

Design of a Web-Based IELP Test Result Inventory Application for IELP Raters at Palembang Aviation Polytechnic

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Abstract

*Air Traffic Controllers (ATCs) bear critical responsibility for ensuring aviation safety, efficiency, and orderly air traffic operations. One essential competency required of ATCs is English communication proficiency in accordance with the International Civil Aviation Organization (ICAO) English Language Proficiency (IELP) standard, with a minimum requirement of Level 4. At Palembang Aviation Polytechnic, IELP test result management is still conducted manually, relying on written documents and audio recordings stored on personal devices, which poses risks of data loss, duplication, and limited accessibility. This study aims to design a web-based application for the inventory management of IELP test results as a digital solution to support centralized, secure, and easily accessible data management for IELP raters. The research employed a Research and Development (R&D) approach using the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. Data were collected through observation, interviews, expert validation, and user evaluation. **The result of this study is a functional prototype application that enables integrated online storage of participant data, assessment scores, and audio recordings. Evaluation results indicate high levels of usability and usefulness, demonstrating that the application effectively improves data accessibility, security, and efficiency. This study concludes that the proposed web-based system is feasible and beneficial for enhancing IELP data management in accordance with international aviation training standards***

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

INTRODUCTION

English communication competence is one of the essential skills that must be possessed by every Air Traffic Controller (ATC). In air traffic control operations, radio communication between ATCs and pilots must be clear, precise, and conducted in accordance with standardized international phraseology. Even minor communication errors may lead to serious safety risks in aviation operations (Hamzah, 2021). Therefore, the International Civil Aviation Organization (ICAO) requires all ATCs to meet the ICAO English Language Proficiency (IELP) standard at a minimum of Level 4, as stipulated in ICAO Annex 1 and ICAO Doc 9835. This standard ensures that aviation personnel are capable of communicating effectively in English, particularly during abnormal or emergency situations and in high-traffic environments.

As a vocational aviation education institution, Palembang Aviation Polytechnic plays a strategic role in supporting the improvement of English communication competence among ATC personnel. One of its key responsibilities is the periodic administration of IELP tests for AirNav Indonesia personnel. Institutional data indicate that from 2022 to 2025, a total of 12 IELP testing activities were conducted with 283 participants from various AirNav branches across Indonesia, including Palembang, Batam, Pekanbaru, Denpasar, Tanjung Pinang, and Banjarmasin. Each testing activity generates extensive records, such as attendance lists, assessment score sheets, audio recordings, and official reports. As the number of tests continues to increase annually, effective and reliable data management becomes increasingly critical.

Despite compliance with Civil Aviation Safety Regulation (PKPS) Part 141, which requires training institutions to ensure the security and integrity of training records, the management of IELP test results at Palembang Aviation Polytechnic is still conducted manually. Test results are stored in hardcopy form and audio recordings are saved on raters' personal

devices. This condition creates challenges in terms of efficiency, accessibility, and data accuracy across different locations and testing periods. Verification and re-evaluation processes often require considerable time, as staff must manually search through physical documents and separate digital files, increasing the risk of data loss or damage.

These issues were formally identified during the 2024 Management Review Meeting, supported by findings from the ISO 9001:2015 and ISO 21001:2018 audits, which highlighted that the IELP record-keeping system had not yet been digitally integrated. The audit recommended the development of an electronic data management system to support institutional quality assurance and the implementation of Electronic-Based Government Systems (SPBE). Furthermore, ICAO Doc 10056 on Competency-Based Training and Assessment (CBTA) emphasizes the necessity of traceable, accurate, and secure assessment documentation to ensure the integrity of competency-based evaluations (ICAO, 2020).

In response to these challenges and regulatory requirements, the development of a web-based IELP test result data inventory application is considered a strategic solution to improve data accessibility, security, and efficiency. Such a system is expected to support IELP Raters in managing assessment data more effectively, while also enhancing institutional accountability and compliance with international aviation standards.

Based on the background described above, the research problems are formulated as follows:

1. What is the current condition of the IELP test result data storage and management system used by IELP Raters at Palembang Aviation Polytechnic?
2. What functional and non-functional requirements are needed for a web-based IELP test result inventory application in accordance with ICAO Doc 10056 and ISO 9001:2015 and ISO 21001:2018 audit recommendations?
3. How do usability, usefulness, and acceptability influence the evaluation of the developed application for improving data security and accessibility?

The objectives of this study are:

1. To design and develop a web-based data storage system that facilitates centralized management of IELP test results for IELP Raters at Palembang Aviation Polytechnic.
2. To support relevant stakeholders, including Palembang Aviation Polytechnic, the Directorate of Air Navigation, and AirNav Indonesia, in conducting IELP evaluation, re-testing, and ATC performance assessment through improved data accessibility.

RESEARCH METHODS

This study employed a Research and Development (R&D) approach aimed at designing and developing a functional product in the form of a web-based application for inventorying IELP test result data. The R&D method was selected because the primary objective of the study was not only to analyze existing problems but also to produce and validate a practical digital solution that can be implemented in an operational environment (Waruwu, 2024). The development process adopted the ADDIE model, which consists of five systematic stages: Analysis, Design, Development, Implementation, and Evaluation. This model was chosen due to its structured and linear characteristics, making it suitable for technology-based system development without requiring complex iterative revisions.

Research Subjects and Objects

The subjects of this study were IELP Raters at Palembang Aviation Polytechnic, who are directly responsible for conducting IELP assessments and managing test result records. The research object was the IELP test result data management process, including participant identity data, assessment scores, documentation, and audio recordings generated during IELP

examinations. These elements were used as the primary materials for system analysis and application development.

