Modular Web-Based Development for English Test Using Testing System with Security and Automation Features

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ABSTRACT

An academic institution in Surabaya continues to administer the English Test named TEFL (Test of English as a Foreign Language) through Google Forms, a method now considered inadequate due to limitations in item management, automated scoring, and exam security. In response, this study developed a web-based TEFL examination system employing the Incremental Software Development Model. This model enables the stepwise implementation, testing, and refinement of system components, ensuring higher adaptability and control throughout the development process. The system integrates key features, including randomized question distribution, automated grading, multi-level user access (administrators, instructors, and students), real-time result display, and anti-cheating mechanisms such as tab-switch detection and user authentication. Functionality testing utilized the Black-box Testing approach to assess system operations without accessing internal code. Additionally, system quality was evaluated using ISO 9126 standards through a structured questionnaire involving 22 student participants. The system scored well across Functionality (76.2%), Usability (79%), Reliability (77.2%), Efficiency (78.2%), and Portability (78.4%), with an overall average of 77.8%, placing it within the "Good" category. The results affirm the system's effectiveness in enhancing the efficiency, transparency, and integrity of online TEFL assessments.

Keywords: TEFL, Online Testing, Web-Based System, Incremental Model, ISO 9126, Black-box Testing.

1. INTRODUCTION

The rapid evolution of educational practices has underscored the necessity of integrating information technology into pedagogical processes. Digital integration in education enhances efficiency, accessibility, and instructional effectiveness—especially in large-scale assessments and remote learning environments [1]. Among the most impactful applications is the development of online testing platforms, which have revolutionized how institutions conduct evaluations. Nevertheless, many still rely on rudimentary tools such as Google Forms. While accessible and user-friendly, such tools fall short in areas like automated assessment, data management, and security, and are ill-equipped to accommodate the growing complexity of digital examinations [2].

In one private institution in Surabaya, TEFL (Test of English as a Foreign Language) assessments remain heavily dependent on Google Forms. Though widely

available, Google Forms lacks essential features such as question item management, real-time scoring, and secure test environments. Prior research [3] highlights persistent challenges—poor internet connectivity may cause submission errors, links often become corrupted, time limits are unenforced, and late submissions are not recorded, potentially leading to data loss and inaccurate results. These shortcomings contribute to delays, scoring errors, and administrative inefficiencies, ultimately affecting the credibility and fairness of the testing process.

To address these limitations, this study proposes the design and implementation of a web-based TEFL testing system developed using the Incremental Software Development Model. Unlike traditional linear approaches such as the Waterfall model, the incremental model allows the system to be developed modularly in manageable segments, each representing distinct functionalities such as question generation, automated scoring, and test security. This iterative development

ensures consistent evaluation and adaptation at every stage.

The primary objective is to automate key components of TEFL testing—including test creation, scoring, and data reporting—while ensuring secure, user-friendly access for both test administrators and students. The system is expected to provide real-time feedback, reduce manual workload, and improve overall test integrity.

The technical framework incorporates Laravel for server-side operations, offering robust back-end functionality and security [4];[5], and ReactJS for building responsive, user-centered interfaces. MySQL is used for secure data storage of test content, user credentials, and results [6].

A core feature of the proposed system is randomized question sequencing to reduce academic dishonesty. Each examinee receives a unique set of items via an algorithmically driven randomization engine. Additional functionalities include automated scoring, real-time feedback, tab-switch detection, and encrypted storage of personal and academic records—ensuring both academic integrity and compliance with data protection principles.

This study acknowledges the demand for reliable digital tools in modern education and aims to replace labor-intensive manual test processes with an automated, secure, and scalable solution. Beyond institutional improvements, the outcomes offer practical insights into best practices for online assessment systems in higher education environments.

2. RESEARCH METHODOLOGY

This study adopts a system design and development approach to build a web-based TEFL-like examination platform, specifically tailored for implementation at a private higher education institution in Surabaya. The development process follows a structured methodology involving system requirement analysis, system architecture design, implementation, and system evaluation. To ensure modular and flexible development, the **Incremental Software Development Model** was selected as the core framework.

2.1 Incremental Model in System Development

The incremental model offers adaptability in responding to dynamic user requirements and system refinements throughout the development cycle [7]. Each increment results in a functional subsystem, enabling iterative testing, feedback integration, and continuous enhancement. This method mitigates systemic design errors often encountered in monolithic models and supports targeted improvements at each phase.

2.2 System Development Stages

The system development is structured into the following key phases:

- **Requirement Analysis**
  Preliminary analysis was conducted through interviews with the institution's Language Center to identify the limitations of the existing system and define the functional and non-functional requirements of the new platform.

