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DIGITALIZATION MODEL OF EDUCATIONAL QUALITY IN THE PROFESSIONAL DEVELOPMENT SYSTEM

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Annotation: This article analyzes the issues of improving the model of digitalization of education quality in the professional development system for preschool education specialists. The study identifies existing problems in the professional development system under modern digital transformation conditions – insufficient digital integration, the persistence of paper-based record-keeping practices in identifying educational needs, as well as limited opportunities for forming individual educational trajectories. The author has developed an improved model consisting of four blocks (needs-based, goal-oriented, process-based, and outcome-based), grounded in systemic, competency-based, andragogical, and functional approaches of digital transformation. A distinctive feature of the model is the integration of BBIT (Kindergarten Information System) and LMS platforms, the design of adaptive educational trajectories based on artificial intelligence, as well as the presence of post-course support and monitoring mechanisms.

Keywords: preschool education, professional development, digitalization, adaptive education, artificial intelligence, BBIT, LMS, quality of education, monitoring, digital competence.

Annotatsiya: Mazkur maqolada maktabgacha ta’lim mutaxassislarini malakasini oshirish tizimida ta’lim sifatini raqamlashtirish modelini takomillashtirish masalalari tahlil qilinadi. Tadqiqotda zamonaviy raqamli transformatsiya sharoitida malaka oshirish tizimidagi mavjud muammolar – raqamli integratsiyaning yetarli emasligi, o‘quv ehtiyojlarini aniqlashda qog‘ozli ish yuritish amaliyotining saqlanib qolganligi hamda individual o‘quv traektoriyalarini shakllantirish imkoniyatlarining cheklanganligi aniqlangan. Muallif tomonidan tizimli, kompetensiyaviy, andragogik va raqamli transformatsiyaning funksional yondashuvlariga asoslangan holda to‘rtta blokdan (ehtiyojli, maqsadli, jarayonli, natijaviy) tashkil topgan takomillashtirilgan model ishlab chiqilgan. Modelning o‘ziga xos xususiyati BBIT (Bolalar bog‘chasi axborot tizimi) va LMS platformalarining integratsiyasi, sun’iy intellekt asosida adaptiv o‘quv traektoriyalarini loyihalash hamda kursdan keyingi qo‘llab-quvvatlash va monitoring mexanizmlarining mavjudligidir.

Kalit so‘zlar: maktabgacha ta’lim, malaka oshirish, raqamlashtirish, adaptiv ta’lim, sun’iy intellekt, BBIT, LMS, ta’lim sifati, monitoring, raqamli kompetensiya.

Annotatsiya. В данной статье анализируются вопросы совершенствования модели цифровизации качества образования в системе повышения квалификации специалистов дошкольного образования. В исследовании выявлены существующие проблемы в системе повышения квалификации в условиях современной цифровой трансформации – недостаточность цифровой интеграции, сохранение практики бумажного делопроизводства при определении образовательных потребностей, а также ограниченность возможностей формирования индивидуальных образовательных траекторий. Автором разработана

усовершенствованная модель, состоящая из четырёх блоков (потребностный, целевой, процессуальный, результативный), основанная на системном, компетентностном, андрагогическом и функциональном подходах цифровой трансформации. Отличительной особенностью модели является интеграция платформ BBIT (Информационная система детского сада) и LMS, проектирование адаптивных образовательных траекторий на основе искусственного интеллекта, а также наличие механизмов посткурсовой поддержки и мониторинга.

Ключевые слова: дошкольное образование, повышение квалификации, цифровизация, адаптивное образование, искусственный интеллект, BBIT, LMS, качество образования, мониторинг, цифровая компетенция.

Introduction

The digital transformation of modern society is having a direct and profound impact on all levels of the education system, including the field of preschool education. As the initial stage of an individual's development, preschool education is considered one of the key factors determining success in subsequent educational processes. Therefore, improving the professional development system for specialists working in this field—including preschool educators, methodologists, psychologists, and administrative personnel—in accordance with contemporary digital requirements has become an issue of significant scientific and practical relevance.

In the context of Uzbekistan, within the framework of the "Digital Uzbekistan–2030 Strategy" [1] and the "Concept for the Development of the Preschool Education System of the Republic of Uzbekistan until 2030" [2], the systematic development of specialists' digital competencies has become one of the most urgent priorities. Therefore, this study focuses on developing a methodological approach to the digitalization of educational quality within the professional development system for preschool education specialists, designing an improved model based on this approach, and exploring mechanisms for its practical implementation.

