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Project ATLAS: An Integrated Learning and Development Management System with Automated CPD/PD Credit Tracking and Competency-Based Talent Mapping Using ISO/IEC 25010:2023 Quality Metrics

Mhel Jun C. Dela Cruz, Eduardo R. Yu II

AMA University, Philippines

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ABSTRACT

Traditional educational training frameworks in public sector governance often rely on disconnected learning platforms, slow manual workflows for tracking professional development (CPD/PD) credits, and fragmented visibility between training initiatives and workforce skill profiles. To address these bottlenecks, this study designed, developed, and validated Project ATLAS (Advanced Training and Learning Administration System), an integrated Learning and Development Management System featuring automated CPD/PD credit tracking, role-stratified administrative dashboards, and competency-based talent mapping engines. Built on a custom Model-View-Controller (MVC) architecture in PHP, a lightweight server-side hypermedia stack, MySQL relational database, and secured through Cloudflare Zero Trust outbound tunnels, the system replaces error-prone manual processes with reliable automation. The platform's architectural quality and functional suitability were evaluated using a descriptive engineering design aligned with the ISO/IEC 25010:2023 software product quality model. A purposive sample of 15 technical experts and administrative evaluators assessed the system, yielding an overall quality score of 3.91 out of 4.00 (SD = 0.11). Security (M = 3.96, SD = 0.05) and Safety (M = 3.94, SD = 0.08) dimensions received the highest ratings. These findings demonstrate that custom MVC backend layers combined with optimized relational database constraints deliver enterprise-grade security, minimized network latencies, and high administrative efficiency in resource-constrained public educational settings. Project ATLAS offers a scalable, compliant, data-driven architecture that mitigates administrative backlogs, preserves institutional memory, and aligns workforce capabilities with institutional needs.

Keywords: Design Science Research, ISO/IEC 25010:2023, Competency Mapping, Learning Management System, Professional Development Tracking.

INTRODUCTION

Modern public educational institutions are undergoing rapid digital transformation toward centralized cloud-based applications and automated information architectures (Bratamanggala, 2023). Tracking continuous professional development (CPD) milestones and delivering competency-focused training are essential for maintaining instructional standards and regulatory compliance (Panda, 2025). Educational governance units increasingly rely on integrated web-based learning environments to upskill both teaching and non-teaching personnel, harmonizing localized professional growth with macro-level institutional expectations (Schuetze et al., 2024). This emphasis on outcome-based instruction demands automated learning analytics and intelligent dashboards to measure, record, and evaluate competency acquisition across organizational tiers (Chaudhari et al., 2026). Digital archiving frameworks and portfolio systems further support systematic recording of professional development milestones and institutional capacity building through lifelong learning paths (Sari, 2026).

Organizations are also transitioning from static spreadsheets to algorithmic human resource management and data-driven talent mapping to isolate operational capabilities and deploy specialized personnel effectively (Meijerink et al., 2021).

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Despite these advancements, many public institutional training workflows remain fragmented (Bratamanggala, 2023; Phaladi & Ngulube, 2024; Chaudhari et al., 2026). Traditional off-the-shelf software routinely fails to align with localized public sector regulations, resulting in unoptimized database queries and low processing performance. Consequently, institutional training curricula are often designed based on anecdotal reports rather than empirical learning data, leading to misallocated development funding and isolated workforce performance appraisals (Chaudhari et al., 2026).

The Proposed Solution: Project ATLAS

This study bridges these operational and systemic gaps by designing, developing, and validating Project ATLAS, an integrated Learning Management System featuring automated CPD/PD credit tracking, role-stratified management modules, interactive virtual training environments, and systematic learning needs assessment engines. The system coordinates training data collection and translates it into real-time metrics for institutional decision-makers. Researchers evaluated the system's structural and operational quality against the ISO/IEC 25010:2023 software product quality model (International Organization for Standardization & International Electrotechnical Commission, 2023). This research demonstrates how combining custom MVC logic with a lightweight hypermedia frontend achieves high performance and robust data security in resource-constrained public sector environments.

Core Pillars of Human Resource Development

The contributions of Project ATLAS rest on six core pillars of human resource development in the educational sector:

- **a) Outcome-Based Professional Growth: Modular Verification Engine**

  The platform establishes an outcome-based framework using a Modular Verification Engine, ensuring earned PD units reflect verified competency achievements rather than passive registration. It implements a customized scoring framework aligned with Outcome-Based Education (OBE) principles, replacing "seat-time" tracking with verifiable outcome metrics (Ni’mah et al., 2023; Crespo et al., 2010).

- **b) Automated Regulatory Compliance: Centralized CPD Dashboard**

  The system automates compliance by consolidating CPD milestones into a single downloadable dashboard, enabling "Digital CPD" for data-driven decision-making and reduced administrative overhead (Panda, 2025; Margienė et al., 2022).

- **c) Resource Person Repository: Strategic Talent Mapping**

  The repository enables scientific identification of internal Subject Matter Experts based on empirical performance data. It maps experience into a unified skill graph, eliminating ambiguous role descriptions (Gugnani et al., 2018; Meijerink et al., 2021).

- **d) Administrative Optimization: Automated Certification Engine**

  An Automated Certification Engine generates digital certificates immediately upon module mastery, reducing processing times by over 80% and mitigating human error (Bin Md Nor et al., 2026; Bratamanggala, 2023).

  e) Data-Driven L&D Planning: Localized Gap Analytics

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The platform supports data-driven planning through high-level analytics for training gap analysis and fiscal optimization of funding, grounded in Competency-Based Training Needs Analysis (Vassileva et al., 2024; Chaudhari et al., 2026).

f) Institutional Memory Preservation: Searchable Digital Archive

The system serves as a permanent, searchable archive for historical training milestones, protecting the organization from knowledge drain (Marriott & Martinez-Marroquin, 2021; Phaladi & Ngulube, 2024).

Key Takeaway: Project ATLAS shifts public sector educational IT from fragmented standalone instances to an interconnected ecosystem optimized for ISO/IEC 25010:2023 quality dimensions under resource constraints.

Framework of the Study

This study employs a Design Science Research (DSR) paradigm to guide the iterative engineering lifecycle, integrating continuous feedback loops across problem identification, artifact creation, and evaluation

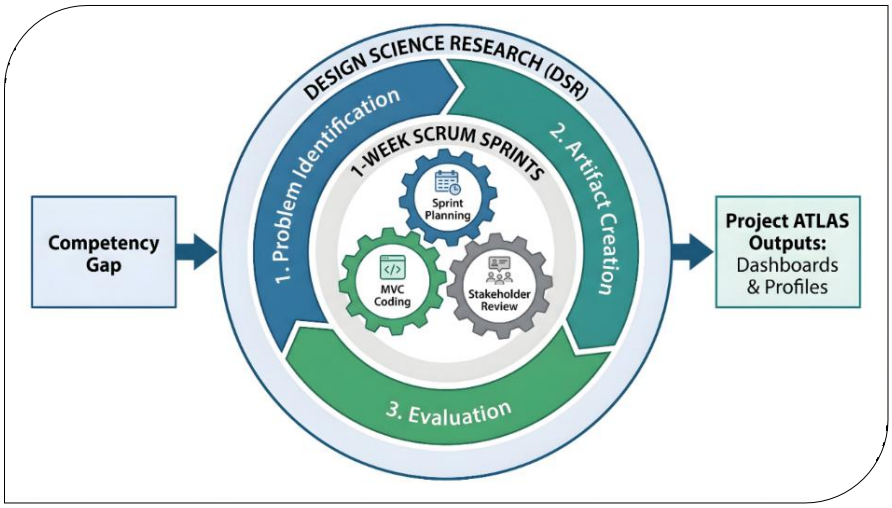

Fig. 1. Methodological Integration Framework.

