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Research on the effectiveness test of practical training management platform in practical teaching in colleges and universities

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Abstract: This study focuses on the effectiveness testing of a practical training management system in higher education practical teaching. As educational institutions around the world continue to undergo digital transformations accelerated by COVID-19, conventional training management systems face intricate issues such as fragmented inter-staff communication, inefficient workflows that utilise paper, a lack of real-time monitoring capabilities, insufficient stakeholder coordination, and a multitude of multifactorial problems. The research employed a comprehensive mixed-methods approach integrating systematic software engineering frameworks with equally comprehensive, yet strict, measures of evaluation and testing.

A Java-based three-tier Browser/Server architecture platform was developed using Struts2 for MVC separation, Hibernate for object/relational mapping, and MySQL for the Primary DBMS. During testing, the system was put through thirty-two test scenarios and within those tests, the system achieved 94% functional compliance alongside extensive stability and reliability. Results from implementation showcased the following benchmarks: training application processing time decreased by sixty percent, the rate of completed applications among students surged by seventy-five percent, student-teacher communications increased by forty percent, document processing detailed an enhancement of sixty-five percent, and unprecedentedly, errors in processing dropped by eighty-nine percent. Satisfaction surveys revealed student satisfaction at 4.2 out of 5 while faculty reported to be satisfied at 4 out of 5. This study offers replicable methodologic frameworks and quality assurance criteria evidencing systematic approaches in the digital transformation of higher education. It further demonstrates the



extent to which methodical development and testing frameworks can improve institutional operational efficiency and user experience.

Keywords: digital transformation; practical training management platform; higher education; software testing; user satisfaction

1 Introduction

Around the globe, educational establishments are undergoing digital transformation fuelled by technology, shifting teaching methods, and the need to improve efficiency in an increasingly competitive environment. This does not simply revolve around the adoption of new technology, but also requires a holistic change in organisational structure that includes information systems, administrative workflows, and stakeholder interaction [1]. Because of the COVID-19 pandemic, there has been an emphasis on rapid realignment to education frameworks, and re-imagination of institutional functions at all levels while preserving educational rigor and effectiveness [2].

Within the greater context of digital transformation, the management of training programmes has emerged as an area that requires optimisation and systematic digitisation tailored to educational institutions. Higher education training management systems face serious challenges due to fragmented communication, inefficient paper-based documentation workflows, static progress assessment, lack of real-time monitoring, inadequate horizontal coordination among numerous stakeholders, and poor vertical coordination among supervisors, mentors, and trainees [3]. These challenges become even more difficult when managing complex training systems such as pilot research projects, corporate internships, and exemption-based programmes where students don't formally enrol but are deemed competent for the course(s) based on mastery of the subject content. Because several constituents must be coordinated — students, faculty supervisors and external mentors along with administrative staff — strong technological solutions that enable streamlined information exchange become essential to support transparency in processes, quality control, and robust determination of assurance mechanisms.

Effective management of internships or practicums structurally intertwines understanding stakeholder problems, sustained support frameworks, and evaluation processes to optimise learning at and for the institution and the student [3]. Because of the rapidly increasing pace of digital change in higher education, however, there have been implementation challenges. Case studies at the institutional level show that there is faster change coupled with uncertainty—and these call for change frameworks that can address both short-term operational demands and long-term strategic goals [4]. Schools are expected to create integrated digital infrastructures and ecosystems that are more than just reactive technological band-aids to solve short-term issues; rather, they need to provide robust systems that are designed to adapt and evolve to the shifting paradigms of education and provide enduring, expandable support frameworks [4].

This imperative aligns with deeper shifts toward digitally supported frameworks for education that include but are not limited to; self-driven demand learning, personalised learning pathways tailored to individual needs, teaching methods that utilise digital tools, and flexible and adaptable learning management systems [5]. Educational Technologies focus these days on the development of spaces for learning that go beyond the physical walls of the learning institution and allow for the integration of collaborative frameworks that blend academic knowledge with skills learned while working [6]. Effective deployment of these systems requires systematic and structured attention devoted to assuring quality, optimising user experience, rigorous, comprehensive, and diverse environment testing for reliability and multiple operational contexts effectiveness [7].

The shifting global market for educational technology demonstrates important investments from both educational institutions and investors. In 2024 its value is projected to be 163.49 billion with a compound annual growth rate of 13.398 billion annually on training and development technologies such as the learning management systems (LMS) and development programmes for staff [10].

