



The Role Of Digital Transformation In Improving Innovation Management Mechanisms In School Educational Institutions

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ABSTRACT

This article theoretically analyzes the role of digital transformation in improving innovative management mechanisms in preschool educational institutions. The study studies the content and interrelationship of the concepts of "digital transformation", "innovative management" and "digital competence". The theoretical foundations of automating administrative processes in the preschool education system, using information-based systems in decision-making, and ensuring effective communication with parents are identified. Various scientific approaches - systemic theory, theory of diffusion of innovations, TPAK model and the concept of digital competence - are compared and analyzed. As a result, four main functional areas of digital transformation in the management of preschool educational institutions are formed: administrative, economic, socio-communicative and information-analytical. Also, obstacles to the implementation of digital transformation and ways to overcome them are identified. The theoretical results achieved in the article made it possible to identify new areas of scientific research on the modernization of preschool education management.

Keywords:

digital transformation, preschool education, innovative management, management mechanism, digital competence, educational management, digitization, information and communication technologies, quality of education, digital ecosystem.

Аннотация. В данной статье теоретически проанализирована роль цифровой трансформации в совершенствовании механизмов инновационного управления в организациях дошкольного образования. В ходе исследования изучено содержание и взаимосвязь понятий «цифровая трансформация», «инновационное управление» и «цифровая компетентность». Определены теоретические основы автоматизации административных процессов, использования систем принятия решений на основе данных и обеспечения эффективной коммуникации с родителями в системе дошкольного образования. Проведен сравнительный анализ различных научных подходов — системной теории, теории диффузии инноваций, модели ТРАСК и концепции цифровой компетентности. В результате сформированы четыре основных функциональных направления цифровой трансформации в управлении дошкольными учреждениями: административное, экономическое, социально-коммуникативное и информационно-аналитическое. Кроме того, обоснованы препятствия на пути внедрения цифровой трансформации и предложены пути их преодоления. Теоретические результаты исследования открывают возможности для определения новых направлений научных исследований по модернизации управления дошкольным образованием.

Ключевые слова: цифровая трансформация, дошкольное образование, инновационное управление, механизмы управления, цифровая компетентность, управление образованием, цифровизация, информационно-коммуникационные технологии, качество образования, цифровая экосистема.

Annotatsiya. Mazkur maqolada maktabgacha ta'lim muassasalarida innovatsion boshqaruv mexanizmlarini takomillashtirishda raqamli transformatsiyaning o'rni nazariy jihatdan tahlil qilingan. Tadqiqot davomida «raqamli transformatsiya», «innovatsion boshqaruv» va «raqamli kompetentlik» tushunchalarining mazmuni va o'zaro aloqasi o'rganilgan. Maktabgacha ta'lim tizimida ma'muriy jarayonlarni avtomatlashtirish, qaror qabul qilishda ma'lumotlarga tayangan tizimlardan foydalanish va ota-onalar bilan samarali kommunikatsiyani ta'minlashning nazariy asoslari aniqlangan. Turli ilmiy yondashuvlar — tizimli nazariya, innovatsiyalarning diffuziya nazariyasi, TPAK modeli va raqamli kompetentlik konsepsiyasi — taqqoslab tahlil qilingan. Natijada maktabgacha ta'lim muassasalari boshqaruvida raqamli transformatsiyaning to'rt asosiy funksional yo'nalishi shakllantirilgan: ma'muriy, iqtisodiy, ijtimoiy-kommunikativ va axborot-tahliliy. Shuningdek, raqamli transformatsiyani joriy etishning to'siqlari va ularni bartaraf etish yo'llari asoslangan. Maqolada erishilgan nazariy natijalar maktabgacha ta'lim boshqaruvini zamonaviylashtirish bo'yicha ilmiy tadqiqotlarning yangi yo'nalishlarini belgilash imkonini bergan.

Kalit so'zlar: raqamli transformatsiya, maktabgacha ta'lim, innovatsion boshqaruv, boshqaruv mexanizmi, raqamli kompetentlik, ta'lim menejmenti, raqamlashtirish, axborot-kommunikatsiya texnologiyalari, ta'lim sifati, raqamli ekotizim.