The aim of the study is to develop a scientifically grounded model for the digitalization of educational quality within the professional development system for preschool education specialists and to provide a theoretical justification of its effectiveness.

The objectives of the study are as follows:

- **to analyze the challenges of digitalization within the professional development system for preschool education specialists;**
- **to determine the methodological foundations for designing a digitalization model;**
- **to develop the structural blocks and implementation stages of the improved model;**
- **to establish criteria and indicators for evaluating the effectiveness of the model.**

Literature Review

The digitalization of the education system is considered in contemporary scientific research as an important factor contributing to sustainable development. In particular, researchers emphasize that the effective digitalization of educational management systems is one of the fundamental conditions for ensuring sustainable development. This approach can also be fully applied to the professional development system for preschool education specialists, since the development of modern competencies among educators within this system is directly associated with improving the quality of education.

In the studies of **S. Kryshtanovych**, the process of digitalization is interpreted not merely as technological modernization but as a systemic transformation. According to the researcher, *"digitalization requires the integration of all elements of the education system"* [3]. Based on this perspective, several aspects become particularly important in the retraining and professional development of preschool education specialists, including the comprehensive digitalization of the educational process, digital monitoring of pedagogical activities, and the implementation of a unified information and educational platform.

While **A. D. Cortese** emphasizes *"the role of educational institutions in shaping a sustainable future"* [4], **R. Lozano** and his colleagues focus on institutional transformation within education, arguing that sustainable development requires the systematic transformation of educational institutions. **M. Kebritchi** and co-authors highlight that online learning environments create both new opportunities and challenges for organizing educational processes.

Y. Sun and **R. Q. Chailar** emphasize the significance of digital analytics systems, noting that *"early warning systems based on learning data contribute to improving educational effectiveness"* [5]. **H. M. Alshuwaikhat** and **I. Abubakar**, in turn, emphasize that integrated management approaches play an important role in achieving sustainability within educational institutions.

The conceptual model developed by **V. Chipornyuk** clearly defines the structural aspects of a quality management system under conditions of digital transformation in higher education institutions. The author identifies *"five main components of the model: goal-oriented, functional, organizational, instrumental, and evaluation components"* [6]. These components function in an interconnected manner and ensure continuous monitoring, analysis, and improvement of educational quality through digital tools such as **Learning Management Systems (LMS), Enterprise Resource Planning (ERP) systems, Business Intelligence (BI) dashboards, and online survey platforms**. The analysis of these components served as the theoretical foundation for developing our **"Model for Improving the Digitalization System of Educational Quality."**

The **improved model for continuous professional development of preschool education organization directors**, developed by **Sh. Qosimova**, is based on an organizational-didactic framework and enriched with modern information and communication technologies [7]. Qosimova's conclusions form the methodological foundation of our model: the professional development of preschool education organization directors can be defined as a process aimed at updating and deepening knowledge of educational management theory, organizing learning activities, and improving the management of preschool education organizations through meeting professional educational needs. We further expand this definition by incorporating mechanisms for its implementation through digital technologies.

As **A. Radjiyev** emphasizes, the effectiveness of professional development largely depends on the knowledge, responsibility, and commitment of methodologists working in district (city) education departments. Today, the position of methodologist has been transformed into that of deputy director. Within a digitalized system, the role of the deputy director remains significant; however, it additionally requires competencies in working with digital platforms, electronic portfolios, and online monitoring tools.

According to **T. Y. Bazarov**, the development of professional mastery depends not only on acquiring the necessary professional knowledge, abilities, and skills but also on cultivating interest and motivation toward a particular type of professional activity. In a digitalized professional development system, motivational mechanisms can be automated through various tools, including awarding points or badges based on participants' engagement, maintaining ranking systems, and providing electronic certificates promptly upon successful completion of training activities.

The organizational-functional model developed by **D. U. Qo‘chqorov** for enhancing the intellectual potential and professional competencies of leaders in vocational education serves as an important theoretical foundation for our model of digitalizing educational quality within the professional development system for preschool education specialists. The forms of professional development identified in this model—including differentiated learning, instructional design, reflective learning, field-based training, heuristic learning, and self-directed learning—as well as the approaches (systemic, methodological, and competency-based), functions (developmental and formative), and principles (continuity, coherence, and gradual progression) acquire new significance within the context of digital transformation through such tools as adaptive learning systems, online simulations, electronic portfolios, gamification, and remote monitoring technologies.

