

## Innovative Workbench as an Instructional Tool for Basic Electronics

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**Abstract:** Industrial Arts is an undergraduate course that involves manual skills development. It is challenging for both teachers and students to work in the absence of a standard working table in the laboratory in testing, soldering, and troubleshooting electronics devices. Laboratory learning task requires fixed and stable equipment and measuring instruments in dealing with actual circuitry for safety. Thus, this study aimed to fabricate and determine the acceptability of the electronic workbench as an innovative instructional tool. The product was evaluated by teachers and students using a survey questionnaire in terms of durability, function, style and design, usability, and transportability. Results showed that the electronic workbench was acceptable. Durability, purpose, style and design, and usability were rated as very acceptable among teachers while transportability was rated as highly acceptable. Amongst students all the criteria were rated as highly acceptable. Both students and teachers have found other features of the instructional tool such as having organized drawers to store the different tools, materials and equipment used for basic electronics activities to be very useful. Based on the findings of the study, it was concluded that the innovative electronic workbench was found to be safe and acceptable for instructional use in the laboratory.

**Keywords:** instructional innovation, fabrication, workbench, basic electronics, and innovative tool

### 1. Introduction

Acquiring the knowledge, skills and competencies required for students can be obtained in different ways. The learning environment, the teachers' knowledge and skills, student's readiness and availability of instructional materials all form part of the efficient way of acquiring the required knowledge and skills that students must attain. The use of instructional tools is one of the factors that contribute to students' learning. Instructional tools are any tangible materials which are used in the teaching-learning process that stimulate students' senses and facilitate concept attainment and achievement of competencies required (Diate and Mordeno, 2021; Rosales and San Diego, 2018). Lack of supplementary materials can thwart students' learning. The importance and usefulness of instructional materials in the teaching and learning process cannot be

undermined as these instructional tools or materials help concretize students' learning and achieve the goals set by the education system. Classroom experiences reveal better concentration and high achievements when students are taught with the appropriate and efficient instructional materials. Effective teachers are masters in the effective use of instructional materials to bring about desired behavioral changes of the learners (Koko, 2016). One of the programs being offered in technology education is the field of Industrial Arts wherein one of the areas being taught is the Electronics course (Pabatang, 2015). Electronics as a course have both the Lecture and Laboratory activities which enhance students who will be future teachers to learn the technical skills and knowledge in the field of basic electronics. In the laboratory activities of Electronics as a course, students are expected to work with different tools such as soldering tools, multimeter, hand tools and other devices. Teachers will be able to support their students by allowing them to plan, construct, assemble, and examine their own works on circuits in a safe and realistic manner. Considering the importance of enhancing the learning process of the students, the researchers' thought of a solution that can enhance their skills in basic electronics wherein students can perform their basic electronics tasks efficiently and effectively in a safe and comfortable manner. A workbench being one of the instructional tools has great potential for enhancing learning. Students with difficulty in understanding a particular circuit concept can work comfortably using the electronics workbench to run the activity repeatedly and analyze circuit problems. This can be a good instructional tool which can be used in conjunction with other effective teaching practices. Students in electronics can add simulation to their collection of electronics experiences and Electronic Workbench is very useful for remedial or accelerated students during tutorials, presentations and experimentation (Albarico et.al., 2014). However, it has been observed that the Industrial Arts students do not have the conducive space while working in their laboratory activities in the basic electronics course. In the study conducted by Albarico et. al in 2014, results from a study conducted have significant finding that there was an inadequate number of instructional resources as well as the amount of the tools and equipment in relation to the number of students enrolled in Bachelor of Science in Education major in Technology and Livelihood Education (BSEd-TLE) subjects; in which one of the courses offered in the said program is the basic electronics (Albarico et.al., 2014). It is on this premise that the researchers aim to fabricate an innovative electronic workbench which is safe to use, multifunctional and mobile. The researcher's aim is to innovate an Electronics Workbench which is unique from other workbenches in which the work is held in one place. Most benches have more than one way of doing circuits, depending on the operation being performed. For the reason of innovating instructional tools which will help students learn the activities in a conducive and safe method, the researchers developed an innovative electronic workbench.

