

Article

Digital Transformation of Learning Process Management in Higher and Vocational Education

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Abstract: The rapid diffusion of digital technologies has turned the management of the learning process in higher and vocational education from a largely administrative, paper-based activity into a data-driven and platform-mediated system. Learning management systems, student information systems, learning analytics and artificial intelligence tools now shape how curricula are planned, how teaching is organised and delivered, and how learning outcomes are monitored and assessed. This article examines the digital transformation of learning process management (LPM) as a managerial rather than purely technological phenomenon. Drawing on a structured review of international literature, analysis of policy documents and secondary statistical data, it compares developments in the European Union and OECD countries with the reforms currently under way in Uzbekistan, where higher education coverage rose from about 9% in 2016 to 47.7% in the 2024/2025 academic year.

The study proposes a functional framework that links the classical management cycle (planning, organisation, delivery, monitoring, assessment and quality assurance) with the digital tools that support each stage. It argues that the scale of educational expansion makes digital LPM a precondition for maintaining quality, and identifies the main barriers: fragmented information systems, uneven digital competence of teaching staff, weak use of data for pedagogical decisions and a persistent gap between universities and vocational institutions.

The article concludes with recommendations on integrated information architecture, data governance, staff development and the extension of digital management practices to the vocational education sector.

Keywords: *digital transformation, learning process management, higher education, vocational education, learning management systems, learning analytics, educational data, Uzbekistan.*

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1. Introduction

Education systems around the world are undergoing a structural shift in the way the learning process is organised and governed. For most of the twentieth century, learning process management in universities and vocational institutions rested on fixed timetables, paper registers, printed curricula and end-of-term examinations, with information flowing slowly and mainly upward for reporting purposes. Digital transformation changes this logic. It is understood not simply as the adoption of new tools, but as a process in which digital technologies trigger changes in value creation, organisational structures and decision-making [1]. In education this means that information about students, courses and learning activities is generated continuously, becomes available in real time and can be used to steer the learning process while it is still taking place.

International organisations describe this shift as one of the defining trends of the decade. The OECD emphasises that digital technologies, learning analytics and artificial intelligence can support more personalised and better-informed management of teaching and learning, provided that institutions develop the necessary capacities and safeguards [2]. UNESCO, in its 2023 Global Education Monitoring Report, adopts a more cautious view: technology improves learning only when it is embedded in sound pedagogy and governance, and its benefits are unevenly distributed [3]. The COVID-19 pandemic accelerated the process dramatically, but also revealed the difference between emergency remote teaching and properly designed digital learning [4].

For Uzbekistan the question is especially relevant. Since 2017 the country has carried out one of the fastest expansions of higher education in the region. The Concept for the development of the higher education system until 2030 envisages a transition to the credit-module system, broader academic autonomy and the use of modern information technologies in the educational process [5]. The “Digital Uzbekistan-2030” strategy sets goals for digitalising public services, including education [6], and the “Uzbekistan-2030” strategy targets higher education coverage of at least 50% [7]. The vocational education sector is also being restructured to meet labour market needs. Rapid growth in student numbers and institutions places heavy pressure on traditional management practices, and digital LPM becomes a means of sustaining quality under conditions of scale.

Against this background, the article analyses how digital transformation changes the content, tools and actors of learning process management in higher and vocational education, and what conditions determine whether this transformation leads to better educational outcomes rather than merely to digitised bureaucracy.

Research on the digital transformation of education has developed along several interrelated lines. The first concerns the adoption and use of digital media by teachers and students. Studies in European universities show that, even in technologically advanced systems, digital tools are used predominantly to distribute materials and administer courses, while more interactive and data-rich forms of teaching remain limited [8]. This suggests that the availability of infrastructure does not by itself transform the learning process; the decisive factor is how institutions manage and integrate it.

