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# Key factors of digital transformation of higher education

**Abstract.** *This article is devoted to the problem of digital transformation of higher education. The digitalization of universities involves increasing the innovations effectiveness in students teaching, the use of digital technologies to develop the research university potential. Academic staff and students of higher education institutions must properly apply digital technologies in teaching, in research and in management. Practical experience in the high school digitalization requires the main factors identification of the digital transformation in the education.*
*The study of theoretical approaches to this problem in the interdisciplinary perspective and the identification of key factors in the digital transformation of higher professional education is the main goal of this article.*
*To solve research issues, the authors analyzed the works devoted to the problems of digitalization and digital transformation of education.*
*Methods were used in this article: analysis and generalization of scientific literature on the problem of education digital transformation, the study of regulatory legal acts.*
*The paper attempts to identify the key factors in the digital transformation of higher education based on the analysis of theoretical approaches in the interdisciplinary plane. The main factors identified are: the development and pedagogical modeling of the digital educational environment, educational platforms; re-equipment of IT resources; the formation of digital competencies for all participants in the educational process; creation of a virtual (digital) educational environment; introduction of personalized models of educational space organization; introduction of virtual reality technologies in higher education; increasing the innovative potential of educational institutions, which can be carried out through the results of the scientific and technical activities of the institution itself, etc.*
*The article focuses on the need to develop a strategy for the science and higher education digital transformation and in the Republic of Kazakhstan, which should reflect the key areas of digital transformation: digital modeling; development of digital services; modernization of infrastructure; data management; human resource management; introduction of digital technologies and platforms; creation of a digital environment, etc. The authors also emphasize the importance of studying the problem of introducing artificial intelligence at the university, solving the issue of observing academic honesty by students when using artificial intelligence to generate ChatGPT (OpenAI) texts. The possibility of creating thinking machines raises many ethical questions, which necessitates the development of a Code of Ethics for Artificial Intelligence. The inclusion of a section on the ethics of using ChatGPT (OpenAI) in the Code of Academic Integrity of Kazakhstani Universities students seems to be an important aspect by the authors.*
**Keywords:** *digitalization, digital transformation of education, digital competencies, innovations, smart universities, technologies, strategy for digital transformation of science and higher education, digital resources.*

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## Introduction

Strategic importance of higher professional education is attracting more and more attention from various stakeholders, such as researchers, government officials.

State Program for the Development of Education of the Republic of Kazakhstan for 2020–2025 notes that commercialization offices, technology parks, business incubators, and implementation units have been created in higher education organizations and research institutes. However, the scientific infrastructure does not meet modern requirements for the implementation of scientific research [1]. In this regard, the Program provides a set of measures to upgrade and modernize the scientific infrastructure, measures to modernize the infrastructure and develop the digital skills of scientists, and the creation of a unified information system of science in Kazakhstan [1].

In modern conditions, the use of digital technologies by academic staff and students of universities in the pedagogical process is the basis for the transformation of the educational sector.

Practical experience in the digitalization of higher schools requires theoretical generalization, determination of the main factors of education digital transformation. In this regard, it seems relevant to identify the key factors in the education digital transformation.

The study of theoretical approaches to this problem in the interdisciplinary plane and the identification of key factors in the digital transformation of higher professional education is the main goal of this article.

To solve the research goal, we analyzed the works of scientists devoted to the problems of digitalization and education digital transformation.

The work on the digital transformation of education is divided into three large interconnected groups: the development of the digital infrastructure of education, the development of digital teaching materials, tools and services, including digital assessment, the development and dissemination of new models for organizing educational work [2, p.16]

Kazakh authors reveal the issues of the impact of the society digitalization on Kazakhstani education (M.S. Ashilova, A.S. Begalinov, K.K. Begalinova [3]), digitalization of the educational service sector in the Republic of Kazakhstan (Sarsenbiyeva N.F., Myrzakhmetova B. Sh., Adylbekova E.T. [4]), etc.

