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About

• The scientific Education & Pedagogy Journal aims to make the results of scientific research and practical activities in the field of pedagogy of education mutually accessible to international and Russian specialists.

• The founder of the journal is Tomsk State Pedagogical University.

The journal publishes:

• Original articles in English dealing with the most pressing problems of theory, practice, philosophy, and history of education. In addition, authors are given the opportunity to publish Russian translations of these articles in other TSPU journals.

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• All articles will be subject to independent, double-anonymous peer review.

• Submitted materials must meet the requirements of the International and Russian Science Citation Index (see https://edujournal.tspu.edu.ru/en/)

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ESG EDUCATION AT RUSSIAN UNIVERSITIES

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Abstract. The successful implementation of the concept of sustainable development depends on the active participation of all sectors of society in all spheres of human activity, in which education plays a crucial role. Universities are of particular importance as they contribute to the establishment and integration of higher education in the field of sustainable development based on ESG principles – in other words, they work in the environmental (E), social (S), and governance (G) spheres of sustainable development. Since 2015, Russian universities have been developing their sustainability strategies and modifying their organizational structures to achieve the United Nations' Sustainable Development Goals (hereafter referred to as SDGs). Russian higher education institutions have also gained experience in implementing educational programs designed to develop competencies for professionals in the field of sustainable development.

This comparative analysis examines Bachelor's, Master's, postgraduate, and continuing education programs in fields such as economics, management, public and local administration, law, and environmental studies. The study found that the foundations for Education for Sustainable Development (hereafter ESD) were laid in Russia in the 1990s, but have only become a widespread phenomenon in the last five years. In the early stages, the leading universities, particularly in Moscow and St. Petersburg, were the most active participants. Currently, the number of Master's programs is increasing, and the share of regional universities in implementing these programs has risen significantly in recent years, accounting for 40–45%.

Keywords: *university, higher education institutions, higher education, ESG education, education for sustainable development, Sustainable Development Goals*

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Introduction

The issues addressed in this article pertain to the development and implementation of educational programs in sustainable development at universities, aimed at training and preparing personnel for the real economy sector. They are of great importance for meeting the commitments to achieve the SDGs for the period from 2015 to 2030 [1].

According to the submitted "Action Plan for the Formation and Development of Education for Sustainable Development in the Russian Federation" [2], which promotes sustainable development in the country and influences the formation of an effectively functioning system of education for sustainable development in Russia, the main tasks have been defined, according to which the competence of universities can include the promotion of the implementation of the ideology of sustainable development [3].

In the 1990s, a system of environmental education was established at classical and technical universities in Russia as part of the development of ESD [4]. At classical universities, education was of a natural science nature (study programs: 'Ecology', 'Geoecology', and 'Nature Management'). In contrast, at technical universities, the focus was on engineering and environmental science (study programs: 'Life Safety', 'Environmental Protection') [3].

In the 2000s, programs were developed to advance Russian universities, reflecting the SDGs in the regions where they were present, for example, within the framework of creating flagship universities (2016–2021). The subsequent implementation of a system approach with the triple participation improvement of universities, corporate structures, and state bodies is reflected in the strategic academic leadership program "Priority-2030" (2021–2030) [5].

Despite significant progress in the development of educational programs in the field of sustainable development, the challenge of optimizing the coordination of interaction between universities, businesses, and the state remains relevant. This hinders the effective achievement of the global SDGs and the implementation of the tasks set. At the current stage, it is necessary to reconsider the approaches to the formation of educational programs that not only take into account the regional specifics and the needs of the real sector of the economy, but also ensure the training of specialists who can flexibly adapt to the dynamic conditions of the labor market, the prospects for their further improvement in the context of modern challenges and trends [6].

Research and Methodology

In this study, the authors conducted a comparative analysis of university programs in ESG and sustainable development over the past five years, encompassing both broad societal areas, such as economics, management, public administration, and international cooperation, as well as more specific areas, including environmental studies and urban

planning. For this comparative analysis, programs were classified by educational level, including bachelor's and master's degree programs, as well as professional development and continuing education programs.

The analysis included a geographical factor – namely, the location of the universities in each entity of the Russian Federation – and assessed the demand for education in ESG and sustainable development in the regions where these universities operate [7]. This approach allowed the authors to examine the percentage change in the growth of educational programs over the past five years.

Baseline data for the analysis came from open sources, including more than twenty official university websites with information on organizational structures (such as sustainable development centers), development programs of participating universities within the framework of federal initiatives (over 100 institutions as of 2022–2023) as part of strategic projects to implement sustainable development practices, results of sustainability rankings of the last three years featuring Russian universities, as well as scientific articles, expert materials and analytical reviews evaluating the development of educational programs in ESG and sustainable development (more than 45 Russian higher education institutions over the last 10–15 years).

Prerequisites for the necessity of ESD

"Education for Sustainable Development (ESD) is education that enables the social change necessary to create more equitable societies and achieve sustainable development" [8].

At the international level, the recognition of ESD as one of the most essential prerequisites for shaping sustainable development is reflected in officially published United Nations (UN) documents, starting with the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (Brazil) in 1992. At the UN World Summit on Sustainable Development (WSSD) in Johannesburg (South Africa) in 2002 [9], the concept of ESD was first presented by the United Nations Educational, Scientific and Cultural Organization (UNESCO), and a resolution on the implementation of the Decade of ESD (2005–2014) was signed [10]. The new program "ESD for the period up to 2030 ", which was developed based on the UN initiatives – "UN Decade of ESD" (2005–2014) and "Global Action Program on ESD" (2015–2019), was approved in 2019 at the 206th session of the Executive Board and the 40th session of the UN General Conference. Later, it was also agreed at the 74th session of the UN General Assembly.

Currently, ESD is also at the heart of the 2030 Agenda for Sustainable Development, which was adopted by the United Nations General Assembly in 2015. The agenda is based on five pillars–people, planet, prosperity, peace, and partnership–and is underpinned by three interlinked dimensions: Environmental Stewardship, Social Inclusion, and Economic Development. The adopted document defines and sets out 17 Sustainable Development Goals (SDGs) with 169 associated targets, which are integrated and indivisible [11]. Particular attention is given to SDG 4 as one of the priority goals – "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" – and the related target – "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and culture contribution to sustainable development" [12]. Consequently, as a goal in its own right, education is also an essential tool for achieving other SDGs. It plays a key role in ensuring the sustainable development of society as a whole.

The report "Education Goals for Sustainable Development. Learning Objectives. UNESCO" [13], published in 2017, is an important document that emphasizes the role of education in achieving the SDGs. The report emphasizes that education is a key tool for promoting the concept of sustainable development, as it provides the knowledge needed to solve global challenges, while taking into account local specificities, and that teachers in educational institutions play a key role in promoting ESD, as they should not only impart knowledge, but also create conditions for the development of skills and values necessary for sustainable development. According to the report, a professional for each of the SDGs should have a range of competencies and interdisciplinary knowledge in the following areas: pedagogical, cognitive, social-emotional, and behavioral. Key competencies in ESD include strategic vision, systems thinking, critical thinking, forward thinking, self-awareness, teamwork, and integrated problem-solving.

The international contribution of universities to the implementation of the SDGs has also been measured in the global Times Higher Education Impact Rankings since 2019 [14]. The most essential prerequisite for universities to be included in this ranking is the provision of metric data on at least four SDGs, including the mandatory SDG 17 – "Partnership for Sustainable Development" [15].

Following the adoption of the Global Strategy for Sustainable Development, Russia in 1992 adopted its concept for transitioning the Russian Federation to sustainable development. It states the need for a gradual transition of the country to sustainable development following the principles established at the UNCED Conference in Rio de Janeiro in 1992, which ensures a balanced solution to socio-economic problems and the problems of preserving a favorable environment and the potential of natural resources to meet the needs of present and future generations of humanity [16].