#### *Literature Review*

On the field of teaching desk making, an invention of Multifunctional Teaching Desk is a patented invention developed by Wang Lei. The design belongs to the field of teaching as a piece of equipment, particularly as a multifunctional lecture table. The teaching desk is complete in function and facilitates the working and education of teachers. The positive effect is the lecture table can accommodate teaching books through a plurality of partitions, and placed in the classroom with convenience (Yeban, 2013).

Multi-Sided Electrical Motor Control Trainer is another innovative instructional trainer developed by Yeban. The said instructional trainer was designed and developed to address the problems met by students in understanding basic motor control, wiring motor control, and power circuits. The MEMCT has different modules that can be performed by two students at the same time for single-phase and three-phase circuit

construction. In the evaluation of the Multi-Sided Electrical Motor Control Trainer, results show that respondents strongly agree on its usability and acceptability (Lei, 2016; Yeban, 2013).

The importance of an expanded training module is also believed to be essential in the training of students. It included the mockup model and learning exercise materials, which served different activities for the students. The training module aimed to accelerate the learning assimilation of knowledge, skills, and attitude of electrical installation and maintenance among senior high school students. The training module was intended to cater to the needs for training and classroom instructions for beginners and those who wanted a refresher and enhancement training. Likewise, it is also essential for the teacher-trainer to facilitate learning situations efficiently and effectively. The expanded training module was found to be very good in terms of its effectiveness, workmanship, functionality, safety, and user friendly (Schembri, 2012).

Refrigeration and Air Conditioning Instructional Trainer was designed and developed by Sumalpong in order to advance the classroom instruction or training on refrigeration and air conditioning. Using simulations, students can experience the actual function of the system that could enhance their learning capabilities in troubleshooting of the basic electrical and mechanical system of refrigeration and air conditioning units. The trainer was evaluated by twenty-five respondents in which variables such as functionality, reliability, portability, safety, and academic impact of the trainer had an excellent evaluation as perceived by the respondents and was rated as Very good by the respondents for the trainer's aesthetic and economy aspects (Progressive Teacher, 2021).

### *Objectives of the Study*

Generally, this study aims to provide an innovative workbench for basic electronics that facilitates the enhancement of knowledge and skills in performing the tasks in basic electronics and seeks to:

1. Establish the need for the fabrication of Workbench for basic electronics.
2. Design basic workbench for basic electronics.
3. Fabricate the designed workbench for basic electronics.
4. Evaluate the workbench in terms of the following criteria:
  - a.) Durability
  - b.) Purpose
  - c.) Style and Design
  - d.) Usability
  - e.) Transportability

### *Framework of the Study*

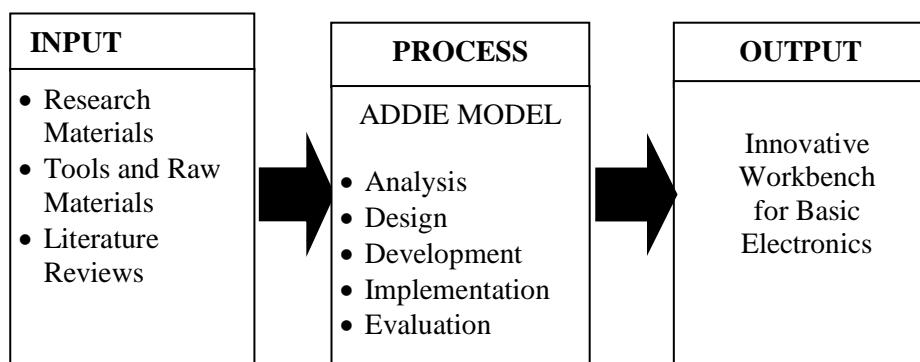


Figure 1: Schematic Diagram of the Innovative Workbench for Basic Electronics

Figure 1 shows the research framework using the Input-Process-Output (IPO) model which identifies the inputs, outputs, and processes presented by a functional graph that represents the flow of data and materials that go into a process that transforms the inputs into output (Schembri, 2012).