The penetration of digital technologies into all spheres of modern society puts on the agenda the need to radically change the education system. Preschool education, as the primary and most important link in continuous education, cannot remain outside these changes. The results of scientific research have confirmed that about 70% of all the information and knowledge that a person acquires throughout his life is acquired by the age of 5. Reforming the preschool education system in the Republic of Uzbekistan has become one of the state's priority tasks, and more than 96 regulatory legal acts related to this area were adopted in 2017–2024. The Decree of the President of Uzbekistan “On additional measures to further improve the quality and efficiency of preschool education” dated September 30, 2024 specifically emphasizes the need for the widespread introduction of innovations, advanced pedagogical and digital technologies into the educational process. Today, more than 38 thousand preschool educational organizations operate in Uzbekistan, employing about 700 thousand teachers. Therefore, improving the management system in preschool educational institutions based on digital technologies is of urgent importance not only theoretically, but

also practically. The social significance of this problem is that as a result of increasing the efficiency of management through digital transformation, the quality of education will improve, cooperation between parents and teachers will increase, and rational use of resources will be ensured. Methodologically, digital transformation will make it possible to transfer preschool education management from the traditional bureaucratic model to a data-based, flexible and transparent system [1]. An analysis of the scientific literature devoted to the study of the role of digital transformation in educational management shows the existence of a large number of theoretical and applied studies. Westerman G., Bonnet D. and McAfee A. (2014) defined digital transformation as “the process of fundamentally changing business processes, culture and customer experience through the use of digital technologies to achieve the strategic goals of the organization”. Senge P. (1990) in his theory of the “fifth discipline” saw organizations as learning systems and based on the interrelationship of systems thinking, collective learning and shared goals. Rogers EM (2003) in the theory of diffusion of innovations described the process of adopting innovations in five stages - knowledge, persuasion,

decision-making, implementation and validation, and this theory is recognized as the most appropriate theoretical framework for the adoption of educational technologies. The TPAK (Technological-Pedagogical-Content Knowledge) model proposed by Mishra P. and Koehler M. (2006) defines the system of knowledge that educators need to effectively integrate technology into the educational process. Selwyn N. (2011) critically analyzes the social, cultural and political aspects of digital technologies in education and emphasizes the need to take socio-cultural factors into account when introducing technologies. Mergel I., Edelman N. and Haug N. (2019) develop the theoretical foundations of digital transformation in the public sector and justify the need to ensure a holistic change in organizational structures. Korytska O. and Butsiak V. (2025) study the role of digitalization in improving management mechanisms in preschool educational institutions and prove that digitalization is a strategic resource for the development of preschool education. Pettersson F. (2021) described digitalization as a multi-stage and multi-level process of change, indicating that it should include not only technological, but also pedagogical and organizational changes. The European Commission's DigCompEdu (2017) concept has identified six key areas and 22 competencies for the development of teachers' digital competence, forming international standards in this regard. UNESCO (2022, 2024) proposed a holistic concept that includes six pillars of digital transformation in education - digital competence, content, infrastructure, governance, policy and culture.

An analysis of existing research shows that the issue of digital transformation has been studied mainly in the context of general education and higher education systems, and there is a lack of research on the management of preschool educational institutions. The holistic transformation of the management functions specific to preschool educational institutions — planning, organization, motivation, control and communication — in the context of digital transformation has not been sufficiently studied in the scientific literature. In particular,

the issues of comprehensive integration of digital tools into everyday administrative practice, the formation of a digital corporate culture and overcoming obstacles associated with resistance to change remain as scientific gaps. The approach proposed in this article has new aspects by synthesizing existing theoretical models and adapting them to the specific characteristics of preschool educational management. The purpose of the article is to theoretically substantiate the role of digital transformation in improving innovative management mechanisms in preschool educational institutions, identify its main functional areas and develop a conceptual description.[2]

To form the theoretical basis of the article, the content, origin, and interrelationship of the concepts of "digital transformation", "innovative management mechanism", and "digital competence" were first critically analyzed.