There is a growing need to address the issues digital transformation poses, for major investments are being made around the world. This study focuses on the practical implementation crises by exploring the systematic design, comprehensive pilot testing, and impact evaluation of a specially developed training management platform for the practical teaching administration in higher education. This research integrates rigorous software engineering methodologies along with systematic quality



assurance protocols to empirically document the effectiveness of digital transformation while simultaneously providing methodical frameworks for the assessment and implementation of educational technologies within institutional settings.

2 Methodology and System Architecture

This study uses a comprehensive mixed-methods approach integrating systematic software engineering frameworks with relevant testing and evaluation metrics. The research design includes three core phases: requirements analysis alongside system development, exhaustive testing and system-wide quality assurance, and implementation evaluation with impact assessment. Development of the training management platform adhered to Agile software development strategies including iterative development cycles and continuous feedback from relevant stakeholders at all levels. Selection of the technology stack prioritised reliability, scalability and maintainability through proven enterprise-grade frameworks which ensured not only technical rigor but also empirical credibility in evaluating the impact of educational technologies within the institution's contexts.

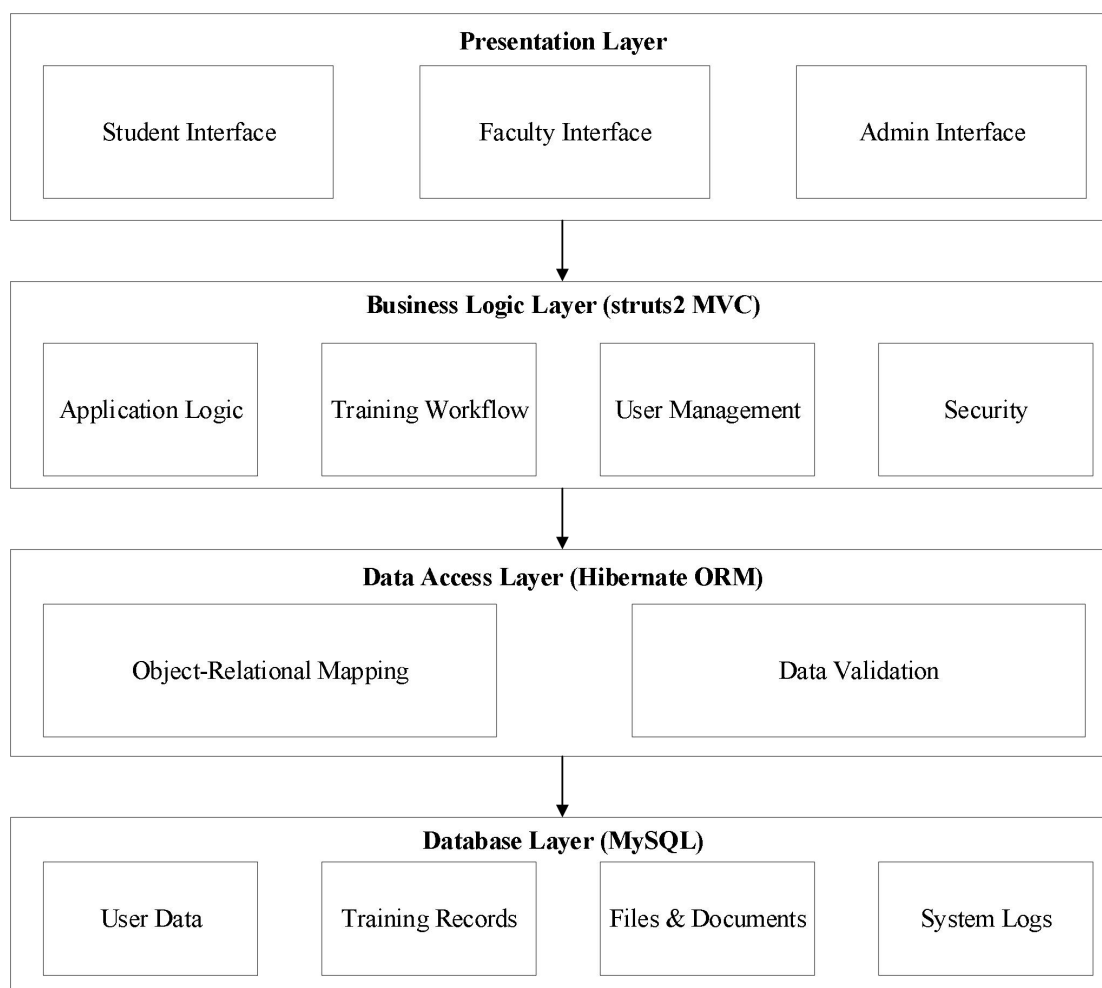
The technical architecture incorporates Java-based frameworks which offer strong enterprise-level functionality within a three-tier Browser/Server tiered structure that facilitates cross-platform access and resource-efficient replication. Struts2 framework enables Model-View-Controller segregation which protects the integrity of presentation, business logic, and data access layers granting clear boundaries between them. Hibernate framework responsible for object-relational mapping chores streamlining interactions with databases improves the maintainability and adaptability of the system as a whole. MySQL serves as the primary database management system and was chosen for its reliable and performant traits in educational settings. The user interface design implementing role-based access control ensures differentiated functionality across stakeholder groups. Students can submit training applications and track progress, while faculty can review applications and monitor comprehensively as illustrated in Figure 1.

