Effectiveness of Aviation Maintenance Simulators for Aircraft Ground Operations

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Abstract- ***Modern technology is being used in the aviation industry to impart knowledge and develop the abilities of aspiring professionals. We are now in a fast-paced changing industry. Simulators are used widely in diverse industries such as education, medical, safety and aviation. The program Aircraft Ground Operation course is for Aircraft Maintenance Technology (AMT) students of any aviation institution. This study aims to evaluate the effectiveness of aviation maintenance simulators for aircraft ground operations. The participants of the study were 60 students from Air Link International Aviation College who were taking Bachelor of Science in Aircraft Maintenance Technology Course. The sample consisted of 30 students who had not yet used the simulator (pre-test group) and 30 students who had already used the simulator (post-test group). The selection of participants was based on their fundamental knowledge in aircraft ground operation and their ability to use the simulator in improving their skills. Pre- and post-tests were given to the students to collect information regarding the effectiveness of the aviation maintenance simulator in aircraft ground operations. The questionnaire covers all aspects of the aviation maintenance simulator, including the aircraft simulator, aircraft run-up and taxing, aircraft servicing, and aircraft troubleshooting. The study focused on the students' experiences and opinions of using the simulator, and their responses to the questionnaire served as the primary source of data for the study. The questionnaire aimed to collect data on the cognitive techniques used by the students during the simulation, as well as their perceptions of the simulator's effectiveness in improving their understanding of aircraft ground operation. These findings suggest that using the aircraft maintenance simulator enhances the knowledge and abilities of BSAMT students. The aviation maintenance simulator can be a valuable tool in enhancing the learning experience of BSAMT students and an advantage skill in applying to aviation field for their professional development and growth.***

I. INTRODUCTION

Aviation maintenance simulators are used to train and develop aircraft maintenance personnel. Maintenance staff may be trained in a safe and controlled environment without risk of aircraft mishaps, injuries, or damage. As simulation technology has advanced and there has been a need for more effective and efficient training techniques, the usage of simulators for aircraft maintenance training has increased.

According to several studies (Cacciabue & Cassani, 2012; Chang & Wang, 2010; Lapoint, 2012; Park, Kang, & Son, 2012), proper training for aviation maintenance staff is an important factor in lowering expensive maintenance errors. Training aids, such as aircraft or simulators, are necessary to support hands-on training to provide an efficient training program for aviation maintenance workers. A secure and dependable aviation maintenance facility must have employee training programs.

Manufacturing systems, as well as the military, healthcare, and public services, have extensively used business process simulation (Jahangirian et al., 2010). Simulating an operations system over time is described as "experimentation with a simplified imitation of an operations system as it progresses through time, for better understanding and improving that system" (Robinson, 2004). The modeling of maintenance system processes is particularly pertinent to this. People, companies, and other entities should adhere to a general set of guidelines for aviation regulations that may be acceptable to the Civil Aviation Authority of the Philippines (CAAP Advisory Circulars, AC 09-007).

II. PROCEDURE

- *Methods of Research*

This study used a quantitative analysis methodology. According to Creswell (2008:6), quantitative research is a type of educational research in which the researcher selects the subject matter to investigate, formulates focused research questions, solicits participants' quantifiable responses, collects the data, performs statistical analysis of the data, and conducts the investigation impartially and impartially. This method was used to categorize the cognitive strategies employed by the students in aircraft ground operations using an aviation maintenance simulator, to gather pre-and post-test data, and to explain the significant distinction between guided and practiced learning simulators for aircraft ground operations. This strategy was chosen because it is consistent with computing the statistical and numerical analysis of the data gathered through surveys.

Pretest and posttest questionnaires were distributed to a select group of students studying aircraft maintenance technology. Both a lecture and a simulation activity were held, respectively. The next step is to identify how many practice sessions in the simulator were used to improve the efficiency of aircraft ground operations to further the specific goal of the study; the collected data were consolidated and evaluated in light of some restrictions.

- Participants of the Study

The study participants were 60 Air Link International Aviation College students taking a Bachelor of Science in Aircraft Maintenance Technology Course. The sample consisted of 30 students who had yet to use the simulator (pre-test group) and 30 who had already used the simulator (post-test group). The selection of participants and the administration of the pre-test and post-test were designed to provide a comprehensive evaluation of the effectiveness of the aviation maintenance simulator in improving students' skills and knowledge of aircraft ground operation. Overall, the sample size and selection criteria were appropriate for the study, and the data collected provided valuable insights into using simulators in aviation maintenance training.

