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RESEARCH ARTICLE

Assessing the Effectiveness of Simulator-Based Training in Aircraft Maintenance Technology Program

Author/s: Eugene E. Toring, Kimberly N. Toring, Marc Jasper C. Lapidario, Carlo C. Apolo, Jason Kyle Cabibil, Guy Jesse A. Castanares, Peter Angelo O. Dayot, Vince Leo A. Gilig, Jhea T. Manacap, Wee Cheen Keegan M. Ong, Earl Vince Urbiztondo, Jhoselle Tus

Affiliation: Indiana Aerospace University

Abstract

This study examines the effectiveness of simulator-based training in the Aircraft Maintenance Technology (AMT) program at Indiana Aerospace University (IAU) during the Academic Year 2023–2024. As the aviation industry rapidly evolves, maintenance training programs must adapt to equip students with both foundational and advanced skills. Simulator-based instruction offers immersive, hands-on experiences in controlled environments that mirror real-world aircraft maintenance tasks. Guided by Experiential Learning Theory, Cognitive Load Theory, and Situated Learning Theory, this study investigates how simulation impacts curriculum integration, training quality, and skill development among AMT students. A descriptive quantitative research design was employed, with data collected from 50 AMT students across year levels. Respondents were divided into two groups—those trained primarily through traditional classroom instruction and those trained via simulators. Data were gathered using a self-constructed Likert-scale questionnaire focusing on three main areas: curriculum integration, training effectiveness, and skill development. Statistical analysis revealed that simulator-based training was perceived as "Highly Effective" to "Very Effective" across all measured aspects. Notably, students reported improved skill retention, increased confidence, enhanced understanding of complex systems, and better preparation for industry expectations. The findings strongly support the incorporation of simulator-based training as a core component of AMT education. It bridges the gap between theoretical knowledge and practical application, reduces operational risks, and improves overall student competency. The study recommends increasing institutional investment in simulation technology, aligning training with industry standards, and continuously evaluating program effectiveness. These initiatives are essential not only for enhancing educational outcomes at IAU but also for shaping the future of aviation maintenance education across the Philippines and beyond.

Keywords: *simulator-based training, aircraft maintenance technology, skill development, curriculum integration, aviation education*

Introduction

The global aviation industry, guided by stringent safety standards and rapid technological advancement, continues to demand highly skilled Aircraft Maintenance Technicians (AMTs) to ensure aircraft airworthiness and operational efficiency. As aircraft systems become increasingly sophisticated, traditional training methods are being challenged to adapt to the evolving complexities of modern aviation. Simulator-based training has emerged as a cost-effective, high-impact instructional strategy aimed at enhancing technical competencies, improving safety outcomes, and reducing operational risks. This approach allows AMTs to gain hands-on experience in a controlled, risk-free environment, promoting skill retention and minimizing the potential for equipment damage and downtime during actual operations (Federal Aviation Administration [FAA], 2020).

Theoretical underpinnings for this study include Experiential Learning Theory (Kolb, 1984), which asserts that learning is most effective when rooted in direct experience—a concept that aligns closely with simulator-based instruction. Cognitive Load Theory (Sweller, 1988) also plays a critical role, emphasizing that training must be structured to accommodate the limitations of working memory, especially in highly technical domains like aviation maintenance. Breaking complex maintenance procedures into manageable tasks through simulation helps learners retain information without cognitive overload. Furthermore, Situated Learning Theory (Lave & Wenger, 1991) supports the idea that knowledge is best acquired in contexts that resemble the real-world environments in which the knowledge will be applied. Simulation training environments mirror real maintenance settings, making them particularly effective for developing practical skills and contextual understanding.

Despite its advantages, simulator-based training presents challenges such as high implementation costs, reliance on robust IT

infrastructure, and sometimes limited realism or feedback. These limitations underscore the need for continuous evaluation of its effectiveness, especially when compared to traditional classroom-based instruction. This study aims to assess how simulator-based training differs from conventional lecture-based methods and to determine whether the integration of both can bridge training gaps in aviation maintenance education.

