RESEARCH ARTICLE

Using Virtual Aerodrome to Teach Aircraft Maintenance at Indiana Aerospace University

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Abstract

Virtual aerodromes are a simulated training environment designed to enhance practical skills in aerodrome operations through realistic activities and tools. This study evaluates its effectiveness as an immersive teaching method for Aircraft Maintenance and Technology (AMT) students at Indiana Aerospace University, focusing on improving competency, skill development, and assessment performance. A mixed-method approach was utilized, combining quantitative statistical analysis with qualitative feedback. The sample included 50 AMT students. Data was gathered using researcher-designed survey questionnaires and interview schedules. Statistical tools such as weighted mean, ranking, and frequency analysis were applied, using a 5-point Likert scale. Findings indicated that the virtual aerodrome significantly enhanced student proficiency, demonstrating a strong correlation between simulation-based training and improved operational skills. However, challenges were identified, including limited simulation realism and insufficient feedback mechanisms. In response, the study proposes an action plan involving collaboration with industry experts for curriculum enhancement, improved feedback systems, integration of realistic aircraft system simulations, scenario-based modules, and the inclusion of additional field experts to foster critical thinking. These recommendations aim to optimize the virtual training environment and better prepare students for real-world aircraft maintenance operations.

Keywords: *virtual aerodrome, aircraft maintenance competency building, skill development*

Introduction

Training is essential to a student's educational journey, particularly for Aircraft Maintenance and Technology (AMT) students who must acquire a broad range of technical competencies to thrive in the aviation industry. Globally, the demand for highly skilled maintenance professionals is critical to maintaining aviation safety, reliability, and efficiency (International Civil Aviation Organization [ICAO], 2020). Using advanced training technologies in major aviation hubs such as the United States and Singapore ensures that industry standards are upheld (Civil Aviation Authority of Singapore [CAAS], 2021). Meanwhile, the Philippines—experiencing rapid aviation growth—requires innovative strategies to meet the increasing demand for proficient technicians (Department of Transportation [DOTr], 2020). In response, Indiana Aerospace University in Cebu City is proactively modernizing AMT education through simulation-based learning.

This study aims to evaluate the Virtual Aerodrome as a teaching method to improve the skills and competencies of AMT students at Indiana Aerospace University. The Virtual Aerodrome bridges the gap between theoretical instruction and practical experience by creating immersive and interactive environments. The findings will inform educational strategies that enhance training quality and student preparedness for local and international industry requirements.

This study adheres to legal standards to ensure ethical research practices. These measures include obtaining informed consent from all participants and observing copyright and licensing agreements related to the virtual simulation software. These measures ensure the protection of intellectual property and participants' rights.

The study is grounded in Cognitive Load Theory (CLT) by John Sweller and the Technology Acceptance Model (TAM) by Fred Davis. CLT emphasizes managing the learner's working memory to facilitate effective knowledge acquisition (Sweller, 1988). Virtual

simulations, when well-designed, can reduce extraneous cognitive load and promote deeper learning. Meanwhile, TAM investigates how users accept and use technology, particularly focusing on perceived ease of use and usefulness (Davis, 1989). This framework will guide the evaluation of students' attitudes toward the Virtual Aerodrome as a learning tool.

accuracy of virtual environments in replicating real-world scenarios, the risk of over-reliance on technology, and potential hardware or software issues. Additionally, the cost of implementation raises questions about long-term sustainability. Thus, this study assesses the educational impact of the Virtual Aerodrome and its practical feasibility as a core training tool.

Ultimately, this research evaluates how simulation-based training enhances AMT students' technical proficiency, understanding of complex systems, and industry readiness. The insights will support the development of an action plan further to improve the integration of virtual tools in aeronautical education.

Research Objectives

This study aims to evaluate virtual aerodrome as a teaching method for the aircraft maintenance and technology students at Indiana Aerospace University for 2024-2025 and propose an action plan. Specifically, this study sought to:

1. Evaluate the virtual aerodrome as a teaching method for the aircraft maintenance and technology students at Indiana Aerospace University regarding Competency Building, Skill Development, and Assessment and Evaluation.

Methodology

Research Design

This study employed a descriptive quantitative research design, which focuses on collecting and analyzing numerical data to identify trends, patterns, and relationships relevant to the research objectives. This approach is appropriate for evaluating the effectiveness of the Virtual Aerodrome as a teaching method, as it allows the researchers to systematically gather quantifiable feedback from participants and draw meaningful conclusions based on statistical analysis. Descriptive research is beneficial for assessing educational interventions and understanding perceptions and outcomes in a structured manner.

Participants/Respondents

The research was conducted at Indiana Aerospace University, located on Kagudoy Road, Lapu-Lapu City, Cebu. Data collection was carried out through the face-to-face distribution of printed survey questionnaires. The participants were second-year and third-year Aircraft Maintenance and Technology (AMT) students who had experienced virtual aerodrome instruction and instructors possessing relevant expertise in this field. This study is consistent with the university's vision of fostering holistic development and its mission of producing globally competitive graduates with strong foundations in aerospace education. It also upholds the institution's core values, including professionalism, teamwork, and excellence in educational practices.