Russia was one of the initiators in the development and adoption of the "Education Strategy for Sustainable Development", the first regional action program in this area, by the UN Economic Commission for Europe in 2005. Based on this document, the "National Education Strategy in the Field of Sustainable Development for the Russian Federation" was developed [17].

Following the discussion in the State Council on the "Environmental development of the Russian Federation in the Interest of future generations" in 2016, the President of the Russian Federation instructed the government to "include in the federal state educational standards requirements for the acquisition of basic knowledge in the field of environmental protection and sustainable development, taking into account current global priorities, in particular the 2030 Agenda for Sustainable Development, the Paris Agreement adopted on December 12, 2015 and the commitments of the Russian Federation in the field of combating climate change and preserving a favorable environment" [18].

ESG education and ESD at Russian universities

In the mid-1990s, the first specialized courses on sustainable development emerged at Russian universities, as confirmed by the creation of corresponding specializations in the natural sciences and socio-economic fields within the higher education system [19, 20].

Until the 2020s, the inclusion of this topic in the educational programs of Russian educational institutions was slow and unsystematic, did not meet the current challenges of the time, and was implemented on the initiative of individual educational institutions [21].

Over the past five years, the number of Master's and Bachelor's degree programs in sustainable development has increased significantly. The data (Fig. 1) on the quantitative growth of ESG programs in Russian higher education institutions, categorized by educational level and regional location, show that in 2022, approximately 26 master's and 9 bachelor's programs were developed. In 2023, 14 master's programs were added.

It is worth noting that, despite Moscow and St. Petersburg remaining the central regions for implementing Master's programs in the field of sustainable development, the share of regional universities currently stands at 40–45% (Fig. 2).

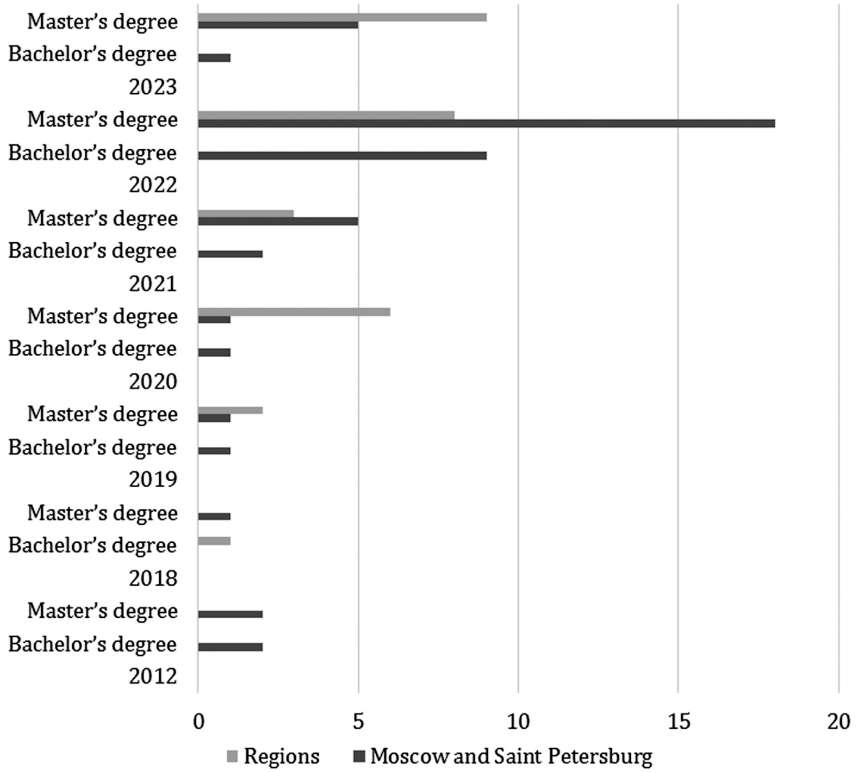

Fig. 1. Growth in the number of ESG education programs in Russian higher education institutions. Source: authors' compilation

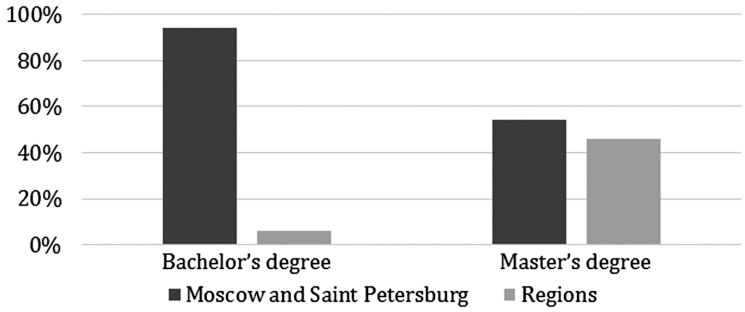

Fig. 2. The ratio of the number of ESG educational programs at Russian higher education institutions. Source: authors' compilation

The demand for ESG education programs from companies and society is also increasing, as reflected in a significant rise in courses for additional professional education and training.

There is an incentive for Russian higher education institutions to demonstrate initiative, ranging from introducing new educational programs in the field of sustainable development at various levels of education, to focusing on the needs of companies, to integrating sustainable development into their strategies, and making changes to their organizational structure. Currently, Centers for Sustainable Development (Table 1) are being established in Russian educational institutions as structural departments responsible for developing educational programs, conducting scientific research in the field of sustainable development, and implementing changes at the management and college policy levels [22].

Table 1

Areas of activity of the Centers for Sustainable Development in Russian educational institutions

№	Name of the institution	Name of the Center for Sustainable Development (year established)	1. EA	2. C	3. P	4. M	5. Ed	6. R	7. Inn	8. Adm	9. Prj
1	Lomonosov Moscow State University (MSU)	Center for Sustainable Development Management (2024), based at the Faculty of Economics	*		*	*	*				
2	St Petersburg State University (SPbU)	Center for Sustainable Territorial Development (2024)		*	*	*	*			*	
3	Ufa University of Science and Technology (UUST)	Eurasian Center for ESG and Sustainable Development (2024)					*	*			
4	National Research University Higher School of Economics (HSE)	Center for Corporate Sustainable Development Management (ESG Center) (2022)	*	*			*	*		*	
5	Peoples' Friendship University of Russia (RUDN)	Sustainable Development Center (2022)	*		*	*			*		

Continuation of Table 1

№	Name of the institution	Name of the Center for Sustainable Development (year established)	1. EA	2. C	3. P	4. M	5. Ed	6. R	7. Inn	8. Adm	9. Prj
6	State University of Management (SUM)	Center for Sustainable Development Design of Civil Society Institutions (2022)	*	*	*		*	*			
7	Southern Federal University (SFU)	Center for Sustainable Development (2022)				*	*				
8	Moscow Witte University	Research and Education Center for Sustainable Development (2021), based at the Department of Sustainable Development Economics				*	*				
9	Samara National Research University named after S.P. Korolev	Resource Center for Sustainable Development (2021)	*	*		*	*		*	*	
10	MGIMO University, Ministry of Foreign Affairs of Russia	Center for Sustainable Development and ESG Transformation (2020), within the Institute of International Trade and Sustainable Development (IMTSD)	*			*	*		*		
11	North Ossetian State University (NOSU)	Center for Sustainable Development (2020)				*	*		*		
12	The Russian Presidential Academy of National Economy and Public Administra-tion (RANEPA)	Research and Education Center for Sustainable Development (2018), within the Institute of Finance and Sustainable Development				*					

End of Table 1

№	Name of the institution	Name of the Center for Sustainable Development (year established)	1. EA	2. C	3. P	4. M	5. Ed	6. R	7. Inn	8. Adm	9. Prj
13	Kabardino-Balkarian State University (KBSU)	Center for Sustainable Development (2017)					*			*	
14	V.I. Vernadsky Crimean Federal University (CFU)	Research and Education Center for Noospherology and Sustainable Noospheric Development (2015; previously since 1997 as Crimean Scientific Center)			*		*				
15	Russian State Agrarian University – Moscow Timiryazev Agricultural Academy (RSAU–MTAA)	Center for Sustainable Development of Rural Territories (1996)				*	*				
16	Moscow School of Management SKOLKOVO	Skolkovo Sustainable Development Center (2006)	*	*	*		*	*			

Legend:

1. 1. EA – Expert and Analytical
2. C – Consulting
3. P – Public Awareness/ Educational Outreach
4. M – Methodological
5. Ed – Educational
6. R – Research
7. Inn – Innovation and Implementation
8. Adm – Administrative
9. Prj – Project

Source: authors' compilation.

