Characteristics of a Developed Low-Cost Power Converter Trainer

Asia Pacific Journal of Management and Sustainable Development
Vol. 9 No. 1, 39-45
March 2021 (Part II)
ISSN 2782-8557 (Print)

James M. Dumaguit
Surigao State College of Technology, Philippines
jmd.ssct@gmail.com

Date Received: October 24, 2020; Date Revised: March 3, 2021

Abstract - *This research assesses the characteristics of a developed Low-Cost Power Converter Trainer. Specifically, it assessed the functional analysis of the developed low-cost power converter trainer as to Cost, Appearance, Output variability, Source compatibility and Safety. Acceptability of the developed device based on TAM constructs was also evaluated. This research uses the descriptive developmental research method and utilized involving 67 respondents who were determined using the purposive sampling. The data were gathered from the respondents using a research questionnaire adopted from previous developmental studies and were analyzed using frequency count and percentage distribution and weighted mean. Result revealed that the device is perceived by the respondent's groups as outstanding on its functionality. When categorized by occupation, the instructors and industry technicians rated all the parameter as outstanding while the OJT students in electronics perceived to be very satisfactory on item number 2 on cost. As to functionality, the three groups of respondents generally rated the device as outstanding. As to acceptability, the three groups of respondents generally rated the device as Highly Acceptable. In light of the findings of the study, the following recommendations are offered: Recommend the utilization of the output of the study in the academe, community, and industry. The device will be used in the conduct of skills competency assessment of TESDA, particularly in electronics qualification. The device will be used as instructional materials to the students and that the administration will provide support for deeper study related to the said device. The device will be registered for patenting at Intellectual Property Office (IPO) with the assistance of the management.*

Keywords*: Power converter, Assessment, Instructional Trainer, Perceptions*

INTRODUCTION

The demands of the times have fostered everyone in all fields and at all levels an unprecedented adjustment to technological changes, so persuasive making life increasingly reliant upon it. These persistent and urgent demands are reinforced by legitimate concerns to include educational goals to produce or develop a fully functioning resource material indicating strongly to innovations and creativity.

Barba pointed out that technology innovation is a process wherein new technologies are developed and apply for widespread use also utilizing of all other available resources to introduce or applying something better than the existing state of the art [1]. These new technologies and innovations are products creatively applying mental and physical efforts to achieve the desired end. It is a result of man's knowledge to continue to find resources to produce tools, apparatus, devices, and machinery which will be employed to solve real-world problems.

Berlex opined that any developed facility or equipment is highly regarded as it raises the school's profile while establishing mutually beneficial links with markets and industries. This is one reason why the researcher and students are attracted to innovate due to motivation and ownership of work they attain based on their personal interests, skills, and expertise [2].

It is very evident and true that improvised electronic device is not as sophisticated and refine as the commercially produced one, yet it can bridge the gap of insufficiency of instructional materials in the school and to the economic ends of the users while maintaining the quality of its purpose [3].

One application of a sophisticated and innovative technology being used today is the power supply circuits. Developing a power supply trainer is of valuable help during project making and doing experiments. This is being used by all Electronics major students to develop their skills and of fruitful use later on in the other areas of their lives, such as communication skills, problem-solving and other acquired skills usable beyond classroom boundary.

The power converter circuit is used advantageously by community users during barangay activity programs, facilitate easy accomplishment of

household chores, a productive increase of quota outputs among manufacturing industries and economically wise among ordinary consumers or users.

Oakes stressed that the development and utilization of instructional materials, device or equipment is an important issue of educational significance [4]. Nowadays, the use of teaching or learning aids is perceived as an integral component of shop room teaching as they highly facilitate knowledge and understanding of the subject lesson being discussed promoting motivation, interest, attention, and interaction between shop instructors and students.

Due to the rapid advancements that have increasingly conquered the work sector today, the demand to develop an electronic device to facilitate completion of assigned tasks or project was a felt need by the researcher to study and further investigate how this electronics trainer influence or affect students technical skills formation before and after using it in their circuits connection and electronic components application.

