# Effectiveness of Aircraft Ground Operation Course in Enriching the Aircraft Maintenance Program

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***Abstract*— The demand for aviation maintenance technicians (AMT) is rapidly increasing and there is a need to provide as many as 769,000 over the next twenty20 years (Boeing, 2018). The program defined in this study is extra enrichment in bracing the delivery of aviation maintenance technology instruction. For the Aircraft Maintenance Technology (AMT) students of any aviation institution, an effective teaching method for a technical student should be given with hands-on training aside from theoretical knowledge for them to experience the actual learning process to maximize their skills and this will be a great help for their professional growth and development. The purpose of this study is to determine the effectiveness of aircraft ground operations in enriching the aircraft maintenance program. The participants of the study were composed of 35 AMT personnel and 25 AMT students which came from three (3) approved Maintenance Organization Company and one (1) approved Training Organization (Maintenance school) in Metro Manila. A four-point Likert scale was employed to survey the level of effectiveness of the Aircraft Ground Operation for the AMT Program and was evaluated in terms of Aircraft Simulator, Aircraft Run-up and Taxiing, Aircraft Fueling and refueling, Aircraft Marshalling, Aircraft Servicing, Facilities and Equipment, Aircraft Inspection and Safety Awareness. In the findings, all participants are males who belong to age ranging from 20-25 years old. Most of the participants are BSAMT/AMT graduates. The overall perception of the participant's AMT personnel and students on the effectiveness of aircraft ground operation has yielded a result that is verbally interpreted as "effective". This was further inferred and validated using Mann Whitney which resulted in the findings that there is no statistically significant difference in the responses of AMT personnel and the students. This meant that there was no significant difference in the perception of the group of participants on the effectiveness of the aircraft ground operation course in enriching the aircraft maintenance program.***

## I. INTRODUCTION

The demand for Aircraft Maintenance Technology today in this day in an age today is overwhelming., according to (Boeing (, 2018), over 769,000 new maintenance technicians, and 914,000 new cabin crew will be needed to fly and maintain the world fleet over the next 20 years. To address s the demand such demand, the need to develop training programs for safe ground vehicle operations, personnel taxiing or towing an aircraft, and pedestrian control on the movement and safety areas of an airport (FAA Advisory Circulars, 2015) through quality standards of instruction from the academe to industry is always connected with it, in order must be provided to provide guidance fully-equip and guide to current and future airport operators.

"Ground handling operations are a source of significant personnel safety and aircraft/equipment damage concerns. Maintaining and improving ground operational safety are challenging in this complex environment yet there are few global regulatory provisions in place" (ICAO, 2016). A general guideline for individuals, organizations, and other entities regarding the policies for Aircraft

The ground arrangement that could be acceptable for the Civil Aviation Authority of the Philippines should be in place (CAAP Advisory Circulars, AC 09-007)

## II. PROCEDURE

- *Methods of Research*

This study utilized a descriptive research method to determine the level of effectiveness of an aircraft ground operation course in enriching the Aircraft Maintenance Technology program.

According to Wierma (2005), this type of research concerns the present situation, prevailing conditions, current practices, as well as the contemporary events, characteristics of individuals or groups, their behavioral patterns, attitudes, as well as opinions. The descriptive method was designed for the investigation to gather information about a present and existing condition. It involves the analysis and interpretation of what was perceived and described.

Krishna Kumar (2011) refers to quantitative research as the systematic empirical investigation of any phenomena via statistical, mathematical, or correlational research. This was the method applied to this study to assess and measure if there is a significant difference in the perception of the participants and the non-program effectiveness.

- *Participants of the Study*

The participants of this research are the following:
The twenty-five (25) 3rd year students of the Bachelor of Science in Aircraft Maintenance Technology m (BSAMT) at Air Link International Aviation College for 2nd Trimester AY 2020-2021. The questionnaires were particularly given to the students at college, private institution that specializes in aviation-related programs and the only school in the Philippines that offers Aircraft Ground Operation course for all its technical students.

For the professional participants, Aircraft Technician employees from different Approved Maintenance Organizations such as ALIAC (15 AMT employees), DAW (9 AMT employees) and PADC (11 AMT employees) which the rating is Airframe, Powerplant, Instrument, and specialized services for small aircraft in Metro Manila. The questionnaires were given to the aircraft technicians after the approval of the management to conduct the survey.

- *Data Gathering Instrument*

The instrument of the study is a structured, researcher-made survey type of questionnaire that was divided into two parts. The first part is about the profile of the participants and the second part is all about the Effectiveness of Aircraft Ground Operation Course in Enriching the Aircraft Maintenance Technology Program. This is a systematic method of gathering information from a target population.

To secure approval for the carrying out of the study, specifically in the distribution of the questionnaire in the said school and AMO company, the researcher should present a formal letter of request to the authorities concerned.

- *Statistical Treatment of Data*

After the retrieval of the questionnaires, the researcher organized and tabulated the data. The data gathered was then interpreted to derive the summary of findings, and consequently, craft the conclusions of the study.

The following statistical tools and techniques were applied to analyze data.

1. Frequency Distribution. The data gathered through the questionnaire was summarized, tallied, and tabulated to indicate the number of participants to specific questions or items in the questionnaire.

Percentage. This was used to determine the frequency of the participants.

$$P = F/(N)X\ 100$$

Where:

P = Percentage
F = Frequency
N = Total Number of participants

2. Weighted Mean. The weighted mean was used to get the average score on the ratings of the participants on level of awareness; satisfaction; and assessment. Further, this was also used in generating the grand mean after the median test.

The formula is:

"X = “ “Σfx" /"N "

Where:

"X" = Weighted mean

Σfx = Sum of frequency

N = Number of Participants

Relatively, the above descriptive rating scale was utilized to indicate the level of effectiveness of aircraft ground operation courses in various aspects. The term described the level of impact of the effectiveness of the BSAMT students' performance as described below will guide the respondents in filling up the survey questionnaire.

