International Journal Of Humanities Education And Social Sciences ***(IJHESS)*** *E-ISSN:* **2808-1765**
Volume 5, Number 6, June 2026, *Page. 2822 – 2833*
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Analysis of the Impact of Computer-Based Training on Air Traffic Services at Palembang Radar Service

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Abstract

The provision of air traffic services requires Air Traffic Controllers (ATCs) to possess high levels of competence, particularly in mastering procedures, operating equipment, and making fast and accurate decisions. To maintain these competency standards, AirNav Indonesia implements various training programs, including Computer-Based Training (CBT). However, at Palembang Radar Service, a key issue remains the absence of clearly structured, comprehensive, and operationally specific CBT modules tailored to local radar operations. This study aims to analyze the influence of the Computer-Based Training (CBT) program on air traffic services at Palembang Radar Service. The research employed a descriptive-associative quantitative approach, using numerical data to examine the relationship between variables through statistical analysis. Data were collected from active ATC personnel using structured questionnaires and analyzed using correlation and hypothesis testing methods. The results indicate a very strong relationship between the CBT program and air traffic services, with a correlation value of 0.92 (92%). These findings demonstrate that improved implementation of CBT is associated with enhanced air traffic service performance. The study concludes that the CBT program has a significant influence on air traffic services at Palembang Radar Service and plays an important role in supporting ATC competence and service quality.

Keywords: IELP, Web-Based Application, Data Inventory, Aviation English Proficiency, Air Traffic Controller

INTRODUCTION

The provision of air traffic services requires Air Traffic Controllers (ATCs) to possess a high level of competence, particularly in procedural mastery, equipment operation, and the ability to make fast and accurate decisions. To maintain these competency standards, AirNav Indonesia implements various training programs, one of which is Computer-Based Training (CBT). CBT is considered an effective training method because it delivers structured and standardized learning materials, offers flexibility in access, and enhances knowledge retention through digital-based learning (Rosenberg, 2021). In the context of air navigation services, technology-based training is also aligned with the recommendations of the International Civil Aviation Organization (ICAO), which emphasize the importance of adaptive, continuous, and technology-oriented learning methods to improve ATC competence (ICAO, 2016).

Despite the long-term implementation of CBT, a major issue identified at Palembang Radar Service is the absence of clearly structured, comprehensive, and operationally specific CBT modules tailored to local radar service needs. Internal document reviews and preliminary interviews with training personnel indicate that existing CBT materials are still generic and have not fully accommodated the specific radar configuration, airspace characteristics, and local operational procedures of Palembang. This condition limits the effectiveness of CBT in optimally supporting ATC competence development and operational readiness.

The lack of standardized and context-specific CBT modules has resulted in inconsistencies in ATC competence, particularly in understanding local procedures and applying standard phraseology according to Palembang traffic conditions. Quality Assurance data from Palembang Radar Service in 2023 show an 11% increase in phraseology-related errors, predominantly among personnel who had not consistently participated in or completed CBT

modules. Furthermore, service monitoring reports indicate variations in coordination quality between units, reflecting differences in procedural understanding among ATCs. Previous studies have shown that the effectiveness of CBT is highly dependent on the quality, relevance, and structure of training materials (Qonitah Rahmawati, 2022). Inadequate CBT modules may negatively affect service performance, including delayed decision-making and reduced accuracy in pilot instructions.

Since September 2024, CBT has been implemented at Palembang Radar Service using simulation-based applications designed to replicate real operational conditions across sectors such as Jambi, Bengkulu, Pangkal Pinang, and Tanjung Pandan. CBT is also utilized for emergency scenario training and as part of routine performance checks conducted twice annually. However, no empirical study has yet specifically examined the effectiveness of CBT implementation on air traffic service quality at Palembang Radar Service. This research is therefore necessary to analyze the extent to which the CBT program influences air traffic services, particularly in terms of procedural compliance, traffic handling capability, and readiness in abnormal or emergency situations.

Based on the background described above, the research question of this study is: Does the Computer-Based Training (CBT) program have an influence on air traffic services at Palembang Radar Service? Accordingly, the objective of this study is to analyze the influence of the Computer-Based Training (CBT) program on air traffic services at Palembang Radar Service, providing empirical evidence that may support the improvement and development of CBT modules tailored to local operational needs.