Data Gathering Instrument

The data gathering instrument used in this study was a pre-test and post-test consisting of 30 conceptual questions related to aircraft ground operation. The questions were designed to measure the effectiveness of the aviation maintenance simulator in improving the student's knowledge and skills.

To ensure the reliability of the pre-test and post-test, the researcher used Google Forms or test paper to administer the questions and checked the students' answers. Additionally, the researcher performed item analysis on the questions to ensure that they were reliable and valid measures of the assessed constructs.

The study's sample size of 30 students was considered reasonable based on the research design and objectives. Larger samples could have been used, but it is essential to ensure that the number of items in the scale is less than the sample size, as Nunally and Bernstein (1994) recommended.

Using a pre-test and post-test instrument allowed for comparing the student's knowledge and skills before and after using the aviation maintenance simulator. The questions were designed to be conceptually related to the simulator and aircraft ground operation, which made them relevant and valuable for the study. Overall, the data-gathering instrument used in this study was appropriate for the research design and objectives.

- Statistical Treatment of Data

The data gathered from the pre-test and post-test were tabulated, and the appropriate frequency table was constructed. After gathering all the data, the researcher will analyze and interpret the acquired data. The collected data must be statistically evaluated, and the null hypothesis tested to ensure accuracy. The statistical procedures listed below should be used:

1. Frequency Distribution. This was used to present the classes of scores obtained from the students under pretest and posttest. This is an organized tally of data utilizing a tabular or graphical representation of the number of individuals in each category on the scale or instrument.
2. Weighted Mean. This variable and the weighted mean determined the response's overall frequency distribution.

The formula is:

$$\overline{X} = \frac{\Sigma fx}{N}$$

Where:

$\overline{X}$ = Weighted mean

Σfx = Sum of frequency

N = Number of Participants

Table 1
4-POINT Likert Scale

Equivalent Weight Points	Unit Weight	Scale Interpretation
3.25– 4.00	4	Highly Effective
2.50 – 3.24	3	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:

Highly Effective – means the competency mentioned in the statement is carried out as expected, thereby contributing to the effectiveness of the Aviation Maintenance Simulators for Aircraft Ground Operations.

Effective - means the competency mentioned in the statement is carried out as below expectation, thereby contributing to the effectiveness of the Aviation Maintenance Simulators for Aircraft Ground Operations.

Least effective - means the competency mentioned in the statement is carried out and, therefore, only partially contributes to the effectiveness of the Aviation Maintenance Simulators for Aircraft Ground Operations.

Not Effective - means the competency mentioned in the statement is carried out and therefore does not contribute to the effectiveness of the Aviation Maintenance Simulators for Aircraft Ground Operations.

III. RESULTS

This chapter provided a summary of the information the researcher utilized to evaluate and interpret the survey questionnaire data, pre-and post-test student knowledge and skills, and the use of the aircraft maintenance simulator. The researcher performed analyses and provided explanations of the study's findings in the following series, using the necessary statistical methods:

1. What extent is the aircraft maintenance simulator effective in simulating the various aspects of aircraft ground operations, in terms of:
3. Standard Deviation. This descriptive statistic was used to measure the variation or dispersion of a data set from its mean value. The standard deviation shows how tightly or loosely the data is clustered around the mean. A low standard deviation indicates that the data is tightly clustered around the norm. In contrast, a high standard deviation indicates that the data is spread over a broader range of values.
4. Paired T-Test or Dependent T-test. This statistical method determines the mean difference between two observational sets. The paired t-test is used to determine if there is a statistically significant difference between two related samples.
5. Pearson's r Correlation. This test statistic was used to measure the relationship between two variables. The formula calculates the strength and direction of the linear relationship between two variables, x, and y, based on their covariance and standard deviations. The correlation coefficient, r, ranges from -1 to 1, where a value of -1 indicates a perfect negative correlation, 0 shows no correlation, and 1 indicates a perfect positive correlation.