Theoretical Background

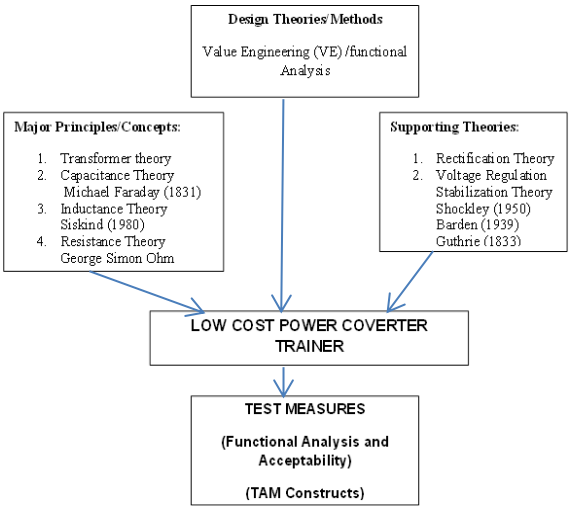

Fig.1

The conceptual framework of the study.

This study is anchored primarily on Technology Acceptance Model (TAM) Model in order to test the acceptability of the proposed device [5]. The design theories and methods used for the device are value engineering (VE) and functional analysis. The theoretical framework also elaborates the different theories principles used in this study such as transformer theory, capacitance theory, and inductance theory of Michael Faraday as well as rectification, power regulation theories of Shockley and Bardin and Resistance theory of George Simon Ohm.

Transformer Theory. A transformer principle was demonstrated by Faraday in 1831, it was used to demonstrate the concepts of electromagnetic induction [11]. A transformer is a device that changes electrical energy which means *to change*. The pressure that drives an electric current through a wire is called voltage. The transformer changes the voltage and current from low to high and vice versa [4].

Grob emphasized that a transformer is an application of mutual inductance. The purpose of the transformer is to transfer power from the primary, where the generator is connected to the secondary winding [6]. The transformer is used to provide power to the load resistance instead of connecting directly to the load whenever the load requires alternating current AC voltage higher or lower than a generator voltage.

Capacitance Theory. It is a measure of the ability to measures the ability of a capacitor to holds electric charges. When the AC voltage is applied to a capacitor, it is continually being charged and discharged, and the current flows in and out the capacitor dependent on the supply frequency [7].

Inductance Theory. According to Siskind [18], induction theory pertains to an electrical phenomenon which always tends to oppose any change in current in the circuit [8]. This induction theory is commonly applicable in all types of AC motors that are generally used in some commercial and industrial establishments.

Resistance Theory. It is an electrical phenomenon or quantities that regulate the flow of current according to the theory of George Simon Ohm in 1847.A resistance is measured in ohms [10].

OBJECTIVE OF THE STUDY

This research assessed the value engineering of the developed low-cost power converter trainer. Specifically, it assessed the following: Functional analysis of the developed low-cost power converter trainer as to Cost, Appearance, Output variability, Source compatibility and Safety; and acceptability of the developed power converter trainer based on TAM constructs

RESEARCH METHODOLOGY

Research Design

This research used descriptive developmental research method. According to Nala (2016), the descriptive development research describes and

interprets the present characteristics or development of a subject or phenomenon through stages.

The study utilizes the purposive sampling since the study targets a particular group of people. Specifically, the Electronics OJT students, industry technician and instructors/professors of Electronics Technology of SSCT.

Research Environment

The study was conducted in Surigao State College of Technology, Surigao City Campus. The institution is situated along Narciso and Magallanes streets, Surigao City which is the only State College in the Province of Surigao Del Norte and Dinagat Islands. It has 3 campuses located at Malimono, Surigao Del Norte, Del Carmen, in Siargao and Mainit, Surigao Del Norte.

Respondents

The respondents of this study were 86 Electronics students in the Bachelor of Electronics Engineering Technology course of Surigao State College of Technology, Surigao City.

Respondents

The respondents of the study were 10 Industry Technicians of Surigao City, 48 Electronics OJT Students and 9 instructors/professors of Surigao State College of Technology, Surigao City Campus.

Table 1. Distribution of the Respondents

Respondents	F	%
OJT Students	48	71.64
Industry Technician	10	14.93
Instructor/Professor	9	13.43
Total	67	100

Research Instrument

The instrument used in the study was the questionnaire adopted from the previous developmental studies.

The questionnaire is divided into four parts. Part 1 deals on the functional analysis of the developed low-cost power converter trainer as to cost, appearance, output variability, source compatibility, safety. Part II deals on the acceptability of the developed power converter trainer based on TAM construct. Part III deals on the findings of the respondents during the testing of the device. Part IV deals on the recommendations of the respondents.

Data Analysis

Frequency and Percent Counts. These are used to determine the profile of the respondents. Weighted Mean. This is used to analyze the data pertaining to the evaluation of the power converter trainer as assessed by the respondents.