Mann-Whitney U-Test was used to generate the median value after the means per the assessment of the statement is generated. The Mann-Whitney test uses a normal approximation method to determine the p-value of the test. Mann-Whitney: Performs a hypothesis test of the equality of two population medians and calculates the corresponding point estimate and confidence interval. Use this test as a non-parametric alternative to the 2-sample t-test.

The same also described the deviation of an individual score to tend closely or away from the average score. To verbally interpret the mean Deauna (1988) suggested an appropriate scale that will narrow down the numerical data into a category. It was suggested that equal spaces should be observed in setting average intervals. Four (4) -point Likert type was used to measure the perception of the respondents. The table below specifies the range used in the verbal interpretation of data.

Table 1

4-Point Likert Scale

| Equivalent Weight Points | Unit Weight | Scale Interpretation |
|---|---|---|
| 3.25– 4.00 | 4 | Effective |
| 2.50 – 3.24 | 3 | Moderately Effective |
| 1.75 – 2.49 | 2 | Least Effective |
| 1.00 – 1.74 | 1 | Not Effective |

Further interpretation of assigned numbers and adjectival equivalent is as follows:

Effective – means the competency mentioned in the statement is carried out as expected thereby contributing to the effectiveness of the Aircraft Ground Operation Course to the Aircraft Maintenance Program.

Moderately effective - means the competency mentioned in the statement is carried out as below expectation thereby contributing to the effectiveness of the Aircraft Ground Operation Course to the Aircraft Maintenance Program.

Least effective - means the competency mentioned in the statement is carried out and therefore does not minimally contribute to the effectiveness of the Aircraft Ground Operation Course to the Aircraft Maintenance Program.

Not Effective - means the competency mentioned in the statement is carried out and therefore does not contribute to the effectiveness of the Aircraft Ground Operation Course to the Aircraft Maintenance Program.

## III. RESULTS

This chapter presents, analyzes, and interprets the data gathered from the survey questionnaires distributed and conducted by the researcher. The researcher used appropriate statistical treatment to determine the results of this study.

1. *Demographic Profile of the Participants*

The profile distribution of the sixty (60) participants who participated in the survey is shown in the following tables below.

1.1 Age

Table 2

FREQUENCY & PERCENTAGE DISTRIBUTION OF PARTICIPANTS' PROFILE ACCORDING TO AGE

| AGE | AMT Personnel | | Student | | TOTAL | |
|---|---|---|---|---|---|---|
| | F | P | F | P | F | P |
| 20 – 25 | 16 | 45.71 | 23 | 92.00 | 39 | 65.00 |
| 26 – 30 | 5 | 14.29 | 0 | 0.00 | 5 | 8.33 |
| 31 – 35 | 3 | 8.57 | 1 | 4.00 | 4 | 6.67 |
| 36 – 40 | 3 | 8.57 | 1 | 4.00 | 4 | 6.67 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 46 – 50 | 1 | 2.86 | 0 | 0.00 | 1 | 1.67 |
| 51 and above | 7 | 20.00 | 0 | 0.00 | 7 | 11.67 |
| Grand Total: | 35 | 100 % | 25 | 100 % | 60 | 100 % |

| Simulator (*PCAR 3.4.3 A/C Instrument) (small airplane) Objective. To determine that the applicant--Exhibits knowledge on the following:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| Magnetic compass operation. | 3.43 | 3.76 | 3.57 | Effective | 4th |
| Pitot and/or static instruments and function. | 3.63 | 3.68 | 3.65 | Effective | 2nd |
| Aircraft instrument range markings. | 3.63 | 3.72 | 3.67 | Effective | 1st |
| Basic T Instrument Panel | 3.54 | 3.64 | 3.58 | Effective | 3rd |
| Average Mean | 3.56 | 3.70 | Effective | | |
| Grand Mean/Interpretation Scaled Response | 3.62 | | | | |
| P-value | 0.0304 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | REJECT | | | | |
| Verbal Interpretation | SIGNIFICANT | | | | |

Participants were asked to provide their age range., Results showed that majority with 39 respondents or 65% are in the group age of 20 – 25 years old.,
This is acceptable, since the sample consisted mostly of students and younger AMT personnel. Table 2 also reported Further, results showed that AMT personnel with from ages that 5 or 8.33 are between 26 – 30 years old, 4 or 6.67% both are 31 – 35 and 36 – 40 years old, 1 or 1.67 are 41 – 50 years old comprised the least number in the sample population. This denotes that most of the respondents are very young and could likely have the least experience. and 7 or 11.67 are 51 years old and above. It only shows that most participants belonged to the age bracket 20 – 25 years old.

1.2 Gender

Table 3
FREQUENCY & PERCENTAGE DISTRIBUTION OF PARTICIPANTS' PROFILE ACCORDING TO GENDER

| GENDER | AMT Personnel | | Student | | TOTAL | |
|---|---|---|---|---|---|---|
| | F | P | F | P | F | P |
| Male | 35 | 35.00 | 25 | 25.00 | 60 | 100.00 |
| Female | 0 | 0.00 | 0 | 0.00 | 0 | 0.00 |
| Grand Total: | 35 | 100% | 25 | 100% | 60 | 100 % |

The table above showed the participants' profiles according to gender. It could be seen that 60 or 100% are male. A hundred percent (100%) response rate was achieved because the researcher personally surveyed ALIAC, DAW, and PADC. This only showed that many AMT practitioners are male implying that the female population has yet to embrace the aviation maintenance profession.

2. *Effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of:*

2.1 Aircraft Simulator

Table 4
MEAN AND MANN-WHITNEY RESULT ON THE EFFECTIVENESS OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS OF AIRCRAFT SIMULATOR

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Table 4 presents the computed mean on the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of aircraft simulator.