To verbally interpret the mean, Deauna (1988) suggested an appropriate scale that will narrow down the numerical data into a category. It was recommended that equal spaces should be observed in setting average intervals. Four (4) point Likert types were used to measure the respondent's perception. The table below specifies the range used in the verbal interpretation of data.

1.1 Aircraft Simulator

Table 2
MEAN DISTRIBUTION ON THE AIRCRAFT MAINTENANCE SIMULATOR EFFECTIVE IN SIMULATING THE VARIOUS ASPECTS OF AIRCRAFT GROUND OPERATIONS IN TERMS OF AIRCRAFT SIMULATOR

Aircraft Simulator	N	Mean	Verbal Interpretation
a. Magnetic compass operation.	34	3.50	Highly Effective
b. Pitot and/or static instruments and function.	34	3.59	Highly Effective
c. Aircraft Instrument range marking.	34	3.53	Highly Effective
d. Basic T Instrument Panel	34	3.32	Highly Effective
Average Weighted Mean	**34**	**3.49**	**Highly Effective**

Table 2 presents the mean distribution of responses from 34 participants on the effectiveness of an aircraft maintenance simulator in simulating various aspects of aircraft ground operations. The factors evaluated include magnetic compass operation, pitot and static instruments and function, aircraft instrument range marking, and the basic T instrument panel. The average weighted mean for all aspects is 3.49, which is interpreted as "Highly Effective."

Based on these results, the aircraft maintenance simulator used in the study is perceived to be effective in simulating various aspects of aircraft ground operations. This is supported by the "Highly Effective" verbal interpretation for all aspects evaluated. It can also be assumed that the participants have prior knowledge or experience in aircraft maintenance and operations, as they could evaluate the simulator's effectiveness based on their expertise.

A recent study by Lopes et al. (2021) investigated the effectiveness of an aircraft maintenance simulator in training mechanics to troubleshoot electrical faults. The results showed that the simulator effectively improved the mechanics' ability to diagnose and fix electrical faults. The study highlights the potential of aircraft maintenance simulators as valuable training tool for maintenance personnel.

Table 3
MEAN DISTRIBUTION ON THE AIRCRAFT MAINTENANCE SIMULATOR EFFECTIVE IN SIMULATING THE VARIOUS ASPECTS OF AIRCRAFT GROUND OPERATIONS IN TERMS OF AIRCRAFT RUN-UP AND TAXIING

Aircraft Run-up and taxiing	N	Mean	Verbal Interpretation
a. Cabin Doors. . . . . CLOSED and LATCHED	34	3.38	Highly Effective
b. Flight Controls. . . . . FREE and CORRECT	34	3.65	Highly Effective
c. Elevator Trim. . . . . .__ TAKEOFF	34	3.41	Highly Effective
d. Flight Instruments. . . ____ . CHECK and SET	34	3.56	Highly Effective
e. Brakes. . . ____ . ON/SET	34	3.68	Highly Effective
f. Throttle. . . . . .__ 1700 RPM (depend on the aircraft type, magnetos, carb heat, engine instruments)	34	3.59	Highly Effective
g. Lights. . . . . .__ AS REQUIRED	34	3.65	Highly Effective
h. Radios/Avionics. . . . . .__ SET	34	3.65	Highly Effective
i. Mixture. . . ____ . RICH	34	3.74	Highly Effective
j. Taxiing of Aircraft	34	3.71	Highly Effective
Average Weighted Mean	**34**	**3.60**	**Highly Effective**

1.2. Aircraft Run-up and taxiing

Table 3 presents the mean distribution of the aircraft maintenance simulator's effectiveness in simulating various aspects of aircraft ground operations regarding aircraft run-up and taxiing. The mean values are based on the ratings provided by 30 participants.

The results show that the aircraft maintenance simulator is Highly Effective in simulating the different aspects of aircraft ground operations related to aircraft run-up and taxiing, as indicated by the verbal interpretation of "Highly Effective" for all the parameters. The average weighted mean of 3.60 also supports this conclusion.

The high effectiveness of the simulator in simulating these aspects of aircraft ground operations is crucial for training maintenance and ground operations personnel. As the aviation industry continues to grow, there is a corresponding increase in demand for trained personnel to ensure that aircraft operations run smoothly and safely. Using effective simulators can provide a cost-effective and safe way to train personnel on the proper procedures for aircraft ground operations.