In this study, the inputs used to start the research process are the research materials which include research concepts on product development, the tools and raw materials in the process of innovation and fabrication of the workbench and literature reviews that help in conceptualizing the design and evaluation of the workbench. In the process stage, the five phases in ADDIE Model namely: Analysis, Design, Development, Implementation, and Evaluation were applied. The ADDIE model is used to represent a dynamic, flexible guideline for building effective training and performance support tools. Analysis is first phase of the ADDIE model, in this phase, the research problem is established and clarified, and the instructional goals and objectives are established and the type of learners' knowledge and skills are identified (Nichols Hess and Greer, 2016). The second phase is the Design phase which includes determining how the workbench will be designed in such a way that the product is conducive, safe and easy to use. This phase includes the process of making a prototype through the use of Computer Aided Design (CAD) application. The development phase is the third phase which is process of making of the project and the fabrication and assembly of the different parts of the innovative electronic workbench based on the designed prototype. In this phase, the workbench is being tested and checked before final evaluation. The fifth phase of the ADDIE model is the Implementation stage, however in this model the implementation stage was not conducted due to limitation of time. The last phase was evaluation, this phase comprised of various tools for data gathering of the study such as questionnaire which is used and distributed to abet the improvised workbench. The last stage of the research framework and process is the Output stage which presents the evaluated innovative workbench for basic electronics.

## 2. Methodology

### 2.1. Research Design

This study used the research and development process with quantitative research methods in the data gathering phase. In this study, the development of an instructional innovation was made by designing and fabricating a workbench to support students in working with their projects and laboratory activities for basic electronics courses. The innovative instructional tool was evaluated by students and teachers.

### 2.2 Participants

The research participants were five (5) faculty members and thirty (30) randomly selected students, a total of thirty-five (n=35) sets of a panel of evaluators. The faculty members are purposely chosen since they are teaching the course Basic Electronics while students are taking the course and are directly involved in the processes and activities in the laboratory. These panels of evaluators have assessed the workbench.

### 2.3 Research Instruments

An adopted and modified evaluation questionnaire from the study entitled "Development of the 2-in-1 Ergonomic Drafting Table with accordion Bed" was used as the main instrument for the data gathering and analysis. The questionnaire involves two parts; first parts is the profile of the respondents (i.e. age, gender, and major/course), and the second part is the set of questions where it involves the evaluation of durability, style and design, purpose, usability, and transportability of the development of the innovative workbench. It is the main instrument used in evaluating the workbench for basic

electronics. The instrument was given to the students and instructors to get their honest opinion upon testing the workbench. The students marked and checked the boxes provided for the statement that best describe their responses.

#### 2.4 Research Procedure

In this stage the researchers selected the materials to be used in fabricating the innovative workbench and accompanied by the carpenter. The procedures and the steps in fabricating the innovative workbench were identified using the ADDIE MODEL as a framework in the research procedure. The analysis stage was completed based on the main objective of the study which is to produce an innovated workbench which caters to the needs of students in developing their skills. The design phase was done by interviewing students who had experienced working with electronics tasks. In this stage working with a blue print was made in order to know the layout of the project.

The development of the innovative electronic workbench had undergone specific processes or steps which contributed to its realization and evaluation of its function and purpose.

A plan and circuit design was made to begin the work with the use of AutoCAD software. After the plan was made, it was presented to the furniture shop to estimate the materials needed and labor cost. Cutting of plywood, lumber, and boards according to the specified dimension and sizes of the design and layout of the table was done by the carpenter. Assembling the structure and joints of the table was done. Necessary adjustments were made to achieve balance and symmetry before the attachment of plywood and boards. Making of holders and drawers were done and installed to the table. Then the electrical components were installed. Testing of all components was also done and necessary adjustments to components have malfunctioned or inconsistencies were made. Finally, application of finishing material to the table was done for aesthetic purposes.