The second line of research concerns learning analytics, defined as the measurement, collection, analysis and reporting of data about learners and their contexts for the purpose of understanding and optimising learning [9]. Early work identified the potential of analytics to support early warning systems, adaptive curricula and evidence-based institutional decisions [10]. Later studies warned that analytics must remain grounded in learning theory and pedagogical goals, otherwise institutions risk measuring what is easy to count rather than what matters [11]. A systematic review of artificial intelligence applications in higher education found that most studies concentrate on profiling and prediction, intelligent tutoring, assessment and adaptive systems, but rarely involve educators or address ethical implications [12]. Critical scholars add that automation of educational management may weaken the professional role of teachers if it is introduced without their participation [13].

The third line concerns human capital and competences. The European Framework for the Digital Competence of Educators (DigCompEdu) describes the professional, pedagogical and learner-oriented digital competences required from teachers [14], while the TPACK model stresses that effective use of technology requires the integration of technological, pedagogical and content knowledge. At the policy level, the European Digital Education Action Plan 2021–2027 treats a high-performing digital education ecosystem and the digital skills of staff as two complementary priorities. For vocational education, the ILO highlights the specific challenges of digitalising practical and work-based learning, the lower digital readiness of many TVET providers and the need for flexible, modular systems that support lifelong learning [15].

Despite this extensive literature, several gaps remain. Much of the research focuses on either the technological side (platforms, analytics, AI) or the pedagogical side (teaching methods, competences), whereas the managerial dimension—how the full cycle of planning, organising, delivering, monitoring and assessing learning is reorganised by digital tools—receives less systematic attention. Moreover, higher and vocational education are usually studied separately, and evidence from Central Asian countries, where the transformation is taking place alongside rapid system expansion, is still scarce.

Purpose of the Article

The purpose of this article is to identify the directions, mechanisms and constraints of the digital transformation of learning process management in higher and vocational education, and to substantiate practical recommendations for its development in Uzbekistan. To achieve this purpose, the study sets the following objectives: to clarify the concept of digital learning process management and its components; to develop a functional framework linking management functions with digital instruments; to analyse the state of digitalisation of the education system in Uzbekistan in comparison with international practice; and to determine the key barriers and priority measures for the integrated digital management of the learning process across both levels of education.[16]

2. Materials And Methods

The study is based on a qualitative, mixed-source research design that combines three methods: a structured literature review, analysis of policy and regulatory documents, and analysis of secondary statistical data.[18]

First, a structured review of scholarly literature was carried out on digital transformation, learning management systems, learning analytics, artificial intelligence in education and digital competences of educators. Searches were conducted in Scopus, Web of Science and Google Scholar using combinations of the terms “digital transformation”, “learning management”, “learning analytics”, “higher education” and “vocational education”. The selection and screening of sources followed the principles of the PRISMA 2020 statement regarding transparency of inclusion criteria [19]. Priority was given to peer-reviewed articles, systematic reviews and reports of international organisations published mainly between 2011 and 2024.

Second, policy documents were analysed to identify the goals, instruments and institutional arrangements of digital transformation in education. These included reports of the OECD, UNESCO, the ILO and the European Commission [20], as well as the main strategic documents of the Republic of Uzbekistan regulating higher education, digitalisation and national development.

Third, secondary statistical data from the National Statistics Committee of the Republic of Uzbekistan and official publications on the development of the education sector were used to characterise the scale of system expansion and the resulting managerial pressure. Comparative, logical and structural-functional analysis were applied to synthesise the findings and to construct a functional framework of digital learning process management.

The study has limitations. It relies on secondary data and does not include primary surveys of students, teachers or administrators; therefore, its conclusions about institutional practice are indicative and should be tested in further empirical research.

3. Results and Discussion

3.1. Concept and components of digital learning process management. The analysis shows that learning process management can be defined as a purposeful system of actions by which an educational institution plans, organises, delivers, monitors and evaluates learning in order to achieve intended learning outcomes. Its digital transformation is not the digitisation of individual documents, but the transfer of the whole management cycle into an integrated information environment where data generated at one stage automatically inform decisions at the next. In this sense, three levels of maturity can be distinguished: digitisation (converting paper records into electronic form), digitalisation (automating separate processes such as enrolment, timetabling or grade books) and digital transformation proper (redesigning processes around integrated data and using analytics for pedagogical and managerial decisions) [21].