1.3 Aircraft Troubleshooting

Table 4 presents the mean distribution of the effectiveness of an Aircraft Maintenance Simulator in simulating various aspects of aircraft ground operations in terms of aircraft troubleshooting. The participants rated the effectiveness of the simulator on a scale from 1 (Not Effective) to 4 (Highly Effective). The average weighted mean of all aspects was 3.43, indicating that the simulator was rated as "Highly Effective" overall in simulating aircraft troubleshooting.

Table 4
MEAN DISTRIBUTION ON THE AIRCRAFT MAINTENANCE SIMULATOR EFFECTIVE IN SIMULATING THE VARIOUS ASPECTS OF AIRCRAFT GROUND OPERATIONS IN TERMS OF AIRCRAFT TROUBLESHOOTING

Aircraft Troubleshooting	N	Mean	Verbal Interpretation
a. General procedures for towing aircraft.	34	3.24	Highly Effective
b. Air Traffic Control (ATC) considerations/requirements for towing aircraft on or across active runways.	34	3.38	Highly Effective
c. Set-up an aircraft and cockpit controls for engine start.	34	3.65	Highly Effective
d. Set-up and connect an aircraft to an external power source.	34	3.38	Highly Effective
e. Determine the engine oil for a specific engine.	34	3.50	Highly Effective
Average Weighted Mean	**34**	**3.43**	**Highly Effective**

The aspect that received the lowest rating was "General procedures for towing aircraft," with a mean score of 3.24. However, this score is still in the "Highly Effective" range. The aspect that received the highest rating was "Set-up and connect an aircraft to an external power source" and "Air Traffic Control (ATC) considerations/requirements for towing aircraft on or across active runways," with mean scores of 3.38 and 3.65, respectively.

The results suggest that the simulator is effective in simulating aircraft ground operations related to troubleshooting, and it can be a valuable tool for training aircraft maintenance personnel. However, there is still room for improvement in simulating the general procedures for towing aircraft. This aspect should be given more attention and further developed in the simulator.

One relevant study supporting this table's findings is the research conducted by Banik et al. (2021), which evaluated the effectiveness of virtual reality (VR) training in aircraft maintenance. The study found that VR training effectively enhanced the skills and knowledge of aircraft maintenance personnel, leading to improved performance in real-life situations. The findings of this study highlight the potential of simulators, such as the Aircraft Maintenance Simulator, in providing realistic and effective training for aircraft maintenance personnel.

Overall, the findings of this table suggest that the Aircraft Maintenance Simulator is effective in simulating various aspects of aircraft ground operations related to troubleshooting, and it can be a valuable tool for training aircraft maintenance personnel. The results also emphasize the importance of continued development and improvement of simulators to enhance the effectiveness of training programs.

Table 5
MEAN DISTRIBUTION ON THE AIRCRAFT MAINTENANCE SIMULATOR EFFECTIVE IN SIMULATING THE VARIOUS ASPECTS OF AIRCRAFT GROUND OPERATIONS IN TERMS OF AIRCRAFT SERVICING

Aircraft Servicing	N	Mean	Verbal Interpretation
a. Visual inspection	34	3.59	Highly Effective
b. Pre-Flight Inspection	34	3.65	Highly Effective
c. Post Flight Inspection	34	3.53	Highly Effective
d. Aircraft preparation for washing, general aircraft cleaning	34	3.35	Highly Effective
e. Inspection for and identification of corrosion in any of it	34	3.41	Highly Effective
f. Inspection requirements for an engine fuel system.	34	3.44	Highly Effective
g. Checks of fuel systems to verify proper operation.	34	3.47	Highly Effective
h. Function and/or operation to engine fuel filters.	34	3.47	Highly Effective
i. Inspect an engine fuel filter assembly for leaks.	34	3.44	Highly Effective
j. Service an engine fuel strainer.	34	3.44	Highly Effective
Average Weighted Mean	**34**	**3.48**	**Highly Effective**

1.4 Aircraft Servicing

Based on the data presented in Table 5, the mean distribution on the aircraft maintenance simulator is highly effective in simulating various aspects of aircraft ground operations in terms of aircraft servicing, with an average weighted mean of 3.48, considered "Highly Effective." The results suggest

that the simulator is highly effective in simulating visual inspection, pre-flight inspection, post-flight inspection, inspection for and identification of corrosion, inspection requirements for an engine fuel system, checks of fuel systems to verify proper operation, function, and operation to engine fuel filters, inspecting an engine fuel filter assembly for leaks, and servicing an engine fuel strainer.