The data in the table shows the item "Aircraft instrument range markings" obtained the highest mean of 3.65 which is verbally interpreted as "Effective".

On the other hand, the item, "A Magnetic compass operation" showed the lowest mean of 3.57 which is verbally interpreted as "Effective".

The previous tabulated data showed the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program. The computed general mean for AMT Personnel is 3.56 which is verbally interpreted as "Effective". For the students, the result is 3.70 which is verbally interpreted as "Effective". The computed over-all mean is 3.62 which is verbally interpreted as "Effective".

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.0304, which is less than the alpha level. In this case, the decision is to "Reject" the null hypothesis. Therefore, there is significant difference on the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of use of an aircraft simulator.

The results underscore previous studies made (Kozuba, 2014) that simulators are an essential tool applied in the process of training and professional development of air personnel such as aircraft technicians and air traffic controllers.

2.2 Aircraft Run-up and Taxiing

Presented in Table 5 is the mean of the responses are the mean results of the participants' responses regarding the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of aircraft run-up and taxiing. As shown, two groups of participants took part in the survey – the AMT personnel and the AMT students.

The data in the table presents that the item "Brakes (on/set)" obtained the highest mean of 3.92, which is verbally interpreted as "Effective". On the other hand, the item "Elevator Trim (take off)" got the lowest mean of 3.72, however, the numerical value is still verbally interpreted as "Effective".

It could be seen on the table that moreover, the computed general mean of the participants obtained yielded a mean value of 3.83, which is verbally interpreted as "Effective".

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.3447, which is greater than the alpha level., The decision is to "Accept" the null hypothesis. Therefore, there is no significant difference in the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of aircraft run-up and taxiing.

| Run-up and Taxiing (*PCAR 3.4.3 Servicing)(small airplane) Objective. To determine that the applicant-- Exhibits knowledge and demonstrate the following procedure:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| a. Cabin Doors . . . . . CLOSED and LATCHED | 3.86 | 3.80 | 3.83 | Effective | 4.5 |
| b. Flight Controls . . . . . FREE and CORRECT | 3.83 | 3.76 | 3.80 | Effective | 8th |
| c. Elevator Trim . . . . . .. TAKEOFF | 3.71 | 3.72 | 3.72 | Effective | 10th |
| d. Flight Instruments . . . . . CHECK and SET | 3.86 | 3.80 | 3.83 | Effective | 4.5 |
| e. Brakes . . . . . .. ON/SET | 3.97 | 3.84 | 3.92 | Effective | 1st |
| f. Throttle . . . . . 1700 RPM (depend on the aircraft type magnetos, carb heat, engine instruments) | 3.94 | 3.84 | 3.90 | Effective | 2nd |
| g. Lights . . . . . .. AS REQUIRED | 3.97 | 3.60 | 3.82 | Effective | 6.5 |

| | | | | | |
|---|---|---|---|---|---|
| h. Radios/Avionics . . . . . .. SET | 3.85 | 3.84 | 3.85 | Effective | 3rd |
| i. Mixture… ……. RICH | 3.74 | 3.92 | 3.82 | Effective | 6.5 |
| j. Taxiing of Aircraft | 3.69 | 3.92 | 3.78 | Effective | 9th |
| Average Mean | 3.84 | 3.80 | Effective | | |
| Grand Mean/Interpretation Scaled Response | 3.83 | | | | |
| P-value | 0.3447 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | ACCEPT | | | | |
| Verbal Interpretation | NOT SIGNIFICANT | | | | |

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Table 5
MEAN AND MANN-WHITNEY RESULT ON THE EFFECTIVENESS
OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS OF AIRCRAFT RUN-UP AND TAXIING

2.3 Aircraft Fueling and defueling.

Table 6 shows the mean responses of the participants regarding the effectiveness of the Aircraft Ground Operation course in enriching an Aircraft Maintenance Program in terms of when it comes to fueling and de-fueling.

It showed that the participants on the item "Inspect an engine fuel filter assembly for leaks" was rated the highest mean of 3.83, which is verbally interpreted as "Effective".

On the other hand, participants' appreciation that "Inspection requirements for an engine fuel system" showed the lowest mean (of 3.75) in the group but is which was verbally still interpreted as "Effective". The overall mean results present that the participants verbally interpreted it as "Effective" has resulted in a general weighted mean of 3.79.

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.0122, which is less than the alpha level, the decision is to "Reject" the null hypothesis. Therefore, there is a significant difference in the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of fueling and de-fueling.

De-fueling and Refueling process is very important in aircraft ground operation especially on the different aspects such as appropriate inspection of the basic fuel system (process and limitation) and fuel management of used fuel and proper disposal of it.

| *Fueling and defueling (PCAR 3.4.3 Fuel System)( (small airplane) Objective. To determine that the applicant-- Exhibits knowledge and demonstrate the following procedure:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| a. Inspection requirements for an engine fuel system. | 3.86 | 3.60 | 3.75 | Effective | 5th |
| b. Checks of fuel systems to verify proper operation | 3.89 | 3.60 | 3.76 | Effective | 4th |
| c. Function and/or operation of engine fuel filters. | 3.94 | 3.60 | 3.80 | Effective | 2.5 |
| d. Inspect an engine fuel filter assembly for leaks. | 3.97 | 3.64 | 3.83 | Effective | 1st |
| e. Service an engine fuel strainer. | 3.89 | 3.68 | 3.80 | Effective | 2.5 |
| Average Mean | 3.91 | 3.62 | Effective | | |
| Grand Mean/Interpretati | 3.79 | | | | |

| | | |
|---|---|---|
| on Scaled Response | | |
| P-value | 0.0122 | |
| Alpha level | 0.05 | |
| Decision | ACCEPT | |
| Verbal Interpretation | SIGNIFICANT | |

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Table 6
MEAN AND MANN-WHITNEYT RESULT ON THE EFFECTIVENESS
OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS
OF AIRCRAFT FUELING AND DEFUELING

2.4 Aircraft Marshalling

Presented in Table 7 is the mean of the responses of the participants regarding the effectiveness of the Aircraft Ground Operation course in enriching an Aircraft Maintenance Program in terms of the aspect of aircraft marshalling.