The primary objective of this research is to evaluate the effectiveness of simulator-based training for AMTs at Indiana Aerospace University. By focusing on how simulations enhance skill development prior to fieldwork, the study seeks to provide evidence-based insights for optimizing training methodologies. The researchers, currently enrolled as AMT undergraduates with two years of hands-on and instructional experience, bring both academic and technical competence to this investigation. The findings may inform training enhancements not only within IAU but also within broader aviation training programs in the Philippines and internationally.

Research Question/ Objectives

This study sought to assess the effectiveness of simulator-based training in the Aircraft Maintenance Technology (AMT) program at Indiana Aerospace University (IAU) for the Academic Year 2023-2024.

1. Assess how well simulator-based training improves the skills and knowledge of aircraft maintenance technicians, emphasizing training methods, skill development, and ways to integrate this training into the curriculum.

Methodology

This study employed a descriptive quantitative research design to evaluate the effectiveness of simulator-based training in Aircraft Maintenance Technician (AMT) education, specifically focusing on training outcomes, skill development, and curriculum integration strategies. Quantitative methods were used to systematically gather and analyze numerical data from students who experienced either traditional lecture-based training or simulator-based instruction.

The research was conducted at Indiana Aerospace University (IAU) in Lapu-Lapu City, Cebu—a leading private aerospace institution in the Philippines offering high-quality educational programs across various aviation disciplines. A total of 50 respondents were selected from the 1st to 4th year AMT student population. Participants were evenly divided into two groups: 25 students trained primarily through traditional classroom instruction and 25 students trained using simulator-based platforms. A self-constructed survey questionnaire was used as the primary data collection instrument. The questionnaire consisted of three parts: respondent demographics (age, gender, and year level), effectiveness of simulator-based training (covering curriculum integration, training quality, and skill development), and problems encountered during training. Responses were rated using a five-point Likert scale, ranging from "1 – Not Effective" to "5 – Very Effective." Surveys were administered in person, and participants received clear instructions and support to ensure accurate and honest responses.

Data gathered were analyzed using descriptive statistics, including the weighted mean and frequency distributions, to identify patterns and interpret the level of effectiveness of simulator-based training. Ethical considerations were carefully observed throughout the research process. Informed consent was obtained from all participants, who were briefed about the study's objectives, their voluntary participation, and the assurance of confidentiality. All data were anonymized and securely stored to ensure participant privacy. The study followed institutional ethical guidelines and aimed to contribute meaningful insights into improving AMT training programs through the strategic integration of simulation technology.

Results

Curriculum Integration Strategies

Table 1 presents assessing the effectiveness of simulator-based training in Aircraft Maintenance technology program in terms of Curriculum Integration strategies.

Table 1.

Indicators	*Weighted Mean*	*Description*
1. The curriculum at Indiana Aerospace University incorporates real world applications and examples relevant to the field.	4.56	Very Effective
2. The Curriculum at Indiana Aerospace University Effectively integrates Theoretical knowledge with Practical skills.	4.49	Very Effective
3. The current curriculum integration strategies are effective in fostering critical thinking and problem-solving skills.	4.37	Very Effective
4. It is the integration of basic skills into the curriculum is essential for comprehensive program.	4.28	Very Effective
5. There is a clear strategy for integrating new technologies and digital tools into the curriculum.	4.12	Highly Effective
Average Weighted Mean	4.37	Very Effective

Legend: 4.21–5.00, Very Effective; 3.41–4.20, Highly Effective; 2.61–3.40, Effective; 1.81–2.60, Fairly Effective; 1.00–1.80, Not Effective

Curriculum integration strategies involve combining multiple subjects and other learning methods into one learning experience, allowing students to have a better hands-on experience in simulator-based training. These strategies promote in-depth learning and skill retention

especially for new students.

Integrating simulator-based training can subject students to real-world problems enabling them to enhance their critical-thinking, problem solving skill, and encourage them to do their task. Allowing for an efficient learning experience and learning the relevant procedures for AMT students. Nevertheless, integrating this to our current curriculum can be beneficial both to the school and the students.