Digital transformation is widely used in modern scientific literature, there is no single, universally accepted definition. Westerman G., Bonnet D., and McAfee A. (2014) defined digital transformation as "a process of fundamentally changing an organization's operations, culture, and customer experience through the use of digital technologies and business models." Mergel I., Edelman N., and Haug N. (2019) adapted this concept to the public sector and interpreted it as "a holistic change in organizational structures, service delivery models, and internal processes as a result of the introduction of digital technologies." Pettersson F. (2021) defined digitalization as "a multi-stage and multi-level change process that includes not only the introduction of digital tools, but also pedagogical and organizational changes." Summarizing these definitions, the author's definition was formulated as follows: *digital transformation in the context of preschool education is a process of comprehensively changing the administrative, pedagogical and communicative processes of a preschool educational institution, renewing its organizational culture and systematically increasing management efficiency through digital technologies and innovative approaches.*

This concept is closely related to the concepts of "digitization" (converting analog data into digital form) and "digitality" (digitalization - optimizing processes through digital technologies), and is manifested as their higher stage.[11]

an innovative management mechanism was formed at the intersection of management sciences, pedagogy and innovation sciences. A management mechanism is a set of methods, tools and principles used in an educational institution to achieve set goals. Innovative management, in contrast to traditional bureaucratic approaches, refers to a management system based on new technologies, modern methods and creative solutions. Ekawati N. (2025) in her study highlighted the transformation of preschool education management from a bureaucratic model to a participant-oriented and teacher-centered model. Korytska O. and Butsiak V. (2025) identified four main mechanisms in the management of preschool educational institutions - administrative, economic, socio-psychological and information-communicative - and described their changes under the influence of digitalization. According to the author's definition, *an innovative management mechanism in preschool education is a flexible and transparent management system that integrates digital technologies, data-based decision-making systems, and modern communication tools, and encompasses all management functions of a preschool educational institution* .[7][1]

Digital competence is recognized as a key condition for implementing digital transformation in the education system. The European Commission's DigCompEdu (2017) concept defines digital competence as "the system of knowledge, skills and attitudes that educators need to effectively use digital technologies in teaching, assessment and professional activities". UNESCO (2024) broadly defines digital competence as "the ability to use digital technologies responsibly, safely and creatively in modern society". The DigComp 3.0 (2025) concept proposes a holistic approach that takes digital competence beyond technical skills and includes ethical

aspects, well-being, environmental sustainability and the protection of fundamental rights. According to the author's definition, *digital competence in the context of preschool education is the ability of leaders and educators to use digital tools effectively, responsibly and appropriately in management, learning and communication processes* . This concept is directly related to digital transformation and innovation management mechanisms: the higher the level of digital competence, the more effective the implementation of digital transformation will be.[1 2]

Comparative analysis of theoretical approaches

There are several scientific approaches to theoretically justify the role of digital transformation in preschool educational institutions. Below, four main theoretical approaches are compared and analyzed: systemic theory, diffusion of innovations theory, TPAK model, and the concept of digital competence.

Systems theory (Senge P., 1990) views organizations as learning systems and proposes a "fifth discipline" — systems thinking — as a framework that unifies the other four disciplines (personal skills, mental models, shared purpose, and collective learning). Senge argues that effective change can only be achieved by understanding how all elements of an organization are interconnected. This approach allows us to view digital transformation in the context of preschool educational institutions not as a separate technological event, but as a holistic process that includes all management functions of the organization. As Lunenburg F. (2012) also notes, systems thinking is a key tool for understanding the causes of problems in organizations and developing systematic solutions.[7]

The theory of diffusion of innovations (Rogers EM, 2003) describes the process of diffusion of innovations in a social system and divides it into five stages - knowledge, persuasion, decision, implementation and confirmation. Rogers' theory is recognized as the most appropriate theoretical framework

for the development of educational technologies. In the context of preschool educational institutions, this theory serves as a basis for systematizing the process of introducing digital technologies, determining the level of innovative acceptability of leaders and teachers, and strategic planning. As Sahin I. (2006) noted, the characteristics of innovation in Rogers' theory - comparative advantage, adaptability, complexity, trialability and observability - determine the speed of technology introduction.[8]