METHODOLOGY

This study adopted a developmental research design focused on architectural modeling, algorithmic implementation, and empirical quality validation of the software artifact. A hybrid approach combined the Successive Approximation Model (SAM) with Scrum's iterative, high-velocity delivery cycles.

Technical Architecture and System Environment

The application follows a strict multi-tier Model-View-Controller (MVC) architectural pattern.

- Backend Logic Layer: Lightweight PHP for programmatic processing and service abstractions, with Python integration for specialized data science and statistical operations.
- Relational Database Tier: MySQL configured for relational entity processing, strict foreign key constraints, and data integrity (core tables: USERS, VIRTUAL_ROOMS, ROOM_ACTIVITIES, ROOM_RESOURCES, FILE_ASSETS).
- Frontend Interface Stack: Lightweight hypermedia-driven architecture using HTMX for low-latency asynchronous updates, Alpine.js for client-side reactivity, and Tailwind CSS for responsive design.

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Network and Production Infrastructure: Cloudflare Zero Trust architecture with encrypted outbound tunnels. Prototyping used an Alienware m15 R6 workstation; production deployment utilized a Dell PowerEdge R250 server with NAS backup and load-balanced multi-fiber connectivity.

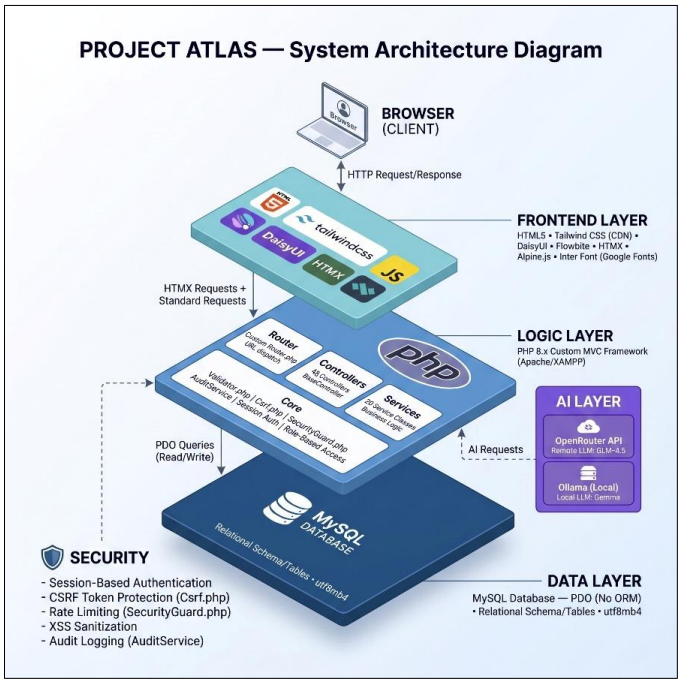

Fig. 2. Project ATLAS Multi-Tier System Architecture Diagram.

Relational Data Store - The database architecture tracks system activities by organizing entities across highly normalized relational tables. Core tables include USERS, VIRTUAL_ROOMS, ROOM_ACTIVITIES, ROOM_RESOURCES, and FILE_ASSETS. Relational links enforce cascading rules to protect operational histories.

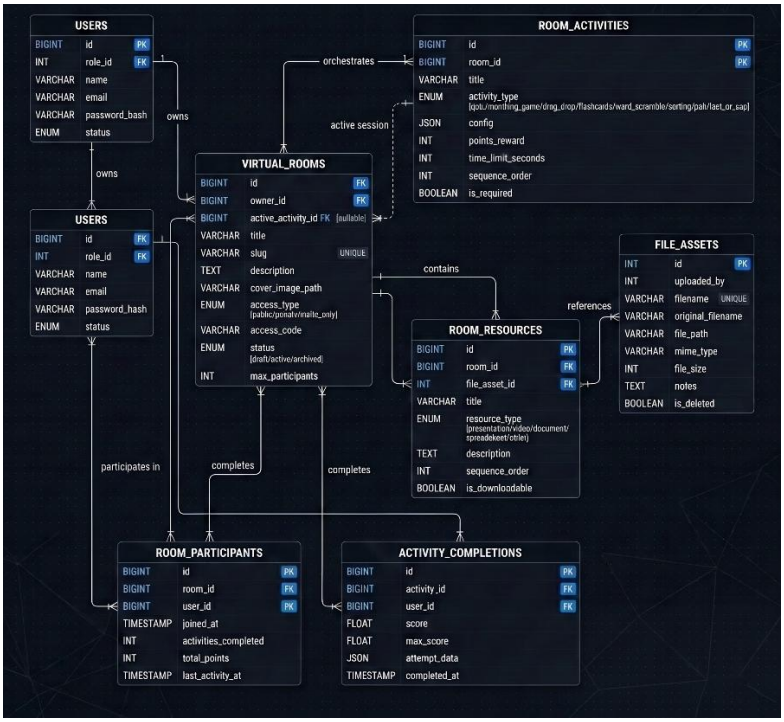

Fig. 3. ATLAS Database Schema Diagram illustrating core entity relationships.

Programmatic control is structured using distinct Object-Oriented component definitions. The interaction model maps workflows through specific execution scopes across controllers, models, and service classes.

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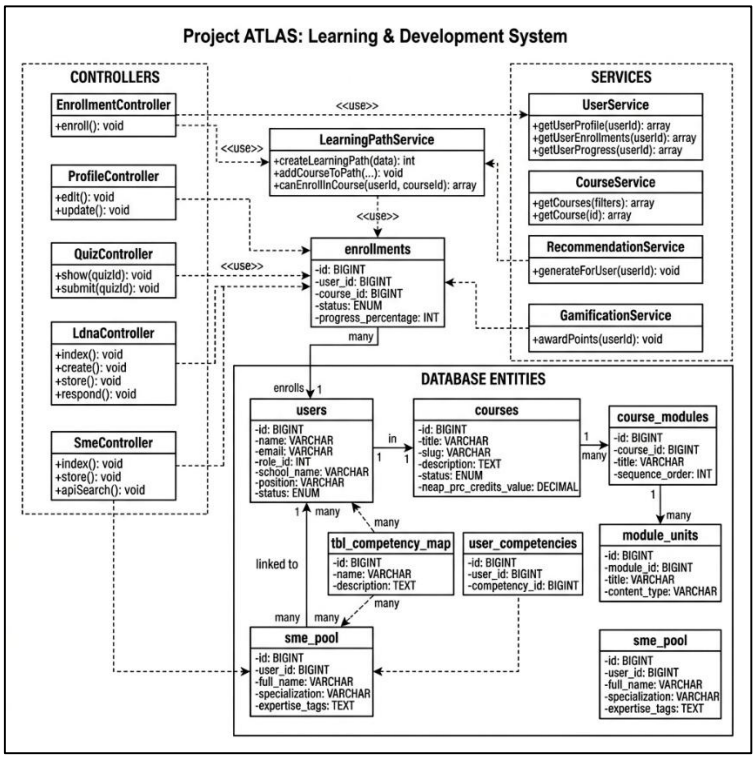

Fig. 4. Project ATLAS Relational Architecture Class Diagram

Functional Decomposition and Data Flow Diagram

The operational pipeline maps raw personnel activity metrics into analytical reporting data, functioning down to Level 1 Data Flow Diagram resolution.

