough overview of the subject, from fundamental automotive to advanced installation. The trainer can be utilized in all levels of automotive training, both general and advanced.

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2. Methodology

The researchers used a descriptive-developmental research method to create an instructional tool for teaching automotive electrical systems, such as the Improvised Motorcycle Electrical Trainer. Developmental research involves designing, developing, and evaluating instructional programs, processes, and products that meet internal consistency and effectiveness criteria. The study was conducted in Cabanatuan City, Nueva Ecija, Philippines, a major economic, educational, medical, entertainment, shopping, and transportation center. A total of 16 respondents were divided into three groups: automotive students, automotive teachers, and industry practitioners. The study used a random sampling method to ensure an unbiased representation of the total population. A research questionnaire was used to rate the improvised motorcycle electrical trainer's technical characteristics, according to ISO 9126 Software quality characteristics such as functionality, usability, portability, and effectiveness. The content validity of the instrument was evaluated by the thesis adviser/committee, and the Improvised Motorcycle Electrical Trainer was tested and retested to determine its reliability. The final draft of the improvised motorcycle electrical trainer was reviewed based on the responses, and experts confirmed the equipment's accuracy and suitability for use as a research tool. The researcher conducted a study on an improvised motorcycle electrical trainer developed by a researcher at Nueva Ecija University. They searched for universities offering automotive technology programs and obtained permission from the school administration. The researcher then approached respondents to discuss the study's purpose and ensured confidentiality of information. The study's findings will be summarized using descriptive statistics and weighted mean scales. The acceptability of the trainer was evaluated by industry practitioners and teacher-student respondents. The study adhered to Republic Act No. 10173, also known as the Data Privacy Act of 2012, by obtaining informed consent from participants, ensuring anonymity, and upholding confidentiality. The data collected was used solely for research purposes and materials were properly cited using the APA referencing system.

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3. Results and Discussion

1. Development of Improvised Motorcycle Electrical Trainer .

The development phase of the study was composed of these stages: Analysis, Design, Development, Implementation, and Evaluation.

1.1 Analysis

During this phase of development, the researcher acquired the necessary information to construct and formulate the Improvise Motorcycle Electrical Trainer ideas. The researcher reviewed automotive curriculum outlines and available instructional materials and equipment. The results served as the basis for the next phase of development so that the device could meet the demands of students and teachers.

1.2 Design

During this phase of development, the researcher created an improvised trainer that could accommodate the demands of students. The design was created using auto-electrical components including a headlight, signal lights, tail lights, horn, panel gauge, starter motor, flywheel, stator, ignition switch, cdi, rectifier, banana plug, relay, fuse, American wire gauge no.18, headlight switch, signal lights switch, hazard switch, horn, switch, starter switch, and brake light switch.

All auto-electrical components were placed and identified on a panel board before being encased in wood. Banana plugs were soldered to auto-electrical components to act as terminals for a range of auto-electrical installations. The design simplifies installation by allowing students to plug in and unplug banana plug connectors dependent on the assignments they

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would get during laboratory lessons.