Since the early 2000s, more than a dozen Russian universities have established centers in the field of sustainable development, both as independent structural units and integrated into existing structures. These centers play a crucial role in promoting ideas on sustainable development, contributing to the formation of environmental awareness,

and developing innovative solutions to socio-economic and ecological problems.

However, the most remarkable upswing in the establishment of Centers for sustainable development has occurred over the last ten years (Fig. 3). These centers are involved in developing educational programs, conducting scientific and applied research, providing information and analysis, offering expert and advisory services, managing public relations, and engaging in academic activities. Particularly noteworthy are the activities of the centers in the field of sustainable development, which aim to implement strategic projects of universities within the framework of the federal program for strategic academic leadership, "Priority-2030". For example, the strategic project "Social policy of sustainable development and inclusive economic growth" is being implemented at the National Research University Higher School of Economics, "ESG models of growth of new eco-territories" at the Ufa University of Science and Technology, and two projects "Water well-being and green economy", "Kabardino-Balkaria – a territory of health resorts and tourism: a new paradigm of treatment, rehabilitation and medical tourism" at the Kabardino-Balkarian State University.

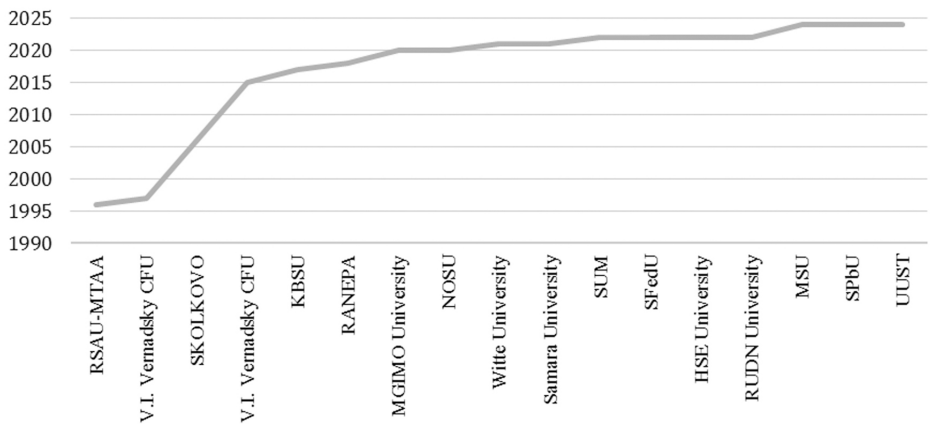

Fig. 3. The period of establishment of centers for sustainable development in Russian educational institutions. Source: authors' compilation

As can be seen from the MGIMO expert report [23], Russian universities that have developed and successfully implemented educational programs for master's and bachelor's degrees in the field of sustainable development have also emerged over the last decade. After analyzing the data, it is possible to determine the focus of ESG education at Russian universities, both in broad social areas, such as economics, management, public administration, and international

cooperation, and in more specialized areas, including ecology and urban development. Table 2 provides a list of ESG education programs in Master's subjects offered by Russian universities.

Table 2

ESG Master's degree programs at Russian higher education institutions

Area of activity	Russian higher education institution	Educational program
Economics, Finance, and Credit	Lomonosov Moscow State University (MSU)	National Models of Sustainable Development (2021)
	The Russian Presidential Academy of National Economy and Public Administration (RANEPA)	Finance and Strategies of Sustainable Development (2022)
	National Research University Higher School of Economics (HSE)	Environmental Economics and Sustainable Development (2022)
	Plekhanov Russian University of Economics (PRUE)	• Finance of Sustainable Development (2022) • "Green Economy" and Resource Management (2022)
	Financial University under the Government of the Russian Federation	Corporate Finance and ESG Business Transformation
	Russian State Agrarian University – Moscow Timiryazev Agricultural Academy (RSAU–MTAA)	Sustainable Development Economics and ESG Business Transformation (2023)
	St. Petersburg State University of Economics (SPbSUE)	• Economics of Energy and Sustainable Development (2012) • Sustainable Energy and Energy Transition Economics • Finance of Sustainable Development / ESG Finance (2022)
	Kazan (Volga Region) Federal University (KFU)	• Low-Carbon and Sustainable Development Economics • Sustainable Development Economics and Integrated Reporting
	Perm National Research Polytechnic University (PNRPU)	Sustainable Development Economics
	North-Caucasus Federal University (NCFU)	Finance of Sustainable Development / ESG Finance (2023)
	North-Eastern Federal University (NEFU)	Environmental Economics and Natural Asset Management
	Kemerovo State University (KemSU)	Environmental Economics and Natural Asset Management (2022)

Continuation of Table 2

Area of activity	Russian higher education institution	Educational program
Management and Administration	MGIMO University, Ministry of Foreign Affairs of Russia	• Sustainable Development Management (2021) • Sustainable Development and Strategic Management in Energy
	HSE University	Corporate Sustainable Development Management (2022)
	Bauman Moscow State Technical University (BMSTU)	Sustainable Development and Environmental Safety of Industrial Enterprises
	Plekhanov Russian University of Economics (PRUE)	Sustainable (Green) Project Management (2023)
	Moscow Institute of Physics and Technology (MIPT)	Business Analytics and ESG Project Management (2022)
	National University of Science and Technology MISIS (NUST MISIS)	Technological Leadership for Corporate Sustainable Development (2022)
	Moscow Witte University	Sustainable Development Systems Management
	Kosygin Russian State University (RSU Kosygin)	Business Sustainable Development: Management and Modern Marketing (2020)
	Russian State University for the Humanities (RSUH)	Corporate Governance and Business Sustainable Development
	Russian Biotechnological University (ROSBIOTECH)	Sustainable Development Management (2022)
	Ural Federal University named after the First President of Russia B.N. Yeltsin (UrFU)	Smart Region: Sustainable Development in the Digital Economy (2021)
	Southern Federal University (SFU)	Sustainable Development (ESG) Management (2022)
	Saint Petersburg Electrotechnical University “LETI” (ETU “LETI”)	Sustainable Development Management of Production Systems (2022)
	Novosibirsk State University (NSU)	Business Management for Sustainable Development
	Perm National Research Polytechnic University (PNRPU)	ESG Management (2023)
Public and Municipal Administration	MGIMO University	Law, Digital Innovation and Sustainable Development (2022)
International Relations	Southern Federal University (SFedU)	International Management and Sustainable Development Economics (2023)