The data in the table presents that the item "Familiarization with safety procedures on the ramp to create safety awareness" obtained the highest mean of 3.86 which can be verbally interpreted as "Effective". On the other hand, the item "Airport Basics (runways, taxiways, signs, lights, and markings)" got the lowest mean of 3.80 but is still verbally interpreted as "Effective". It can be seen on the table that the computed general mean of the participants. Generally, this cluster obtained a mean value of 3.84, which can be interpreted as such components are seen as "Effective" by the participants.

| Marshalling *(PCAR 3.4.3 Airport and Runways)( (small airplane) Objective: To determine that the applicant-- Exhibits knowledge and demonstrate the following procedure:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| . Promote safe operations at the ramp through efficient hand signal communications | 3.83 | 3.88 | 3.85 | Effective | 2.5 |
| . Airport Basics (runways, taxiways, signs, lights, and markings) | 3.83 | 3.76 | 3.80 | Effective | 5th |
| . Familiarization with safety procedures on the ramp to create safety awareness. | 3.91 | 3.80 | 3.86 | Effective | 1st |
| . Direct Movement of Aircraft (distance and position) | 3.94 | 3.72 | 3.85 | Effective | 2.5 |
| . Parked Aircraft (visual check of aircraft) | 3.94 | 3.68 | 3.83 | Effective | 4th |
| Average Mean | 3.89 | 3.77 | Effective | | |
| Grand Mean/Interpretation Scaled Response | 3.84 | | | | |
| P-value | 0.0367 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | REJECT | | | | |
| Verbal Interpretation | SIGNIFICANT | | | | |

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Table 7
MEAN AND MANN-WHITNEYT RESULT ON THE EFFECTIVENESS
OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS OF AIRCRAFT MARSHALLING

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.0367, which is less than the alpha level, the decision

is to "Reject" the null hypothesis. Therefore, there is a significant difference in the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of aircraft marshalling.

It is visual communication and a part of the aircraft ground operation course wherein the marshaller provides a signal to the pilot to keep turning, slow down, stop, and shut down engines, leading the aircraft to its parking stand or the runway. The marshaller also should be aware of proper guidelines in handling the aircraft.

2.5 Aircraft Servicing

Table 8 shows mean responses on the effectiveness of the Aircraft Ground Operation course in enriching an Aircraft Maintenance Program relative to aircraft servicing.

It showed that the participants have rated the items "Set-up an aircraft and cockpit controls for engine start" and "Determine the engine oil for a specific engine" similarly as both yielded a mean value of 3.78, the highest mean for the cluster, which translates to "Effective".

| Servicing (*PCAR 3.4.3 Troubleshooting) (small airplane) To determine that the applicant-- Exhibits knowledge and demonstrate the following procedure:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| . General procedures for towing aircraft. | 3.74 | 3.56 | 3.67 | Effective | 3rd |
| . Air Traffic Control (ATC) considerations/ requirements for towing aircraft on or across active runways. | 3.20 | 3.68 | 3.40 | Effective | 5th |
| . Set-up an aircraft and cockpit controls for engine start. | 3.80 | 3.76 | 3.78 | Effective | 1.5 |
| . Set-up and connect an aircraft to an external power source. | 3.60 | 3.68 | 3.63 | Effective | 4th |
| . Determine the engine oil for a specific engine. | 3.80 | 3.76 | 3.78 | Effective | 1.5 |
| Average Mean | 3.63 | 3.69 | | | |
| Grand Mean/Interpretation Scaled Response | 3.65 | | Effective | | |
| P-value | 0.8345 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | ACCEPT | | | | |
| Verbal Interpretation | NOT SIGNIFICANT | | | | |

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Table 8
MEAN AND MANN-WHITNEYT RESULT ON THE EFFECTIVENESS
OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS
OF AIRCRAFT SERVICING

On the other hand, participants' appreciation that "Air Traffic Control (ATC) considerations/requirements for towing aircraft on or across active runways" was lowest with mean of 3.65 yet it is still verbally interpreted as "Effective".

The overall mean results present that the participants verbally interpreted it as "Effective" having resulted in a general weighted mean of 3.65.

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.8345, which is greater than the alpha level, the decision is to "Accept" the null hypothesis. Therefore, there is no significant difference on the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of aircraft servicing.

It is one of the processes wherein the aircraft is service upon landing and take-off like change of landing gear, cleaning of sparkplugs, towing services, and any line maintenance for making the aircraft airworthy.

2.5 Facilities and Equipment

Table 9

MEAN AND MANN-WHITNEYT RESULT ON THE EFFECTIVENESS OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS OF FACILITIES AND EQUIPMENT

| Facilities and Equipment *(PCAR 3.4.3 ground operation)( (small airplane) Objective: To determine that the applicant--Exhibits knowledge demonstrate the following procedure:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| a. Airport (Design and Infrastructure) | 3.51 | 3.64 | 3.57 | Effective | 4th |
| b. Air Traffic Controller (Structure and Location) | 3.40 | 3.60 | 3.48 | Effective | 5th |
| c. Airport Personnel / Vehicle | 3.49 | 3.48 | 3.90 | Effective | 1st |
| d. Runway Markings and Taxi Way | 3.60 | 3.76 | 3.67 | Effective | 3rd |
| e. Manual fueling Tools (Pump and Hose) | 3.80 | 3.72 | 3.77 | Effective | 2nd |
| Average Mean | 3.56 | 3.64 | Effective | | |
| Grand Mean/Interpretation Scaled Response | 3.68 | | | | |
| P-value | 0.4647 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | ACCEPT | | | | |
| Verbal Interpretation | NOT SIGNIFICANT | | | | |

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Presented in Table 9 is the mean of the responses of the participants regarding the effectiveness of the Aircraft Ground Operation course in enriching an Aircraft Maintenance Program in terms of facilities and equipment.