RESULT AND DISCUSSION

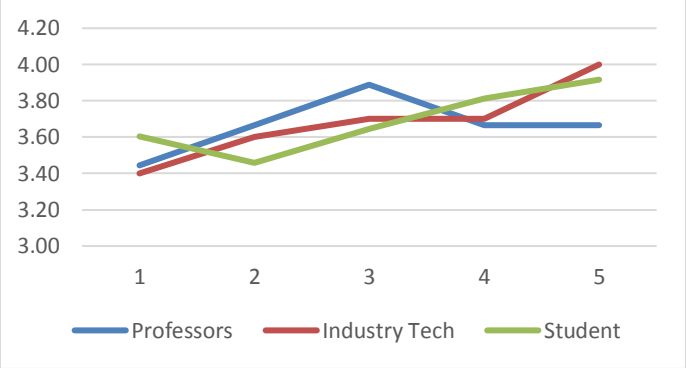

Figure 1. Mean Responses of different users on the Cost

The graphical representation of the responses of professors, industry technician, and students range from 3.40 to 4.0, which means that the variations of the responses fall within the category of very satisfactory and outstanding only. For a graphical representation of the responses of professors, industry technician, and students range from 3.40 to 4.0, which means that the variations of the responses fall within the category of very satisfactory and outstanding only. For students, it is the indicator number 2, "Device can be assembled using recycled components and materials" is the lowest when it comes to cost. Meanwhile, both the electronics professors and industry technician perceived that indicator number 1, "Components and materials readily available in the locality" are the lowest. However, this does not mean that it is very low since this indicator is just one unit below the highest indicator. For students, it is the indicator number 2, "Device can be assembled using recycled components and materials" is the lowest when it comes to cost. Meanwhile, both the electronics professors and industry technician perceived that indicator number 1, "Components and materials readily available in the locality" are the lowest. However, this does not mean that it is very low since this indicator is just one unit below the highest indicator. Essentially, technology innovation can be a crucial component of any effort to address needs and better serve individuals and families. This, in turn, encourages experimentation

with at low cost and low risk, leading to innovative ways of using technology to deliver healthcare and human services. It is relevant to improve assessment processes by means of technological innovation given the learning capacity it provides to all parties involved: students, teachers and educational institutions (Rivas & Arrufat 2016)

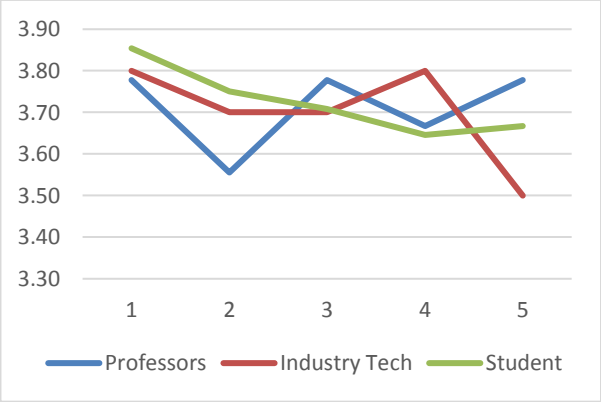

Figure 2. Responses of Different Users/ respondents on Aesthetics and Appearance

Figure 2 showed a comparison of the responses of professors, industry technician, and students. The figure showed on a smaller scale how the responses differ. Although, statistical significance was not tested as the difference of their responses. The figure showed what indicator number they differ in their responses. Most notable in the responses of the three groups is the item 2, 4 and 5. For the professors,indicator 2, "*The components and other peripherals are well arranged for the comfortability of the users"* was considered the lowest average. Meanwhile, the indicator 5, "*The device used binding post paired with a jack to avoid short circuits and maintain good appearance of RMSPS*" was the least feature of the device. This further means, that all the needed requirements for aesthetic considerations are fully accomplished. Aesthetics regarding how electronics professors, industry technician, and students perceived the device as beautiful and attractive based on their perception of beauty. Furthermore, the visual appearance of the device had a positive effect on performance, leading to reduced task completion times for the attractive model [16].

Figure 3 showed the comparison of the responses of the respondents on the different indicators of output variability. Two points that are very notable in the graph since these are the two very low points, those indicators 1 and indicators 5 for the responses of the electronics professors.