Continuation of Table 2

Area of activity	Russian higher education institution	Educational program
Ecology and Environmental Management	MGIMO University	Climate and Carbon Regulation (2022)
	Peoples' Friendship University of Russia (RUDN)	• Environmental Expertise and Sustainable Development • Sustainable Development and Environmental Safety
	Plekhanov Russian University of Economics (PRUE)	ESG Business Transformation (2022)
	D. Mendeleev University of Chemical Technology of Russia (MUCTR)	• Green Chemistry for Sustainable Development • Expertise for Sustainable Development in the Chemical Industry
	Perm National Research Polytechnic University (PNRPU)	Waste Management and Circular Economy (2020)
	National Research Tomsk Polytechnic University (TPU)	Environmental Engineering and Sustainable Development
	Tyumen State University (TSU)	• Waste Management for Sustainable Development (2023) • Business Process Greening (2023)
	Siberian Federal University (SibFU)	• ESG Concept: Environmental Risk Assessment and Management • Sustainable Development and Environmental Safety
	North-Caucasus Federal University (NCFU)	Environmental Monitoring for Sustainable Development (2020)
	Grozny State Oil Technical University (GGNTU) named after acad. M.D. Millionshchikov	Environmental Monitoring for Sustainable Development (2018)
	Chechen State University (CSU) named after A.A. Kadyrov	Geoecological Foundations of Sustainable Development (2021)
	Karachay-Cherkess State University named after U.D. Aliev	Environmental Monitoring for Sustainable Development (2020)
Urban Planning, Architecture, and Geography	HSE University	Low-Carbon Development Management (2022)

End of Table 2

Area of activity	Russian higher education institution	Educational program
Urban Planning, Architecture, and Geography	ITMO University (National Research University of Information Technologies, Mechanics and Optics)	Smart City and Urban Studies / Sustainable Urban Development (2021)
	St Petersburg State University (SPbU)	Forest Geography and Sustainable Forest Management (2019)
	Ural Federal University (UrFU)	Sustainable Building Design (2019)
	Altai State University (AltSU)	• Agro-Monitoring and Territorial Sustainable Development • Geoinformation Technologies for Regional Sustainable Development • Cadastre and Territorial Sustainable Development
	Voronezh State Technical University (VSTU)	Sustainable Development of Urbanized Areas
	Perm National Research Polytechnic University (PNRPU)	Economics and Management of Sustainable Development in Urbanized Areas (2020)
	Irkutsk National Research Technical University (IRNITU)	Architecture of Sustainable Living Environments
	Orel State University named after I.S. Turgenev (OSU)	Architecture of Sustainable Living Environments

Source: authors' compilation.

Based on the 62 master's degree programs offered by Russian universities, it is evident that their number has increased significantly in recent years, including those offered by regional universities. The data presented (Fig. 4) shows that at the universities in Moscow and St. Petersburg, the number of Master's programs in areas of public activity, such as economics and management, is increasing, while at the regional universities, Master's programs in ecology and nature management, urban planning, and architecture predominate.

Table 3 lists ESG Bachelor's degree programs at Russian higher education institutions.

Bachelor's degree programs are offered in equal numbers in all areas of public activity, except for urban development. At the same time, the number of universities offering Bachelor's degree programs does not exceed ten, and they are mainly concentrated in Moscow (Fig. 5).

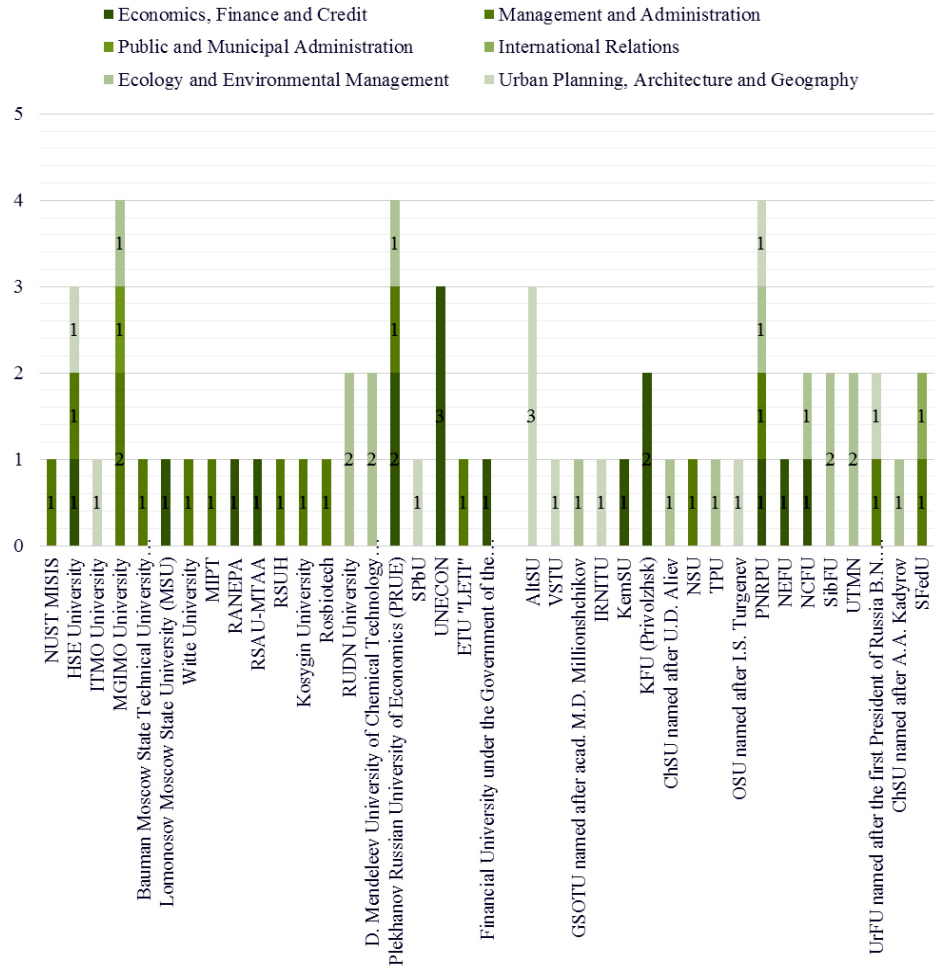

Fig. 4. ESG education programs in the Master's program at Russian higher education institutions in the field of social activities. Source: authors' compilation

Table 3

ESG Bachelor's degree programs at Russian higher education institutions

Area of activity	Russian higher education institution	Educational program
Economics, Finance, and Credit	The Russian Presidential Academy of National Economy and Public Administration (RANEPA)	Finance and ESG Business Transformation (2021)
	Financial University under the Government of the Russian Federation	Corporate Finance / Corporate Economics and ESG Investing
	Gubkin Russian State University of Oil and Gas (National Research University)	Economics and Sustainable Energy Projects

End of Table 3

Area of activity	Russian higher education institution	Educational program
Economics, Finance, and Credit	Irkutsk National Research Technical University (IRNITU)	Sustainable Innovation Economy (2018)
Management and Administration	The Russian Presidential Academy of National Economy and Public Administration (RANEPA)	• ESG Project Management (Sustainable Development Projects) (2022) • Quality Management / Quality Management in ESG Transformation Strategies and Processes (2022)
	Moscow Institute of Physics and Technology (MIPT)	Innovation Management in Business / Sustainable Development and Management (2022)
Public and Municipal Administration	MGIMO University, Ministry of Foreign Affairs of Russia	Law, Digital Innovation, and Sustainable Development
	The Russian Presidential Academy of National Economy and Public Administration (RANEPA)	Public Administration for Sustainable Development (Sustainable Development Projects) (2022)
International Relations	MGIMO University, Ministry of Foreign Affairs of Russia	International Economic and Environmental Processes (2012)
	The Russian Presidential Academy of National Economy and Public Administration (RANEPA)	International Sustainable Development Programs (Sustainable Development Projects) (2022)
	Plekhanov Russian University of Economics (PRUE)	Global Sustainable Development (2022)
Ecology and Environmental Management	MGIMO	Climate and Environmental Security (2012)
	ITMO University (National Research University of Information Technologies, Mechanics and Optics)	Eco-Technologies and Sustainable Development
	Peoples' Friendship University of Russia (RUDN)	Ecology and Sustainable Development (2023)
	Russian State Agrarian University – Moscow Timiryazev Agricultural Academy (RSAU–MTAA)	Ecology and Sustainable Development (2019)
Urban Planning and Geography	National Research University Higher School of Economics (HSE)	Geography of Global Change and Geoinformation Technologies (2020)

Source: authors' compilation.