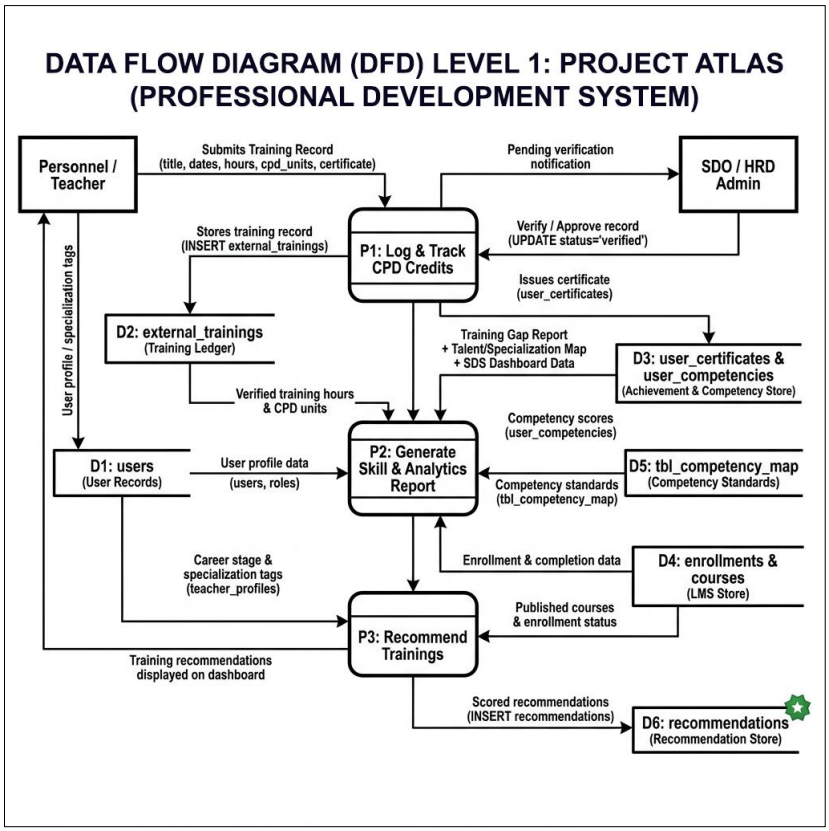

Fig. 5. Level 1 Data Flow Diagram (DFD): Project ATLAS Operational Ecosystem.

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Evaluation Instrument and Purposive Sampling Plan

The system was evaluated using a 40-item instrument mapped to ISO/IEC 25010:2023 quality attributes. A purposive sample of 15 evaluators (technical experts, administrative leaders, and end-users) rated features on a 4-point Likert scale. Quantitative analysis used sample means (M) and standard deviations (SD):

$$M = (1/n) \sum_{(i=1)}^{n} x_i$$

$$SD = \sqrt{\left(\left(\sum_{(i=1)}^{n} (x_i - M)^2 \right) / (n-1) \right)}$$

RESULTS

Key Features of the Developed Web-Based System

Project ATLAS includes a unified authorization portal, role-stratified dashboards with summary metrics and interactive widgets, training management interfaces, personal record tracking with XP and badges, personnel audit tables, virtual training rooms, curriculum content players with inline quizzes, strategic analytics boards, needs analysis questionnaires, audit logs, forum management, nomination workflows, and comprehensive LMS administration (Figs. 6–19).

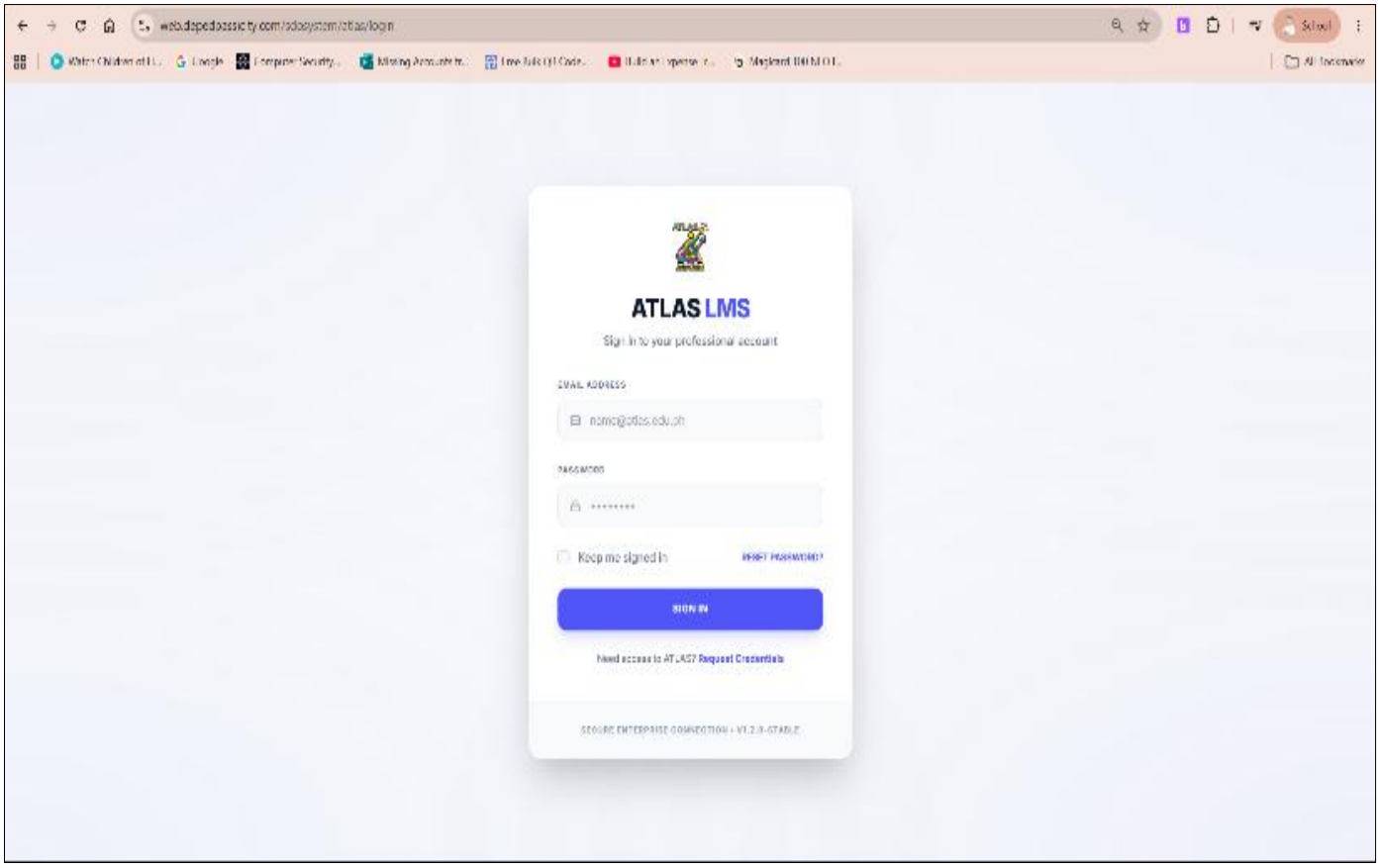

Fig. 6: Login Page: Screen display showing the "ATLAS LMS" unified authorization portal requiring email and password credentials over an encrypted route

