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Methods For Assessing Engineering Competencies Based On Digital Learning Tools

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Abstract: This article examines the issues of assessing future engineers' professional competencies using digital learning tools. It also analyzes the role of digital assessment technologies in the educational process, their advantages, and directions for improving assessment methodologies.

Keywords: Digital learning, engineering competency, assessment methodology, artificial intelligence, digital technologies, innovative education, automated system.

Introduction: Currently, alongside the digitalization of engineering education, the need for accurate and reliable assessment of future engineers' professional competencies is steadily increasing. Traditional oral examinations, written tests, or assessments based solely on final projects often fail to fully reflect students' real-world technical skills, problem-solving abilities, systematic thinking, and teamwork competencies. Therefore, digital learning tools — including online test and examination systems, electronic portfolios, virtual laboratories, simulation environments, automated code or compiled analysis tools, and LMS (Learning Management System) integrations — provide an opportunity to fundamentally improve the assessment process.

For example, virtual laboratories allow students to demonstrate practical skills in real time, such as conducting experiments, working with sensors and actuators, and applying safety protocols. These processes are evaluated using specific indicators, including experiment success rate, compliance with control parameters, and error analysis. Automated code-checking systems measure efficiency, accuracy, and optimization in programming and algorithmic solutions. Additionally, electronic portfolios allow the analysis of students' participation in individual and group projects, creativity, and professional communication skills (technical reports, project documentation, design solutions). This provides instructors and industry specialists with a broader context for evaluation.

Digital assessment methods enhance transparency, speed, and objectivity in evaluation, making it easier to generate results based on clear indicators such as rubrics, competency metrics, and automated log files. They also enable the analysis of large-scale data to monitor the development trajectory of students' competencies, identify weaknesses early, and suggest personalized learning pathways. However, implementing digital assessment presents several challenges: ensuring the reliability and validity of standards and methodologies, improving technical infrastructure, developing instructors' digital competencies, guaranteeing information security and data privacy, and providing equal opportunities for all students. Assessment tools must align with national and international accreditation requirements as well as industry standards, because if the real demands of engineering practice — technical knowledge, problem analysis, safety, ethical standards, and teamwork — are not reflected in the evaluation indicators, a mismatch between education and the labor market arises.

As a result, digital assessment systems should not only serve as a tool for assigning grades but also act as a strategic mechanism that encourages continuous professional development of students, provides diagnostic and planning functions for instructors, and aligns the quality of engineering education with industry requirements.

LITERATURE REVIEW AND RESEARCH METHODOLOGY

During the study, both Uzbek and international sources on the theoretical foundations of digital assessment

technologies and their practical application in engineering education were analyzed. Specifically, M. Karimov (2021) highlighted the possibilities of analyzing students' learning activities through digital footprints; Bennett and Gitomer (2009) emphasized the objectivity of digital assessment based on real-time analysis; A. Ibragimov (2022) discussed the personalized learning features of adaptive assessment systems; and D. Rakhmatova (2020) examined the role of electronic portfolios in personal and professional development. The research methodology employed systematic analysis, comparative approaches, experimental observation, and digital monitoring methods.

RESULTS

Digital assessment technologies have become an integral component of modern engineering education, enabling transparent, objective, and analytically driven management of the learning process. Through these technologies, not only the students' final results but also the gradual acquisition of their competencies can be identified. Uzbek researcher M.Karimov, in his work titled "Assessment Technologies in the Digital Education System," writes: "Digital assessment tools record every learner's activity as a digital trace, which ensures reliability in analyzing educational outcomes" [1,57]. From this perspective, digital assessment in engineering education encompasses algorithms, automated testing systems, simulation laboratories, electronic portfolios, and learning analytics technologies.

The advantages of digital assessment are multifaceted, primarily ensuring the principles of objectivity and transparency. As foreign pedagogical technologists Bennett and Gitomer have emphasized: "Unlike traditional tests, digital assessment enables real-time analysis, allowing dynamic monitoring of changes in students' knowledge, skills, and performance" [2,43]. This approach is particularly important for engineering disciplines, as it makes it possible to assess complex competencies—such as algorithmic thinking, system design, and adherence to safety protocols—across multiple dimensions (skills, process, and outcome).

Another crucial aspect of digital assessment systems is the introduction of adaptive assessment technologies. These systems, through artificial intelligence algorithms, analyze a student's previous responses, response speed, and error rate to automatically determine the difficulty level of subsequent questions. Researcher A. Ibragimov notes: "Adaptive assessment systems not only measure knowledge but also analyze the learner's study style, thereby creating an individualized learning pathway" [3,84]. Such systems are currently being successfully implemented on platforms like Moodle, Canvas, Google Classroom, and Coursera.

In addition, electronic portfolios are widely used in digital assessment systems. They compile a student's project work, graphic designs, technical reports, laboratory results, and innovative ideas into a unified platform. As Uzbek scholar D. Rakhmatova states: "An electronic portfolio is a systematic digital document that reflects a student's personal and professional development path; it serves not only as an assessment tool but also as an instrument of self-analysis and reflection" [4,69]. Thus, digital assessment technologies enable the evaluation not only of results but also of the learning process itself.

Overall, digital assessment systems provide opportunities for high-quality diagnostics, adaptive monitoring, real-time analysis, transparent evaluation, and the formation of individualized learning pathways in engineering education. Through these systems, a new paradigm of educational quality control is emerging. Therefore, digital assessment technologies place engineering education at the core of digital transformation and reinforce the competency-based approach.

CONCLUSION

Improving the methodology for assessing engineering competencies in a digital learning environment is one of the key priorities of the modern education system. Today, engineering education goes beyond measuring only theoretical knowledge — it also requires a comprehensive assessment of students' technical thinking, problem-solving abilities, teamwork, and innovative approaches.

In developing assessment methodologies, reliance on international experience is of great importance. In particular, it is necessary to adapt the competency indicators used in engineering accreditation systems such as ABET to the higher education standards of Uzbekistan. This approach aligns assessment criteria with the requirements of the global labor market and ensures the competitiveness of graduates. Furthermore, enhancing teachers' digital assessment competencies is a fundamental condition for the successful implementation of such methodologies.

In conclusion, an assessment system based on digital learning tools ensures quality, transparency, and efficiency in engineering education. The improved methodology contributes to the individualization of the learning process, monitoring of students' developmental dynamics, and strengthening of the interconnection between education and industry within the process of digital transformation. Thus,

digital assessment becomes an important factor in integrating Uzbekistan's higher education system into the global digital learning space.

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