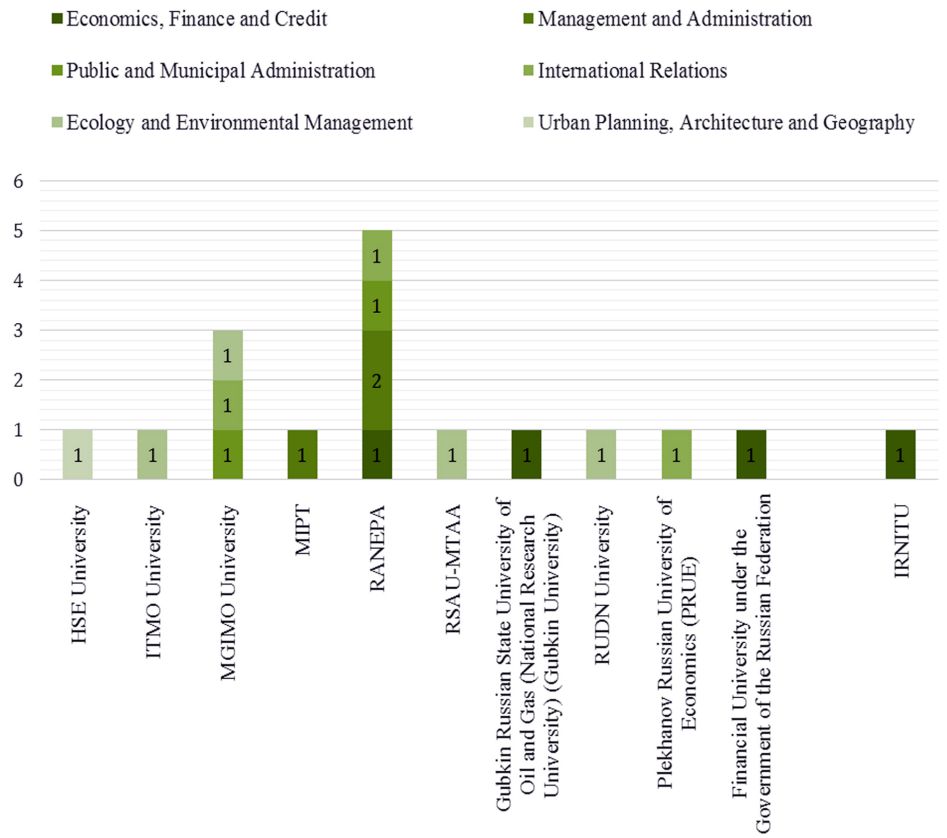

Fig. 5. ESG education programs in the Bachelor's degree program at Russian higher educational institutions in the field of social activities. Source: authors' compilation

Currently, the demand for specialists in sustainable development is increasing, primarily driven by the expansion of continuing education programs and advanced training initiatives. Given the pace of training specialists with bachelor's and master's degrees in the field of ESG education, it can be assumed that retraining programs will continue to play a key role in meeting the shortage of specialists in sustainable development. Table 4 presents a list of continuing education and retraining programs in sustainable development conducted by Russian higher education institutions.

Since the early 2020s, Russian universities have increased the number of higher education programs in sustainable development, especially Master's programs in economics, management, ecology, and environmental management. Narrowly specialized Master's programs in sustainable development are offered by Russian higher education institutions that train specialists for the oil and chemical industries, as well as in fields such as urban planning and architecture.

Table 4

Continuing education programs in Russian higher education institutions in the field of sustainable development and ESG

Russian higher education institution	Program
Lomonosov Moscow State University (MSU)	• Sustainable Land Resource Management in the Eurasian Region • ESG and Environmental Safety • Ecology and Sustainable Development • Legal Support for Sustainable Development and ESG Strategies in Achieving the Goals of the Climate Agreement • Sustainable Development Leaders: ESG Transformation of Society and Business • Sustainable Development: Risks and Management Principles
MGIMO University, Ministry of Foreign Affairs of Russia	• Greenhouse Gas Emission Management: From Calculation to Compensation (2022) • Business Management Based on ESG Principles: From Practitioners to Practitioners (Baikal Communications Group) (2023) • Online Training for Students and Staff: Tools for Sustainable Development and ESG Transformation (Priority 2030 Program)
The Russian Presidential Academy of National Economy and Public Administration (RANEPA)	• ESG Transformation of the System of Public and Municipal Administration • Specialist in Effective ESG Investment • Assessment of Company Maturity Level According to ESG Criteria • Media Communications and PR Management within the ESG Transformation Strategy of a Company • ESG Business Transformation: Practice and Tools (2022)
National Research University Higher School of Economics (HSE)	• Sustainable Development and ESG: Global Challenges and National Priorities (Basic Course) • Short-Term Educational Program for Students • Autumn School “ESG Transformation of the Financial Sector” (2022)
Plekhanov Russian University of Economics (PRUE)	• Business Transformation on ESG Principles • Finance of Sustainable Development
Financial University under the Government of the Russian Federation	Sustainable Development Management in Business
Moscow Witte University	Sustainable Development Management of Territories
Gubkin Russian State University of Oil and Gas (National Research University)	Implementation of ESG Principles in an Oil and Gas Company

Source: [23].

A study conducted by the rating agency RAEX following the “Universities and Sustainable Development” conference [24] revealed that Russian employers are showing an increasing interest in specialists in the field of sustainable development and ESG. The need to train personnel capable of developing and implementing sustainable

development strategies that encompass environmental, social, and corporate governance aspects is emphasized. Skills in ecological management and management practices aimed at the ESG transformation of companies are particularly valued. The study identified and presented the role and capabilities of universities in implementing sustainability strategies at national and regional levels, as well as best practices worth disseminating and emulating. It is worth noting that there is a shortage of human resources in the field of ESG, particularly in the financial and banking services, forestry, oil and gas, trade, and real estate sectors. This highlights the need to enhance the collaboration between universities and employers in training professionals who meet the contemporary demands of the labor market in the field of sustainable development.

Conclusion

ESG education programs are gaining popularity due to the growing focus on sustainable development, globalization, and social and environmental concerns. In the current state of the national economy, there is a need for professionals who know how to integrate the principles of sustainable development into production business processes and corporate management strategies. Russian higher education institutions are actively developing and implementing ESG educational programs to train professionals who can analyze and adapt best practices to the specific conditions of the national economy.

Most often, Russian universities conduct ESG education programs in the fields of “economics”, “finance”, and “management”, including disciplines dealing with sustainable development, environmental responsibility, and corporate governance. These programs aim to develop the knowledge required to manage corporate sustainability, assess ecological risks, and interact with key stakeholders.

In addition, such programs are often interdisciplinary and aim to train specialists who can work in both the private sector and governmental organizations, as well as in non-profit structures. Some leading Russian universities already offer specialized Master’s programs in sustainability and ESG education, which enable graduates to be competitive in the labor market.

One of the main challenges facing Russian universities in today’s conditions is the lack of faculty with sufficient knowledge in the field of sustainable development, as well as the inadequacy of proposed teaching materials and the need to adapt international standards to the content of

the disciplines. However, the growing interest of companies and government agencies in the training and retraining of ESG professionals encourages Russian universities to develop educational programs in ESG education that are in demand.