The data in the table presents that the item "Airport Personnel / Vehicle" obtained the highest mean of 3.90 which verbally interpreted as "Effective".

On the other hand, the item "Air Traffic Controller (Structure and Location)" got the lowest mean of 3.80 verbally interpreted as "Effective".

It could be seen on the table that the computed general mean of the participants obtained a mean value of 3.48 which verbally interpreted as "Effective".

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.4647, which is greater than the alpha level, the decision is to "Accept" the null hypothesis. Therefore, there is no significant difference on the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of facilities and equipment.

It is important for any aviation personnel to be familiarized with equipment and facilities inside the airport, especially the location of those, in times of

emergency and for the proper storage of the aircraft parts and aircraft itself.

2.6 Aircraft Inspection

Table 10

MEAN AND MANN-WHITNEYT RESULT ON THE EFFECTIVENESS OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS OF AIRCRAFT INSPECTION

| Inspection *(PCAR 3.4.3 Inspection)( (small airplane) Objective: To determine that the applicant- Exhibits knowledge and demonstrate the following procedure:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| . Visual inspection | 3.94 | 3.80 | 3.88 | Effective | 1st |
| . Pre Flight-Inspection | 3.86 | 3.72 | 3.80 | Effective | 4th |
| . Post Flight Inspection | 3.86 | 3.64 | 3.77 | Effective | 5th |
| . Aircraft preparation for washing, general aircraft cleaning (washing) procedures. | 3.91 | 3.72 | 3.83 | Effective | 3rd |
| . Inspection for and identification of corrosion in any of its various forms. | 3.89 | 3.80 | 3.85 | Effective | 2nd |
| Average Mean | 3.89 | 3.74 | Effective | | |
| Grand Mean/Interpretation Scaled Response | 3.83 | | | | |
| P-value | 0.0122 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | REJECT | | | | |
| Verbal Interpretation | SIGNIFICANT | | | | |

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Table 10 shows mean responses on the effectiveness of the Aircraft Ground Operation course in enriching an Aircraft Maintenance Program through aircraft inspection.

It showed that the participants on the item "Visual inspection" rated 3.88 which obtained the highest mean which is verbally interpreted as "Effective".

On the other hand, participants' appreciation that "Post Flight Inspection" mean of 3.77, which is also "Effective".

The overall mean results present that the participants verbally interpreted it as "Effective" having resulted to a general weighted mean of 3.83.

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.0122, which is less than the alpha level, the decision is to "Reject" the null hypothesis. Therefore, there is significant difference on the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of aircraft inspection.

According to airport authorities, each hour spent in flight will have an equivalent of several hours' maintenance. The process of every session of maintenance applied on the aircraft must include the time together with corresponding activities for the safety of an aircraft (Compton, 2019).

2.7 Safety Awareness

Table 11

MEAN AND MANN-WHITNEYT RESULT ON THE EFFECTIVENESS
OF AIRCRAFT MAINTENANCE PROGRAM IN TERMS OF SAFETY AWARENESS

| Safety Awareness (*PCAR 3.4.3 Aviation Safety)( (small airplane) Objective: To determine that the applicant- Exhibits knowledge and demonstrate the following procedure:* | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| . Approach to the project; proper information and tools; preparation of the equipment; and observation of safety precautions. | 3.97 | 3.92 | 3.95 | Effective | 1st |
| . Cleaning, preparing, and protecting parts; skill in handling tools; thoroughness and Cleanliness. | 3.94 | 3.88 | 3.92 | Effective | 2nd |
| . Inspection requirements for an engine fire extinguisher and safety practices/ precautions. | 3.89 | 3.88 | 3.88 | Effective | 3rd |
| . Jacking safety practices/ precautions. | 3.89 | 3.76 | 3.83 | Effective | 5th |
| . Landing gear and/or tire and wheel safety practices/precautions. | 3.86 | 3.84 | 3.85 | Effective | 4th |
| Average Mean | 3.91 | 3.86 | Effective | | |
| Grand Mean/Interpretation Scaled Response | 3.89 | | | | |
| P-value | 0.1437 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | REJECT | | | | |
| Verbal Interpretation | NOT SIGNIFICANT | | | | |

Legend: 1:00 – 1.74 Not Effective; 1.75 – 2.49 Least Effective; 2.50 – 3.24 Moderately Effective; 3.25 – 4.00 Effective

Table 11 shows the mean responses of the participants regarding the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of safety awareness.

It showed that the participants on the item “Approach to the project; proper information and tools; preparation of the equipment; and observation of safety precautions” was rated highest with the mean value of 3.95 and this is verbally interpreted as “Effective”.

On the other hand, participants’ appreciation that “Jacking safety practices/ precautions” obtained a mean of 3.83 which was verbally interpreted as “Effective”.

The overall mean results present that the participants verbally interpreted it as “Effective” has resulted in a general weighted mean of 3.89.

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.1437, which is greater than the alpha level. The decision is to "Accept" the null hypothesis. Therefore, there is no significant difference on the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of safety awareness.

Before the incident, aviation safety was a huge concern for many in the industry, that's the reason why everyone is expected to be aware of the policies and regulations mandated by the authority for their proper guidance. Likewise, all are expected to be compliant of what is directed in every field of expertise in which you are involved.