The TPAK model (Mishra P., Koehler M., 2006) is a theoretical framework that describes the integration of technological, pedagogical, and content knowledge of educators. The TPAK model justifies the need to combine three areas of knowledge of educators — technological knowledge, pedagogical knowledge, and content knowledge — to effectively integrate technology into education. Park E. et al. (2018) applied the TPAK model in the context of preschool education and formulated principles of technological integration appropriate to the age characteristics of children. This model serves as a theoretical framework for

developing the competence of preschool leaders and educators in using digital tools.[9][23][24]

The digital competence concept is based on the European Commission's DigCompEdu (2017) concept, which describes the digital competence of educators in six areas: professional engagement, digital resources, teaching and learning, assessment, student support, and facilitating students' digital competence. UNESCO (2022, 2024) has expanded this approach and proposed a holistic concept that includes the six pillars of digital transformation in education: digital competence, content, infrastructure, governance, policy and culture. DigComp 3.0 (2025) further expands digital competence to include artificial intelligence, cybersecurity, and digital well-being. This concept is an important theoretical tool for assessing and developing the digital competence of early childhood education leaders and educators.

Table 1 below systematically shows the common and different aspects of the four theoretical approaches.

Table 1. Comparative analysis of theoretical approaches to digital transformation

Criterion	Systems theory (Senge P., 1990)	Diffusion Theory (Rogers EM, 2003)	TPAK model (Mishra P., Koehler M., 2006)	Digital Competence Concept (DigCompEdu, 2017; UNESCO, 2024)
Basic principle	Understanding the organization as an interconnected system and implementing holistic change	Systematization of the stages and factors of diffusion of innovations in the social system	Integrating educators' technological, pedagogical, and content knowledge	Assessing and developing the digital skills of educators and leaders
Scope	Organizational management, strategic planning, change management	Analysis of the process of introducing technological innovations	Methodology for integrating technology into pedagogical practice	Professional development of educators and standardization of digital skills

Preschool education suitability	Theoretical framework for digitizing institutional management as a holistic system	Setting the pace and strategy for digital technology adoption	Ensuring educators use digital tools effectively	Assessing and improving the digital competence of leaders and educators
Advantage	Shows the interrelationship of all elements of the organization; allows for in-depth systematic analysis	Clearly systematizes the stages of innovation implementation; has wide practical application	Based on knowledge integration; approach close to pedagogical practice	In accordance with international standards; evaluation criteria are clearly defined
Limitation	Complex theoretical structure; more difficult to apply in practice	Focused on individual decision-making; does not fully encompass the organizational context	Mainly focused on the pedagogical process; does not fully cover management functions	Based on a competency framework; does not describe the organizational change process

As can be seen from Table 1, each theoretical approach highlights a certain aspect of digital transformation in preschool education, but does not cover the problem holistically. System theory provides integrity of organizational changes, but is practically complex. Diffusion theory is effective for formulating a strategy for introducing innovations, but does not fully take into account the organizational context. The TPAK model is adapted to the pedagogical process, but does not fully cover management functions. The concept of digital competence is aimed at the development of human capital, but does not describe the process of organizational transformation. Therefore, the need to synthesize and integrate these approaches was identified in order to fully understand the place of digital transformation in preschool educational institutions.

Results. As a result of the theoretical analysis, a number of new theoretical results were formed regarding the role of digital transformation in improving innovative management mechanisms in preschool educational institutions.