The evaluation process of the innovative workbench was done through the distribution of questionnaires among the respondents, who are teachers, handling basic electronics and students who have taken up the course. Students and teachers have tried and used the electronic workbench and have evaluated the workbench through a set of criteria.

#### 2.5 Data Analysis

The data gathered was tabulated and statistically treated using the percentage, weighted mean and standard deviation. Data gathered will be taken to mean with the following interpretation and description according to the range of mean:

Legend:

| Range of Mean | Interpretation       | Description           |
|---------------|----------------------|-----------------------|
| 3.70- 4.00    | Extremely Satisfied  | Highly Acceptable     |
| 2.80- 3.69    | Very Satisfied       | Very Acceptable       |
| 1.90- 2.79    | Slightly Satisfied   | Not Acceptable        |
| 1.00 -1.89    | Not at all Satisfied | Highly Not Acceptable |

### 3. Results and discussions

The main objective of this study is to produce an innovative workbench for Basic Electronics that can cater the needs of students in developing their skills. The researchers conducted an assessment survey to determine if it is necessary to make supplementary materials to improve the skills and learning capabilities of the students in basic electronics. Five (5) teachers evaluated the innovative workbench for basic electronics using a rubric. Thirty (30) students that had already taken up Basic Electronics subject also take part of the evaluation. The workbench was evaluated according to the following criteria: Durability, Purpose, Style and Design, Usability and Transportability.

The results of the evaluation are as follows:

#### 3.1 Teacher's Evaluation of the Innovative Workbench

The result of teacher evaluation on innovative workbench was presented in terms of its durability, purpose, style and design, usability, and transportability.

##### *Teachers' evaluation on innovative workbench in terms of its durability*

Table 1 shows the evaluation of the teachers on the durability of the workbench in terms of its ability to withstand when used in a longer period of time, the durability of the skeletal structure and its drawer capacity which has a mean of 2.80, 3.20 and 3.40 respectively. Results showed that all the indicators gained a descriptive rating of "Very acceptable" with an Interpretation of "Very Satisfied". These results suggested that the teachers are very satisfied with the innovative electronic workbench's durability.

Table 1: Teachers evaluation on innovative workbench in terms of its durability

| Indicators of durability                                      | Mean        | SD          | Descriptive Rating     | Interpretation        |
|---|-------------|-------------|------------------------|-----------------------|
| The workbench can withstand even if it's used in longer time. | 2.80        | 1.10        | Very Acceptable        | Very Satisfied        |
| Durability of the skeletal structure. (base, frame, and etc.) | 3.20        | 0.84        | Very Acceptable        | Very Satisfied        |
| The drawer can hold its specific usage.                       | 3.40        | 0.55        | Very Acceptable        | Very Satisfied        |
| <b>Overall</b>  | <b>3.13</b> | <b>0.83</b> | <b>Very Acceptable</b> | <b>Very Satisfied</b> |

##### *Teachers' evaluation on innovative workbench in terms of its purpose*

Table 2 presents the Teachers' evaluation in terms of the innovative workbench's purpose. Results of the study shows that the workbench can be used in shop for basic electronics classes with a mean of 3.60, the students will be motivated in learning laboratory activities using the innovated workbench with a mean rating of 3.20 and that the compartments of the workbench have enough storage capacities with a mean rating of 3.00. These results show that for teachers, have rated the innovative workbench's purpose as very acceptable with an interpretation of very satisfied.

Table 2: Teachers evaluation on innovative workbench in terms of its purpose

| Indicators of purpose   | Mean        | SD          | Descriptive Rating     | Interpretation        |
|---|-------------|-------------|------------------------|-----------------------|
| The product can be used in shop for basic electronics classes.                                  | 3.60        | 0.55        | Very Acceptable        | Very Satisfied        |
| The students will be motivated in learning laboratory activities using the innovated workbench. | 3.20        | 0.84        | Very Acceptable        | Very Satisfied        |
| The compartment of the workbench can store enough tools and materials.                          | 3.00        | 1.23        | Very Acceptable        | Very Satisfied        |
| <b>Overall</b>  | <b>3.27</b> | <b>0.87</b> | <b>Very Acceptable</b> | <b>Very Satisfied</b> |