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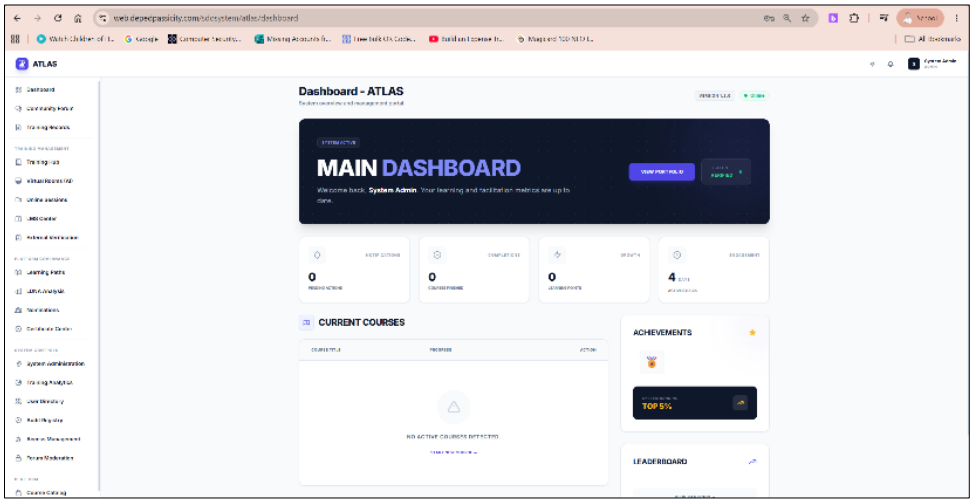

Fig. 7: Dashboard Page: Main dashboard layout for user profiles displaying summary metrics (Courses Attended, Pending Tasks, Completed Badges) alongside current course cards and interactive requirement tracking widgets

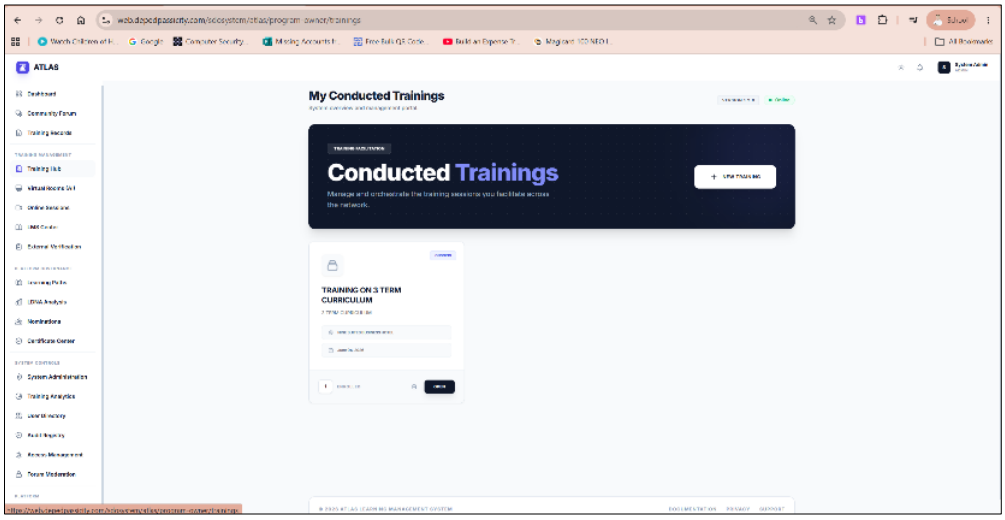

Fig. 8: Manage Training Page: Form view for Program Owners containing configuration selectors for daily schedules, enrollment limits, and training venue designations

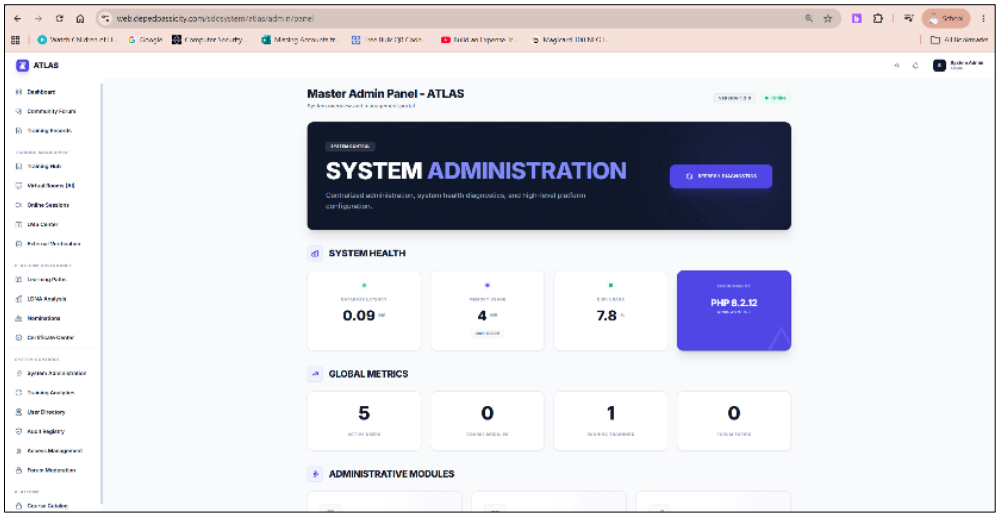

Fig. 9: Admin Dashboard Page (Master Admin Panel): System health screen outlining server configuration loads, memory cache allocations, active Cloudflare secure routes, and global user registration counts

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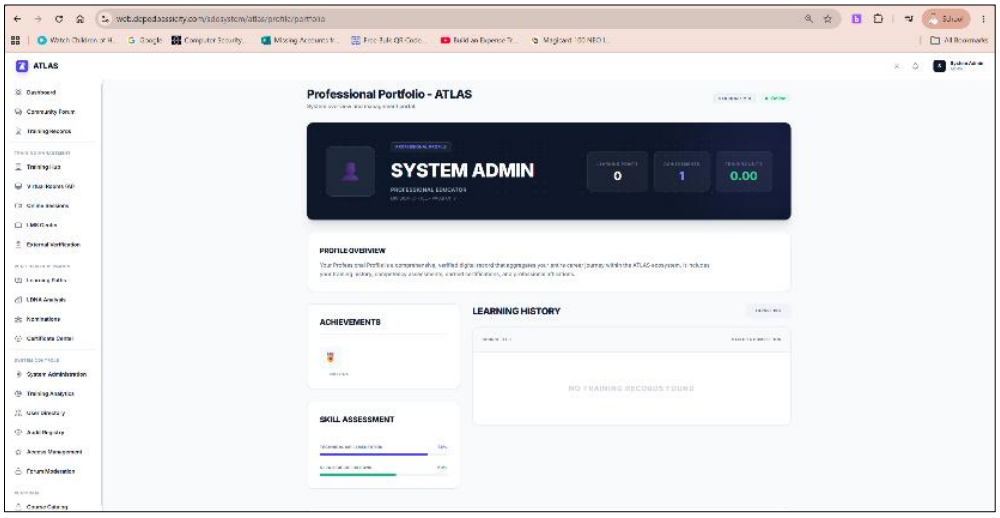