Table 1 summarises how each classical management function changes under digital transformation and which instruments support it.

Table 1. Transformation of learning process management functions under digitalisation

Management function	Traditional mode	Digitally transformed mode	Enabling tools
Planning	Fixed curricula and manual timetables approved once a year	Modular, credit-based curricula; automated timetabling; planning based on enrolment and outcome data	Student information systems, credit-module planning tools
Organisation	Paper registers, face-to-face groups, manual distribution of workload	Electronic enrolment and group formation; flexible individual learning paths	HEMIS-type information systems, e-admission portals
Delivery	Classroom lectures, printed materials	Blended and online learning; digital content; simulators and virtual labs	LMS (Moodle etc.), video platforms, simulators
Monitoring and control	End-of-term reporting; retrospective control	Continuous tracking of attendance, activity and progress; early warning of academic risk	Learning analytics dashboards
Assessment	Paper examinations, manual grading	Online and adaptive testing; e-portfolios; automated feedback	Testing systems, e-portfolios, AI-assisted assessment
Quality assurance	Periodic inspections and paper surveys	Data-based programme review; online student feedback; transparency of results	Integrated data warehouses, survey tools

As the table shows, the essential change is the shift from retrospective control to continuous, data-informed management. In the traditional model, information about student progress became available only at the end of a semester, when it was too late to intervene. In a digitally transformed model, attendance, submission of assignments, activity in the learning management system and interim assessment results are recorded continuously, which allows early identification of students at risk and timely pedagogical support. At the same time, the literature cautions that such data should support, not replace, the professional judgement of teachers [22].

3.2. Scale of educational expansion in Uzbekistan as a driver of digital management. The Uzbek case illustrates why digital LPM is becoming a necessity rather than an option. According to the National Statistics Committee, the coverage of the population aged 18–23 by higher education reached 47.7% at the beginning of the 2024/2025 academic year, an increase of 40.9 percentage points compared with 2014 [23]. The number of higher education institutions grew from 69 in 2016 to 222 in 2024/2025 (Fig. 1).

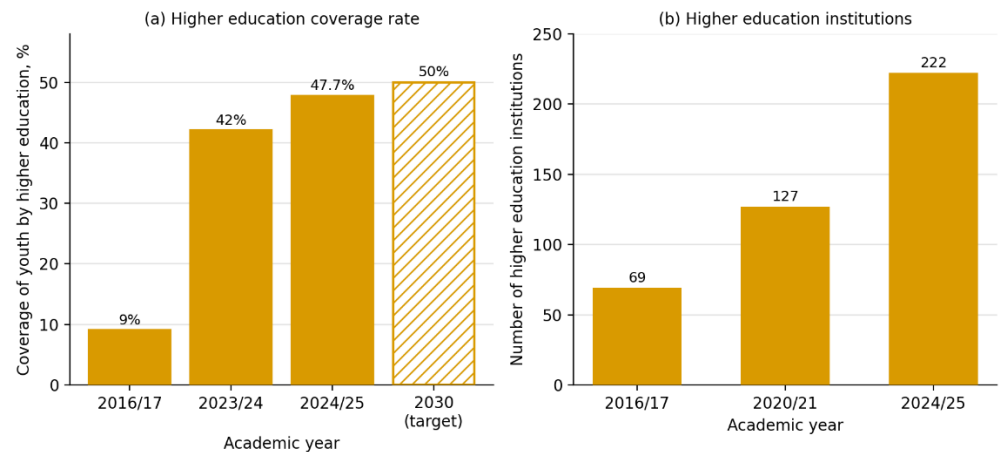


Fig 1. Expansion of higher education in Uzbekistan: coverage rate and number of institutions

Such growth multiplies the number of students, groups, courses, teachers and assessment events that must be planned and controlled. Managing a system of this size manually leads to duplication of data, delays in reporting and a high administrative workload for teaching staff, which reduces the time available for teaching itself. The introduction of the national Higher Education Management Information System (HEMIS), electronic admission procedures and the transition to the credit-module system envisaged by the Concept until 2030 represent important steps towards centralised and transparent data on the educational process. However, the analysis indicates that these systems are still used mainly for administrative accounting and reporting, while their potential for pedagogical analytics—identifying learning difficulties, evaluating course design, personalising learning paths—remains largely untapped.