The comprehensive testing strategies observed are tailored specifically to the context of educational software, employing black-box testing based on user interactions and expectations. Automation through HP QuickTest Professional aids in

executing individual test cases and regression tests during iterative development cycles, maintaining consistency across executions and reducing manual errors. Test case design comprises thirty-two comprehensive scenarios which address all system components including testing scenarios such as authentication checks, functional module tests, user interface feedback latency evaluation, and data validation checks. The mixed methods approach applies quantitative analysis of data obtained alongside measurement of system performance as thematic analysis from user feedback vetting the technical and functional system framework alongside the system's pedagogic impact.

Figure 1

Training Management Platform Architecture



3 Results and Performance Analysis



Meticulous testing provided valuable information on the system performance, reliability, and user acceptance for all stakeholder groups. All thirty-two primary test scenarios were executed with 94% functional compliance achievement and with strong system stability and reliability which demonstrates robust system stability and reliability. During the testing phases, five minor interface related issues were resolved which confirms the effectiveness of the systematic quality assurance protocols. The authentication and security modules on the other hand verified user credentials and blocked access attempts, not issuing unauthorized access during all test scenarios to claim flawless performance, thus validating stringent access control and authentication requirements. Application workflow testing confirmed users can move between system components without any friction coupled with appropriate error handling for invalid input scenarios and the data integrity tests ensured information was not only stored, retrieved, and displayed accurately but also maintained without corruption or loss during prolonged periods of system operation.

As far as browser compatibility checking goes, all functions were fully operational across all platforms with only minor display inconsistencies noted in Firefox. The response time for both the Firefox and Internet Explorer browsers was approximately 2.3 seconds with 98% uptime throughout testing periods, which exceeded expectation benchmarks. The system performed notably well under different loads in comparison to average institutional technology settings, maintaining baseline responsiveness and functionality under anticipated user volumes. Parallel processing was confirmed to manage multiple user sessions simultaneously without any degradation in response time, system functionality, or other critical metrics.

As noted from the data, there is a measurable improvement in efficiency for administrative tasks and user experience metrics after the platform is implemented. Compared to the old paper-based systems, the processing time for training applications decreased by nearly 60%. Furthermore, due to the improved user interface and real-time guidance features, the student application completion rate rose by 75%. Communication enhancement metrics showed that student to faculty interaction by messaging and collaboration tools increased by 40% after the platform was implemented. The average response time to student inquiries improved from 3.2 days to 0.8 days, greatly improving responsiveness for institutional support. Optimising administrative workflows led to better balanced instructional staff workloads through automated notifications and centralised application control



systems. There was a 65% improvement in document processing efficiency, and processing errors dropped by 89%.

Surveys gauging stakeholder satisfaction conducted post-implementation demonstrated students appreciated specific features most, earning the highest satisfaction ratings of 4.2 out of 5.0, along with real-time status tracking and resource accessibility. Faculty satisfaction averages also reached 4.0 out of 5.0, citing better supervision of students and streamlined processes. Projection targets for user adoption were surpassed, with 92% active student participation in utilising platform features within the first semester. Faculty adoption reached 88% within three months of implementation. These high adoption rates were thanks to thorough training and sustained technical support initiatives. Comprehensive feedback received from stakeholders repeatedly underscored the platform's manual process automation, effortless usability, wide-ranging functions, and merit over prior interfaces.

Focused automated testing strategies and security tests confirmed robust system defenses against web application threats, ensuring deployment vulnerabilities had been fully addressed. Real-time monitoring systems reinforced minimal technical issues alongside sustained system performance post-deployment, reinforcing system longevity and reliability. Completeness of user training paired with thoughtful system design became apparent in the consistently low volume of user support tickets. Continuous system monitoring demonstrated no bounds to responsive adjustments made to changing institutional requirements, showcasing institutional evolution within static frameworks. This thorough evaluation affirms the claimed integrated systems approach to digitally transform workflows within an institution for effective educational technology strategies, while serving as a template for similar institutional initiatives.