Fig. 10: My Records Page (My Profile): Personal record tracking profile ledger showing cumulative accrued experience points (XP), logged certificates, and career milestone progress meters

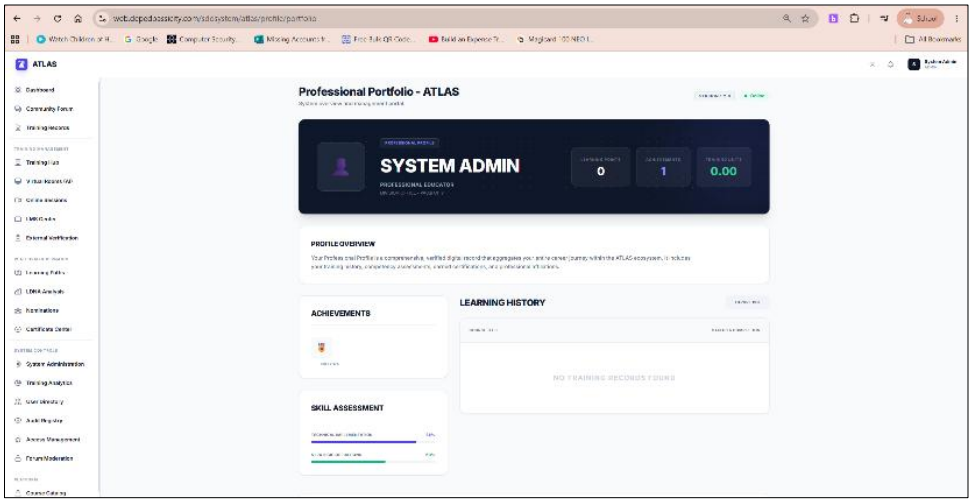

Fig. 11: All Personnel Record Page (XP audit hub): Master table grid for HR officers allowing multi-vector filtering of employee transcripts, recorded credits, and compliance standings

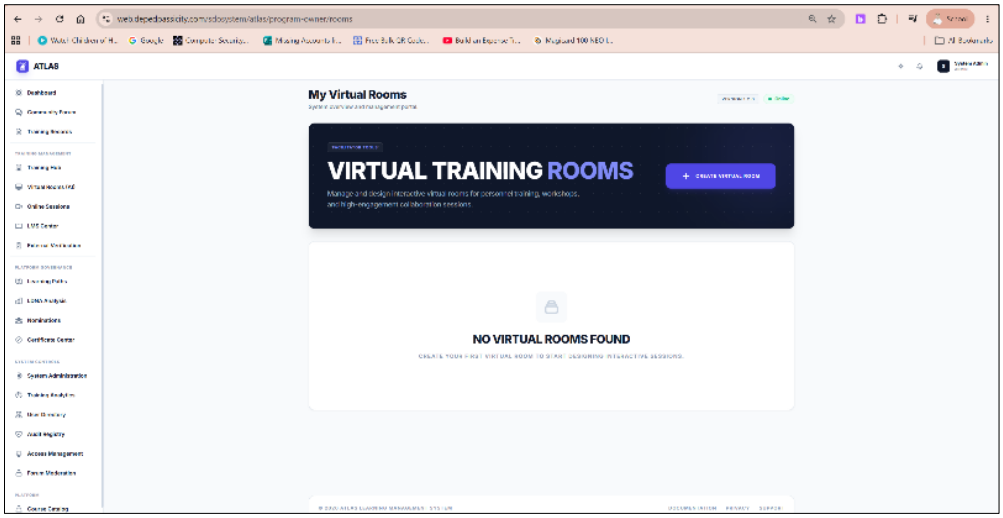

Fig. 12: Browse Virtual Room Page: Directory screen tracking available virtual training spaces and dynamic room activity catalogs

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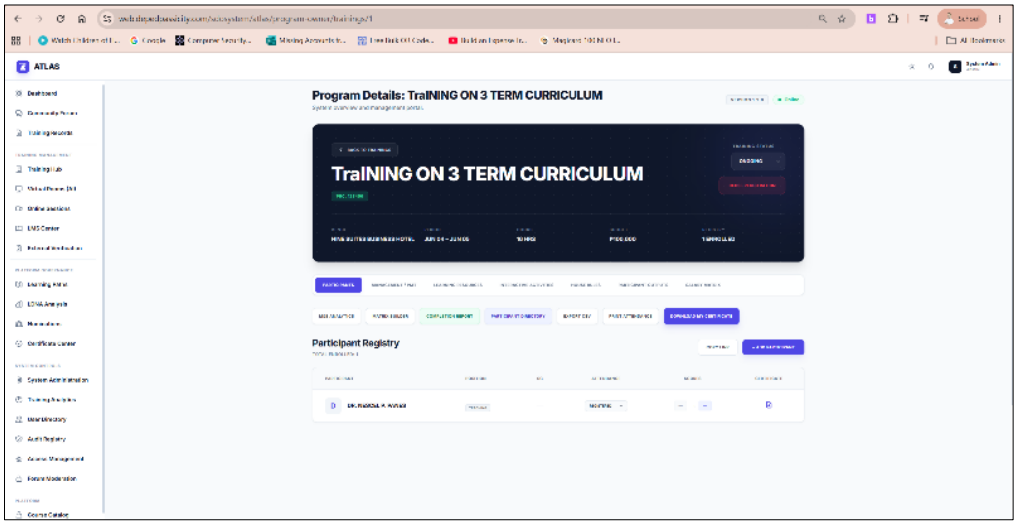

Fig. 13: Program Details Page (Training Curriculum): Content player mapping lessons, inline quizzes, and interactive progress tracking elements for active modules

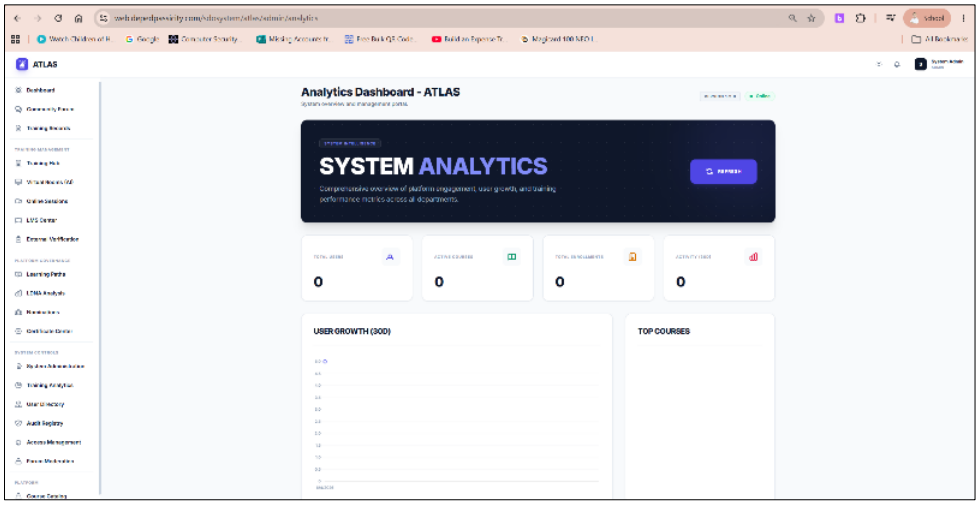

Fig. 14: Strategic Analytics Page (Training Analytics): Visual analytics data boards tracking overall division-level course completion rates, active enrollment numbers, and user distribution indices