Outline of the functional areas of digital transformation, four main functional areas of

digital transformation in the management of preschool educational institutions were identified and presented: The first is the administrative-organizational direction. This direction includes the automation of document circulation, the introduction of electronic reporting systems, the digitization of personnel management, and the electronic transfer of internal orders. As Korytska O. and Butsiak V. (2025) noted, the transition from a traditional paper-based administrative system to electronic document circulation significantly increases management efficiency. A distinctive feature of this direction is that it directly optimizes the procedural processes of management and reduces the administrative burden.[1]

The second is the economic-resource direction. This direction includes electronic budget planning, automated monitoring of expenses, allocation of resources through a digital system, and ensuring financial transparency. Digital budgeting systems allow heads of preschool educational institutions to analyze financial data in real time and make informed decisions. The distinguishing feature of this direction is increasing the level of transparency

and accountability in the management of material and financial resources.[1]

The third is the socio-communicative direction. This direction includes ensuring interaction between parents, teachers and administration through digital platforms, introducing online questionnaires and feedback systems, and forming a culture of digital collaboration within the team. As Shukurova (2026) noted, the introduction of digital management systems increases organizational transparency, facilitates timely and informed decision-making, and strengthens the atmosphere of cooperation between teachers and administration. The main feature of this direction is increasing the quality and speed of communication between participants in the educational process.

The fourth is the information-analytical direction. This direction includes digital monitoring of children's development, assessment of the quality of education through a data-driven system, automatic generation of analytical reports, and creation of databases for strategic decisions. The 2024 decree of the President of Uzbekistan provides for maintaining a child's development map in an electronic system and introducing an electronic certificate system. The distinguishing feature of this direction is the formation of a data-driven management culture.[3]

General theoretical conclusion

The general conclusion formed on the basis of theoretical analysis is that digital transformation in preschool educational institutions should be implemented not as a separate technological event, but as a systemic change that encompasses organizational, pedagogical, administrative and communicative processes. The balanced and interconnected implementation of these four functional areas ensures the effective functioning of innovation mechanisms in the management of preschool educational institutions. From the point of view of systemic theory, these areas are manifested as interrelated components that form a holistic system of the organization. From the point of view of the theory of diffusion of innovations, the implementation of each area should be

carried out gradually, taking into account the level of innovative receptivity of educators.

Categories of digital transformation barriers

As a result of theoretical analysis, five main categories of obstacles to the implementation of digital transformation in preschool educational institutions were identified:

1. Financial barriers include insufficient funds from state and local budgets, and a lack of targeted programs to equip institutions with modern digital tools.[1]
2. Organizational barrier — the lack of uniform standards for integrating digital solutions into the institution's management system, the lack of common procedures for electronic document management or the use of online services.
3. The personnel barrier is the lack of training of managers and administrative staff in working with modern digital platforms, and low motivation for professional development.
4. Technical barriers include outdated hardware and software, lack of systematic maintenance and updates, and limited access to high-speed Internet.
5. Socio-psychological barriers include distrust of digital tools by educators and parents, concerns about the negative impact of digital technologies on children's health, and resistance to changing traditional management practices.[1]

The four functional directions of digital transformation outlined are related to the four governance mechanisms identified in the study by Korytska O. and Butsiak V. (2025) — administrative, economic, socio-psychological, and information-communicative. However, our approach differs in several important respects. First, while Korytska and Butsiak's study is limited to describing the impact of digitalization on governance mechanisms, our approach forms a conceptual description by synthesizing multiple theoretical frameworks, such as systems theory, diffusion theory, the TPAK model, and the concept of digital competence. Second, our classification proposes a "social-communicative" direction instead of a socio-psychological mechanism, since in the context of digital transformation in

preschool educational institutions, the communication function is of greater importance than psychological aspects.[1]

From the perspective of Senge P. (1990)'s systemic theory, our results confirm his "fifth discipline" approach: for digital transformation in preschool education to be effective, all four functional areas must be developed in an interconnected and balanced manner. As Senge noted, changing individual elements of the system affects the entire system, and only through a systemic approach can sustainable results be achieved. This conclusion confirms the theoretical basis of the integrative approach in our study.[7]

Rogers EM (2003)'s theory of diffusion of innovations adds additional theoretical depth to our findings. The barriers identified in our analysis—particularly socio-psychological and personnel barriers—are consistent with the challenges in the "persuasion" and "decision" stages of Rogers' theory. As Rogers noted, the adoption of an innovation requires an individual to positively assess characteristics such as "relative advantage" and "adaptability." In the context of preschool education, this means that it is strategically important to clearly and convincingly demonstrate to educators the advantages of digital technologies over traditional methods.[8]