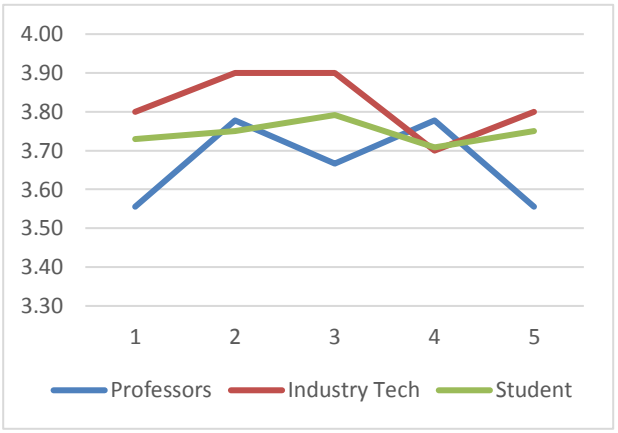

Figure 3. Responses of Different users/ respondents on Output Variability

Meanwhile, industry technicians also showed high values for the indicators 2 and 3. While students' remains in the middle points relative to both the electronics professors and industry technicians. The goal of device variability analysis is to predict their impact on circuit performance variability hence design tolerances and ultimately yield [13].

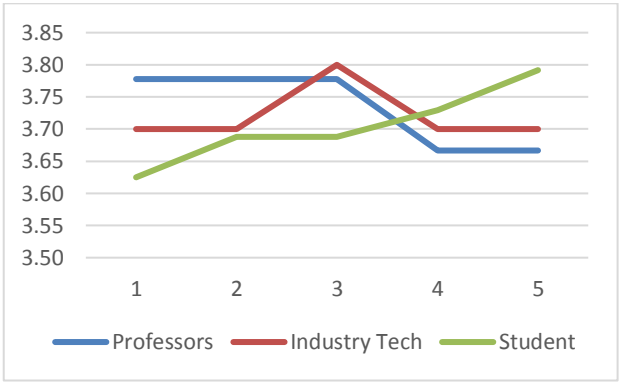

Figure 4. Responses of different users/respondents on Source Compatibility

The pattern of responses of the electronics professors and industry technician almost obeyed the same pattern for their perception on the compatibility of the device on its source, while students' responses obeyed a different path as shown in the graph. One notable point, for example, is the students' response to indicator 1 and indicator 5. The response of the students on indicator 1, "*The device is designed suitably to the source to be supplied*" is below the responses of the electronics professors and industry technician, similarly for the indicators 3 to 5, where students totally showed a different direction than the electronics professors and industry technician. Although

respondents are in opposing patterns of responses, they all under the range of outstanding category, which that the devise output compatibility according to the perception of the respondents have fully accomplished the necessary requirements for output compatibility. If they perceive themselves as compatible with the device, recipients perceive the review as more helpful because they attribute the review's content to the quality of the reviewed object; if they regard it as incompatible, recipients assume the review reflects the personal dispositions of the reviewer and discount its helpfulness [11].

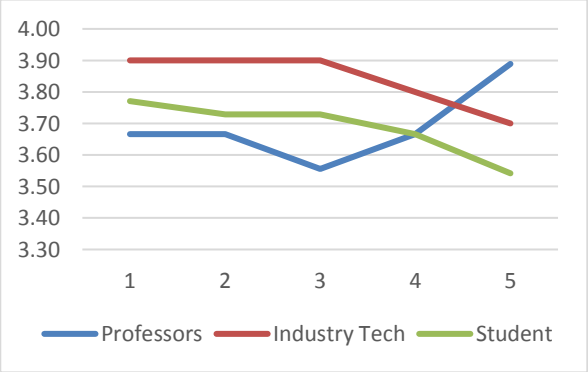

Figure 5. Responses of different users/respondents on Safety

Looking at the comparison of the responses of the electronics professors, industry technician, and students as shown in Figure 5, students and industry technician follows almost the same pattern of responses. While, electronics professors has an opposite trend in the graph particularly on item number 5, where the three lines crossed. These results might suggest that increasing levels of awareness and familiarity with technology could help mitigate concerns for safety, reducing this potential attitudinal barrier to their rapid adoption [12].

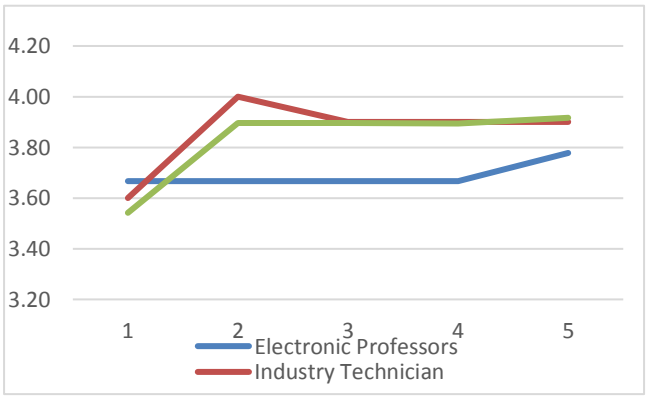

Figure 6. Responses of different users/ respondent on the Performance of the Device.