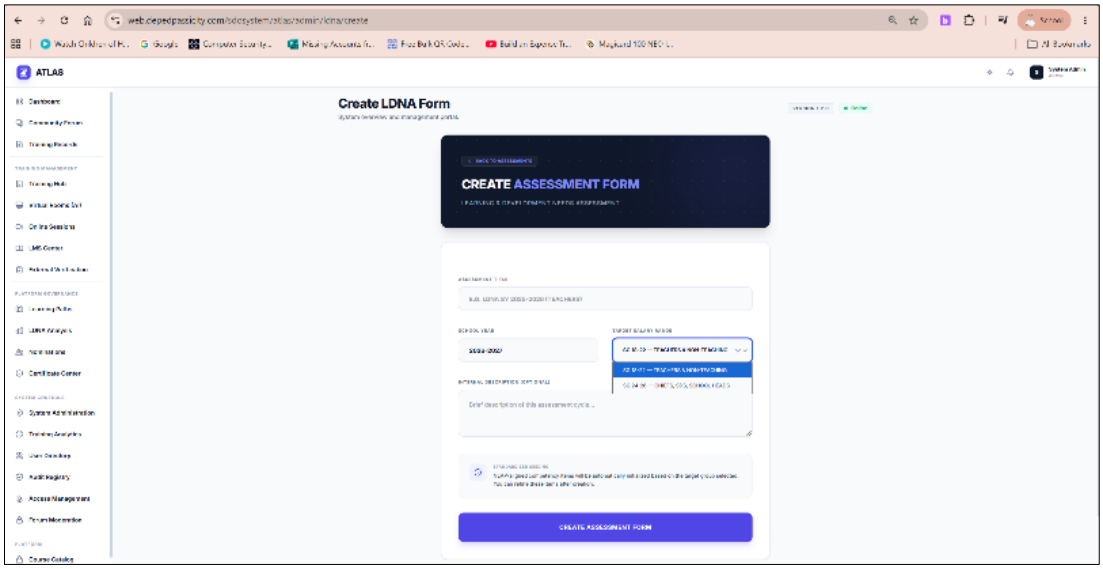

Fig. 15: Needs Analysis (LDNA) Page: Digital diagnostic questionnaire interface aggregating self-assessment skill matrices across Salary Grades 18–26

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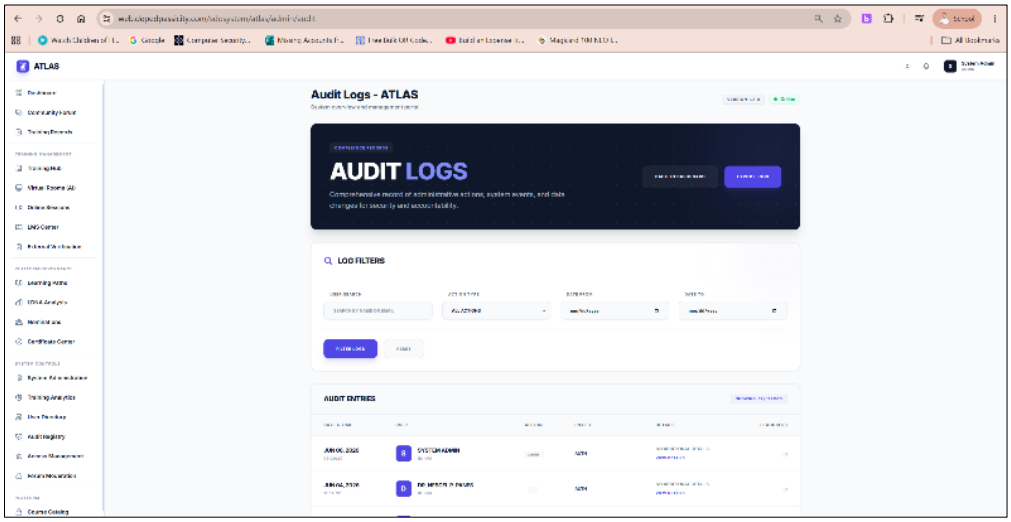

Fig. 16: Audit Logs: Read-only data table detailing timestamped system activities, user interactions, and administrative updates for validation checking

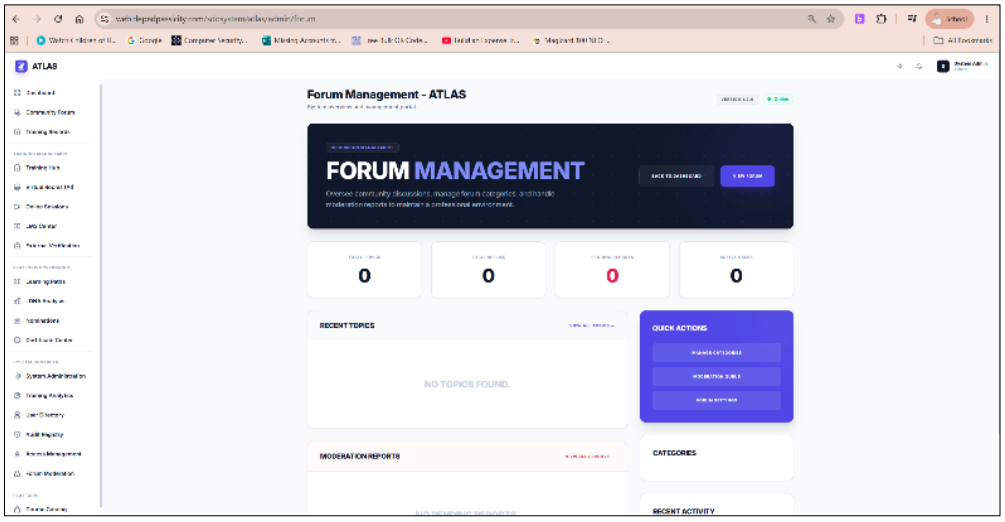

Fig. 17: Forum Management: Community panel allowing administrative review, comment mapping, and interaction tracking within collaborative learning hubs

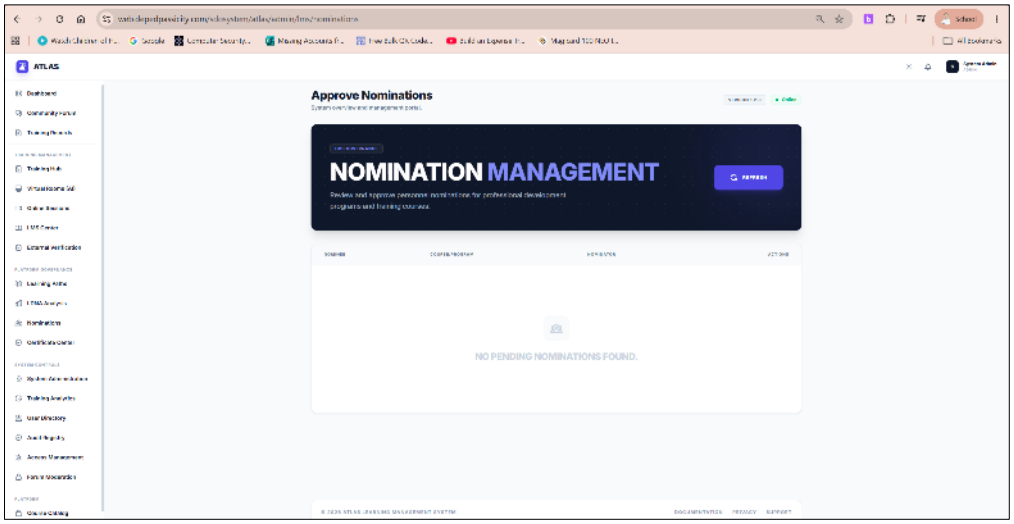

Fig. 18: Nomination Management: Selection grid allowing HR administrators to approve, route, or override participant nominations for specialized technical paths