Research Methods

The study adopted systemic, competency-based, andragogical, and functional approaches to digital transformation as its methodological foundations. The development of the model involved the application of modeling methods, structural-functional analysis, comparative analysis, and generalization methods.

The object of the research was the professional development system for preschool education specialists and its digitalization processes. During the study, the current state of digitalization within the existing professional development system, its challenges, and prospects for further development were analyzed.

Methodological Foundations of the Proposed Model

Systemic approach – all components of the model (needs-based, goal-oriented, process-oriented, and outcome-oriented blocks) function as an integrated system, with all elements being closely interconnected through logical and functional relationships.

Competency-based approach – the central objective of the model is the development of participants’ professional and digital competencies.

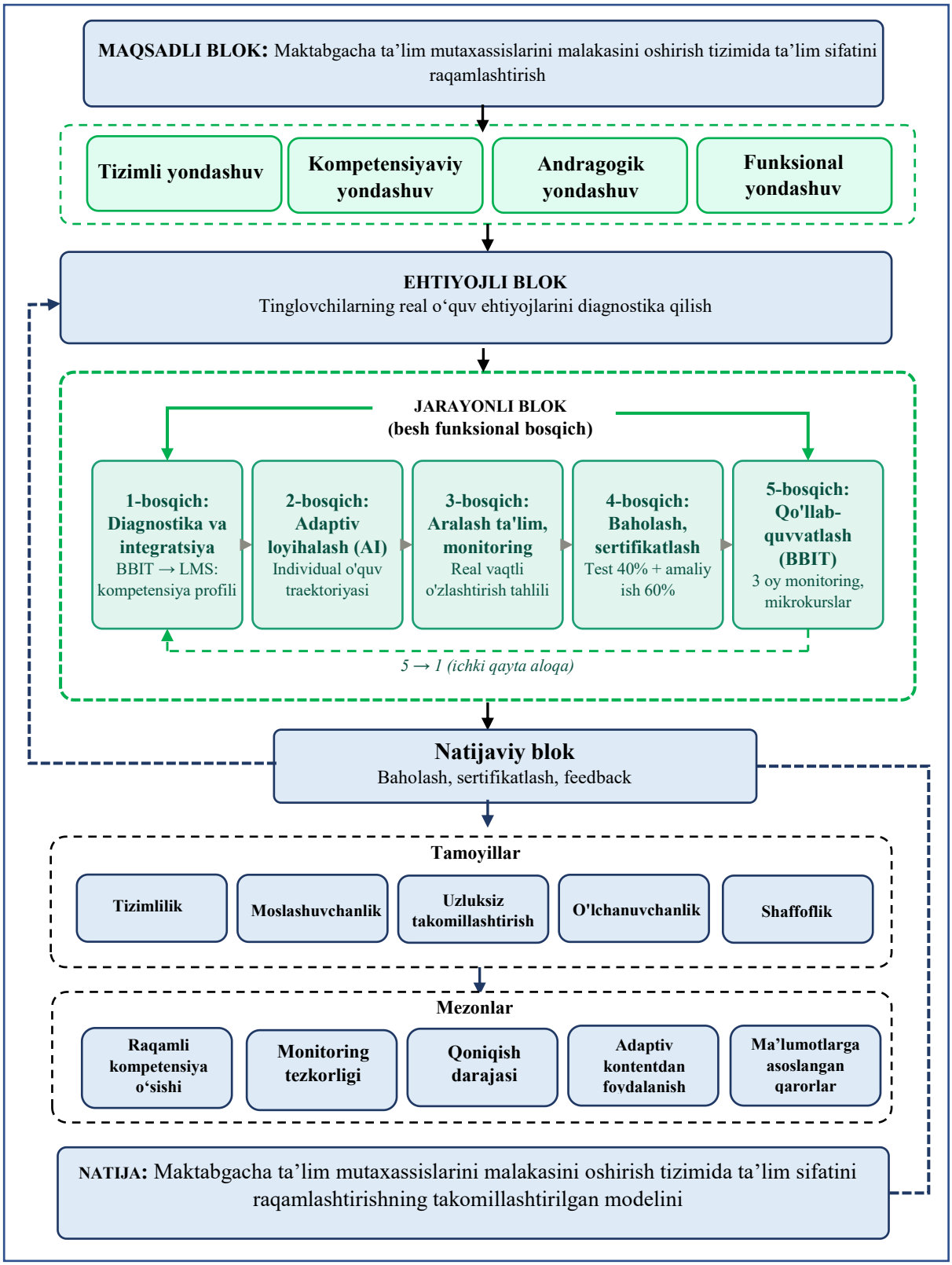
Andragogical approach – the model takes into account the specific characteristics of adult learning, including self-directed learning, reliance on practical professional experience, needs-oriented learning, and flexibility of the educational process.