Looking at the pattern in Figure 6, the comparison of the performance ratings of the different respondents shows that both the pattern of the responses of the On-the-job trainee and Industry Technician are the same. Item 2 shows that they both agree that item 2 has the highest ratings for the performance indicators. Thus it is imperative to augment the cooling systems of device to obtain optimum performance. But the use of active coolers puts additional stress on the Power Supply Unit of the laptop [8]. This can increase the demand for power on the battery, thus leading to a faster power drain of the laptop's battery [8].

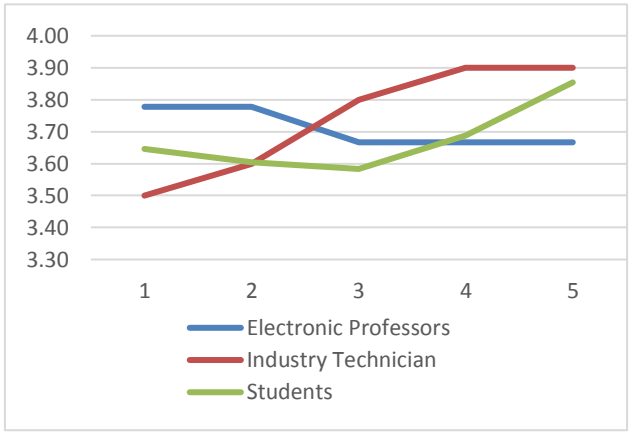

Figure 7. Responses of different users/ respondents on Service and Maintenance of the device

As shown in Figure 7 the pattern of the responses of the Electronics professors and the student are almost the same particularly on the items 1 to 3, however, the pattern suddenly shifted for indicators 4 and 5. The electronics professors and students differ in their responses for items 4 and 5. Note that the industry and students have the same pattern for the items 3 to 5. The definition of a general approach to maintenance, employing knowledge-based technology could be applicable. This view recognizes the essential need of successful maintenance to use and transfer knowledge about the business domain and its systems [10].

In Figure 8, Comparing the responses of different respondents from industry technician, electronic professors, and on-the-job trainee pattern showed that industry technician and students for items 1 to 3, and both electronics professors and industry technician. Note that all the responses of the different respondents differ in the directions of their responses for items number 5. Some students used more than one device/application, this can be attributed to that most students felt they were tech savvy; therefore, the devices/applications are easy to use. Students from

both the groups indicated that they would use devices/applications in the future, this can be attributed to their positive attitude towards usefulness and satisfaction. [17].

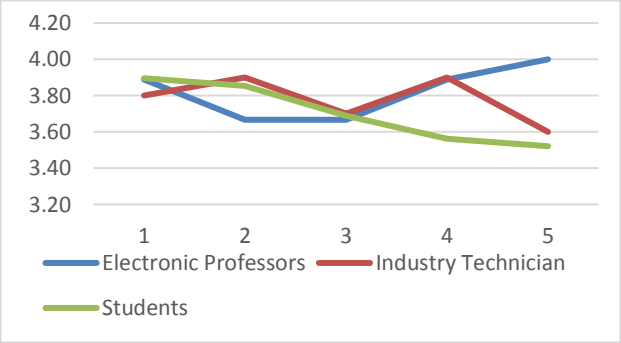

Figure 8. Responses of different users/ respondents on the Ease of Use of the device

Findings

The device is perceived by the respondent's groups as outstanding on its functionality. When categorized by occupation, the instructors and industry technicians rated all the parameter as outstanding except on item number 1 on cost wherein they rate very satisfactory while the OJT students in electronics, perceived to be very satisfactory on item number 2 on cost. As to functionality, the three groups of respondents generally rated the device as outstanding. As to acceptability, the three groups of respondents generally rated the device as Highly Acceptable.