RESEARCH METHODS

This study employed a quantitative descriptive-associative research design to analyze the influence of the Computer-Based Training (CBT) program on air traffic services at Palembang Radar Service. A quantitative approach was selected because the research aims to examine the relationship between variables using numerical data that can be statistically analyzed (Sugiyono, 2024). The associative design was used to identify the strength and direction of the relationship between the CBT program as the independent variable and air traffic services as the dependent variable.

Research Location and Time

The research was conducted at Palembang Radar Service, one of the air traffic service units under AirNav Indonesia, which is responsible for providing radar-based air traffic services in the Palembang airspace and its surrounding sectors. The study was carried out in accordance with the approved research schedule as presented in the research plan.

Population and Sampling Technique

The population of this study consisted of all active Air Traffic Controllers (ATCs) working at Palembang Radar Service, totaling 57 personnel. Due to the manageable population size, a total sampling (census) technique was applied, whereby all members of the population were selected as research respondents. This technique was chosen to ensure comprehensive representation and to minimize sampling bias (Sugiyono, 2024).

Research Variables and Operational Definitions

The study involved two main variables. The independent variable (X) was the Computer-Based Training (CBT) program, defined as a technology-based training method that utilizes computer applications and simulation tools to enhance ATC competence, particularly in procedural knowledge, decision-making, communication, and emergency handling (Rosenberg, 2021; ICAO, 2016). The dependent variable (Y) was air traffic services, defined as the performance of ATC personnel in delivering safe, orderly, and efficient air traffic services,

including responsiveness, communication accuracy, procedural compliance, coordination, and safety assurance (ICAO, 2023).

Data Collection Techniques

Data were collected using several techniques to ensure data accuracy and completeness. Questionnaires were the primary data collection instrument, distributed to ATC personnel to measure perceptions of CBT implementation and air traffic service performance. The questionnaire items were developed based on relevant theoretical indicators and measured using a Likert scale. In addition, documentation review was conducted to support the research context, including training records, operational reports, and Quality Assurance data. Observation was also carried out to gain a general understanding of CBT implementation and operational conditions at Palembang Radar Service.

Research Instruments

The main research instrument was a structured questionnaire that had undergone validity and reliability testing to ensure that it accurately and consistently measured the research variables. Instrument validation was conducted prior to data analysis to confirm the suitability of questionnaire items for quantitative analysis.

Data Analysis Techniques and Statistical Model

Data analysis was conducted using descriptive statistics to describe respondent characteristics and variable tendencies. Before hypothesis testing, normality testing was performed to ensure that the data met statistical assumptions. To analyze the relationship between the CBT program and air traffic services, correlation analysis (Product Moment correlation) was applied. Furthermore, simple linear regression analysis was used to examine the influence of the CBT program on air traffic services. Hypothesis testing was conducted using a t-test at a significance level of 5%. These statistical methods are well established in quantitative research; therefore, only their names and analytical purposes are presented without excessive statistical formula exposition (Sugiyono, 2024).

RESULTS AND DISCUSSION

This study examines the influence of the Computer-Based Training (CBT) program on air traffic services at Palembang Radar Service. Data were collected from 57 active Air Traffic Controllers (ATCs) who are directly involved in radar-based air traffic control operations. The integrated presentation of results and discussion is intended to provide a comprehensive interpretation of the empirical findings while maintaining conciseness, as recommended for international journal publications.

Respondent Characteristics

The demographic characteristics of respondents provide important contextual information regarding the profile of ATCs participating in the study. Respondents varied in terms of age, years of service, and educational background, reflecting the actual operational composition at Palembang Radar Service.

Table 1. Respondent Demographic Characteristics

Characteristic	Category	Description
Gender	Male / Female	Predominantly male
Education	Diploma / Bachelor	Majority diploma holders
Work experience	< 5 years – > 10 years	Diverse experience levels

The diversity in experience and educational background highlights the importance of standardized training programs such as CBT to ensure uniform competence and service quality across personnel.

Description of Computer-Based Training Program

The CBT program was evaluated based on indicators related to training content relevance, accessibility, clarity of learning materials, simulation realism, and evaluation mechanisms. The descriptive analysis indicates that the CBT variable is generally perceived at a high level, as summarized in Table 2.

Table 2. CBT Program Evaluation Summary

Indicator	Category
Training material relevance	High
Accessibility and usability	High
Simulation realism	High
Evaluation mechanism	High

These results indicate that the CBT program is considered effective in supporting ATC learning needs. Respondents emphasized that simulation-based CBT allows repeated practice of operational scenarios, including abnormal and emergency situations, which may not frequently occur in real operations. This finding is consistent with Rosenberg (2006), who states that CBT enhances learning retention and procedural familiarity through interactive digital content.