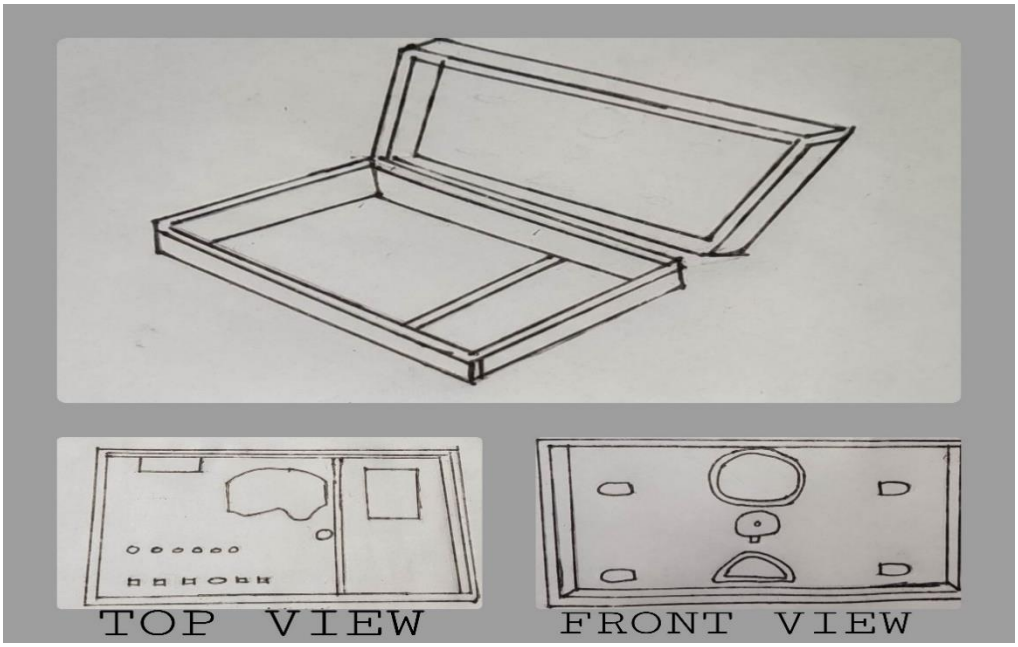

Figure 1 Shows the Design of Improvised Motorcycle Electrical Trainer

1.3 Development

During this phase of development, various components were prepared and assembled in accordance with the design.

1.3.1 Materials, tools and equipment's

The materials, tools, and equipment required for the construction of the Portable Auto-Electricity Trainer are detailed here.

Plywood, Fiber glass panel board, banana plug and jack, headlight, signal lights, tail lights, horn, panel gauge, starter motor, flywheel, stator, cdi, rectifier, relay, fuse, American wire gauge no.18, headlight switch, signal lights switch, hazard switch, horn switch, starter switch, brake light switch.

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Table 1 List of Materials in the Construction of Improvised Motorcycle Electrical Trainer.

Unit	Qty	Parts	Amount	Total Amount
2	Pieces	Fiber Glass Panel Board 35x 55	₱250	₱500
1	Pieces	Head Lights	₱350	₱350
140	Pieces	Banana Plug	₱10	₱1400
1	Pieces	Tail Lights	₱150	₱150
1	Pieces	Horn	₱45	₱45
4	Pieces	Signal Lights	₱80	₱160
1	Unit	Starter Motor	₱450	₱450
1	Set	Relay	₱150	₱150
1	Piece	Fuse	₱25	₱25
1	Piece	Panel Gauge	₱250	₱250
1	Set	Ignition switch	₱180	₱180
1	Unit	Flywheel	₱600	₱600
1	Piece	Stator	₱450	₱450
1	Piece	CDI	₱150	₱150
1	Piece	Rectifier	₱110	₱110
1	Set	Brake light switch	₱25	₱25
1	Unit	Flasher relay	₱60	₱60
¼	kilo	Nails “2”	₱30	₱30
1	Pieces	Cabinet Handle	₱60	₱60
1	Pieces	Drawer Lock	₱140	₱140
1	Pieces	Sticker Paper	₱50	₱50
1	Pieces	Chain	₱100	₱100
1	Liter	Lacquer Paint	₱200	₱200
1	Pieces	Plywood “60 x 120 ¾ “	₱550	₱550
5	Meters	Soldering lead	₱35	₱35
20	Meters	Automotive Wires, American Wire Gauge 18	₱18	₱360
		GRAND TOTAL		₱6,580

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Table 2. List of tools and Equipment in the Construction of Improvised Motorcycle Electrical Trainer

Unit	Quantity	Specification of Materials, Tools and Equipment
1	Unit	Circular Saw
1	Piece	L-square
1	Unit	Electric drill
1	Unit	Steel Tape Measure
1	Unit	Soldering iron, 60watts
1	Piece	Philip screw driver
1	Piece	Pliers
1	Piece	Hammer

1.3.1 Development of Improvised Motorcycle Electrical Trainer

During the Development of Improvised Motorcycle Electrical Trainer, the following factors were taken into account:

1. Prepare the essential materials, equipment, and tools.
2. Measure the appropriate plywood box dimensions (55 centimeters in length and 35 centimeters in width).