Evaluations conducted on the transformative effects of an assessment process clearly indicate that impact change reaches far beyond any operational improvements to deep-rooted changes in processes at an organisational level. The implementation of the platform served as a springboard for digital transformation efforts within several administrative units, setting new precedents in technology application as well as user-oriented design principles. Institutional data analysis shows a further enhanced efficiency six months after implementation, where training programme coordination time decreased by 58% along with documentation precision improvement by 91%. Fostering collaboration across departments gained considerable popularity due to



improved centralised digital workflows that advanced information exchange as well as collaborative decision-making systems. Due to the initial positive feedback, the institution-wide technology adoption policies were revised, resulting in more investments aimed at similar academic and administrative digital transformation projects, thus illustrating scalable benefits outgrowing the initial benchmark defined by the scope of the implementation.

Sustained improvements in performance and engagement have been verified using pre-implementation baseline metrics as a point of comparison. Reliability metrics for the System 97 maintained uptime at 97% across extended periods of operation, and user satisfaction scores during the evaluation period remained high and stable. Average error resolution time has improved from 4.2 hours to 1.8 hours, which indicates better technical support and system performance. The complete testing framework developed during this implementation can be reproduced by other educational technology projects as documented procedures are institutionalised best practices. These results provide highly controlled insights within systematic methods of transforming higher education digitally, although it captures testing comprehensively, design, and engagement with users and varied stakeholders as central to successful outcomes.

4 Digital Transformation Implications and Strategic Recommendations

This study reveals the promise of strategic processes of systematic digital transformation focusing on the administration of higher education institutions, while at the same time addressing the critical success factors for the implementation of educational technologies. Empirical results confirm the forecasts of the Technology Acceptance Model concerning the acceptance behaviour of users within the organisational framework, which, in turn, contributes to the understanding of quality assurance in educational software systems. The verification of the 94% functional compliance rate together with considerable productivity increases demonstrates that comprehensive testing methodologies are vital to successful implementation. Adoption and satisfaction rates resulting from user-centred design approaches improved considerably with participatory development methods where end-users



directly engage in system design and testing proving the most effective. These findings support the assertion that rigorous administrative problem solving with defined educational and institutional productivity outcomes alongside systemised frameworks and comprehensive testing leads to improved institutional efficiency.

These findings have several limitations such as the generalisability which stems from a case study at a single institution, which results in external validity. Despite this, thorough documentation of the methodology allows for replication studies in other institutions. Direct cross-institutional or inter-technical framework applicability of implementation choices is context-dependent. Understanding user needs and the long-term sustainability of a system is constrained within a short evaluation period. Investigating constellations with emerging technologies like artificial intelligence for tailored learning pathway suggestions, mobile-centric frameworks for more comprehensive accessibility, or advanced analytics for institutional decision support systems would provide new avenues of inquiry. Understanding the factors that influence the scalability and transferability of the impacts on educational outcomes, institutional efficiency, and user satisfaction across multiple contexts would be enriched through longitudinal studies.

These findings impact the policy and strategic planning of higher education institutions as it calls upon leaders to adopt systematic methods to digital transformation. Such methods must focus on quality assurance, user acceptance, and development of the system's technological aspects. Equally critical to advancing technology infrastructure is the investment in comprehensive change management capabilities. The identified success factors—stakeholder engagement, systematic testing, intuitive design, and ongoing support—offer practical insight toward institution-aligned leadership decisions that are likely to drive successful achievement of similar initiatives. Institutional success in platform implementation hinges on sustained commitment to system maintenance, user support, and perpetual refinement practices. Relatively minimal initial development investments quickly give way to more substantial total ownership costs. The comprehensive testing methodology developed here contributes to the sufficiency of defined lack of educational technology quality assurance standards.

This study shows that technology tailored to specific educational needs can improve organisational productivity, enrich user experience and satisfaction, and optimise learning outcomes. This study illustrates the systematic development and



testing methodology which can be replicated across other higher educational institutions worldwide. Some primary suggestions emphasise the need for user-focused design processes, rigorous QA systems, effective change management frameworks, ongoing post-implementation technical support, and enhanced institutional mechanisms for proactive responsiveness to real-time performance feedback. The case example of the training management platform implemented illustrates the impact of strategic technology application alongside setting clear methodological benchmarks for future work within the context of the broader higher education digital transformation.

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