Development Procedure (ADDIE Model)

At the Analysis stage, needs analysis was conducted through direct observation and interviews with IELP Raters to identify weaknesses in the existing manual data storage system, particularly related to data accessibility, security, and efficiency. At the Design stage, system architecture, data flow, user interface, navigation structure, and database design were formulated based on user requirements and relevant standards. The Development stage involved building a functional website-based application using a local web server environment. The application was developed to support centralized data storage, user authentication, and structured data retrieval. During the Implementation stage, the application prototype was tested on a limited scale by IELP Raters to examine system functionality, usability, and operational compatibility. Finally, the Evaluation stage was carried out through expert validation and user testing to assess system feasibility, usability, and usefulness.

Data Collection Techniques

Data were collected using several techniques aligned with the ADDIE stages. Observation was used to examine existing data management practices. Interviews were conducted with IELP Raters to gather detailed user requirements and operational constraints. Questionnaires were distributed during the evaluation stage to measure user perceptions of system usability and usefulness, employing indicators adapted from the Technology Acceptance Model (TAM) (Huda & Waluyowati, 2023).

Data Analysis Techniques

Data analysis was conducted using descriptive quantitative analysis. Questionnaire responses were converted into percentage scores to determine feasibility levels based on predefined interpretation intervals. This approach was used to evaluate expert validation results and user acceptance without excessive statistical formula presentation, in accordance with applied R&D research practices (Sugiyono, 2019).

Research Instruments and Tools

The main research instruments included interview guidelines, observation sheets, validation forms for experts, and user evaluation questionnaires. The application development utilized Visual Studio Code as the programming editor and XAMPP as a local web server environment. Web browsers were used to test system compatibility and accessibility across different platforms.

RESULTS AND DISCUSSION

This study presents the results of designing and evaluating a web-based inventory application for IELP test result data intended for IELP Raters at Palembang Aviation Polytechnic. The results and discussion are integrated to provide a comprehensive interpretation of the system development process, validation outcomes, and user evaluation results within the context of aviation training data management.

Identification of Existing Problems

Initial observations and interviews with IELP Raters revealed several challenges related to the existing manual data management system. As summarized in Table 1, the growing volume of IELP test records since 2022 has increased the risk of data loss, physical damage, and delayed access, particularly when raters are assigned outside the campus location.

Table 1. Identified Problems in Existing IELP Data Management

Issue	Operational Impact
Manual (hardcopy-based) storage	Slow data retrieval and high risk of physical damage
Non-centralized records	Limited access when raters are off-site
Separated audio and document files	Inefficient monitoring and re-evaluation

These findings confirm the need for digitalization, in line with ISO 9001:2015 and ISO 21001:2018 audit recommendations and ICAO Doc 10056 requirements for traceable and secure competency-based assessment records (ICAO, 2020).

System Design and Development Outcomes

Based on the needs analysis, a web-based application was developed using the ADDIE model to support centralized storage of IELP test data, including participant identity, assessment scores, documentation, and audio recordings. The system architecture was designed with structured menus for location selection, test schedules, and participant records, enabling efficient data navigation. This structure supports the principles of traceability and accessibility emphasized in competency-based training and assessment frameworks (ICAO, 2020).

Expert Validation Results

The developed system underwent expert validation involving both subject-matter and media experts. The validation results are summarized in Table 2.

Table 2. Expert Validation Summary

Validator	Average Score	Interpretation
Subject-matter expert	80.6%	Feasible
Media expert	83.7%	Feasible
Overall average	82.15%	Feasible

These results indicate that the application meets functional, content, and usability requirements and is suitable for implementation. The findings align with digital data management standards in vocational education institutions, which emphasize security, organization, and efficiency (Kamsin et al., 2021).

System Implementation and User Evaluation

System implementation was conducted through limited trials involving IELP Raters. User evaluation focused on perceived ease of use and perceived usefulness, following the Technology Acceptance Model (TAM) (Huda & Waluyowati, 2023). The evaluation results show high acceptance levels, as summarized in Table 3.

Table 3. User Evaluation Results

Evaluation Aspect	Average Percentage	Category
Perceived ease of use	96%	Very feasible
Perceived usefulness	91%	Very feasible

These results demonstrate that the application is easy to learn, intuitive to operate, and effective in supporting IELP data management tasks. Users reported faster data retrieval, improved security, and reduced dependency on physical archives. The system also enables real-time access across locations, which is critical for monitoring and audit processes in aviation training environments.

The integrated findings indicate that the developed web-based application effectively addresses the limitations of the previous manual system. By centralizing data storage and enabling secure online access, the system enhances efficiency, transparency, and accountability in IELP test result management. This outcome supports previous studies highlighting the benefits of digital information systems in vocational and aviation training institutions (Al-Emran & Shaalan, 2021; Wimatra, 2023). Moreover, the high usability and usefulness scores confirm that

the system is well aligned with user needs and institutional requirements, reinforcing its potential contribution to strengthening ATC professionalism and compliance with international aviation safety standards.

CONCLUSION

Based on the results and discussion, this study concludes that the web-based application for inventorying IELP test result data is feasible, effective, and beneficial for supporting IELP Raters at Palembang Aviation Polytechnic. The developed system successfully addresses the limitations of the previous manual data management process by providing centralized, secure, and easily accessible storage for participant data, assessment scores, and audio recordings. Expert validation and user evaluation results indicate high levels of usability and usefulness, demonstrating that the application improves efficiency, data security, and traceability in IELP assessment management. The implementation of this system supports compliance with ICAO requirements for competency-based training and assessment as well as institutional quality assurance standards. Therefore, the proposed web-based application can be considered a practical digital solution that enhances the management of IELP test data and contributes to improving the reliability and professionalism of aviation English proficiency assessment.

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