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3. Cut the wood according to the measurement

Figure 17

Shows the cutting of plywood according to the measurement

4. Assemble the parts of the frame using nail

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5. Apply wire to the frame for finishing

Figure 18

Shows the application of paint on the frame

6. Installing the automotive parts and materials to its designated locations and solder through the terminals of banana jack using a soldering iron.

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Figure 19

Shows the finished mounting and soldering of automotive parts and materials.

Figure 20

Shows the Finished Improvised Motorcycle Electrical Trainer

Testing of Improvised Motorcycle Electrical Trainer

This is one of the most significant phases of product development, in which the developed product is tested by Industrial Technology Teachers, Students, and Industrial Technology Experts in order to instantly address any issues. The product underwent various trials for each Automotive Electricity component examined, and for each trial of each component, various mistakes and issues were identified and resolved. The Improvised Motorcycle Electrical Trainer included the following components: headlights, brake lights, Tail lights, Signal lights, Hazard Lights, Horn, Starter Motor, Panel Gauge, and Flywheel.

1.4 Implementation

To test the capability and acceptability of the trainer, the researcher invited an automotive technician from Motortrade, an automotive technician

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from Wheeltek, and an automotive major student from the College of Industrial Technology. These individuals installed all the activities according to the researcher's operational manual. They agreed wholeheartedly that the technology was extremely useful and functional, and were excited that students can use it with minimal supervision.

1.5 Evaluation

There was strong agreement among professionals, industry teachers, and students regarding the Improvised Motorcycle Electrical Trainer, functionality, usability, portability and level of effectiveness. They were confident that the delivery of instruction would become more efficient with the presence of this trainer, particularly in regards to the completion of tasks that took place in the laboratory.

2.Assessment of Industrial Materials by Industrial Technology Students

The SEEM was assessed by Industrial Technology Students in terms of the following instructional qualities:

1.4 Functionality

Functionality refers to whether a design works and helps the users meet their goals and needs. (www.interaction-design.org, 2022).

Respondents rated the headlight, stop light, signal light, and panel gauge a weighted mean of 4.00 with a qualitative description of very functional. Result also showed that setting up the horn received a weighted mean of 3.75, with a qualitative description of very functional. The device got an overall score of 3.92, which means it works very well.

1.5 Usability

Respondents rated the device utilization by following the instruction with a weighted mean of 4.00, with a qualitative description of very usable. Result also revealed that the simplicity of use of the trainer received a weighted mean of 3.63 with a qualitative description of very highly usable. The device got an overall score of 3.83, with a numerical rating of very usable.

1.6 Portability

Portability refers to the degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another. (iso25000.com, 2022).

Findings revealed that the ease of installment and un-installment of the

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components of the trainer received a weighted mean of 4.00, with a qualitative description of very portable. Findings also showed that movability of the trainer received a weighted mean of 3.75, with a qualitative description of very highly portable. The device got an overall score of 3.83, with a with a qualitative description of very portable.

1.1 Level of Effectiveness

Effectiveness means finding out if it produced any outputs, outcomes and/or societal benefits or impact. (Hinrichs-Krapels, S., Grant, J., 2016).

The research findings showed that Industrial Technology Students found the trainer to be compatible with the curricular framework in place receiving a weighted mean of 3.88, with a qualitative description of very highly portable very effective. This also showed that learners found the trainer to be more effective learning tool compared with traditional way, receiving a weighted mean of 3.75, with a qualitative description of very effective. The device got an overall score of 3.83, with a qualitative description of very effective.

3.Assessment of Industrial Materials by Industrial Technology Teachers

The SEEM was assessed by Industrial Technology Teachers in terms of Instructional

Qualities in the following:

3.1Functionality

In terms of functionality, Industrial Technology Teachers found headlight, signal light, hazard, horn, starter motor, and panel gauge very functional with weighted mean score of 4.00. This also indicates that setting stop light, tail light, and flywheel were found to be very functional with weighted mean score of 3.75. The device received an overall mean of 3.92 and a qualitative description of very functional.