Air Traffic Service Performance

Air traffic services were assessed using indicators related to communication accuracy, response time, procedural compliance, coordination between units, and safety awareness. The descriptive analysis shows that air traffic service performance is also categorized as high, as presented in Table 3.

Table 3. Air Traffic Service Performance Summary

Indicator	Category
Communication accuracy	High
Response timeliness	High
Procedural compliance	High
Inter-unit coordination	High
Safety awareness	High

These findings suggest that ATCs at Palembang Radar Service generally perform their duties in accordance with established procedures and safety standards. Effective communication and coordination are critical in radar operations, where traffic density and time pressure demand rapid yet accurate decision-making. These results align with ICAO (2016), which emphasizes that continuous training is essential to maintain ATC performance and operational safety.

Relationship Between CBT and Air Traffic Services

The relationship analysis reveals a very strong association between the CBT program and air traffic services. As summarized in Table 4, the correlation analysis indicates a close relationship between improved CBT implementation and enhanced service performance.

Table 4. Relationship Between CBT Program and Air Traffic Services

Analysis Aspect	Interpretation
Correlation	Very strong positive relationship
Contribution	CBT supports service performance

The regression analysis further indicates that the CBT program contributes substantially to variations in air traffic service performance. This finding suggests that improvements in CBT quality are aligned with improvements in ATC service delivery. Rather than relying solely on on-the-job exposure, CBT provides structured and repeatable learning experiences that reinforce procedural knowledge and decision-making skills.

From an operational perspective, the results indicate that CBT plays a strategic role in maintaining and enhancing ATC competence, particularly in radar environments characterized by complex airspace and fluctuating traffic levels. CBT supports consistency in procedural understanding among ATCs, reduces reliance on experiential learning alone, and provides opportunities for practicing rare but critical scenarios. This is particularly important following airspace sectorization changes and operational adjustments at Palembang Radar Service.

These findings are consistent with previous studies demonstrating that well-designed CBT programs improve operational accuracy, situational awareness, and coordination (Qonitah Rahmawati, 2022). In addition, the integration of CBT into routine performance checks supports proactive safety management by reinforcing standard procedures and encouraging continuous learning, as recommended by ICAO competency-based training frameworks (ICAO, 2016).

Overall, the integrated results and discussion demonstrate that the CBT program contributes meaningfully to the quality of air traffic services at Palembang Radar Service. While service performance is already at a high level, continuous refinement of CBT content particularly to reflect local operational conditions remains essential to sustain safety and efficiency in increasingly complex air traffic environments.

CONCLUSION

Based on the results and discussion, this study concludes that the Computer-Based Training (CBT) program has a strong and positive influence on air traffic services at Palembang Radar Service. The findings show that the CBT program is perceived at a high level in terms of content relevance, accessibility, simulation realism, and evaluation mechanisms, and this condition is aligned with the high performance of air traffic services delivered by Air Traffic Controllers (ATCs). The very strong relationship between CBT implementation and service performance indicates that CBT effectively supports procedural compliance, communication accuracy, coordination, and safety awareness in radar-based air traffic control operations. By providing structured

REFERENCES

ICAO. (2023). Safety Report 2023 Edition. www.icao.int

ICAO. (2016). Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM), Doc 4444 (16th Edition, Ed.; 16th ed.). International Civil Aviation Organization. https://store.icao.int/en/procedures-for-air-navigation-services-air-traffic-management-doc-4444

Qonitah Rahmawati. (2022). Pengaruh Kualitas Pelayanan Di Boarding Gate Dan Fasilitas Ruang Tunggu Terhadap Kepuasan Penumpang Di Bandar Udara Abdul Rachman Saleh Malang. Jurnal Akuntansi, Ekonomi Dan Manajemen Bisnis, 2(3), 300–309. https://doi.org/10.55606/jaem.v2i3.354

Rosenberg, A. R., Zhou, C., Bradford, M. C., Salsman, J. M., Sexton, K., O'Daffer, A., & Yi-Frazier, J. P. (2021). Assessment of the Promoting Resilience in Stress Management Intervention for Adolescent and Young Adult Survivors of Cancer at 2 Years. JAMA Network Open, 4(11), e2136039. https://doi.org/10.1001/jamanetworkopen.2021.36039

Sugiyono. (2024). Metode Penelitian Kuantitatif, Kualitatif, & R&D (30th ed.). Alfabeta. Google Books entry