CONCLUSION

Based on the above perceptions of the respondents, most of them were electronics graduates, well trained and duly certified by TESDA on electronics qualification that industrial and commercial experience and expertise made them qualified for this assessment. It was noted that the appropriateness of the device was considered the standards set forth by the National Electrical Code (NEC) and Philippine Electrical Code (PEC) and conformed to the national standards for TESDA competency assessment for electronics products assembly servicing NC II qualification. Moreover, the device is convenient and helps augment the insufficiency of instructional materials and can be utilized for skills competency assessment in electronics technology qualification.

RECOMMENDATIONS

Recommend the utilization of the output of the study in the academe, community, and industry.

2. The device will be used in the conduct of skills competency assessment of TESDA, particularly in electronics qualification. The device will be used as instructional materials to the students and that the administration will provide support for deeper study related to the said device. The device will be registered for patenting at Intellectual Property Office (IPO) with the assistance of the management.

ACKNOWLEDGEMENT

The author would like to express his gratitude to the people who in one way or another contributed to the success of this study.

REFERENCES

[1] Barba, J. A. (2006). Building Utilities Electrical, Mechanical, Acoustic. Andes Mountain Printers, Bitano, Legaspi City, Albay

[2] Berlex, A. (2012). Selection, utilization,and evaluation of instruction: Fundamentals of Educational technology. Ibadan: Y- Books

[3] Davis, F. (1989). Technology Acceptance Model.http://edutechwiki.unige.ch/en/Technology_acceptance_model.date retrieved: January 23,2019.

[4] Enriquez, M. Q. and Gantalao, F. T. (2004). Simple Electronics. Andes Mountain Printers#251.Francisco St., Malinta, Valenzuela City. 311pp.

[5] Faraday, M. (2018). Faraday's Law of Induction: How Transformer Work. Retrieved in https://www.arrow.com/en/research-and-events/articles/how-transformers-work#:~:text=Transformers%20contain%20a%20pair%20of,that%20winding%20via%20electromagnetic%20induction

[6] Gates, E. D. (2001). Introduction to Electronics. Fourth Edition. Delmar, a division of Thomas Learning.430pp.

[7] Grob, B. (1993). Basic Electronics. Seventh Edition. Echanis Press, Inc.760 Boni Avenue, Mandaluyong City

[8] Go, M. B. & Calzada, L.M. (2019). Development and performance of microcontroller-based laptop cooler. Journal of Agriculture and Technology Management (JATM) 22(1): xx-xx (January-June 2019) In Press

[9] Jenneson, J. (2003). Electrical Principles for Electrical Trades. Fifth Edition. McGraw-Hill Australia Pty Limited.

[10] Layzell P.J & Macaulay, L. P. (2014). An Investigation into Software Maintenance -Perception and Practices. Journal of software maintenance: Research and Practices, 6(3), 105-120.

[11] Marz, A., Schubach, S. & Schumann, J.H. (2017), "Why Would I Read a Mobile Review?" Device Compatibility Perceptions and Effects on Perceived Helpfulness, Psychology and Marketing , (34)2, 199-137. doi: 10.1002/mar.20979., retrieved from: https://onlinelibrary.wiley.com/doi/abs/10.1002/mar.20979

[12] Moodya , J., Baileyb, N., & Zhaoc, J.(2019). Public perceptions of autonomous vehicle safety: An international comparison. Safety Science. doi.org/10.1016/j.ssci.2019.07.022

[13] Nassif, S.R. (No Date), Design forVariability in DSM Technologies, Proceedings IIEE 2000 First International Furon on Electronics Design (Cat.No. PR00525), doi: 10.1109/isqed.2000.838919. retrieved from https://sci-hub.se/https://ieeexplore.ieee.org/abstract/document/838919#, date retrieved March 6, 2021.

[14] Oakes, J. (2008). Access to textbooks, instructional materials, equipment, and technology: inadequacy and inequality in California Public School. UC Los Angeles: William Watch Series.

[15] Pagarigan, M. S. & Bandi, S. A. (1986). Practical Electronics Solid State Servicing, Electrolab, 649 M & A Bldg., Quezon Blvd., Quiapo, Manila.207pp.

[16] Sonderegger, A. & Sauer, J. (2010),The influence of design aesthetics in usability testing: Effects on user performance and perceived usability. Applied Ergonomics(41)3,403-410. doi.org/10.1016/j.apergo.2009.09.002, retrieved March 6, 2021

[17] Singh, U.G. & Msibi, A. (2021). Students' perceptions towards IoTs adoption: A case study. Journal of Physics: Conf. Ser. 1714 012044

[18] Siskind, C. S. (1982). Electrical Machines.International Student Edition.Meriam and Webster. Manila, Philippines.