- **System Design**
  Based on the findings from the requirement analysis, the system architecture was designed using flowcharts and Entity Relationship Diagrams (ERDs). The backend is developed using Laravel (a PHP framework), the frontend with ReactJS, and the data layer is handled using MySQL.
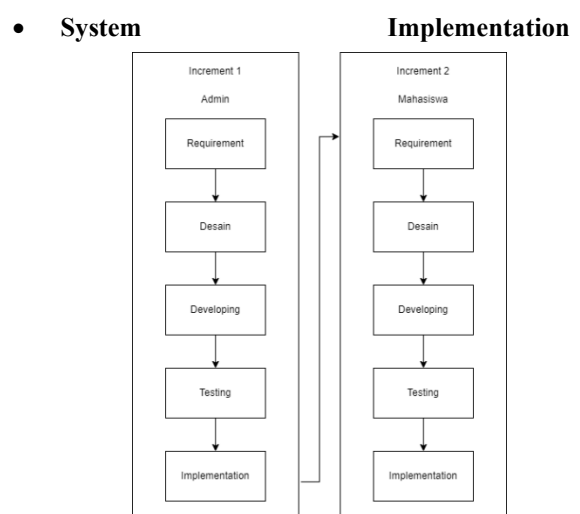
- **System Implementation**

Figure 1 Incremental Development Model Diagram

The system was implemented incrementally. Each iteration delivered core features such as question bank management, randomized item sequencing, and automated grading mechanisms.

- **Testing and Evaluation**
  Functional validation and performance testing were conducted using the **Black-box Testing** technique. This ensured that system components operated according to specified requirements, particularly in terms of security and reliability.

Deployment and Maintenance
After testing, the system was deployed at the Language Center. Maintenance involved debugging and enhancing features based on user feedback to ensure continuous system relevance and operational integrity.

2.3 Tools and Technologies Utilized

The development of this system involved the integration of modern tools and technologies as listed below:

- Backend: Laravel (PHP framework)
- Frontend: ReactJS
- Database: MySQL
- Testing: Black-box Testing
- Development: Visual Studio Code, PHPMyAdmin,
- Execution: Modern Web Browsers

3. RESULTS AND DISCUSSION

This section presents the functional achievements, system evaluation outcomes, and comprehensive testing results of the web-based TEFL testing platform.

3.1 Functional Achievements of the System

The developed system successfully fulfils the needs of key stakeholders—namely the Language Center (PUSBA), faculty members, and students. Several major features have been implemented and verified for operational stability and user relevance.

a. Digital Test Item Management with Randomization

The web-based architecture enables administrators to efficiently manage test items, including creating, editing, and deleting content via a digital interface. The system implements **randomized sequencing of test questions**, ensuring that each student receives a unique item order. According to [8], randomization in large-scale online assessments reduces plagiarism rates by up to 37%. This feature not only enhances security but also improves fairness in academic evaluation.

b. Automated Scoring Mechanism

A core innovation of the system is its automated scoring engine. Student responses are matched against predefined answer keys in real time and stored securely within the database. This eliminates the need for manual grading, reduces human error, and expedites result reporting.

c. Enhanced Test Security Features

Security is reinforced through features such as **tab-switch detection**, which monitors and logs attempts to leave the test window as a potential indicator of dishonest behavior. Additionally, all test data are encrypted, safeguarding both personal and academic information, and aligning with digital education data protection standards.

d. Real-Time Monitoring and Result Transparency

The platform includes a **real-time result dashboard**, enabling students to access their scores immediately after test completion. Administrators and instructors can monitor class-wide performance through integrated data visualizations, fostering data-driven academic decision-making [9].
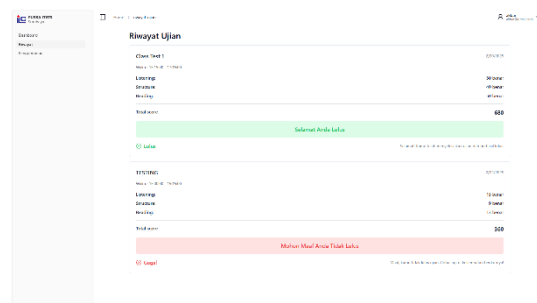

Figure 2 Evaluation Dashboard Interface

3.2 System Evaluation and User Feedback

Evaluation involved three user groups: faculty (instructors), students (test-takers), and administrative staff (test organizers). Both qualitative interviews and quantitative Likert-scale surveys were administered to gather insights into system usability and effectiveness.

a. User Interface and Accessibility

Students emphasized the system's intuitive and accessible interface, which significantly reduced technical barriers during test execution. Even users with limited digital proficiency could navigate the platform with ease, reflecting effective UX design.

b. System Speed and Responsiveness

Faculty and administrators reported notable improvements in operational efficiency, especially in test scoring and data recap processes. The automated scoring function notably reduced grading time and enabled real-time score generation.

c. Recommendations for Feature Expansion

Feedback suggested that the system be expanded to include **open-ended question types**, such as short answers and essays. This enhancement would broaden the assessment scope and support more holistic evaluation strategies.

d. Comparative Reflection with Legacy Systems

Compared to the previously used Google Forms-based system, the new platform demonstrated marked improvements. Manual processes have been replaced by automation, real-time access to results is now available, and academic data handling has become more secure and flexible.