Functional approach to digital transformation – digitalization is interpreted not as mere technological modernization but as a systemic transformation encompassing all functions of the educational process, including diagnosis, instructional design, teaching and learning, monitoring, assessment, and support.

Structure and Content of the Improved Model

The proposed model consists of four interrelated blocks: the **needs-based, goal-oriented, process-oriented, and outcome-oriented blocks** (Figure 1).

Figure 1. Improved model for digitalizing educational quality within the professional



development system for preschool education specialists.

The **needs-based block** serves to determine the initial state of the system and diagnose the actual learning needs of participants. Within the proposed model, this block is implemented through the first stage — **diagnosis and integration**. At this stage, an individual competency profile is developed for each participant based on BBIT data (position, work experience, qualification category, and performance indicators) as well as the results of adaptive assessment tests.

The **goal-oriented block** defines the strategic direction of the model and focuses on achieving both individual and systemic outcomes. Within this block, the development of an individual learning pathway for each participant (the second stage) and the achievement of final outcomes — obtaining an electronic certificate and ensuring sustainable growth of digital competencies — are envisaged.

The **process-oriented block** represents the core driving component of the model and ensures the consistent, step-by-step, and technologically integrated implementation of the educational process. It consists of five logically interconnected functional stages:

Stage 1: Diagnosis and integration (BBIT → LMS).

The initial professional competencies, learning needs, and existing knowledge levels of participants are identified. Data obtained through the BBIT system (position, work experience, qualification category) are transferred to the LMS platform via API integration. Adaptive diagnostic tests are conducted, and an individual competency profile is generated for each participant.

Stage 2: Adaptive design (based on artificial intelligence).

Based on the competency profile developed during the first stage, an individual learning pathway is designed for each participant. Artificial intelligence algorithms analyze the participant's professional experience, knowledge gaps, and learning motivation, and select mandatory and optional learning modules from the available module database.

Stage 3: Blended learning and real-time monitoring.

The learning process is organized according to the developed individual learning pathway. The theoretical component is delivered online (asynchronously) through the LMS platform, while the practical component is implemented in offline or hybrid formats (webinars, case studies, and simulations). Learning analytics tools are used to analyze participants' engagement and learning outcomes in real time.

Stage 4: Assessment and micro-certification.

The final assessment consists of a computer-based test (40%) and a practical project or qualification work (60%), with the passing threshold set at 56 points. Upon successful completion of each module, participants are awarded QR-code-based micro-certificates using blockchain technology.

Stage 5: Post-course support and BBIT monitoring.

After completion of the course, participants' real professional activities are monitored through the BBIT system for three months. In cases where performance efficiency decreases, short-term micro-courses (2–4 hours) are recommended based on predictive algorithms.

The **outcome-oriented block** represents the final and functional closing stage of the model, where the effectiveness and overall results of the entire educational process are comprehensively reflected and evaluated. This block encompasses both **short-term outcomes** (formative and summative assessment results obtained during and at the end of the course, micro-certificates, and electronic certificates) and **long-term outcomes** (changes in professional practice identified through three-month post-course BBIT monitoring).

The evaluation of outcomes is carried out through a scientifically grounded system of criteria, including the growth of digital competencies, acceleration of monitoring processes, participants' satisfaction level, effectiveness of adaptive content utilization, and the proportion of data-driven management decisions. These indicators are scientifically validated through comparison of experimental and control group results, as well as through statistical methods (Student's *t*-test, Pearson's χ^2 test, and confidence intervals).

The model incorporates a **two-level feedback system** — internal (operational) and external (strategic) — which functions in an interconnected manner.

Internal feedback enables the system to adapt to participants' individual needs. For example, if a deputy director with insufficient digital competencies experiences difficulties in mastering a particular module, the system provides an opportunity to revisit the same topic in a simplified format with additional examples and explanations.

External feedback ensures the monitoring of how effectively participants apply the acquired knowledge in their professional activities after completing the course. Based on the collected data, it contributes to the improvement of the model's diagnostic, design, and assessment stages.

The proposed model is based on five fundamental principles:

The principle of systemicity – all blocks and stages are logically and functionally interconnected and operate as an integrated system.

The principle of flexibility (adaptability) – the model automatically generates an individual learning pathway for each participant according to their specific needs.