This suggests that the developed instructional materials are comparable to those available in the market. This means that teachers may utilize the trainer to aid in the teaching-learning process, as it is highly functional.

3.2 Usability

Industrial Technology Teachers found the trainer easy to use having a weighted mean score of 3.75, with a qualitative description of very usable. Additionally, respondents rated the device utilization by following the instruction with a weighted mean score of 3.50, which corresponds to a

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qualitative description of very usable. The device received an overall score of 3.67, indicating that it is very usable.

3.4. Portability

Industrial Technology Teachers rated the trainer's portability with a weighted mean score of 4.00, which corresponds to the qualitative description very portable. Moreover, in terms of ease of installation and UN-installation, the device is very portable with a weighted mean score of 3.50 The trainer received an overall score of 3.75, which means it is very portable.

3.5 Level Of Effectiveness

Industrial Technology Teachers found the trainer to be very beneficial in instruction, having rated with weighted mean score of 4.00, that corresponds to a qualitative description of very effective. Finding also revealed that the respondents found the trainer to be aligned with the curricular framework in place, having scored with a weighted mean score of 3.75 that corresponds to a qualitative description of very effective. The device got an overall score of 3.83, with a numerical rating of very effective.

4.Assessment of Industrial Materials by Industrial Technology Experts

The SEEM was assessed by Industrial Technology Experts in terms of Instructional

Qualities in the following:

4.1 Functionality

The assessment of stop light, tail light, horn, and starter motor functionality by Industrial Technology Experts received the highest weighted mean of 4.00 with a qualitative description of very functional. This also indicates that setting-up headlight, hazard, flywheel and panel gauge was found to be very functional, being rated with a weighted mean score of 3.50. The device received an overall mean score of 3.78 with a qualitative description very functional.

This suggests that the developed instructional materials are comparable to those available on the market. This also serve as an evidence that teachers may utilize to aid the teaching-learning process, as it is highly functional.

4.2 Usability

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Industrial Technology Experts found the trainer easy to use by simply following the instruction, thus receiving a weighted mean score of 3.75, which corresponds to a qualitative description of very usable. Additionally, the trainer is found to be user friendly, having rated with a weighted mean score of 3.50, which corresponds to a qualitative description of very usable. The device received an overall mean score of 3.58, indicating that it is very usable

4.3 Portability

Industrial Technology Experts rated the trainer's portability with a weighted mean score of 3.75, which corresponds to the qualitative description of very portable. Experts also found the device to be handy and easy to carry, moreover it is also found to be easy to be installed and uninstalled, having rated with a weighted mean score of 3.50, which corresponds to the qualitative description very portable. The trainer received an overall score of 3.58, indicating that it is very portable.

4.5 Level Of Effectiveness

Industrial Technology Experts found the device to be instrumental in teaching and learning process, having a. weighted mean score of 3.75, which corresponds to a qualitative description of very effective. This also showed that utilization of the trainer in instruction is better that the traditional way of teaching automotive technology, having scored with a weighted mean of 3.25, that corresponds to the qualitative description very effective. The device got an overall score of 3.42, with a numerical rating of very effective.

5. SUMMARY

The primary objective of this research was to develop an electrically powered improvised motorcycle electrical trainer that can be used in practicing of automotive electrical components. The following is a synopsis of the study's findings:

1. On the Development of Instructional Material

1.1 Analysis

The concepts for the Portable Auto Electricity Trainer were prepared in accordance with the needs of students and teachers as outlined in the automotive programs.

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1.2 Design

The researcher was responsible for preparing the automotive and electrical plan of the device, which included the components that were utilized.

1.3 Development

The components of the Device were put together using the design that was created.

1.4 Implementation

The researcher invited a technician from Motortrade, a technician from Wheeltek, and a major in automotive technology from the College of Industrial Technology. These individuals performed all activities in accordance with the researcher's operating manual. They agreed that the technology was incredibly useful and functional, and they were thrilled that students may utilize it with minimal intervention.