Instruments

The primary data collection tool was a researcher-made printed survey questionnaire. The questionnaire consisted of three parts: (1) respondent profile, including age, gender, and year level; (2) evaluation of the virtual aerodrome as a teaching method, focusing on competency building, skill development, and assessment and evaluation; and (3) identification of challenges encountered by AMT students. A 5-point Likert scale (5 – Strongly Agree to 1 – Strongly Disagree) was used to gather responses in the second and third parts.

Data Analysis

Data collected through the questionnaires were analyzed using descriptive statistical tools, including weighted mean, ranking, and simple rate calculations. These tools enabled the researchers to summarize the data effectively and interpret students' and instructors' perceptions of the virtual aerodrome. A 5-point Likert scale provided a standardized format for measuring the levels of agreement or disagreement with key statements, supporting a comprehensive assessment of the virtual teaching method's impact on learning outcomes.

Results

Competency Building

Competency building involves enhancing essential skills, knowledge, and abilities necessary for effective performance in a role or field. This process includes engaging in formal training and education, gaining practical experience, receiving mentorship and guidance, pursuing self-directed learning, and undergoing regular feedback and evaluation. By developing these competencies, individuals and organizations can improve performance, adapt to evolving challenges, and achieve their objectives. All of these elements work together to help individuals grow and improve in their roles.

The virtual aerodrome refines competency building by providing a hands-on, collaborative learning experience that enhances students' practical skills in aircraft maintenance technology. Grounded in Cognitive Load Theory (CLT), it helps manage cognitive demands by breaking down complex tasks into manageable simulations, allowing students to process information more efficiently. By navigating

real-world scenarios, students improve their teamwork, communication, problem-solving, safety awareness, and technical communication. The system also aligns with the Technology Acceptance Model (TAM), as its intuitive design increases students' perceived ease of use and usefulness, fostering engagement with the technology. The virtual aerodrome encourages open dialogue, constructive feedback, and collaboration, enabling students to work together effectively while gaining valuable experience with modern tools, ultimately preparing them for real-world challenges.

Table 1 presents the evaluation of the virtual aerodrome as a teaching method for the aircraft maintenance and technology students at Indiana Aerospace University in terms of competency building.

Table 1. *Competency Building*

Indicators	Mean	Description
1. The virtual aerodrome is a beneficial tool for improving students' competency in aerodrome operations	4.68	Strongly Agree
2. The virtual aerodrome incorporates activities that foster the development of the student's competency.	4.56	Strongly Agree
3. The module content of the virtual aerodrome provides comprehensive instructions and serves as a foundation for competency building	4.54	Strongly Agree
4. The virtual aerodrome facilitates the development of critical thinking and competency building in real-life aerodrome operations	4.52	Strongly Agree
5. The virtual aerodrome provides sufficient opportunities for hands-on practices.	4.36	Strongly Agree
Average Weighted Mean	4.53	Strongly Agree

Legend: (4.21 - 5.0) Strongly Agree (3.41 - 4.20) Agree (2.61 - 3.40) Neutral (1.81 - 2.60) Disagree (1.0 - 1.80) Strongly Disagree

Skill Development

Skill development is about building and improving the abilities required to succeed in different areas, which involves intentionally increasing one's knowledge, skills, and hands-on experience for effective and assured task performance. In the context of aircraft maintenance and technology, this means acquiring the specialized skills needed to ensure aircraft are safe and efficient. Technicians must learn how to inspect, repair, and maintain various aircraft systems, such as engines, avionics, and airframes. They also need to understand technical documentation, operate specialized tools and diagnostic equipment, and adhere to rigorous safety and regulatory standards. Mastery in this field integrates theoretical knowledge with practical expertise, focusing on precision, analytical skills, and staying current with technological innovations and industry practices.

A virtual aerodrome is a modern approach to skill development for Indiana Aerospace University students studying aircraft maintenance technology, grounded in Cognitive Load Theory (CLT) and the Technology Acceptance Model (TAM). By using virtual tools, students engage in hands-on learning with aircraft systems, operations, and maintenance skills, reducing reliance on physical resources while managing cognitive demands. CLT ensures that the virtual environment helps students process complex tasks in manageable steps, enhancing learning without overwhelming them. Aligned with TAM, the ease of use and usefulness of the virtual aerodrome foster students' acceptance of the technology, encouraging engagement and confidence. This method enhances flexibility, quick decision-making, and problem-solving by simulating real-time scenarios in a controlled environment. Ultimately, it promotes effectiveness and safety, preparing students to tackle real-world aviation challenges with greater competence and confidence.

Table 2 presents the evaluation of the virtual aerodrome as a teaching method for the aircraft maintenance and technology students at Indiana Aerospace University in terms of skill development.