In the studies of scientists from the near abroad, the following problems of education digitalization are revealed: digitalization of higher education and its social results (Minina V.N. [5]), the main directions and factors of digital transformation of the science and education sector (Gavrilyuk E.S., Izotova A. G. [6]), difficulties and prospects of digital transformation of education (A. Yu. Uvarov, E. Gable, I. V. Dvoretskaya et al. [2]); concepts of digital didactics as the basis for designing advanced education for vocational education teachers (Andryukhina L. M., Lomovtseva N. V., Sadovnikova N. O. [7]), development of digital competencies (Larionov V. G., Sheremetyeva E. N., Gorshkova L. A. [8]).

English-speaking researchers examined several key factors in a study related to learning motivation, learning readiness, and student self-efficacy when participating in real-time online learning during the coronavirus outbreak, taking into account gender differences and differences between educational levels [9].

J. Xiao's publication reveals the role of digitalization in the strategic development plans of 75 leading universities in China, revealing that digitalization in the perception of these universities is characterized by instrumentality (construction and use of electronic campuses) and modernization (maintaining and increasing the effectiveness of innovations in teaching and education), which is also observed in other countries [10].

## Methods and materials

The article uses methods: analysis and generalization of scientific literature on the problem of digital education transformation, the study of regulatory legal acts.

The starting point of this study was the analysis of published studies of scientists on the problem.

In this article, we proceed from the position of A. Yu. Uvarov, S. Wang, C. Kan, who believe that the essence of the education digital transformation is the achievement by each student of the necessary educational results through the personalization of the educational process based on the use of the digital transformation growing potential, including the use of artificial intelligence methods, virtual reality tools; development of a digital educational environment in high school; providing public broadband access to the Internet, working with big data [11, p.38]. Regarding the concept of «factor», we follow to its definition as the main cause or operating force of any process, which determines the nature of the process itself and its features [6, p.25].

**Results and discussion**

Digitalization of the educational service sector in the Republic of Kazakhstan began in 1997. From attempts to automate the education sector, including spreading online learning [4].

In recent years, a pilot project has been prepared - the National Open Education Platform, which is a hardware and software complex consisting of distance learning systems, teleconferences and webinars, educational courses, a complex for conducting online lessons, object-oriented programming, robotics, 3D modeling and printing, remote passing and taking exams [3].

According to the Ministry of Science and Higher Education of the Republic of Kazakhstan, universities will move to the "smart universities" model. This involves the formation of a student's digital profile, that is, a student life track, the development of EdTech digital services, process optimization in accordance with advanced digitalization trends [12].

According to the results of the IMD-2022 digital competitiveness rating, Kazakhstan took 36th place (Table 1)

**Table 1. Kazakhstan's position in the IMD-2022 Digital Competitiveness Ranking**

| | *2021 (among 64 countries)* | *2022 (among 63 countries)* | *Dynamics* |
|---|---|---|---|
| *Overall rating* | ***32*** | ***36*** | ▼3 |
| **1. Knowledge** | **36** | **30** | ▼6 |
| Talents | 45 | 46 | ▼1 |
| Training and education | 14 | 1 | ▼13 |
| Scientific concentration | 54 | 51 | ▼3 |
| **2. Технологии** | **40** | **40** | - |
| Regulatory framework | 22 | 21 | ▼1 |
| Capital | 51 | 50 | ▼1 |
| Technological base | 47 | 47 | - |
| **3. Readiness for the future** | **28** | **30** | ▼2 |
| Адаптивные отношения | 32 | 34 | ▼2 |
| Business flexibility | 6 | 6 | - |
| IT-Integration | 44 | 56 | ▼12 |

**Source:** Economic Research Institute (ERI), [13].

As can be seen from the table, according to the «Knowledge» factor, Kazakhstan has risen to the 30th line (+6). The positions improved in two sub-factors «Training and education» (+13). «Scientific concentration (+3).

The digital competitiveness of the country is directly related to the development of digitalization of higher professional education, the functioning of the digital educational environment at universities. Kazakhstan's universities need to focus on the implementation of the main factors and conditions of digitalization of higher professional education.