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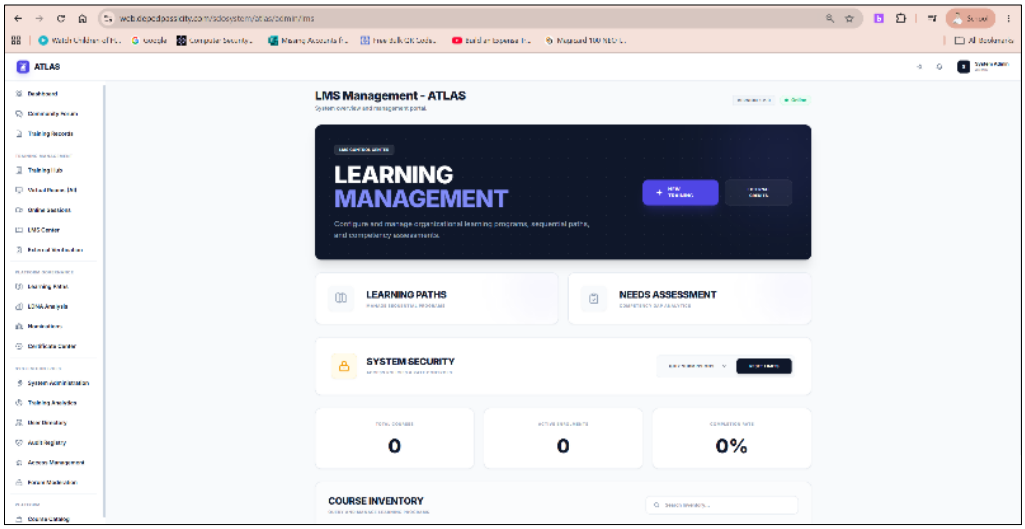

Fig. 19: LMS Management: Core course management center displaying system-wide lesson catalogs, course parameters, and module asset setups

Post-deployment verification confirmed 100% completion across core modules. The system manages operations through a lightweight service layer across 47 routes with hardened Role-Based Access Control (RBAC) to prevent privilege escalation. The interface employs a dark slate and indigo design with asynchronous HTMX exchanges for fluid single-page behavior.

Quantitative Usability Metrics

Table 1. ISO/IEC 25010:2023 Software Quality Evaluation Summary Results

ISO/IEC 25010:2023 Quality Characteristic	Covered Items / Evaluation Scope	Mean (M)	SD (SD)	Adjectival Interpretation
1. Functional Suitability	Feature completeness, grading correctness, training appropriateness.	3.88	0.14	Strongly Agree
2. Performance Efficiency	Response times, resource utilization, file upload capacities.	3.84	0.18	Strongly Agree
3. Compatibility	Co-existence with open browser tabs, data interoperability exports.	3.91	0.11	Strongly Agree
4. Interaction Capability	Learnability, recognizability, error protection, user engagement.	3.93	0.09	Strongly Agree

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5. Reliability	Platform availability, fault tolerance, data recoverability.	3.87	0.16	Strongly Agree
6. Security	RBAC confidentiality, data integrity, audit trails, authentication.	3.96	0.05	Strongly Agree
7. Maintainability	System modularity, layout reusability, error analysability.	3.89	0.13	Strongly Agree
8. Flexibility	Device adaptability, database scalability, installability.	3.92	0.10	Strongly Agree
9. Safety	Operational constraints, hazard warnings, fail-safe integration.	3.94	0.08	Strongly Agree
Overall Quality Profile	Composite Evaluation Metrics Summary	3.91	0.11	Strongly Agree

Mean Score Distribution

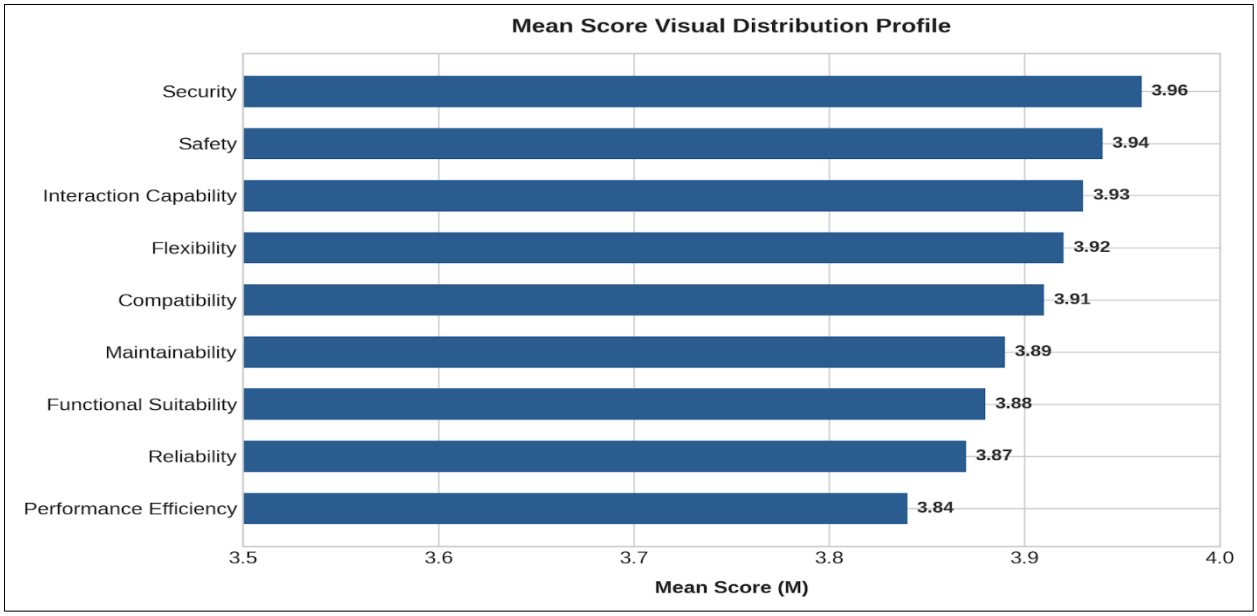

Fig. 20. Mean Score Visual Distribution Profile Chart.

Key Empirical Findings Narrative

- Security (M = 3.96, SD = 0.05): This metric scored the highest overall value. Respondents confirmed that the encrypted Cloudflare tunnel, parameterized database expressions, and role-based validation matrices provide robust defenses against data tampering and vertical leaks.

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- Safety (M = 3.94, SD = 0.08): Achieved high marks driven by strict database constraint layers. Programmatic checks successfully prevent administrative users from executing accidental deletions of active personnel records, while verification prompts stop raw data entry errors from affecting compliance histories.

- Interaction Capability (M = 3.93, SD = 0.09): Evaluators noted strong user retention parameters. The integration of progress trackers and responsive text layouts allowed personnel across diverse age brackets and technical skill levels to navigate core workflows easily.