Table 2. *Skill Development*

Indicators	Mean	Description
1. The virtual aerodrome provides sufficient knowledge that helps in developing the skills of the aircraft maintenance and technology students	4.52	Strongly Agree
2. The virtual aerodrome prepares students in real-world skill development challenges in aircraft maintenance	4.46	Strongly Agree
3. The virtual aerodrome provides clear representation of real-world aircraft operations that helps students improve their technical skills effectively	4.42	Strongly Agree
4. The virtual aerodrome is an engaging learning tool that helps in developing technical skills of the aircraft maintenance and technology students	4.38	Strongly Agree
5. Students receive useful feedback from the virtual aerodrome that helps them improve their skills effectively	4.18	Agree
Average Weighted Mean	4.39	Strongly Agree

Legend: (4.21 - 5.0) Strongly Agree (3.41 - 4.20) Agree (2.61 - 3.40) Neutral (1.81 - 2.60) Disagree (1.0 - 1.80) Strongly Disagree

Assessment and Evaluation

Assessment involves collecting data on students' knowledge, skills, attitudes, and understanding through tests, assignments, and discussions. It provides feedback to guide learning and improves outcomes. Evaluation, on the other hand, evaluates the learning process, teaching methods, and academic programs based on assessment results. It helps determine if educational goals have been met

and may lead to final decisions like grading or curriculum adjustments. Assessment and evaluation are key concepts in educational research, especially when exploring the effectiveness of new teaching methods.

The study evaluates the effectiveness of a virtual aerodrome as a teaching method for aircraft maintenance and technology students at Indiana Aerospace University, incorporating Cognitive Load Theory (CLT) and the Technology Acceptance Model (TAM). It examines students' understanding, retention, and practical application of aerodrome procedures through quizzes, exercises, and feedback

surveys. By using CLT, the study assesses how the virtual aerodrome minimizes cognitive overload, enabling students to manage complex tasks in a more efficient and structured way. TAM is used to explore how students perceive the ease of use and usefulness of the virtual platform in applying their learning to real-world scenarios, evaluating their accuracy and efficiency. The findings will highlight the virtual aerodrome's strengths and limitations, its impact on students' readiness for real aerodrome environments, and how well students accept and engage with the technology. This will guide decisions on its future use and potential improvements.

Table 3 presents the evaluation of the virtual aerodrome as a teaching method for the aircraft maintenance and technology students at Indiana Aerospace University in terms of assessment and evaluation.

Table 3. *Skill Development*

Indicators	Mean	Description
1. The virtual aerodrome has given the students confidence in their ability to apply aerodrome procedures after using it	4.50	Strongly Agree
2. Provides effective assessment tools for evaluating students understanding of aerodrome operations	4.50	Strongly Agree
3. Interaction with the virtual aerodrome helps students in developing a deeper and clearer understanding of aircraft systems	4.44	Strongly Agree
4. The virtual aerodrome helps in bridging the gap between theoretical knowledge and practical application	4.40	Strongly Agree
5. The theoretical knowledge that the students have learned can be easily applied when using the virtual aerodrome	4.32	Strongly Agree
Average Weighted Mean	4.43	Strongly Agree

Legend: (4.21 - 5.0) Strongly Agree (3.41 - 4.20) Agree (2.61 - 3.40) Neutral (1.81 - 2.60) Disagree (1.0 - 1.80) Strongly Disagree

Conclusion

The study concludes that the Virtual Aerodrome is an effective and innovative teaching tool for Indiana Aerospace University's Aircraft Maintenance and Technology (AMT) students. The students strongly agreed on its value in enhancing their competencies, developing technical skills, and reinforcing learning through assessment and evaluation. The platform creates an immersive and structured environment that fosters critical thinking, practical application, and confidence in handling real-world aerodrome operations. These findings suggest that integrating the Virtual Aerodrome into the academic curriculum prepares students for future industry demands.

Despite its effectiveness, the study also identified several areas where the Virtual Aerodrome could be improved. To address the limited real-world representation, developers should collaborate with industry experts to create more authentic and up-to-date simulation scenarios. Regular feedback mechanisms must also be established, where instructors provide constructive performance reviews, enabling students to recognize areas for improvement. Virtual lessons should be supplemented with hands-on training sessions and physical interaction with real equipment to deepen students' understanding of aircraft systems. This blended approach will strengthen the connection between theoretical knowledge and practical application.

Furthermore, the virtual modules should be redesigned to follow a progressive structure, from fundamental aerodrome concepts to advanced operational skills. Aligning each section with specific learning outcomes will enhance competency development. Problem-based scenarios, debriefings, and collaborative group tasks should be incorporated to foster critical thinking. These strategies will improve student engagement and promote the analytical skills required for complex aerodrome operations. Addressing these challenges, the Virtual Aerodrome can evolve into a more comprehensive and effective educational platform for future aviation professionals.

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