1.5 Evaluation

Experts in the industry, teachers and students all strongly agree that the Improvised Motorcycle Electrical Trainer is highly useful in terms of its degree of functionality, usability, portability, and level of effectiveness. They were confident that the delivery of instruction would become more efficient with the presence of this device, particularly in regards to the completion of tasks that took place in the laboratory.

2.On the Assessment of Instructional Materials by Industrial Technology Students

Industrial Technology Students evaluated the Improvised Motorcycle Electrical Trainer in terms of functionality, usability, portability and level of effectiveness. The respondents strongly agreed that the trainer meets the whole intent of the indicators, and the existence of attributes was well supported by data. Their overall mean evaluation scores are 3.85. These mean values correlate to the qualitative descriptors very functional/very usable/very portable and very effective.

3.On the Assessment of Instructional Materials by Industrial Technology Teachers

Industrial Technology Teachers evaluated the Improvised Motorcycle Electrical Trainer in terms of functionality, usability, portability and level of effectiveness. The respondents strongly agreed that the trainer meets the whole intent of the indicators, and the existence of attributes was well supported by data. Their overall mean evaluation scores are 3.79. These mean values correlate to the qualitative descriptors very functional/very usable/very portable and very

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effective.

4.On the Assessment of Instructional Materials by Industry Technology Experts

Industrial Technology Experts evaluated the Improvised Motorcycle Electrical Trainer in terms of functionality, usability, portability and level of effectiveness. The respondents strongly agreed that the trainer meets the whole intent of the indicators, and the existence of attributes was well supported by data. Their overall mean evaluation scores are 3.59. These mean values correlate to the qualitative descriptors very functional/very usable/very portable and very effective.

6. CONCLUSIONS

Based on the results of the study, the following conclusion were drawn

1.According to the results of their respective evaluations, the SEEM meets the approval of automotive/electrical Industrial Technology Teachers, Students, and Experts.

2.The results indicated that students utilizing this device performed well with minimal or no oversight from teachers.

3.Having been evaluated with compelling and favorable findings, the SEEM can be of significant assistance in facilitating the teaching-learning process.

7. RECOMMENDATIONS

On the basis of the study's findings and conclusions, several recommendations were made.

1. This trainer enhances the abilities of both students and teachers.
2. The SEEM is simple to operate and use after reading the manual.
3. The SEEM should make use of a color-coding wire.

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References

Arda, I. (2019, November). Trainer Development of the Electrical and Electronics Course as a Learning Media in Electrical Department SMKN 1 Tilatang Kamang. In Journal of Physics: Conference Series (Vol. 1387, No. 1, p. 012130). IOP Publishing. Accessed on September 13, 2022 from https://iopscience.iop.org/article/10.1088/1742-6596/1387/1/012130/pdf

Awotua-efebo EB (2001). Effective teaching: Principles and Practice, Port Harcourt, Para graphics. Accessed on September 28, 2021 from http://www.sciencewebpublishing.net/jerr/archive/2013/December/pdf/Nsa%20et%20al.pdf

Balbin, N. B. (2015). Development of a multi-system automotive engine electrical trainer. IAMURE International Journal of Mathematics, Engineering and Technology, 11(1), 1-1. Accessed on September from 10, 2021 https://www.ejournals.ph/article.php?id=2855

En.wikipedia.org "What is Instructional Material" Access on October 20, 2021 from https://en.wikipedia.org/wiki/Instructional_materials

En.wikipedia.org "Cabanatuan" Accessed on October 26, 2021 from https://en.wikipedia.org/wiki/Cabanatuan

Hickcox, L. K. (2006). Learning styles: A review of the inventories. In R. R. Sims & S. J. Sims (Eds.), Learning styles and learning a key to meeting the accountability demands in education (pp. 3 – 15). New York: Nova Science. Accessed on September 29, 2021 from https://files.eric.ed.gov/fulltext/EJ887444.pdf