3. *On the significant difference in the perception of the participants as to the effectiveness of an aircraft ground operation course in terms of:*

Presented in the table below are the mean responses of the participants regarding the perception of the participants as to the effectiveness of an aircraft ground operation course with respect to different criteria.

It shows that the variable safety awareness obtained the highest general weighted mean of 3.89, which is verbally interpreted as "effective".

On the other hand, the variable aircraft simulator got the lowest mean of 3.62 and is verbally interpreted as "Effective".

The overall mean results present that the participants verbally interpreted it as "Effective" having resulted to a general weighted mean of 3.77.

Under the Mann-Whitney U Test result, the alpha level is 0.05 or 95%, since the P-Value of the test was 0.1437, which is greater than the alpha level. The decision is to "Accept" the null hypothesis. Therefore, there is no significant difference on the effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in terms of Aircraft Simulator, Aircraft Run-up, and Taxiing, Aircraft Fueling and Defueling, Aircraft Marshalling, Aircraft Servicing, Facilities and Equipment, Aircraft Inspection and Safety Awareness.

Table 12
MEAN AND MANN-WHITNEYT RESULT INTERPRETATION OF DATA IN THE PERCEPTION OF THE PARTICIPANTS ON THE EFFECTIVENES OF AN AIRCRAFT GROUND OPERATION WITH RESPECT TO DIFFERENT CRITERIA

| CRITERIA | AMT Personnel | Student | Weighted Mean | Interpretation | Rank |
|---|---|---|---|---|---|
| . Aircraft Simulator | 3.56 | 3.70 | 3.62 | Effective | 8th |
| . Aircraft Run-up and Taxiing | 3.84 | 3.80 | 3.83 | Effective | 3rd |
| . Aircraft Fueling and Defueling | 3.91 | 3.62 | 3.79 | Effective | 5th |
| . Aircraft Marshalling | 3.89 | 3.77 | 3.84 | Effective | 2nd |
| . Aircraft Servicing | 3.63 | 3.69 | 3.65 | Effective | 7th |
| . Facilities and Equipment | 3.56 | 3.64 | 3.68 | Effective | 6th |
| . Aircraft Inspection | 3.89 | 3.74 | 3.82 | Effective | 4th |
| . Safety Awareness | 3.91 | 3.86 | 3.89 | Effective | 1st |
| Average Mean | 3.77 | 3.73 | Effective | | |
| Grand Mean/Interpretation Scaled Response | 3.77 | | | | |
| P-value | 0.1437 | | | | |
| Alpha level | 0.05 | | | | |
| Decision | REJECT | | | | |
| Verbal Interpretation | NOT SIGNIFICANT | | | | |

## IV. SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter presents a summary of the findings of the study, the conclusion, and recommendation relative to the results of data interpretation and analysis.

Summary and Findings

The Following are the outcomes of the study in accordance with the problem statements indicated in the first chapter.

1. *The Profile of the Participants*

The demographic profile of the AMT personnel from different companies and the students of ALIAC, were considered in terms of age, gender, company, educational attainment, and employment status.

1.1 Age

39 participants or 65% can be identified as young. This only showed that many of the participants belong to the age range from 20-25 years old.

1.2 Gender

The total population is composed of 60 participants or 100%. All the participants are male and came from ALIAC, DAW and PADC.

2. *Effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program in the following aspects.*

2.1 Aircraft Simulator

Participants favorably perceive themselves to be "effective" in this aspect with a general weighted mean of 3.62. Among the aircraft simulator procedures, the highest mean score of 3.67 was on the aircraft instrument range markings which are verbally interpreted as "effective".

2.2 Aircraft Run-up and Taxiing

As revealed by a general weighted mean of 3.83, participants consider themselves as "effective". Along with Run-up and taxiing procedure, the highest mean score of 3.92 was the brake on/set which can be verbally interpreted as "effective".

2.3 Aircraft Fueling and Defueling

The mean results significantly show that participants are "effective" with 3.79. In conjunction with fueling and de-fueling procedure, the highest mean as distinguished by participants is the inspection of an engine fuel filter assembly for leaks with a mean score of 3.83, which verbally interpreted "effective".

2.4 Aircraft Marshalling

A verbal interpretation of "Effective" is defined in this item as the average mean falls under the scale of 3.80 to 3.86. It also shows that the participants assessed themselves "effective" on all the five statements.

2.5 Aircraft Servicing

The data represented that most of the participants had a verbal interpretation of "Effective". It showed that on the item "Set-up an aircraft and cockpit controls for engine start" and "Determine the engine oil for specific engine" both rated 3.78 which obtains the highest mean which verbally interpreted as "Effective".

2.6 Facilities and Equipment

With a mean average of 3.68, it was interpreted that most of the participants were "Effective" on all five procedures. "Airport Personnel/Vehicle" obtained the highest mean of 3.90 which verbally interpreted as "Effective" while the "Air Traffic Controller (Structure and Location)" got the lowest mean of 3.80 which verbally interpreted as "Effective".

2.7 Aircraft Inspection

The overall mean results present that the participants verbally interpreted as "Effective" having resulted to a general weighted mean of 3.83, were the "Visual Inspection" rated 3.88 and obtained the highest mean which verbally interpreted as "Effective", compared to "Post Flight Inspection" mean of 3.77 which was verbally interpreted as "Effective".

2.8 Safety Awareness

The computed mean average of each statement falls from 3.83 to 3.95 which had a verbal interpretation of "Effective". It showed that the participants on the item "Approach to the project; proper information and tools; preparation of equipment; and observation of safety precautions' rated 3.95 which obtained the highest mean which is verbally interpreted as "Effective".

3. *Significant differences on the effectiveness of an aircraft ground operation course in enriching the aircraft maintenance program.*

Inferential statistics using the Mann-Whitney result shows that there is no statistically significant difference in the responses of AMT personnel and student. Meaning there is no significant difference on the perception of the group of participants in the effectiveness of the aircraft ground operation course in enriching the aircraft maintenance program.