*Teachers' evaluation on innovative workbench in terms of its style and design*

It can be observed in Table 3 that the style and design of the innovative workbench with the indicator "The physical appearance conveys satisfactory and comfort." has a mean of 3.00 followed by "The color adds interest to the user" with a mean of 3.20, the style and design adds interest to the user." has a mean of 3.20, and the features are different from the existing workbench has a mean of 3.00. Results of this evaluation showed that the teachers have evaluated the style and design of the electronic workbench to be very acceptable with an interpretation of very satisfied. Previous study about variables affecting student motivation revealed that one of the most important areas affecting student motivation are the field of teacher teaching methods which includes teaching methods and strategies and the use of instructional technologies (Yilmaz et.al., 2017). It is significant to think of how to integrate style and design in creating equipment for instruction for the benefits that will create an experience that motivates your learners and users and give them enthusiasm to learn. This in turn also enhances usability of the instructional materials or tools used (Malamed, 2021). The present study aims to incorporate style and design in fabricating the innovative electronic workbench to motivate learners, give them ease and comfort while working with laboratory activities and give them enthusiasm to learn.

Table 3: Teachers evaluation on innovative workbench in terms of its style and design

| Indicators of style and design                            | Mean        | SD          | Descriptive Rating     | Interpretation        |
|---|-------------|-------------|------------------------|-----------------------|
| The physical appearance conveys satisfactory and comfort. | 3.00        | 0.71        | Very Acceptable        | Very Satisfied        |
| The color adds interest to the user.                      | 3.20        | 0.45        | Very Acceptable        | Very Satisfied        |
| Style and design adds interest to the user.               | 3.20        | 0.84        | Very Acceptable        | Very Satisfied        |
| <b>Overall</b>  | <b>3.10</b> | <b>0.68</b> | <b>Very Acceptable</b> | <b>Very Satisfied</b> |

*Teachers' evaluation on innovative workbench in terms of its usability*

Table 4 showed the evaluation of teachers on the usability of the innovative workbench. The workbench's effectiveness and efficiency to use to achieve specified goals in the course has a mean rating of 3.20 and 3.60 respectively while users' satisfaction and easiness of operation and use of the workbench has a mean rating of 3.40 and 3.60 correspondingly. These results showed that the teachers rated very acceptable with a very satisfied interpretation on the usability of the instructional tool and thus the tool is functional and working.

Table 4: Teachers evaluation on innovative workbench in terms of its usability

| Indicators of usability   | Mean        | SD          | Descriptive Rating     | Interpretation        |
|---|-------------|-------------|------------------------|-----------------------|
| The product is effective to use to achieve specified goals in the course. | 3.20        | 0.45        | Very Acceptable        | Very Satisfied        |
| The product is efficient to use to achieve specified goals in the course. | 3.60        | 0.55        | Very Acceptable        | Very Satisfied        |
| The product assures users satisfaction.                                   | 3.40        | 0.55        | Very Acceptable        | Very Satisfied        |
| The product is easy to operate or use.                                    | 3.60        | 0.55        | Very Acceptable        | Very Satisfied        |
| <b>Overall</b>  | <b>3.45</b> | <b>0.53</b> | <b>Very Acceptable</b> | <b>Very Satisfied</b> |

*Teachers' evaluation on innovative workbench in terms of its transportability*

As presented in Table 5, results showed that the Teachers have evaluated the workbench to as easy to maintain, easy to transfer and is rigid or stable when moved from one place to another with the mean rating of 3.50, 3.90 and 3.66 correspondingly. Among the indicators, being transportable has the highest mean rating with a highly acceptable rating and an interpretation of extremely satisfied. Therefore, teachers have assessed the workbench as a very mobile tool. Furthermore, results also showed that the over-all rating of the transportability of the workbench is 3.70 which means that the teachers rated it as highly acceptable with an interpretation of extremely satisfied.