3.3. Specific features of vocational education. The vocational education sector faces additional challenges. A large share of learning takes place in workshops and at enterprises, which makes it harder to capture learning activities in digital form. Practical skills require assessment through observation and demonstration rather than tests, and many vocational institutions have more limited infrastructure and fewer staff with advanced digital skills than universities. At the same time, vocational education stands to gain particularly strongly from digital tools: simulators and virtual laboratories reduce the cost of practical training, electronic portfolios record the acquisition of competences, and shared platforms with employers make it possible to align training content with labour market demand. The results suggest that integrating vocational and higher education data within a unified architecture would support recognition of prior learning and smoother learning pathways from college to university, which is consistent with the lifelong learning agenda.

3.4. Barriers to digital transformation. The analysis identified four groups of barriers. The first is technological and architectural fragmentation: institutions often operate several unconnected systems (for admission, timetabling, learning content, testing and HR), which forces staff to enter the same data repeatedly and prevents a comprehensive view of the learning process. The second is the uneven digital competence of teaching and administrative staff; as European experience shows, digital infrastructure produces results only when accompanied by systematic professional development. The third is weak data governance: unclear rules on data ownership, quality, privacy and access limit the responsible use of learning analytics and create risks for students' rights [24]. The fourth is organisational culture, in which digital systems are perceived primarily as instruments of reporting and control rather than as tools for improving teaching, reproducing a "digitised bureaucracy" instead of transformation.

3.5. Directions for development. Based on the results, several directions are proposed. (1) Institutions should move from a set of separate applications to an integrated information architecture in which the student information system, the learning management system and assessment tools exchange data through common standards and interfaces. (2) Data collected in these systems should be systematically used for pedagogical decisions: dashboards for teachers and programme heads, early warning of academic risk and regular analysis of course results. (3) A national framework for the digital competence of educators, adapted from DigCompEdu, could guide continuous professional development and be linked to academic career incentives. (4) Clear data governance rules, including protection of personal data and transparency of algorithms, are required before large-scale use of predictive analytics and AI. (5) Digital management practices and platforms developed in universities should be extended to vocational institutions, with particular attention to work-based learning and cooperation with employers [25].

The discussion shows that the digital transformation of learning process management is primarily a managerial and organisational change. Technology creates the possibility of continuous, data-informed management, but its realisation depends on institutional strategy, human capital and governance.

4. Conclusion

The study shows that digital transformation fundamentally changes learning process management in higher and vocational education. The management cycle—planning, organisation, delivery, monitoring, assessment and quality assurance—is increasingly carried out in an integrated digital environment, where data generated during learning can be used to make timely decisions. This allows a shift from retrospective control to continuous, evidence-informed management and creates conditions for personalised learning and greater transparency.

For Uzbekistan, where higher education coverage has increased more than fivefold since 2016 and the network of institutions has tripled, digital LPM is a precondition for maintaining the quality of education at a new scale. Important foundations have already been created in the form of national strategies, the credit-module reform and centralised information systems. The main task now is to move from administrative digitalisation to genuine transformation: integrating fragmented systems, using educational data for pedagogical decisions, developing the digital competence of staff, establishing rules of data governance and extending these practices to the vocational education sector. Future

research should include empirical surveys of teachers, students and managers of universities and colleges, as well as quantitative assessment of the relationship between the level of digital maturity of learning process management and educational outcomes.

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