The principle of continuous improvement – the model is updated and enhanced after each learning cycle.

The principle of measurability – all objectives and expected outcomes of the model are expressed through quantitative indicators and evaluation criteria.

The principle of transparency – all processes within the model are open, accessible, and understandable for participants, instructors, and administrators.

As a result of the research, an improved model for digitalizing educational quality within the professional development system of preschool education specialists was developed. The methodological foundations, structural blocks, stages, principles, and efficiency assessment criteria of the model were defined.

The main scientific novelty of the model includes the following:

- A mechanism for the automatic transfer of participant data through API integration between BBIT and LMS platforms has been developed;
- An adaptive system for designing individual learning pathways based on artificial intelligence algorithms has been proposed;
- A blockchain-based micro-certification system has been introduced;
- A post-course monitoring and support mechanism based on three-month tracking and predictive algorithms has been developed;
- The self-improvement capacity of the model has been ensured through a closed-loop feedback system.

The practical significance of the model lies in its ability to digitalize, individualize, and improve the efficiency of the professional development process for preschool education specialists. Since the model is based on an andragogical approach, it takes into account the specific characteristics of adult learners, including professional experience, employment conditions, and readiness for independent learning.

Discussion

The developed model incorporates the components of the conceptual model proposed by **V. Chipornyuk** (target-oriented, functional, organizational, instrumental, and evaluative components) by adapting them to the preschool education system. Furthermore, the model integrates the principles of professional development for preschool education specialists proposed in the models developed by **Sh. Qosimova** and **D. U. Qo‘chqorov** with modern digital technologies.

A distinctive feature of the model is that it covers not only the educational process during the course but also post-course support and monitoring. This eliminates the limitation of traditional professional development courses, where communication between the participant and the system is often discontinued after obtaining a certificate. As a result, the professional development process becomes a closed-loop system, in which the outcome data of each cohort are used to optimize diagnostic and instructional design materials for subsequent cohorts.

The implementation of the model in practice contributes to addressing the following challenges:

- eliminating paper-based procedures in collecting participant data and identifying learning needs;
- establishing full digital integration between the professional development system and preschool education organizations;
- creating opportunities for the development of individual learning pathways based on the actual needs of specialists;
- improving the effectiveness of alternative and hybrid professional development courses.

The criteria established for evaluating the effectiveness of the model (growth of digital competencies, monitoring efficiency, participants’ satisfaction, the level of adaptive content utilization, and the extent of data-driven management decisions) correspond to the assessment standards accepted in Scopus-indexed journals. In the future, an experimental study based on these criteria is planned, and the obtained results will be verified through statistical methods.

Conclusion. Based on the results of the research conducted to improve the model for digitalizing educational quality within the professional development system of preschool education specialists, the following conclusions were drawn:

Although the process of digitalization within the professional development system for preschool education specialists has already begun, its incomplete integration and the presence of certain functional limitations continue to restrict the overall effectiveness of the system. In particular, some processes have not yet been fully transferred to a digital environment, and complete digital integration between the professional development system and preschool education organizations has not yet been achieved.

The proposed model is constructed through the integration of four major approaches: systemic, competency-based, andragogical, and functional approaches to digital transformation. The model consists of four interconnected blocks (needs-based, goal-oriented, process-oriented, and outcome-oriented), which operate through direct and feedback relationships.

The central component of the model, the process-oriented block, includes five logically interconnected functional stages: diagnosis and integration, adaptive design, blended learning and real-time monitoring, assessment and micro-certification, and post-course support with BBIT monitoring. Each stage has its own specific objectives, implementation mechanisms, and expected outcomes.

The main scientific novelty of the model lies in the integration of BBIT and LMS platforms, the design of adaptive learning pathways based on artificial intelligence, the implementation of a blockchain-based micro-certification system, and the development of post-course monitoring and support mechanisms based on predictive algorithms.

Five key criteria have been developed to evaluate the effectiveness of the model: growth of digital competencies, monitoring efficiency, participants' satisfaction, the level of adaptive content utilization, and the extent of data-driven management decisions. The possibility of validating these criteria through statistical methods has been established.

The proposed model is based on the principle of continuous professional development and enables the systematic updating of preschool education specialists' knowledge and skills. The integration of digital technologies makes this continuous development process more flexible, accessible, and effective. The model's capacity for self-improvement, adaptability, and measurable outcomes ensures that it not only meets current educational requirements but also maintains sustainable development potential in the future.

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