Table 3: Teachers evaluation on innovative workbench in terms of its style and design

| Indicators of style and design                    | Mean        | SD          | Descriptive Rating       | Interpretation             |
|---|-------------|-------------|--------------------------|----------------------------|
| Is it easy to maintain?                           | 3.5         | 0.32        | Very Acceptable          | Very Satisfied             |
| Is it easy to transfer from one place to another? | 3.9         | 0.31        | Highly Acceptable        | Extremely Satisfied        |
| The product is rigid even if it's moved.          | 3.66        | 0.48        | Very Acceptable          | Very Satisfied             |
| <b>Overall</b>                                    | <b>3.70</b> | <b>0.37</b> | <b>Highly Acceptable</b> | <b>Extremely Satisfied</b> |

### 3.2 Student's Evaluation of the Innovative Workbench

The result of student evaluation on innovative workbench was presented in terms of its durability, purpose, style and design, usability, and transportability.

*Students' evaluation on innovative workbench in terms of its durability*

Results of on students' evaluation of the innovative workbench in terms of its durability as shown in Table 6 suggests that in terms of its ability to withstand when used in a longer period of time, the durability of the skeletal structure and its drawer capacity has a mean of 3.73, 3.76 and 3.70 respectively. Results showed that all the indicators gained a descriptive rating of "Highly Acceptable" with an Interpretation of "Extremely Satisfied". These results suggested that the students are extremely satisfied with the innovative electronic workbench's durability.

Table 6: Students evaluation on innovative workbench in terms of its durability

| Indicators of durability                                      | Mean        | SD          | Descriptive Rating       | Interpretation             |
|---|-------------|-------------|--------------------------|----------------------------|
| The workbench can withstand even if it's used in longer time. | 3.73        | 0.45        | Highly Acceptable        | Extremely Satisfied        |
| Durability of the skeletal structure. (base, frame, and etc.) | 3.76        | 0.43        | Highly Acceptable        | Extremely Satisfied        |
| The drawer can hold its specific usage.                       | 3.70        | 0.47        | Highly Acceptable        | Extremely Satisfied        |
| <b>Overall</b>  | <b>3.73</b> | <b>0.45</b> | <b>Highly Acceptable</b> | <b>Extremely Satisfied</b> |

*Students' evaluation on innovative workbench in terms of its purpose*

Results of students' evaluation on innovative workbench in terms of its purpose as shown in Table 7 suggests that the workbench can be used in shop for basic electronics classes with a mean of 3.83, the students will be motivated in learning laboratory activities using the innovated workbench with a mean rating of 3.76 and that the compartments of the workbench have enough storage capacities with a mean rating of 3.56. These results show that for the students' assessment, they have rated the innovative electronic workbench's purpose as highly acceptable with an interpretation of extremely satisfied. This also suggests that the students who have worked with laboratory activities for basic electronics found the innovative workbench to be useful.

Table 7: Students evaluation on innovative workbench in terms of its purpose

| Indicators of purpose   | Mean        | SD          | Descriptive Rating       | Interpretation             |
|---|-------------|-------------|--------------------------|----------------------------|
| The product can be used in shop for basic electronics classes.                                  | 3.83        | 0.38        | Highly Acceptable        | Extremely Satisfied        |
| The students will be motivated in learning laboratory activities using the innovated workbench. | 3.76        | 0.43        | Highly Acceptable        | Extremely Satisfied        |
| The compartment of the workbench can store enough tools and materials.                          | 3.56        | 0.50        | Very Acceptable          | Very Satisfied             |
| <b>Overall</b>  | <b>3.71</b> | <b>0.44</b> | <b>Highly Acceptable</b> | <b>Extremely Satisfied</b> |

*Students' evaluation on innovative workbench in terms of its style and design*

Table 8 shows the students' evaluation on the innovative workbench in terms of style and design. In terms of physical appearance which conveys satisfactory and comfort has the highest mean rating of 4, while color, style and design and the features being unique from the other existing workbench has the mean rating of 3.76, 3.66, and 3.56 respectively. Over-all the style and design of electronic workbench as evaluated by the students is highly acceptable which means that they are extremely satisfied. This suggested as well that the style and design of the electronic workbench is fitting for classroom use.