Hinrichs-Krapels, S., Grant, J. Exploring the effectiveness, efficiency and equity (3e's) of research and research impact assessment. Palgrave Commun 2, 16090 (2016). Accessed on November 29, 2022 from https://www.nature.com/articles/palcomms201690

Iso25000.com/index.php/en/iso-25000-standards/iso-25010/64-portability" What is Portability". Accessed on November 29, 2022 from https://iso25000.com/index.php/en/iso-25000-standards/iso-25010/64-portability

Labtech.org "What is Automotive Electrical System" Accessed on September 23,

2021 from https://labtech.org/education/automotive/electrical-electronic-systems

Lacanilao, J. (2020) Development and Assessment of Portable Auto-Electricity Trainer. Accessed on November 18, 2021

Members.aect.org" What is Developmental Research" Accessed on October 26, 2021 from http://members.aect.org/edtech/ed1/42/index.html

Muskhir, M. (2019, February). Development of Industrial Electrical Installation Trainer Nuanced To Training within Industry for Students of Electrical Industrial Engineering Universitas Negeri Padang. In Journal of Physics: Conference Series (Vol. 1165, No. 1, p. 012014). IOP Publishing. Accessed on September 13, 2022 from https://iopscience.iop.org/article/10.1088/1742-6596/1165/1/012014/pdf

Nsa SO (2012). Instructional Strategies and Students Skills Acquisition in vegetable production. J. Bus. Econ. Review, 3(1). Accessed on September 28, 2021 from http://www.sciencewebpublishing.net/jerr/archive/2013/December/pdf/Nsa%20et%20al.pdf

Nwachukwu CE (2006). Designing Appropriate Methodology in Vocational and Technical Education for Nigeria, Nsukka, University, Trust Publishers. Accessed on November 16, 2021 from https://www.researchgate.net/publication/275515562_Planning_Techniques_Needed_to_Improve_the_Teaching_and_Learning_of_Basic_Technology_in_the_Junior_Secondary_Schools_in_Nigeria

Olaitan S.O. & Aguisiobo ON (1994). Teaching of clothing and Textile. New York John Wiley and Sons Publishers. Accessed on September 28, 2021 from https://www.ijhssi.org/papers/v6(9)/Version-3/F0609033644.pdf

Pasion, Billie Jack DR. (2021), "Development and Assessment of Notable Ergonomic Universal Working Table". Nueva Ecija University of Science and Technology. Dissertation. Unpublished

Pereyras, J. G. (2020). Development of an electrical wiring installation trainer. International Journal of Scientific and Technology Research, 9(3), 4458-4461. Accessed on September 13, 2022 from https://www.researchgate.net/profile/JeffPereyras/publication/340478754_DEVELOPMENT_OF_AN_ELECTRICAL_WIRING_INSTALLATION_TRAINER/links/5e8c4c704585150839c6715d/DEVELOPMENT-OF-AN-

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https://neust.journalintellect.com/quest

ELECTRICAL-WIRING-INSTALLATION-TRAINER.pdf

Perreault, David J., and Vahe Caliskan. 2004. "Automotive Power Generation and Control." IEEE Transactions on Power Electronics 19 (3): 618–30. Accessed on November from 16, 2021 https://ieeexplore.ieee.org/abstract/document/1296737

Ramdi, O. D. (2020). DEVELOPMENT OF AUTOMOTIVE ENGINE ELECTRICAL SYSTEMS TRAINER FOR AUTOMOTIVE TECHNOLOGY STUDENTS. DEVELOPMENT, 2(12). Accessed on September 15, 2021 from http://www.ijciras.com/PublishedPaper/IJCIRAS1570.pdf

Roberts, T. G. (2003). An Interpretation of Dewey's Experiential Learning Theory. Accessed on October 12, 2021 from https://files.eric.ed.gov/fulltext/ED481922.pdf

Www.scribbr.com" What is Descriptive Research" Accessed on October 26, 2021 from https://www.scribbr.com/methodology/descriptive-research/

Www.interaction-design.org "What is Functionality" Accessed on November 29, 2022 from https://www.interaction-design.org/literature/topics/functionality