- Performance Efficiency (M = 3.84, SD = 0.18): Remained firmly inside the positive parameters but displayed higher statistical variance. This behavior was traced to localized network bandwidth limits during concurrent multi-user execution phases, such as processing bulk data exports or large certification uploads.

DISCUSSION

Critical Evaluation of Technical Outcomes

The empirical results establish a high-performing software quality profile across evaluated dimensions (M = 3.91). However, a critical architectural examination reveals specific trade-offs inherent in the system's design. The exceptional rating achieved for Security (M = 3.96) directly validates the isolation of data assets through a Cloudflare Zero Trust outbound tunnel combined with strict role-based access control (RBAC) verification.

Enforcing multi-tier database role checks at every parent controller boundary creates an operational bottleneck during complex application routing. Because server-side hypermedia architectures trigger separate, discrete asynchronous HTTP requests for individual interface components (e.g., lazy-loaded elements or segmented page updates), these security verification queries execute repeatedly per user interaction. While this mechanism completely prevents vertical privilege escalation and unauthorized horizontal data access, it injects a recurring processing overhead for every hypermedia block requested via HTMX. This distinct trade-off echoes systemic design considerations documented in recent literature. Custom information architectures significantly maximize control over public sector business rules, but they introduce rigid processing bounds that require careful data layout and query optimization (Bratamanggala, 2023).

Similarly, the high score in Safety (M = 3.94) stems from deep backend validation rules and strict database foreign key configurations. These database constraint layers successfully prevent administrative users from executing destructive, cascading deletions of active personnel files. However, they heavily restrict system flexibility. Modifying a primary user profile structure or shifting historical certification records requires updating multiple relational dependencies simultaneously. This operational friction reinforces observations by Meijerink et al. (2021) regarding the processing hurdles and systemic rigidity encountered when re-engineering fluid administrative configurations into automated, highly normalized relational database platforms

Performance and Hypermedia Architecture

The lower relative rating and higher statistical variance observed in Performance Efficiency (M = 3.84, SD = 0.18) highlight a central architectural challenge. Unlike heavy, client-side JavaScript Single Page Application (SPA) frameworks that handle data compilation and UI rendering tasks directly on the user's terminal device, Project ATLAS utilizes server-side hypermedia exchanges via HTMX. This programmatic choice keeps the client interface exceptionally responsive and minimizes the application's local memory footprint, directly matching the strong ratings recorded for Maintainability (M = 3.89) and Interaction Capability (M = 3.93).

Unlike lightweight JSON payloads common in traditional client-side rendering, HTMX transfers raw HTML fragments across the network wire for every dynamic state change or view update. When a large cohort of users simultaneously triggers data actions—such as submitting local diagnostic assessments or uploading large PDF certification files—the network infrastructure must process an immediate, sharp spike in data transfer volume. Under standard local area conditions, the load-balanced multi-fiber lines at the division data center manage this

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traffic effectively. However, automated certification and evaluation engines that pass raw data or documents across network boundaries require heavily optimized localized server infrastructure to prevent visible latency under concurrent traffic spikes (Bin Md Nor et al., 2026). On slower, field-level wide area network connections, this reliance on constant server-side rendering explains the increased statistical variance in efficiency ratings. This demonstrates that server-side hypermedia shifts the operational dependency entirely onto the surrounding network bandwidth.

Real-World Operational Insights

From an operational perspective, connecting individual learning histories directly with regional competency needs assessments provides public governance units with an efficient, data-driven platform. The system successfully replaces slow, error-prone manual calculations and separated spreadsheet logs with automated dashboards, radically reducing clerical overhead for human resource units. This outcome directly supports the empirical conclusions of Ni'mah et al. (2023), where automated modular tracking frameworks successfully improved tracking accuracy by up to 40% while mitigating systemic data entry errors.

Nevertheless, the platform's long-term utility depends on keeping its internal competency models updated. Because human resource criteria, training mandates, and licensing regulations shift frequently within the public sector, hardcoded database benchmarks can quickly become obsolete. Appraisal and training systems remain isolated unless they are tied to a dynamic taxonomy framework that evolves alongside institutional policy shifts (Vassileva et al., 2024). To maintain its long-term effectiveness as an institutional tool without requiring continuous developer intervention, the system must transition from static entity mapping to a flexible, user-managed metadata framework.

CONCLUSION AND RECOMMENDATIONS

This study successfully engineered, deployed, and empirically validated Project ATLAS, an integrated Learning and Development Management System designed to resolve the systemic operational fragmentation, tracking delays, and data silos characteristic of traditional manual professional training frameworks. By consolidating automated CPD/PD credit tracking routines, role-stratified dashboards, interactive virtual execution spaces, and algorithmic talent profiling tools into a unified relational architecture, the platform provides a scalable blueprint for digital modernization in public sector governance.

Field evaluation utilizing the international product quality baseline ISO/IEC 25010:2023 (International Organization for Standardization & International Electrotechnical Commission, 2023) demonstrated that Project ATLAS operates at an exceptional standard of technical excellence, earning a total overall quality score of 3.91 out of 4.00 (SD = 0.11). The platform's architectural resilience was strongly underscored by its peak scores under the Security vector (M = 3.96, SD= 0.05) and Safety vector (M = 3.94, SD = 0.08). This empirically confirms that isolating core data pathways with a custom MVC logic and secure Cloudflare Zero Trust network tunneling completely mitigates risks of unauthorized access or accidental data anomalies.

Ultimately, Project ATLAS achieved its primary objective: replacing vulnerable, manual clerical procedures with a high-performance, responsive hypermedia architecture that successfully drives verification accuracy, eliminates certificate issuance backlogs, and provides clear visibility into organizational skill profiles.

Recommendations for Future Work

a) Cross-Institutional Scale-Testing: Because the initial evaluation cohort relied on a purposive sample of administrative and technical evaluators within a centralized sector, future researchers should scale testing across multi-tiered institutional environments to analyze system utility, load tolerances, and user adoption variances over diverse, distributed governance units.
b) Telemetry and Direct Resource Monitoring: While the expert evaluation metrics confirmed high user satisfaction and interface accessibility, future technical audits should transition from perception-based scoring toward direct telemetry capture tracking raw server response latencies, database transaction

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velocities, concurrent payload overheads, and hardware resource utilization spikes during high-traffic intervals.

c) Automated Skill Ontology Integration: Building upon the platform's custom competency mapping layout, future software iterations should integrate natural language processing (NLP) layers and automated skill ontologies to automatically parse, tag, and align unstructured text records with national professional capability frameworks, minimizing manual parameter inputs.

d) Third-Party API & Distributed Integration: To enhance systemic utility, next-phase development should engineer secure, open-standard API endpoints that allow Project ATLAS to securely sync data with external legacy personnel registries and regional human resource tracking databases without introducing security bottlenecks.

e) Proactive Cybersecurity Penetration Analysis: Although the platform's Zero Trust tunnel architecture and database constraint layers earned exceptional security ratings, subsequent studies must subject the system to formal white-box penetration testing and automated stress-testing simulations to explicitly verify its structural defense against advanced cross-site and injection vulnerabilities.

Additional Statements

- Conflict of Interest: The authors declare no conflict of interest.
- Data Availability: System architecture and evaluation data are available upon reasonable request from the corresponding author.
- Ethical Approval: While explicit institutional human subjects approval was not required for this software evaluation study, all expert and administrative evaluations were conducted voluntarily, anonymously, and with informed consent.

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