Table 8: Students evaluation on innovative workbench in terms of style and design

| Indicators of style and design                            | Mean        | SD          | Descriptive Rating       | Interpretation             |
|---|-------------|-------------|--------------------------|----------------------------|
| The physical appearance conveys satisfactory and comfort. | 4           | 0.5<br>3    | Highly Acceptable        | Extremely Satisfied        |
| The color adds interest to the user.                      | 3.76        | 0.4<br>3    | Highly Acceptable        | Extremely Satisfied        |
| Style and design adds interest to the user.               | 3.66        | 0.5<br>3    | Very Acceptable          | Very Satisfied             |
| The features are different from the existing workbench.   | 3.56        | 0.5<br>6    | Very Acceptable          | Very Satisfied             |
| <b>Overall</b>  | <b>3.75</b> | <b>0.51</b> | <b>Highly Acceptable</b> | <b>Extremely Satisfied</b> |

*Students' evaluation on innovative workbench in terms of its usability*

Results on the students' evaluation on the innovative workbench in terms of usability were shown in Table 9. The workbench is effectiveness to use to achieve specified goals in the course has a mean rating of 3.83 which means the workbench is highly acceptable in terms of effectiveness while in terms of efficiency the mean rating is 3.66 that suggests that the workbench is efficiently useful. On the other hand, users' satisfaction and easiness of operation and use of the workbench has a mean rating of 3.40 and 3.60 correspondingly with a descriptive rating of very acceptable and highly acceptable. The over-all results showed that students rated highly acceptable with an extremely satisfied interpretation on the usability of the instructional tool and thus the tool useful for classroom instruction use.

Table 9: Students evaluation on innovative workbench in terms of usability

| Indicators of usability   | Mean        | SD          | Descriptive Rating       | Interpretation             |
|---|-------------|-------------|--------------------------|----------------------------|
| The product is effective to use to achieve specified goals in the course. | 3.83        | 0.38        | Highly Acceptable        | Extremely Satisfied        |
| The product is efficient to use to achieve specified goals in the course. | 3.66        | 0.48        | Very Acceptable          | Very Satisfied             |
| The product assures users satisfaction.                                   | 3.5         | 0.32        | Very Acceptable          | Very Satisfied             |
| The product is easy to operate or use.                                    | 3.9         | 0.31        | Highly Acceptable        | Extremely Satisfied        |
| <b>Overall</b>  | <b>3.72</b> | <b>0.27</b> | <b>Highly Acceptable</b> | <b>Extremely Satisfied</b> |

*Students' evaluation on innovative workbench in terms of its transportability*

Table 10 showed the result of students' assessment of the workbench in terms of transportability. An overall mean rating of 3.7 shows that the innovative workbench is easy to maintain, easy to transfer and is rigid or stable when moved from one place to another. Results showed that the workbench's transportability is highly acceptable and students are extremely satisfied with this feature. Therefore, teachers have assessed the workbench as a very mobile tool.

Table 10: Students evaluation on innovative workbench in terms of its transportability

| Indicators of transportability                    | Mean        | SD          | Descriptive Rating       | Interpretation             |
|---|-------------|-------------|--------------------------|----------------------------|
| Is it easy to maintain?                           | 3.5         | 0.32        | Very Acceptable          | Very Satisfied             |
| Is it easy to transfer from one place to another? | 3.9         | 0.31        | Highly Acceptable        | Extremely Satisfied        |
| The product is rigid even if it's moved.          | 3.66        | 0.48        | Very Acceptable          | Very Satisfied             |
| <b>Overall</b>                                    | <b>3.70</b> | <b>0.37</b> | <b>Highly Acceptable</b> | <b>Extremely Satisfied</b> |

In summary, the overall evaluation of teachers on innovative workbench was very acceptable on the set of criteria while the students' evaluation of the innovative workbench yielded a descriptive rating that was highly acceptable in terms of the instructional tools' durability, purpose, style and design, usability and transportability. The findings showed that the innovative workbench can be used by teachers and students in their laboratory and practical activities in the class. Students are extremely satisfied with the workbench as it conforms to its purpose and use in the classroom. In addition, its style and design convey with the comfort when using and its appearance helps the classroom to be aesthetically conducive for the classroom.