Therefore, the introduction of ESG educational programs in Russian higher education institutions is a crucial tool for training specialists, offering a new format that can effectively implement the principles of sustainable development and thereby enhance Russia's competitiveness at both national and international levels.

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ПЕДАГОГИКА

ESG-ОБРАЗОВАНИЕ В РОССИЙСКИХ УНИВЕРСИТЕТАХ

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Аннотация. Успешная реализация концепции устойчивого развития (далее – УР) зависит от активного взаимодействия представителей общества во всех направлениях деятельности человечества, в которой важную роль предопределяют образованию. Особенно выделяются университеты, которые способствуют становлению и внедрению высшего образования в области УР, опираясь на принципы ESG, иными словами, действуют в экологическом (E (англ. абб.) – environment), социальном (S (англ. абб.) – social) и управленческом (G (англ. абб.) – governance) направлениях УР. Начиная с 2015 г. российские университеты разрабатывают собственные стратегии УР и трансформируют организационные структуры, способствующие реализации Целей устойчивого развития ООН (далее – ЦУР). Российские образовательные организации высшего образования (далее – ООВО) также накопили определенный опыт реализации образовательных программ по формированию компетенций для специалистов в области УР. В представленной сравнительной аналитике рассмотрены образовательные программы бакалавриата, магистратуры, дополнительного профессионального образования и повышения квалификации, по таким профилям как экономика, менеджмент, государственное и муниципальное управление, юриспруденция и экология. В результате исследования установлено, что фундамент образования в интересах устойчивого развития (далее – ОУР) был заложен в России еще в 1990-х годах, однако как массовое явление фиксируется в последние 5 лет. На момент становления наибольшую активность проявляли ведущие университеты, которые в основном сосредоточены в Москве и Санкт-Петербурге. На текущий момент возросло количество образовательных программ магистерской подготовки, при этом доля региональных университетов в их реализации в последнее время значительно возросла, достигнув почти 40–45%.

Ключевые слова: *университет, образовательная организация высшего образования, высшее образование, ESG-образование, образование в интересах устойчивого развития, цели устойчивого развития*

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ANALYSIS OF ASPECTS OF THE DIGITAL TRANSFORMATION OF THE EDUCATION SYSTEM IN RUSSIA

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Abstract. The article presents a comprehensive analysis of the digital transformation of the education system, which is understood as a fundamental shift in the pedagogical paradigm driven by modern technologies. The authors highlight key aspects of digitalization, including technical equipment, the development of digital resources, the formation of a digital culture, and the legal framework. Special attention is given to the benefits of digital technologies, such as personalized learning, increased visibility of teaching materials, and the development of critical thinking in students.

The main problems of digital transformation are considered: regional differences in access to technology, inadequate training of teaching staff, and the need to methodologically justify the effectiveness of digital tools. The authors emphasize the importance of a balance between technological innovation and pedagogical appropriateness, as well as the need for interdisciplinary research to assess the long-term impact of digitalization on the quality of education.

Promising areas of development include the creation of adaptive educational environments, the introduction of virtual and augmented reality technologies, and the transparency of educational processes. The article will be of interest to researchers, teachers, and education managers dealing with digital transformation issues.

Keywords: *digital transformation, education, digitalization, personalization of learning, digital technologies, pedagogical innovation, regional inequality, methodological justification, adaptive systems, information transparency*

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The modern education system is undergoing a phase of fundamental change, driven by the rapid development of digital technologies and their increasing penetration into all areas of human activity. The process of digitalization of education is now considered not only as a technical modernization of the educational process, but as a comprehensive transformation of the entire educational paradigm, affecting the methodological, content, and organizational aspects of education.

Several key factors determine the relevance of examining the digitalization of education. First, modern digital technologies create

fundamentally new opportunities to improve the quality and accessibility of education. Second, they enable students to develop skills that meet the challenges of the digital economy and the demands of the 21st-century labor market. Thirdly, the digital transformation of education is becoming an essential element of national development strategies in many countries, including Russia and Kazakhstan.

It is worth noting that the term "digitalization of education" is interpreted ambiguously in modern scientific literature. In the broadest sense, it includes: the technical equipment of educational institutions, the development and implementation of digital educational resources, the formation of a digital culture among participants in the educational process, the creation of a legal framework for digital education, and the development of infrastructure for distance learning and blended learning.

At the same time, the researchers note that the digitalization of education entails not only the use of new technological tools but also a fundamental shift in approaches to organizing the educational process, teaching methods, and the assessment of results.

However, despite the apparent potential of digital transformation, this process faces several significant challenges. These include: insufficient development of the methodological foundations of digitalization, problems in training teachers to work in the new conditions, digital inequality between regions and social groups, the need to revise educational content, psychological and pedagogical aspects of adapting students to the digital environment, issues of information security, and digital ethics.

The problem of methodological justification of digitalization deserves special attention. As experts rightly emphasize, the introduction of digital technologies into the education system should be based on a serious scientific foundation and not be pursued as an end in itself. This requires complex interdisciplinary research that combines the achievements of pedagogy, psychology, computer science, and other sciences.

A distinctive feature of the research is its comprehensive approach to analyzing the digitalization of education, which considers not only technological aspects but also pedagogical, psychological, social, and economic factors. The authors aim to avoid both a technocratic approach that overemphasizes the role of digital tools and a conservative skepticism that underestimates the potential of digital transformation.

One of the most pressing and controversial issues in the modern digital transformation of education is the problem of scientifically and methodologically substantiating the effectiveness of digital technologies

in the educational process. As E. Kiseleva and V. Tsarkova rightly note, the methodology should provide a sufficient and convincing (scientifically verified and practically implementable) rationale for the digitalization of education [1, p. 106]. This statement highlights the core issue of the current stage of technological modernization in the education system: the need to transition from the spontaneous introduction of digital tools to their systematic, scientifically justified use, with a clear understanding of the pedagogical implications and potential risks.

Today, there is no uniform, generally accepted evidence base in Russian and international educational practice that comprehensively assesses the effectiveness of digitalization based on various parameters, including its impact on the quality of knowledge acquisition, the development of professional competencies, student motivation, the accessibility of education, and other key indicators. The lack of such a methodological justification leads to several serious problems. These include the unsystematic use of technologies, the lack of clear criteria for evaluating their effectiveness, and, consequently, the inability to objectively determine the actual impact of digital tools on educational outcomes.

However, despite the lack of a comprehensive evidence base, individual studies and practical experience show a range of convincing evidence of the positive impact of digitalization on the modernization of education. In particular, numerous studies confirm that the correct use of digital technologies:

1. Promotes the development of individualized educational pathways through adaptive learning systems that take into account the cognitive characteristics and learning pace of each student.

2. Increases the visibility and accessibility of complex educational material through the use of multimedia resources, virtual and augmented reality technologies, especially in fields such as science, medicine, and engineering.

3. Expands students' opportunities for independent work through access to digital educational resources anytime, anywhere.

4. Creates the conditions for the development of critical thinking and information literacy as key 21st-century skills.

5. Improves feedback in the teacher-student system through automated systems for assessing and analyzing educational outcomes.

The question of the need for a differentiated approach to methodological justification of digitalization for various levels of

education (schools, universities, and further education institutions), different subject areas, and forms of education warrants special attention. For example, the effectiveness of using digital technologies in teaching the exact sciences may differ significantly from their impact on the humanities, which requires the development of specific methodological approaches.

An essential aspect of the scientific underpinning of digitalization is the analysis not only of its benefits but also of the potential risks, which include digital inequality, a decline in face-to-face professional communication, a possible deterioration of cognitive functioning due to excessive reliance on digital tools, and other adverse effects. A comprehensive assessment of the balance between benefits and risks should form the basis for developing balanced models for the digitalization of education in general.