The analysis of approaches to the problem of *digital transformation of higher education* [2, 5-8 p.], [11; 14] allows us to determine its *key factors*:

Key factors of higher education digital transformation

- development and pedagogical modeling of the digital educational environment, educational platforms
- building network communication on pedagogical grounds;
- optimization of all internal processes of the educational institution;
- re-equipment of IT resources;
- inclusion in the development of higher education of digital technologies that ensure the construction of a flexible learning system;
- integration of electronic and blended education;
- the formation of digital competencies for all participants in the educational process;
- creation of a virtual (digital) educational environment;
- focus on priority educational programs, the development of which requires certain digital competencies;
- increasing the innovative potential of educational institutions, which can be carried out through the results of the scientific and technical activities of the institution itself;
- introduction of personalized models of educational space organization;
- providing the educational process with digital tools and materials;
- introduction of virtual reality technologies in higher education;

Compiled from sources [2, 5-8 p.], [11,14].

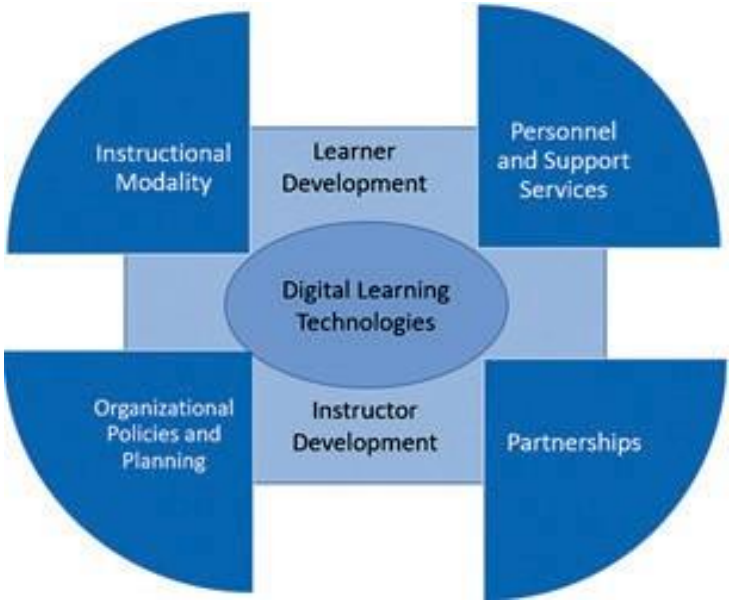


**Figure 1. Key factors of higher education digital transformation**

According to the National Report on the state and development of the education system of the Republic of Kazakhstan (by the end of 2020), one of the challenges of distance learning, university rectors note the low skills of academic staff in distance teaching (MES RK, 2021) In this regard, the key recommendations proposed by European scientists based on research on the problem of digital education at the university seem significant:

1) universities should adopt a learning-oriented approach to digital transformation, i.e. create a common learning space by integrating technology, pedagogy and organizational measures;

2) professors and lecturers should reconsider their role by moving from lecturing to digital resource management;

3) students should improve their ability to work in complex hybrid environments where various forms of digitalization take place [15].

For example, L.N. Gumilyov Eurasian National University has implemented 15 of its own digital services. New technological solutions form a single ecosystem of ENU – Digital University and are aimed at digitalization of the scientific and educational process, automation of business processes, development of digital competencies of employees and teachers [16]. Digital services have optimized daily work processes, increased labor productivity and the efficiency of the organization of the educational process [16].

Digitalization also implies changes in the approach to managing educational organizations. Thus, universities that are actively introducing digital technologies into the educational process are gradually moving from a bureaucratic to a participatory management model [5].

The development of a digital transformation strategy for the field of science and higher education in the Republic of Kazakhstan is of great importance. The digital transformation of higher education and science in the Republic of Kazakhstan is possible only if there is a systemic strategy for it. For example, the strategy of digital transformation of the science and higher education industry of the Russian Federation outlines the key trajectories for achieving "digital maturity" of the science and higher education industry both for educational institutions of higher education, and for companies and authorized executive authorities.

It should be emphasized that the digitalization of universities involves not only the construction and use of electronic campuses, increasing the effectiveness of innovations in student learning, but also the use of digital technologies to develop the research potential of the university.