One implication of these findings is that the aircraft maintenance simulator can effectively train aircraft maintenance personnel. The simulator can help them gain practical experience performing various aircraft ground operations, leading to a more competent and confident workforce. Using simulators in aviation training has improved safety, reduced costs, and enhanced learning outcomes (Chang, 2021).

Table 6
OVERALL MEAN SUMMARY DISTRIBUTION ON THE AIRCRAFT MAINTENANCE SIMULATOR EFFECTIVE IN SIMULATING THE VARIOUS ASPECTS OF AIRCRAFT GROUND OPERATIONS

Variables	N	Mean	Verbal Interpretation
1. Aircraft Simulator	34	3.49	Highly Effective
2. Aircraft Run-up and taxiing	34	3.60	Highly Effective
3. Aircraft Troubleshooting	34	3.43	Highly Effective
4. Aircraft Servicing	34	3.48	Highly Effective
Average Weighted Mean	**34**	**3.50**	**Highly Effective**

Table 6 shows the overall mean summary distribution of the effectiveness of the aircraft maintenance simulator in simulating various aspects of aircraft ground operations. The data presented are based on 30 respondents who have used the simulator.

The results indicate that the respondents rated the simulator as "Highly Effective" in simulating all aspects of aircraft ground operations. The mean ratings range from 3.43 to 3.60, with an average weighted mean of 3.50. This suggests that the simulator is highly effective in visually stimulating aircraft ground operations.

Implications of these results could be significant in terms of cost savings and safety improvements in aircraft maintenance operations. A highly effective simulator can reduce the need for costly and potentially dangerous live aircraft maintenance procedures. The results also suggest that the simulator can provide an effective training tool for maintenance personnel.

One relevant study supporting this table's findings is "The Effectiveness of simulation-based training for aircraft maintenance personnel" by Seo et al. (2020).

2. The results of the pre-test and post-test taken by the students before and after simulation

The exam consisted of 30 items covering topics such as Aircraft Simulator, Aircraft Run-up and Taxiing, Aircraft Servicing, and Aircraft Troubleshooting. The table shows a range of class scores and their corresponding interpretation.

Table 7
FREQUENCY AND PERCENTAGE DISTRIBUTION OF BSAMT STUDENTS PRE-TEST USING THE AVIATION MAINTENANCE SIMULATOR N=30

Range of Class Scores	Frequency f	Percentage %	Verbal Interpretation
25 – 30	0	0.00	High
20 – 24	7	23.30	Above Average
15 – 19	17	56.70	Average
10 – 14	6	20.00	Below Average
0 – 9	0	0.00	Low

Table 7 provides the frequency and percentage distribution of the pre-test results of 30 Bachelor of Science in Aircraft Maintenance Technology (BSAMT) students who used the aviation maintenance simulator.

The table shows that none of the students scored within the high range (25-30), and none scored within the low range (0-9). The majority of the students, 17 out of 30, achieved within the average range (15-19), while seven students scored above average (20-24), and six students scored below average (10-14).

This distribution of scores suggests that the aviation maintenance simulator was moderately effective in improving the student's knowledge and skills. The simulator helped most students achieve average scores, which is still positive. However, the results also show that some students scored below average, indicating that the simulator could have been more

effective for them or that they may require additional support to improve their understanding.

Table 8
FREQUENCY AND PERCENTAGE DISTRIBUTION OF BSAMT STUDENTS POST-TEST USING THE AVIATION MAINTENANCE SIMULATOR N=30

Range of Class Scores	Frequency f	Percentage %	Verbal Interpretation
25 – 30	23	76.70	High
20 – 24	5	16.70	Above Average
15 – 19	2	6.70	Average
10 – 14	0	0.00	Below Average
0 – 9	0	0.00	Low

Table 8 provides the frequency and percentage distribution of the post-test results of 30 Bachelor of Science in Aircraft Maintenance Technology (BSAMT) students who used the aviation maintenance simulator.
The table shows that a vast majority of the students, 23 out of 30, scored within the high range (25-30), indicating a significant improvement in their knowledge and skills after using the aviation maintenance simulator. Five students scored above average (20-24), while only two scored within the average range (15-19). None of the students scored below average (10-14) or low (0-9).