A promising direction for the digital transformation of education is to conduct longitudinal studies to assess the long-term impact of digital technologies on the quality of education, and to create experimental platforms to test and evaluate the effectiveness of different digital pedagogical tools. Of particular value are comparative studies that analyze the experiences of other countries and education systems in the field of digitalization.

Digital technologies are changing education in three ways:

– formal processes – organizational changes such as the introduction of electronic journals and learning management systems;

– content aspect – updating methods of knowledge transfer, including the use of multimedia resources;

– mental concept – development of digital skills and adaptation of students to new learning conditions [2, p. 9].

These changes require not only technical equipment but also a revision of pedagogical approaches, which underscores the duality of digitalization: on the one hand, it formalizes routine processes, and on the other hand, it creates conditions for creativity and self-directed learning [3, p. 45].

One of the most acute and systemic problems of the digital transformation of education in Russia is the pronounced regional asymmetry in terms of the pace and quality of digital technology implementation. As Li Yajuan convincingly demonstrates in his study, the current educational situation varies significantly across different regions due to differences in economic development or geographical location [4, p. 209]. This is confirmed by data from monitoring studies,

which reveal a significant gap between capital regions, large cities, and rural areas in key indicators, including the technical equipment of educational institutions, access to high-speed internet, and the availability of modern digital educational resources. This problem is particularly acute in the remote areas of Siberia, the Far East, and the North Caucasus, where geographical remoteness is compounded by underdeveloped infrastructure and a shortage of qualified personnel.

The depth of the digital divide between the regions becomes even clearer when analyzing parameters such as the number of computers per student, the speed of internet connection in educational institutions, and the availability of specialized software. For example, if in Moscow schools on average there are 5–7 students per computer, in some rural schools this number can reach 20–25 students. The quality of the Internet connection also remains a significant issue – in many rural schools, the speed is limited to 1–2 Mbps, which makes it impossible to utilize modern cloud-based learning platforms and video lessons. This situation creates the conditions for the formation of a 'digital barrier' between students from different regions, which in the long term can lead to increased social inequality and limited social mobility for young people from remote areas.

In mid-May 2024, the government of the Russian Federation published the annual report on the implementation of state education policy in 2023, which states: The proportion of schools with high-speed internet (over 50 Mbit/s): Moscow and St. Petersburg – 98%; the Republic of Dagestan – 34%; Zabaykalsky Krai – 28%.

An equally significant problem that directly affects the effectiveness of digital education transformation is the level of professional training among teaching staff. According to research data, "the general educational qualifications of primary school teachers are low, and their information literacy is incomplete" [4, p. 210]. This problem is multifaceted: on the one hand, many teachers, especially those from the older generation, struggle to master the new digital technologies; on the other hand, even young professionals often lack the necessary skills to integrate digital tools into the classroom in a methodologically competent manner. This problem is particularly acute in rural schools, where there is a double deficit: a lack of both technical equipment and qualified teachers who can work effectively with the available digital resources [5].

The conducted analysis allows us to identify several key factors that exacerbate the problem of digital inequality between regions: different budget financing of educational institutions in various subjects of the

Russian Federation, uneven development of telecommunications infrastructure, migration of qualified teaching staff to more developed regions, lack of uniform standards for digital equipment of educational institutions, lack of targeted programs for training and retraining of teachers to work in the digital environment.

Additionally, digitalization necessitates a revision of educational content. As A. Kisarin emphasizes, education should include the acquisition of skills that employers need [6, p. 160]. This leads to a shift in emphasis from traditional disciplines to practice-oriented modules, which in turn sparks discussions about the balance between basic and applied knowledge.

The modern digital transformation of education presents fundamentally new opportunities for implementing the concept of personalized learning, which considers the individual characteristics, abilities, and educational needs of each student. As researchers note, digitalization opens up unprecedented prospects for creating adaptive educational environments, in which the educational process can be designed as individually as possible [7, p. 305]. This is made possible by the extensive use of modern digital tools and pedagogical methods that allow us to design unique educational paths for each student [5].

A key element of personalized learning in the digital age is the use of blended education formats that optimally combine the advantages of traditional classroom learning with the possibilities of digital technologies. Such hybrid models allow students to set their own pace of learning, choose the most suitable formats for interacting with educational content and teachers, and organize their learning time flexibly. Flipped classroom models are particularly effective, where theoretical material is studied independently using digital resources, and class time is dedicated to practical application of knowledge and in-depth discussion of complex topics.

It is essential to emphasize that the effective personalization of learning in a digital environment necessitates not only technological solutions but also the development of a digital culture among all stakeholders involved in the educational process [8, p. 138]. The formation of a digital culture should become an integral part of both individual disciplines and comprehensive general education programs. This includes developing a whole range of competencies in students: from basic skills in using digital tools to the ability to critically evaluate information, build a digital identity, and adhere to ethical standards in a virtual environment.

Introducing elements of digital culture into the educational process requires a systematic approach. This includes: developing specific digital literacy modules within different disciplines, creating conditions for the practical application of digital skills in academic and research activities, creating a digital portfolio of students that reflects their achievements and competencies, and organizing events to develop digital culture [9].

Preparing teachers to work in the context of personalized digital learning is particularly important. Teachers must not only master modern technologies, but also understand the methodology of how to use them to support students individually. This requires a revision of approaches to improve teachers' qualifications, with a focus on mastering tutoring support methods, adaptive learning technologies, and educational data analysis tools.

The personalization of learning through digital technologies poses new challenges to assessment systems in education. Traditional methods of knowledge assessment are insufficient for accurately evaluating students' progress in a digital environment. This requires the development of new formative assessment systems that analyze students' digital footprints and utilize artificial intelligence technologies to identify individual educational needs.

To fully leverage the potential of digital personalization in learning, a comprehensive approach that combines technological infrastructure, methodological support, and organizational changes within the educational process is necessary. Only such a systematic approach will create a truly flexible and adaptable educational environment capable of meeting the diverse academic needs of students within the context of society's digital transformation. At the same time, it is crucial to maintain a balance between technological possibilities and pedagogical feasibility so that digital tools serve the goals of personal development, and do not become an end in themselves of the educational process.

Ensuring the quality of modern education in the context of digital transformation requires fundamentally new approaches to organizing the educational process, in which the principle of transparency for all key educational processes is of particular importance. As N. Tarkhanova rightly notes, "the use of digital technologies leads to greater openness of information, which is an important aspect of quality assurance" [10, p. 133]. This idea is confirmed in the practice of leading educational organizations, where digital openness is not just an additional tool but a fundamental principle of organizing educational activities.

At the same time, digital technologies enable the organization of this process while maintaining the necessary balance between openness and the protection of personal data, which is particularly important in the context of current legislation on information protection.

Modern education management systems, based on the principles of digital transparency, also include open data on the material and technical base of educational organizations, as well as the results of monitoring the quality of education, employment rates, and the number of graduates, among other vital aspects of academic activities. Such a comprehensive approach to information openness enables the creation of a system of multilateral feedback, in which not only educational organizations provide information about their activities, but all interested parties have the opportunity to participate in the discussion and improvement of the educational process. Sociological research conducted at our university has shown that teachers who utilize AI algorithms to individualize tasks have seen a 22% increase in their students' academic performance. The introduction of the SmartTrack system into the educational process organization has reduced the time teachers spend reviewing their students' work by 35%.

Digital document management and education management systems play a special role in ensuring the transparency of education processes. They enable the tracking of all key stages of the education process in real-time – from the submission of an application for admission to the issuance of the diploma. This not only increases the efficiency of administrative processes but also significantly reduces the risk of corruption, creating the conditions for an honest and objective educational environment.