## CONCLUSION

Based on the result of the study, the following conclusions were derived:

1. The Profile of the Participants

Most of the participants are from AMT personnel and within the age bracket ranging from 20-25 years old and a total of 25 participants who came from the 3rd year BSAMT students. All participants are male Males were more fascinated to technical courses compared to female. Most of the participants are BASAMT/AMT. Many of the participants are from ALIAC. AMT personnel belonged to one (1) to four (4) years in service bracket were in greater volume.

2. *The assessment of effectiveness of the aircraft ground operation course in enriching an Aircraft Maintenance Program.*

The overall mean results present that the participants verbally interpreted it as "Effective" having resulted to a general weighted mean of 3.77.

Ranking of the eight (8) criteria based on their weighted average mean is as follows: Safety Awareness (3.89), Aircraft Marshalling (3.84), Aircraft Run-up and Taxiing (3.83), Aircraft Inspection (3.82), Aircraft Fueling and Defueling (3.79), Facilities and Equipment (3.68), Aircraft Servicing (3.65) and Aircraft Simulator (3.62). This perception can be attributed to the fact that not all the participants are knowledgeable or can demonstrate all the procedures in all aspects due to lack of proper guidelines for their learning process which is the said course has yet to be fully implemented and training for the specific equipment has yet to be available in other educational institution.

3. *Significant differences on the effectiveness of an aircraft ground operation course in enriching the aircraft maintenance program*.

There is no significant difference that existed on the perceptions between the AMT Personnel and AMT students on the effectiveness of the aircraft ground operation course in enriching the aircraft maintenance program.

## RECOMMENDATION

In reference to the findings and conclusion of the study, the researcher proposes the following recommendations to sustain the effectiveness of the aircraft ground operation course.

1. ATOCID of CAAP to provide a standard scope for guidelines on the aircraft ground operation course to all aviation schools which offer the aircraft maintenance program.
2. Common subject areas shall be grouped together to prevent redundancy.
3. Continuous training for the technical instructor to upgrade their capability to align with fast changing trends in technology in the field of aviation as per PCAR Part 3.4.5 and revision of Training Procedure Quality Manual of ALIAC (TPQM)
4. Regular monitoring from authority (CAAP/CHED) to supervise the full implementation of aircraft ground operation course.

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REFERENCES

BOOKS

[1] Allen, J. M. (2012). Advisory Circular 120-16F: Air carrier maintenance program, Washington D.C: Federal Aviation Administration.

[2] Civil Aviation Authority of the Philippines. CAR Part 2 Personnel licensing (2014)

[3] Civil Aviation Authority of the Philippines. CAR Part 3 Approved Training Organizations (2011)

[4] Dictionary of Aeronautical Terms (2006) Aviation supplies and Academics, Inc. 7005 132nd Place SE Newcastle, Washington

[5] Lunenberge F., Ornstein A., "Concepts and Practices one's worth: Belmont California", Fourth Edition, 2004.

B. ARTICLES

[6] Anders Halskov-Jensen (2014) "Aviation Training Forward". ICAO Training Report

[7] BAA Training. (2017) "Why ground handling Team needs training" 2017-04-24.

[8] Boeing Market Outlook. "Pilot and Technician Outlook" (2019) 2019-2038

[9] Branon, Tommy (2019) "Aviation Maintenance Technology Program" Midland International Air and Space Port, Hangar E 2405 Windecker Street Midland, TX 79706

[10] Chiappetta, E. L., & Koballa, T. R. (2002). Science Instruction in the middle and Secondary schools. Upper Saddle River, NJ: Prentice Hall.

[11] Civil Aviation Authority of the Philippines Advisory Circulars 09-007. "Acceptable Ground Handling Arrangement"

[12] CHED Memorandum Orders (CMO No. 37, 2012) "Policies standards and Guidelines in Establishments of Outcome Based Education Institution

[13] Compton, B. (2019, December 29). Aircraft Inspections for Safety and Reliability [Blog post]. Retrieved from https://ivypanda.com/essays/aircraft-inspections-for-safety-and-reliability/Offering Engineering Programs."

[14] Dkeidek, I., Mamalok-Naaman, R., & Hofstein, A. (2012). Assessment of the laboratory learning environment in an inquiry-oriented chemistry laboratory in Arab and Jewish high schools in Israel. Learning Environments Research, 15, 141-169.

[15] Eilks, I., Prins, G. T., & Lazarowitz, R. (2013). How to organize the classroom in student – active mode. In I. Eikles & A. Hofstein (eds.). Teaching chemistry – A study book (pp. 183-212). Rotterdam: Sense.

[16] Esiobu, G. O., & Soyibo, K. (1995). Effects of concept and vee mappings under three learning modes on students' cognitive achievement in ecology and genetics. Journal of Research in Science Teaching, 32, 971-995.

[17] FAA Advisory Circulars. "Ground Vehicle Operations to include Taxiing or Towing an Aircraft on Airports" (2015)

[18] Fitouri-Trabelsi, S., Mora-Camino, F., Nunes-Cosenza, C. and Weigang, L. (2015). Integrated Decision Making for Ground Handling Management.

[19] Global Journal of Science Frontier Research: F Mathematics and Decision Sciences Gardner, M. (1978). Aha! Insight. New York: Scientific American.

[20] Gerber, B. L., Cavallo, A.M.L., & Marek, E.A. (2001). Relationships among informal learning environment, teaching procedure and scientific reasoning ability. International Journal of Science Education, 23(5), 535-549.

[21] Gittens, A. (2013) "The Importance of Ground Handling Safety"

[22] Hofstein, A., & Lunetta, V, N. (2004). The laboratory In science education: Foundation for the 21st century. Science Education, 88, 28-54.