The distribution of scores suggests that the aviation maintenance simulator was highly effective in improving the student's knowledge and skills, as most students scored within the high range. This improvement is a positive outcome and suggests that the aviation maintenance simulator can be a useful tool in enhancing the learning experience of BSAMT students.

Overall, the results of Table 8 are promising, and it may be useful to incorporate the aviation maintenance simulator into the curriculum of BSAMT students to enhance their learning outcomes further.

Table 9
SUMMARY OF PRE-TEST AND POST-TEST RESULT OF BSAMT STUDENTS USING THE AVIATION MAINTENANCE SIMULATOR N=30

Sample	N	Mean	Median	Standard Deviation	Minimum	Maximum
Pre-Test	30	3.03	3.00	0.669	2.00	4.00
Post-Test	30	4.70	5.00	0.596	3.00	5.00

Table 9 summarizes the pre-test and post-test results of 30 Bachelor of Science in Aircraft Maintenance Technology (BSAMT) students who used the aviation maintenance simulator. The table shows the measures of central tendency (mean, median) and variability (standard deviation, minimum, maximum) for the pre-test and post-test results.

The mean score for the pre-test is 3.03, which is interpreted as an average score based on the scale in Table 1. The mean score for the post-test is 4.70, which is interpreted as a high score. The increase in mean score from the pre-test to the post-test suggests that the aviation maintenance simulator positively impacts the knowledge and skills of BSAMT students. The median score for the pre-test and post-test is 3.00 and 5.00, respectively. The difference in the median score between the pre-test and post-test indicates that the aviation maintenance simulator significantly improves the students' knowledge and skills.

The standard deviation for the pre-test is 0.669, while the standard deviation for the post-test is 0.596. The lower standard deviation for the post-test compared to the pre-test indicates that the scores are more consistent and less varied after using the aviation maintenance simulator.

The minimum score for the pre-test is 2.00, the maximum score is 4.00, the minimum score for the post-test is 3.00, and the maximum score is 5.00. The increase in the minimum and maximum scores for the post-test compared to the pre-test further supports the notion that the aviation maintenance simulator positively impacts the knowledge and skills of BSAMT students.

These results imply that the aviation maintenance simulator positively improves the knowledge and skills of BSAMT students, as evidenced by the increase in mean score, median score, and the decrease

in standard deviation. This result suggests that the aviation maintenance simulator can be a valuable tool in enhancing the learning experience of BSAMT students.

3. The significant difference between the pre-test and post-test results of the students before and after simulation

Table 10
PAIRED T-TEST FOR PRE-TEST AND POST-TEST RESULTS OF BSAMT STUDENTS USING THE AVIATION MAINTENANCE SIMULATOR

Sample	N	Mean	Standard Deviation	SE	95 CI for Difference		t	P-Value
					Lower	Upper		
Pre-Test	30	3.03	0.669	0.122	-2.01	-1.32	-9.90	0.000
Post-Test	30	4.70	0.596	0.109				

Table 10 presents the paired t-test results for the pre-test and post-test results of BSAMT students using the aviation maintenance simulator. The paired t-test is a statistical test used to compare the means of two related samples. In this case, the pre-test and post-test scores of the same group of students are compared to see if there is a significant difference in their scores after using the simulator.

The table shows that the mean pre-test score is 3.03, with a standard deviation of 0.669, while the mean post-test score is 4.70, with a standard deviation of 0.596. The paired t-test result shows a significant difference between the pre-test and post-test scores, with a t-value of -9.90 and a p-value of 0.000 (less than the conventional alpha level of 0.05).

These results imply that using the aviation maintenance simulator has significantly improved the knowledge and skills of the BSAMT students. The mean post-test score of 4.70 is substantially higher than the mean pre-test score of 3.03, indicating that the simulator has positively impacted the student's learning outcomes. The significant difference in the scores also suggests that using the simulator is an effective method of instruction for teaching aviation maintenance technology. These results could be useful in improving the aviation maintenance technology curriculum and designing effective instructional practices for teaching the subject.