3.3 System Testing and Performance Evaluation

Comprehensive testing was conducted to ensure that the system meets functional, performance, and security standards.

a. Functional Testing

Core modules—including item creation, randomization, auto-grading, and result reporting—underwent rigorous functional testing. All components operated successfully without major technical issues, and results were accessible immediately upon test completion.

b. System Performance

Performance testing revealed a maximum response time of approximately **five seconds** for critical actions such as loading questions, submitting responses, and displaying scores. This responsiveness addressed common delays in previous systems and was positively noted by users.

c. Security Testing

The platform integrates advanced security protocols, including **automatic alerts for tab-switching behavior** [10], Test results and student data are securely encrypted within the backend database, ensuring data integrity and preventing tampering or unauthorized access.
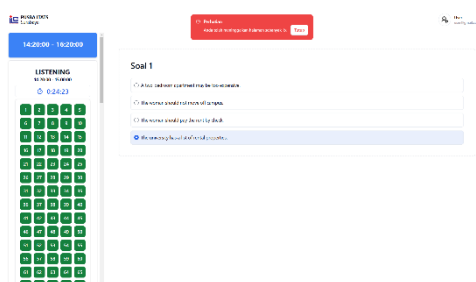

Figure 3 Tab-Switch Alert Notification Example

4. ANALYSIS

Based on extensive system testing and stakeholder feedback, the newly developed TEFL online examination system demonstrates clear improvements over the previously used Google Forms-based model. Through innovations in automation, question management, and security enforcement, the platform addresses key limitations historically associated with digital assessment.

4.1 Efficiency and Effectiveness

The implementation of automation has significantly reduced administrative burdens on both instructors and institutional exam coordinators. The grading process, previously conducted manually, is now executed automatically with near-instant results and a high degree

of accuracy [11].The time saved allows for faster feedback delivery, improved data handling, and better allocation of academic resources.

4.2 Fulfillment of Research Objectives

The core objective of enhancing the efficiency and quality of TEFL assessments at ITATS has been achieved. Students benefit from a streamlined, intuitive testing process, while instructors gain real-time access to test performance data via a centralized dashboard. This digital transformation marks a significant step forward in institutional assessment practices.

4.3 Recommendations for Future Development

Despite strong system performance, several areas remain open for further enhancement. Among the most prominent suggestions is the **integration of diverse question types**, including essays and short answer formats, which would allow for more comprehensive assessment of language proficiency. Additionally, optimizing the interface for mobile accessibility is recommended to expand reach and improve the testing experience across devices.

4.4 System Scalability and Replication Potential

The modular and adaptable architecture of the system allows for customization based on institutional needs. With minimal configuration changes, the platform may be replicated and deployed in other educational environments. Its scalability makes it suitable for large cohorts, varied curricula, and institutions aiming to digitize their evaluation processes in line with contemporary educational trends.

5. CONCLUSION

The research and development of a web-based TEFL online examination system using the incremental development model has led to the following key conclusions:

1. The **Incremental Software Development Model** proved effective in supporting modular development, enabling evaluation and refinement at each stage while minimizing systemic errors.

2. The system successfully addressed core limitations of the Google Forms-based approach—particularly in the areas of question management, automatic grading, and real-time result publication—thus improving instructional efficiency and assessment quality.

3. Security features such as login authentication, randomized question generation, and tab-switch detection were successfully implemented to uphold academic integrity and deter cheating.

4. System evaluation involved a 25-item online questionnaire completed by 22 student participants. Assessment of five ISO 9126 quality attributes yielded the following results:

Quality Attribute	Score (%)	Category
Functionality	76.2%	Good
Usability	79.0%	Good
Reliability	77.2%	Good
Efficiency	78.2%	Good
Portability	78.4%	Good
Average	**77.8%**	**Good**

Table 1. ISO 9126

These results indicate that the system meets the standards for digital education implementation and is deemed suitable for institutional deployment. Future iterations may focus on enriching test formats and refining the user interface to maximize accessibility and learning outcomes.

AUTHORS' CONTRIBUTIONS

MODULAR WEB-BASED DEVELOPMENT FOR ENGLISH TEST USING TESTING SYSTEM WITH SECURITY AND AUTOMATION FEATURES

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