[23] Hofstein, A., Navon, O., Kipnis, M., & Mamlok-Naaman, R. (2005). Developing students' ability to ask more and better questions resulting from inquiry-type chemistry laboratories. Journal of Research in Science Teaching, 42(7), 971-789

[24] ICAO "Assembly-39th Session/Technical Commission. Montreal" 5th August 2016.

[25] Kozuba, J. & Bundaruk, A. (2014) "Flight Simulator as an essential device supporting the process of Shaping Pilot's Situational

Awareness". International Conference of Scientific Paper AFACES 2014

[26] Laguador, J. M., & Dotong, C. I. (2014). Knowledge versus Practice on the Outcomes-Based Education Implementation of the Engineering Faculty Members in LPU. International Journal of Academic Research in Progressive Education and Development, 3(1), 63-74.

[27] Meagher, T. (2015) "Effective Training for Ground Operations necessary for Skill Set".

[28] Nasrallah, R. (2014). Learning outcomes' role in higher education teaching. Education, Business and Society: Contemporary Middle Eastern Issues, 7(4), 257-276

[29] Radem, A. (2009). The effectiveness of lecture demonstration to enhance learning of chemistry. In GupaBhown, M. (Eds.), Chemistry education in ICT age. Dordrecht, Springer.

[30] R.Sethumadhavan (2013), effectiveness of training in auto component industry – an empirical study, volume no. 3 (2013), issue no. 02

[31] Tabares D.A, Camino F. (2017)" Aircraft ground handling: Analysis for automation". 17th AIAA Aviation Technology, Integration, and Operations Conference, Jun 2017, Denver, United States. 16 p.

[32] Teijeiro, M., Rungo, P., Freire, M. J. (2013). Graduate Competencies and Employability: The impact of matching firms' needs and personal attainments, economics of education review, Volume 34:286-295

[33] Thompson, J., & Soyibo, K. (2002). Effects of lecture, teacher demonstrations, discussion, and practical work on 10th graders attitudes to chemistry and understanding of electrolysis. Research in Science and Technological Education, 20(1), 25-37.

C. JOURNALS

[34] Barman, L., Bolander-Laksov, K., & Silén, C.(2014). Policy enacted – teachers' approaches to an outcome-based framework for course design. Teaching In Higher Education, 19(7), 735-746. Doi:10.1080/13562517

[35] Basheer, Hugerat et. al (2017) "The Effectiveness of Teachers' Use of Demonstrations for Enhancing Students' Understanding of and Attitudes to Learning the Oxidation-Reduction Concept". EURASIA

[36] Journal of Mathematics Science and Technology Education ISSN: 1305-8223 (online) 1305-8215 (print) 2017.

[37] Buncick, M. C., Betts, P. G., & Horgan, D.D. (2001). Using demonstrations as a contextual road map: enhancing course continuity and promoting active in introductory college physics. International Journal of Science Education, 23(12), 1237-1255

[38] De Guzman, Domingo, et.al (2017) Understanding the Essence of the Outcomes Based Education (OBE) and Knowledge of its Implementation in a Technological University in the Philippines. Asia Pacific Journal of Multidisciplinary Research Vol. 5 No.4, 64-71 November 2017 P-ISSN 2350-7756 E-ISSN 2350-8442

[39] Fanta, F., & Boubacar, I. (2016). EXPERIENTIAL Vs. LECTURE-BASED TEACHING: DOES THE CHOICE OF INSTRUCTIONAL METHOD MATTER? Journal Of Economics & Economic Education Research, 17(3), 60-73.

[40] Giridraha K., Raju R. (2017) "Impact of Teaching Strategies: Demonstration and Lecture Strategies and Impact of Teacher Effect on Academic Achievement in Engineering Education". International Journal of Sciences Pages 174-186, published online: 25 Sep 2017

[41] Haq Nawaz, A., Malik, M., (2014) "Assessing the Learning Level of Student through Bloom's Taxonomy in Higher Education in Punjab", Journal of Educational and Social Research MCSER Publishing, Rome-Italy Vol. 4 No. 3, ISSN 2239-978X ISSN 2240-0524

[42] Hofstein, A., Navon, O., Kipnis, M., & Mamlok-Naaman, R. (2005). Developing students' ability to ask more and better questions resulting from inquiry-type chemistry laboratories. Journal of Research in Science Teaching, 42(7), 971-789.

[43] Meyar, L. S., Schmidt, S., Nozawa, F. & Paneee, D. (2003). Using demonstration to promote

student comprehension in chemistry. Journal of Chemical Education, 80(4), 431-435.

[44] Journal of Aerospace Technology and Management Print version ISSN 1984-9648On-line version ISSN 2175-9146

[45] Odom, A. L., & Bell, C. V. (2015). Association of middle school student science achievement and attitudes about science with student-reported frequency of teacher lecture demonstrations and students –centered learning. International Journal of Environment al & Science Education, 10 (1) 8797.

[46] Okpala, P., & Onocha, C. (1988). Difficult physics topics in Nigerian secondary schools. Physics Education, 23, 168-172.

[47] Shakhashiri, B. Z. (1983, 1985, 1989, 1992, 2011). Chemical Demonstration: a Handbook for Teacher of Chemistry. Vol. 1-5, Madison, Wisconsin: University of Wisconsin Press.

[48] Sweeder, R. D., & Jeffery, K. A. (2013). A comprehensive general chemistry demonstration. Journal of Chemical Education, 90, 96-98.

[49] Tan, K. C. D., (2000). Development and application of diagnostic instrument to evaluate secondary students' conceptions of qualitative analysis. Ph.D. Thesis, Curtin University of Technology.

[50] Takahashi S., Saito (2013) “Unraveling the process. and meaning of problem- based learning experiences Higher Education”