4. The significant relationship between the pre-test and post-test results of the students before and after simulation

Table 11 presents the pre-test and post-test scores of BSAMT students who used the aviation maintenance simulator.

The correlation coefficient between the pre-test and post-test scores is -0.061, which indicates a weak negative correlation. The p-value is 0.751, more significant than the significance level of 0.05. Therefore, we fail to reject the null hypothesis that no significant correlation exists between the pre-test and post-test scores.

Table 11
PEARSON'S R CORRELATION RESULTS OF PRE-TEST & POST-TEST OF BSAMTSTUDENTS USING THE AVIATION MAINTENANCE SIMULATOR

Correlation Matrix		Pre-Test	Post-Test
Pre-Test	Pearson's r	—	
	p-value	—	
	N	—	
Post-Test	Pearson's r	-0.061	—
	p-value	0.751	—
	N	30	—

5. Participant's recommendations to improve the training provided by aviation maintenance simulators to enhance students' knowledge and skills in aircraft ground operations

Table 12
FREQUENCY AND PERCENTAGE DISTRIBUTION OF THE PARTICIPANTS RECOMMENDATIONS TO IMPROVE THE MAINTENANCE SIMULATORS AVIATION MAINTENANCE SIMULATOR FOR AIRCRAFT GROUND OPERATIONS

RECOMMENDATIONS	Frequency f	Percentage %	Rank
Develop simulator scenarios that reflect real-world maintenance challenges	**29**	96.67	1
Provide interactive feedback during training	22	77.33	3.5
Incorporate different types of simulators	21	70.00	5
Provide refresher training	22	73.33	3.5
Incorporate virtual reality (VR) technology	20	66.67	6
Provide hands-on training on real aircraft	27	90.00	2

Table 12 shows the frequency and percentage distribution of participants' recommendations to improve the aviation maintenance simulator for aircraft ground operations. The proposals are ranked in descending order of frequency.

The most frequently recommended improvement is the development of simulator scenarios that reflect real-world maintenance challenges, with a frequency of 29 (96.67%) and a rank of 1. This suggests that participants believe that simulators should closely mimic the challenges faced by maintenance personnel in real-world situations.
The second most frequent recommendation is to provide hands-on training on actual aircraft, with a frequency of 27 (90.00%) and a rank of 2. This indicates that participants feel that hands-on training on real aircraft is important for developing practical skills.

The third and fourth recommendations have the same frequency of 22 (73.33%) but are ranked 3.5, suggesting that participants consider them equally important. These recommendations are to provide interactive feedback during training and to provide refresher training. Interactive feedback allows trainees to receive immediate feedback on their performance, which can improve learning outcomes. Refresher training can reinforce knowledge and skills learned in earlier training sessions.

The fifth recommendation is to incorporate different types of simulators, with a frequency of 21 (70.00%) and a rank of 5. This suggests that participants believe using various simulators can better prepare trainees for different maintenance scenarios.

The sixth and final recommendation is to incorporate virtual reality (VR) technology, with a frequency of 20 (66.67%) and a rank of 6. This recommendation is less frequently mentioned than the others, but it still indicates that some participants see the potential benefit of using VR technology in maintenance training.

Overall, the recommendations reflect the importance of providing realistic and hands-on training experiences to develop the skills and knowledge needed for aircraft ground operations. These recommendations imply that training programs should prioritize allowing trainees to practice in environments resembling real-world scenarios. Incorporating feedback mechanisms and varied training approaches can also enhance learning outcomes.

CONCLUSION

1. The aircraft maintenance simulator is Highly Effective in simulating various aspects of aircraft ground operations and can be used to enhance training in the aviation industry.
2. The results of the study indicate that the use of the aviation maintenance simulator for aircraft ground operations positively impacted the knowledge and skills of BSAMT students. The significant increase in the mean score from the pre-test to the post-test suggests that the Simulator effectively enhanced their understanding and performance.
3. There was a significant improvement in the scores of BSAMT students who used an Aviation Maintenance Simulator for their pre-test and post-test evaluations.
4. There is no significant correlation between the pre-test and post-test scores of BSAMT students who used an Aviation Maintenance Simulator.
5. The participants believe that developing simulator scenarios reflecting real-world maintenance challenges and providing hands-on training on real aircraft are the most important recommendations for improving the Aviation Maintenance Simulator for Aircraft Ground Operations.

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