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IMPROVING SOFTWARE QUALITY OF THE "ELECTRONIC UNIVERSITY" SYSTEM BASED ON BALANCED TESTING

Abstract

The article presents a comprehensive study of methods for improving the software quality of the "Electronic University" information ecosystem, using the JetIQ platform of Vinnytsia National Technical University as a case study. The relevance of the work is driven by the rapid development of digital educational services and the need to establish reliable quality control mechanisms in complex distributed systems that encompass administrative, educational, and auxiliary processes.

The scientific novelty of the research lies in the substantiation of an integrated approach to testing project planning, combining the strategic V-model with operational management via Kanban technology. The author proposes an adapted V-model where each testing level (functional, communication, emotional) clearly correlates with specific ecosystem services: from verifying individual modules of the "Electronic Dean's Office" to validating the integrity of the functional and communication layers.

Special attention is paid to balancing manual and automated verification methods. The specifics of testing three key system layers are investigated: functional (educational processes and gamification), communication (interaction between users and notification services), and emotional (motivation and feedback). The implementation of a Kanban board is described to visualize the automation workflow, including stages of layer analysis, automated test execution, and emotional feedback assessment.

The practical significance of the results lies in the development of test cases for functions such as student activity monitoring, academic performance rating calculations, and data delivery reliability in notification systems. It is determined that the proposed strategy not only effectively identifies software bugs during frequent updates but also enhances the overall quality of the electronic informational educational environment. Further research prospects are related to the development of metrics for user emotional satisfaction as a crucial indicator of software quality.

Keywords: software quality, JetIQ, V-model, Kanban, test automation, information ecosystem, educational processes, management processes, auxiliary processes, software engineering.

Problem statement. The rapid development of digital educational platforms necessitates the creation of reliable quality control mechanisms. The "Electronic University" system is a complex distributed ecosystem that encompasses thousands of users and heterogeneous processes [1]. The problem lies in the need to develop a strategy and tactical testing tasks that account for not only functional correctness but also the specific nature of communication and emotional connections within the electronic informational educational environment.

The development of the project "Testing of JetIQ System Service Contours" is an integral part of the IT development strategy of Vinnytsia National Technical University. The primary goal of this strategy is to implement a unified information ecosystem for the automation of managerial, educational, and auxiliary processes. The creation of cases for automated and manual tests, their balancing, and periodic execution will enable the identification of system weaknesses and the continuous improvement of its performance.

Analysis of recent research and publications. The theoretical foundations

of the JetIQ ecosystem's functioning are highlighted in the works of Ye. Palamarchuk, O. Kovalenko, and O. Bisikalo [1]. A systematic analysis of global LMS construction practices confirms that the key challenge for educational platforms remains the balance between multi-functionality and usability. This makes the implementation of our proposed balanced testing strategy relevant, as it covers not only the technical integrity of modules but also the emotional interaction of the user with the university ecosystem [2]. Experience in developing web-based LMS demonstrates the effectiveness of using Black Box testing for basic functionality; however, for complex university ecosystems such as JetIQ, it is necessary to implement more dynamic approaches and strategic planning to cover all interaction contours [3]. Nevertheless, an integrated approach to testing planning using the V-model within a multi-contour university model remains insufficiently explored. For the implementation of automated tests, it is advisable to use established methodologies for their creation [4; 5]. Research by Krisper and colleagues [6] in the field of automated system testing for the LMS of Graz University of Technology points to the importance of proper test case design and test data management. This enables the implementation of system-level automation processes. Such testing is aimed at verifying the integrity of the functional and managerial contours of the ecosystem during frequent software updates. This research can be utilized for the adaptation of the V-model. The Kanban methodology is recognized as one of the effective methods for implementing learning management systems and developing electronic services for university management [7].

Purpose of the article. The purpose of the study is to substantiate the methodology for planning and implementing the JetIQ system testing project through a combination of the strategic V-model, Kanban management, and the automation of test cases across the functional, communication, and emotional layers. The purpose of the study is to substantiate the methodology for planning

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Presentation of the main material of the study. To improve the software quality of JetIQ, an adapted V-model is proposed, which allows for the synchronization of operational verification stages and ecosystem architecture enhancements with the corresponding levels of verification. In contrast to the classical approach, each testing level corresponds to specific services that automate university activities:

- Component Level: enables the verification of individual services (the "Electronic Dean's Office" module, student and teacher personal accounts, management service operations, etc.).
- Integration Level: allows for the evaluation of the communication layer and the levels of interaction between students and teachers, students and the dean's office, faculty and administrative services, etc.
- System Level: involves the verification of the integrity of the functional and communication layers as the core contours of the system.
- Motivational (Emotional) Layer Assessment: must be carried out across various dimensions — checking for the presence of feedback at defined communication points, the availability of gamification and its impact on student learning levels, and the generation of dynamic emotional messages for students based on the system’s operational content.

The implementation of the testing project for individual JetIQ services requires high flexibility. Utilizing a Kanban board allows for the visualization of the automation workflow. The board structure includes specific stages: "Layer Analysis," "Automation Test Case Creation," "Automated Test Execution," and "Emotional Feedback Analysis." This enables a prompt response to changes in educational processes, for example, during examination sessions.

Automation of Case Studies by System Layers System quality is examined through three key layers, with specific automation cases developed for each. This includes the automation of educational process testing, providing access to electronic information resources, calculating scores and academic performance ratings based on test results, completion of instructor assignments, and monitoring the activity of students and faculty within the system. The operation of the system's core functions can be verified using automated tests.

Table 1

Example of system testing by layers (contours)

Layer (Contour)	Testing Object (Cases)	Testing Method
Communication	CommunicationFile and notification delivery, forum activity, management of news and sites, knowledge assessment (testing).	Load, integration, and manual testing of result acquisition processes.
Emotional	Feedback messages, gamification and activity results, presence of inquiries or complaints, satisfaction assessment results.	Manual testing, surveys

Testing of the instant messaging system, SMS and e-mail notification services, statistical data generation, repository data replenishment, document management systems, and educational program management involves active communication between services and users. When performing testing, it is necessary to utilize both automated and manual test cases. The primary focus of communication layer testing is on performance and data delivery reliability.

The emotional layer involves the use of automated scripts for the collection and primary analysis of gamification results. The pilot project for emotional layer testing includes the accumulation of data regarding inquiries

from students and faculty to administrators and other support specialists of the learning management system, as well as those supporting methodical, scientific, and managerial activities. It also tracks the frequency and duration of system downtime caused by unstable communication networks, power supply issues, etc. Furthermore, the qualifications of specialists across various departments and services are taken into account.

The V-model for the testing project provides for the creation of automated tests as a software product, alongside cases for hybrid and manual testing, with continuous implementation and result analysis. The Kanban board allows for the distribution of all tasks among performers and over time, ensuring comprehensive system testing.

Conclusions. The application of the V-model ensures strategic testing integrity, while Kanban enables efficient management of automated test development for individual JetIQ services. Categorizing testing into functional, communication, and emotional layers allows not only for software bug detection but also for improving the overall quality of the educational environment. Future research will be dedicated to developing metrics for user emotional satisfaction as a software quality indicator.

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