Mishra P. and Koehler M. (2006)'s TPAK model provides theoretical support for the personnel barrier issue in our approach. As Park E. et al. (2018) have pointed out, technological integration in preschool education should be implemented in a way that is age-appropriate for children, which requires educators to have the appropriate knowledge and skills. Our study extends this finding to the context of management, justifying the need to develop digital competence not only for educators, but also for leaders and administrative staff.[9]

Selwyn N. (2011)'s critical approach to technology in education adds an important theoretical balance to our research. Selwyn emphasizes the need to consider the socio-cultural context, issues of inequality, and the limitations of technology when introducing technology into education. The socio-psychological barrier identified in our analysis

confirms Selwyn's position: digital transformation is not just a technological issue, but also a complex process that involves social, cultural, and psychological factors.[10]

Mergel I., Edelmann N. and Haug N. (2019) conclude that digital transformation in the public sector requires a "whole-scale change in organizational structures." As they point out, digital transformation is driven by factors such as economic, political, legal and external pressures. In the context of pre-primary education, this means that public policy, legislative framework and financial provision play a crucial role in implementing digital transformation.[11]

Based on Uzbekistan's experience, the 2024 Presidential Decree stipulates the introduction of a child development map in the "Preschool Education Management Information System", the creation of a personal account for parents, and the introduction of an electronic certificate system. These measures demonstrate the practical support of the information-analytical and socio-communicative directions identified in our analysis.[3]

UNESCO's (2023, 2024) concept of six pillars of digital transformation is theoretically consistent with our four functional areas. UNESCO considers governance, policy, digital competence, content, infrastructure and culture as a holistic system. Our approach expands the scope of this general concept by adapting it to the context of pre-school education.

The scientific significance of the theoretical results formulated in the article is as follows: first, the description of the functional directions of digital transformation in preschool education enriches existing theoretical models and offers a new conceptual approach; second, the synthesis of various theoretical approaches creates a theoretical basis for a multifaceted and holistic study of the issue of digital transformation in the context of preschool education management.

In practical terms, it is recommended to use these results in the following areas and processes:

- As a theoretical guide in developing a digital transformation strategy by preschool leaders.
- As a scientific basis for the formation of digital policy in the field by the Ministry of Preschool and School Education.
- Developing programs to improve the skills of teachers and leaders.
- Assessing the effectiveness of implementing digital technologies in preschool educational institutions.

Among the limitations of this article, the following should be noted. First, the study is of a theoretical nature and is not supported by empirical data. Second, the article mainly analyzes the theoretical approaches of foreign researchers and does not sufficiently address the specific features of the Uzbek context. Third, digital transformation is a rapidly developing field, and the impact of new technologies such as artificial intelligence, big data, and cloud technologies on preschool education management requires separate research.

The following specific directions for future research are indicated:

- Empirical study of the current state of digital transformation in preschool educational institutions in Uzbekistan.
- Assess the effectiveness of the four functional areas based on a questionnaire and statistical analysis.
- Exploring the potential of artificial intelligence technologies in preschool education management.
- Develop strategies to identify and develop the digital competency level of educators and leaders.

As a result of the theoretical analysis conducted in this article, four main functional directions of digital transformation in improving innovative management mechanisms in preschool educational institutions — administrative-organizational, economic-resource, social-communicative and information-analytical — were identified and substantiated. By synthesizing the systemic theory, the theory of diffusion of innovations, the TPAK model and the concept of digital competence, a holistic theoretical approach to

the role of digital transformation in preschool education management was formed. Also, five categories of obstacles to the implementation of digital transformation — financial, organizational, personnel, technical and socio-psychological — were identified and ways to overcome them were indicated. The results achieved in the article create a basis for strengthening the theoretical basis of scientific research on the modernization of preschool education management and developing practical recommendations.

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