The scientific literature also actively discusses the problems of introducing artificial intelligence at the university. Artificial intelligence is an auxiliary but valuable tool that can perform and improve a large number of different operations carried out at the university, help organize an effective educational process and build the necessary communications [17].

The possibility of creating thinking machines raises many ethical questions. In English-language studies, issues are discussed that relate both to ensuring that such machines do not harm people, and the moral status of the machines themselves [18].

In November 2022, OpenAI created ChatGPT - a chatbot that has a wide range of capabilities: writing code, writing poetry, creating texts, translation capabilities, getting answers, solving problems.

This chat, according to the expert's description, was created on top of the OpenAI GPT-3.5 family of large language models and refined using reinforcement learning and supervised methods [19]. The following are the features of ChatGPT:

1) one of the most important functions is a detailed answer to your request in the form in which you asked it.

2) Compared to its predecessor InstructGPT, ChatGPT focuses on reducing false and harmful responses.

3) Training data includes information regarding Internet phenomena, man pages and programming languages such as the python programming language, bulletin board systems, etc.

4) the GPT chat keeps track of the state and remembers the previous requests given to it in the same conversation [19].

At the same time, the use of artificial intelligence for text generation undermines academic integrity and is becoming a serious problem for higher education institutions in Kazakhstan. In this regard, it is necessary to develop a Code of Ethics for Artificial Intelligence. It is also important to include a section on the ethics of using ChatGPT (OpenAI) in the Code of Academic Integrity of Kazakhstani students.

**Conclusion**

Thus, the problems of digital transformation of higher education are revealed by scientists in the context of various aspects.

Kazakhstan's universities need to take into account the main factors of digitalization of higher professional education and focus on their implementation. Taking into account the analysis of the scientists' approaches, we have identified as key factors: development and pedagogical modeling of the digital educational environment, educational platforms; re-equipment of IT resources; formation of digital competencies for all participants in the educational process; creation of a virtual (digital) educational environment; introduction of personalized models of the organization of educational space; introduction of virtual reality technologies into higher education; increasing the innovative potential of educational institutions, which can be carried out through the results of scientific and technical activities of the institution itself, etc.

An important factor in the digital transformation of higher education and science of the Republic of Kazakhstan is the development of its strategy reflecting the key areas of digital transformation: digital modeling; development of digital services; modernization of infrastructure; data management; human resources management; introduction of digital technologies and platforms; creation of a digital environment, etc.

In the context of preserving academic integrity when using artificial intelligence, it is necessary to develop a Code of Ethics for Artificial Intelligence, as well as the inclusion of a section on the ethics of using ChatGPT (OpenAI) in the Code of Academic Integrity of Students of universities in Kazakhstan.

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## Жоғары білім берудің цифрлық трансформациясы: негізгі факторлар

**Аңдатпа.** Осы мақала жоғары білім берудің цифрлық трансформациясы мәселесіне арналған. Университеттерді цифрландыру студенттерді оқытуда инновациялардың тиімділігін арттыруды, ЖОО-ның ғылыми-зерттеу әлеуетін дамыту үшін цифрлық технологияларды пайдалануды көздейді. Жоғары оқу орындарының оқытушылары, студенттері мен қызметкерлері цифрлық технологияларды оқытуда, ғылыми зерттеулерде және басқаруда тиісті түрде қолдануы тиіс.

Зерттеу мәселелерін шешу үшін автор білім беруді цифрландыру және цифрлық трансформациялау мәселелеріне арналған жұмыстарды талдады.

Бұл мақалада мынадай әдістер қолданылды: білім берудің цифрлық трансформациясы мәселесі бойынша ғылыми әдебиеттерді талдау және жалпылау, нормативтік құқықтық актілерді зерделеу.