The overall results support the findings of Rosales and San Diego that innovative training equipment would make students be exposed to the specific hands-on activities and workouts and will allow college students to comprehend and apprehend the studying approaches in performing electrical installation and maintenance (Schembri, 2012).

Another study by Sumalpong, justifies the findings that the instructional device or trainer serves its purpose to equip college students with information and skills in refrigeration and air-conditioning situation as it provides complete educating and learning capability (Sumalpong, 2014). .

#### 4. Conclusion and recommendations

The Innovative Workbench for Basic Electronics was believed and highly accepted by students as it exemplified its objectives in terms of durability, function, style and design, usability, and transportability. This innovative workbench was designed to help students work on tasks and activities in basic electronic subject to be easier and faster with conformity to its safety and efficiency when using the workbench. Moreover, the Innovative Workbench was believed to have helped students to engage and demonstrate learning of technical skills in the laboratory activities of basic electronics and that it is an effective supplementary material used in working electronics task.

On the basis of the conclusions drawn, it is recommended that the enhancement of soldering iron holder may be improved by mounting alternative lock for safety and steady position and the height of the bench must be appropriate for medium size user. The workbench must have a light or lamp in order to have more lighting specifically when the rooms are not well lighted. Future researchers may improve the innovated workbench for Basic Electronics by applying the recommendation given by the respondents. Further study may be conducted in order to better enhance the design of the workbench to cater collaborative group activity in the classroom.

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## 6. Appendices

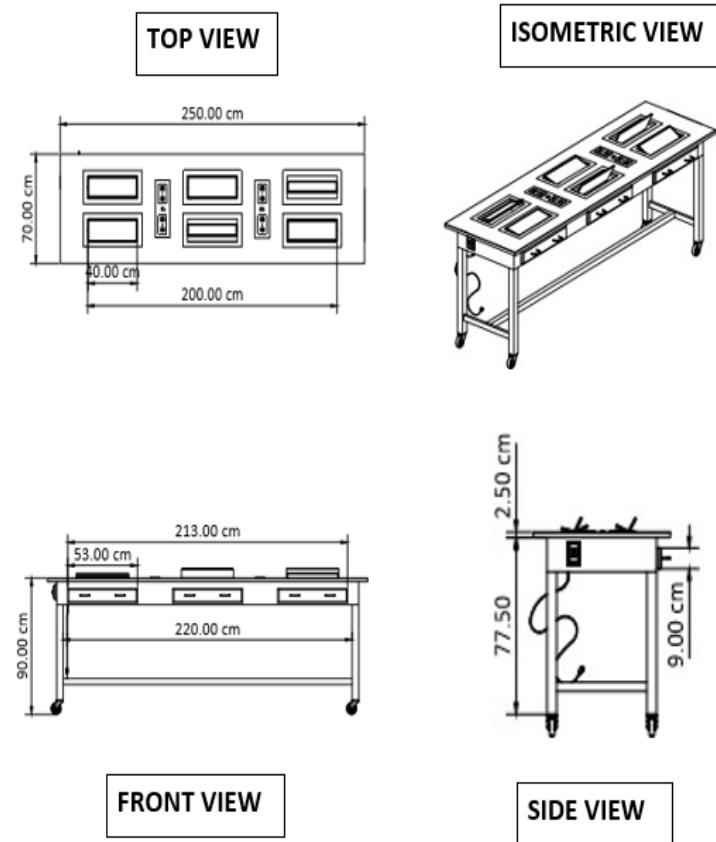


Figure 2: Design plan of the Innovative Workbench



Figure 3: The Innovative Workbench