Training

Training is the process of learning or developing a student's skill and knowledge, especially in the field of aviation. Proper training equips AMT students with deep understanding of different aircraft systems, regulations and protocols.

The main purpose of training is to gain experience and ensure up to date knowledge, which is needed to safely and effectively maintain and repair aircraft. That is why simulator-based training can ensure students then are capable of doing their task before actual training on real aircraft. Proper training prepares them to contribute to aircraft reliability and overall flight safety in the aviation industry.

Table 2 presents assessing the effectiveness of simulator-based training in Aircraft Maintenance technology program in terms of Training

Table 2.

Indicators	*Weighted Means*	*Description*
1. The training program provided at Indiana Aerospace University are effective in enhancing students' skills	4.16	Highly Effective
2. Students are satisfied with the opportunities provided for hands-on practice during laboratory classes.	4.14	Highly Effective
3. The frequency of laboratory classes provided is sufficient for continuous professional development.	4.1	Highly Effective
4. Laboratory classes are well structured and provide comprehensive coverage of relevant topics.	4.04	Highly Effective
5. Students feel that the laboratory classes are adequately tailored to meet the needs of their job role.	3.96	Highly Effective
Average Weighted Mean	4.08	Highly Effective

Legend: 4.21–5.00, Very Effective; 3.41–4.20, Highly Effective; 2.61–3.40, Effective; 1.81–2.60, Fairly Effective; 1.00–1.80, Not Effective

Skill development

Skill development is also a process of acquiring and improving a student's abilities needed to perform their tasks effectively. Skill development is crucial for an AMT student as one wrong mishap could lead to dire or fatal accidents.

It enables precision in handling complex systems in an aircraft. Enhanced skills lead to a more efficient repairs, reducing aircraft downtime and costs. Simulator-Based training can help students hone their skills before handling real aircrafts.

Table 3 presents assessing the effectiveness of simulator-based training in Aircraft Maintenance technology program in terms of Skill Development.

Table 3.

Indicators	*Weighted Mean*	*Description*
1. Skill development initiatives at Indiana Aerospace University are aligned with current industry standard.	4.28	Very Effective
2. Students feel encouraged to pursue further skill development opportunities outside the formal training development.	4.22	Very Effective
3. Students have observed a significant improvement in their skills as a result of participating in simulator-based training.	4.16	Highly Effective
4. The skills acquired through simulator-based training and laboratory classes are directly applicable to daily tasks.	4.06	Highly Effective
5. There are adequate resources and support available to help students develop new skills.	3.84	Highly Effective
Average Weighted Mean	4.11	Highly Effective

Legend: 4.21–5.00, Very Effective; 3.41–4.20, Highly Effective; 2.61–3.40, Effective; 1.81–2.60, Fairly Effective; 1.00–1.80, Not Effective

Conclusion

Based on the findings of this study, it can be concluded that simulator-based training is a highly effective tool in enhancing the competencies of Aircraft Maintenance Technology (AMT) students. Students from first to fourth year, regardless of age and gender, perceived simulator training as a valuable approach that improves skill retention, builds confidence, and enables them to apply their knowledge effectively. The integration of simulators into the curriculum promotes deeper understanding, reduces errors, and prepares students for real-world aircraft maintenance scenarios, contributing to safer and more cost-efficient operations in the aviation industry.

In light of these conclusions, it is recommended that educational institutions offering AMT programs invest in expanding simulator-based training and incorporate it more deeply into their curriculum. This includes increasing access to relevant technologies, tools, and hands-on experiences that mirror actual aircraft systems. Curriculum planners should also establish structured integration of digital and

simulator tools, ensuring a seamless blend of theoretical and practical learning. Such improvements will not only align with industry standards but also support the professional growth and readiness of AMT students for future employment.

Finally, institutions must ensure that skill development in laboratories reflects industry expectations by providing activities that build both foundational and advanced competencies. Mentorship programs, adequate laboratory resources, and progressive training methods will help students gain confidence and mastery of their roles. By fostering an environment that prioritizes both knowledge and practical application, AMT programs can better equip students with the essential skills needed in the fast-paced and high-stakes world of aircraft maintenance.

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