Жұмыста пәнаралық жазықтықтағы теориялық тәсілдерді талдау негізінде жоғары білім берудің цифрлық трансформациясының негізгі факторларын анықтауға әрекет жасалды. Негізгі факторлар ретінде: цифрлық білім беру ортасын, білім беру платформаларын дамыту және педагогикалық модельдеу; IT-ресурстарды қайта жарақтандыру; білім беру процесінің барлық қатысушыларында цифрлық құзыреттіліктерді қалыптастыру; виртуалды (цифрлық) білім беру ортасын құру; білім беру кеңістігін ұйымдастырудың дербестендірілген модельдерін енгізу; жоғары білім беруге виртуалды шындық технологияларын енгізу; мекеменің ғылыми-техникалық қызметінің нәтижелері арқылы жүзеге асырылуы мүмкін білім беру мекемелерінің инновациялық әлеуетін арттыру және т. б.

Мақалада цифрлық трансформацияның негізгі бағыттарын: цифрлық модельдеуді; цифрлық сервистерді дамытуды; инфрақұрылымды жаңғыртуды; деректерді басқаруды; кадрлық әлеуетті басқаруды; цифрлық технологиялар мен платформаларды енгізуді; цифрлық ортаны құруды және т. б. т. б. айқындауға тиіс Қазақстан Республикасының ғылымы мен жоғары білім беруінің цифрлық трансформациясы стратегиясын әзірлеу қажеттігіне баса назар аударылады.

**Түйін сөздер.** цифрландыру, білім беруді цифрлық трансформациялау, цифрлық құзыреттер, инновациялар, smart-университеттер, технологиялар, ғылым мен жоғары білім беруді цифрлық трансформациялау стратегиясы, цифрлық ресурстар.

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## Цифровая трансформация высшего образования: ключевые факторы

**Аннотация**. Данная статья посвящена проблеме цифровой трансформации высшего образования. Цифровизация университетов предполагает повышение эффективности инноваций в обучении студентов, использование цифровых технологий для развития научно-исследовательского потенциала вуза. Преподаватели, студенты и сотрудники вузов должны надлежащим образом применять цифровые технологии в обучении, в научных исследованиях и в управлении. Практический опыт в цифровизации образования вузов требует определения основных факторов цифровой трансформации образования.

Исследование теоретических подходов по данной проблеме в междпредметной плоскости и определение ключевых факторов цифровой трансформации высшего профессионального образования является основной целью данной статьи.

Для решения исследовательских вопросов авторами проанализированы работы, посвященные проблемам цифровизации и цифровой трансформации образования.

В данной статье были использованы методы: анализ и обобщение научной литературы по проблеме цифровой трансформации образования, изучение нормативных правовых актов.

В работе сделана попытка определить ключевые факторы цифровой трансформации высшего образования на основе анализа теоретических подходов в междпредметной плоскости. В качестве основных факторов выделены: развитие и педагогическое моделирование цифровой образовательной среды, образовательных платформ; переоснащение IT-ресурсов; формирование цифровых компетенций у всех участников образовательного процесса; создание виртуальной (цифровой) образовательной среды; внедрение персонализированных моделей организации образовательного пространства; внедрение технологий виртуальной реальности в высшее образование; повышение инновационного потенциала образовательных учреждений, которое может осуществляться посредством результатов научно-технической деятельности самого учреждения и др.

В статье акцентируется внимание на необходимости разработки стратегии цифровой трансформации науки и высшего образования Республики Казахстан, которая должна отражать ключевые направления цифровой трансформации: цифровое моделирование; развитие цифровых сервисов; модернизация инфраструктуры; управление данными; управление кадровым потенциалом; внедрение цифровых технологий и платформ; создание цифровой среды и др. Также авторами подчеркивается значимость исследования проблемы внедрения искусственного интеллекта в университете, решения вопроса соблюдения академической честности студентами при использовании искусственного интеллекта для генерации текстов ChatGPT (OpenAI). Возможность создания мыслящих машин поднимает множество этических вопросов, что обусловливает необходимость разработки Кодекса этики искусственного интеллекта. Включение в Кодекс академической честности обучающихся вузов Казахстана раздела, посвященного этике применения ChatGPT (OpenAI), представляется авторами важным аспектом.

**Ключевые слова**: цифровизация, цифровая трансформация образования, цифровые компетенции, инновации, smart-университеты, технологии, стратегия цифровой трансформации науки и высшего образования, цифровые ресурсы.

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