It is essential to note that the digital transparency of education extends beyond the formal aspects of the educational process organization. Modern technologies enable the substantive elements of education to become more open, including teaching methods, approaches to organizing students' independent work, and forms of interaction between participants in the educational process. Such transparency of content helps to create a new quality of the academic environment, based on the principles of cooperation, mutual learning, and continuous improvement.

The experience of leading educational organizations shows that the consistent implementation of the principles of digital transparency leads to a significant improvement in the quality of education due to several interrelated factors: firstly, by creating a system of public control over

the quality of educational services, secondly, by forming a culture of continuous improvement at all levels of the educational system, and thirdly, by increasing the motivation of all those involved in the educational process to achieve high results. At the same time, digital transparency is not an end in itself, but rather the most critical tool for ensuring the quality of education, as well as the opportunity to contribute to its continuous development and adaptation to the changing demands of modern society. Particular attention is paid to the development of "21st century skills" such as critical thinking, collaboration, and information literacy [11, p. 123]. These skills form the foundation for graduates to adapt to the conditions of the digital economy successfully.

The digitalization of education is a complex and multi-layered process that requires an integrated approach at all levels of the education system, from pre-school to higher vocational education. This process not only affects the technical equipment of educational institutions but also requires a radical overhaul of the methodological foundations of pedagogical action, the content of educational programs, and approaches to assessing learning outcomes. Many teachers, especially those from the older generation, struggle to deal with new technologies and often fail to recognize their educational potential. This problem is exacerbated by the lack of a systematic program to improve teachers' digital skills and insufficient methodological support for digitalization processes at the local level. Despite the existing difficulties, however, digital technologies open up fundamentally new opportunities for modernizing the entire education system. They allow us to overcome geographical barriers, make education more accessible and individualized, and significantly expand the range of pedagogical technologies used.

Among the key areas of digital education development, several priority areas can be identified. The first and most important area is the creation of a standardized methodological basis for digital education. This includes the development of scientifically sound standards for the use of digital technologies in education, the creation of uniform platforms for publishing educational content, and the development of criteria for evaluating the effectiveness of digital educational technologies. Without such a basis, the digitalization process runs the risk of becoming a chaotic implementation of technologies without adequate pedagogical justification.

The second most important area is the improvement of teachers' qualifications in utilizing digital technologies. This requires the creation of a system of continuous professional development for teachers that

includes both the acquisition of technical skills in using digital tools and an understanding of the methodology for their application in the educational process. Particular attention should be paid to the training of tutors who will be able to provide methodological support to their colleagues in this area.

The third strategic direction involves individualizing educational paths with the aid of digital technologies. Modern educational platforms and adaptive learning systems enable the consideration of individual student characteristics, learning pace, and cognitive preferences. This opens up new possibilities for implementing the principles of personalized learning, which are particularly important in the context of inclusive education.

The fourth key area is ensuring transparency and accessibility of education through digital technologies. The development of open educational resources, the creation of digital portfolio systems, and the introduction of blockchain technologies to record educational achievements can make the educational process more transparent and accessible to all its participants.

The implementation of these areas requires a coordinated approach from all stakeholders, including government agencies, individual teachers, and educational technology developers. It is necessary to develop a comprehensive program for the digital transformation of education, which includes not only a technological component but also serious methodological training, changes in the legal framework, and the creation of a motivation system for all those involved in the educational process. Only with such a systematic approach will it be possible to fully realize the potential of digital technologies in creating a modern, flexible, and effective education system that can meet the challenges of the 21st century.

Promising areas for further research in the field of digital education should focus on addressing several fundamental problems that are crucial for a successful transformation of the education system. Of particular importance is the search for an optimal balance between the formal and informal aspects of digital learning, which requires in-depth interdisciplinary research involving specialists from the fields of pedagogy, psychology, sociology, and digital technologies. The formal aspects of digitalization, including legal regulation, standardization of educational programs, and a system of formal assessment of learning outcomes, must be harmoniously combined with informal elements, such as the development of a digital culture of participants in the educational

process, the formation of professional networking communities, and support for informal educational initiatives. At the same time, special attention should be paid to studying the psychological and pedagogical effects of digitalization, the transformation of communication models in the digital educational environment, and the impact of digital technologies on learning motivation.

An equally important area of scientific research should be the development of differentiated strategies for digitalizing education that take into account the specificities of different regions. Such strategies should be based on a comprehensive analysis of regional characteristics, including the level of technological development, the state of educational infrastructure, human resources, and socio-cultural factors. Research on bridging the digital divide between urban and rural areas, as well as between different federal subjects, deserves special attention. In this regard, it seems promising to study models of network interaction between educational organizations, develop adaptive programs to improve the digital literacy of teachers, taking into account regional specifics, and analyze the effectiveness of various mechanisms of state support for digitalization in problem regions.

Let us make it clear that the most important task of future research is also the development of methodological foundations for evaluating the effectiveness of the digital transformation of education. To this end, a comprehensive system of indicators must be created that enables the assessment not only of the technical equipment of educational institutions but also of the actual impact of digital technologies on the quality of educational outcomes, the availability of education, and the development of key student skills. Of particular importance are longitudinal studies that enable the tracking of the long-term effects of digitalization at various levels of the education system.

It should be noted that a separate area of research should be devoted to studying the best practices of digitalizing education, both in Russia and abroad, with subsequent adaptation of the most successful solutions to Russian conditions. This includes a comparative analysis of various models of digital education transformation, identification of success factors, and obstacles to implementation. Particular attention should be paid to studying the experience of digitalization in countries with similar socio-economic conditions and comparable territorial dimensions.

Research into the possibilities of integrating the latest technological developments (such as artificial intelligence, virtual and augmented reality, blockchain) into the educational process, with a mandatory

assessment of their pedagogical effectiveness and possible risks, also appears promising. This also includes research in the field of protecting the personal data of participants in the educational process, preventing digital dangers and threats, and developing methods for forming a digital culture and responsible behavior in the digital environment among all participants in the educational process.

The implementation of the above-mentioned research areas, therefore, requires the consolidation of the efforts of the scientific community, educational organizations, educational authorities, and representatives of the IT industry. The creation of a distributed network of research centers specializing in various aspects of digital education and fostering a continuous dialogue between researchers and practitioners is of great importance. This will not only deepen the theoretical understanding of the digital transformation processes in education but also provide a scientific basis for informed management decisions, thereby contributing to the sustainable development of the digital education environment in Russia.

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АНАЛИЗ АСПЕКТОВ ЦИФРОВОЙ ТРАНСФОРМАЦИИ ОБРАЗОВАТЕЛЬНОЙ СИСТЕМЫ РОССИИ

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Аннотация. Статья посвящена комплексному анализу цифровой трансформации системы образования, которая рассматривается как кардинальное изменение педагогической парадигмы под влиянием современных технологий. Авторы выделяют ключевые аспекты цифровизации, включая техническое оснащение, развитие цифровых ресурсов, формирование цифровой культуры и нормативно-правовой базы. Особое внимание уделяется преимуществам цифровых технологий, таким как персонализация обучения, повышение наглядности учебного материала и развитие критического мышления у учащихся.

Рассматриваются основные проблемы цифровой трансформации: региональные различия в доступе к технологиям, недостаточная подготовка педагогических кадров и необходимость методологического обоснования эффективности цифровых инструментов. Авторы подчеркивают важность баланса между технологическими инновациями и педагогической целесообразностью, а также необходимость междисциплинарных исследований для оценки долгосрочного влияния цифровизации на качество образования.

Перспективными направлениями развития являются создание адаптивных образовательных сред, внедрение технологий виртуальной и дополненной реальности, а также прозрачность образовательных процессов. Статья представляет интерес для исследователей, педагогов и менеджеров образования, занимающихся вопросами цифровой трансформации.

Ключевые слова: *цифровая трансформация, образование, цифровизация, персонализация обучения, цифровые технологии, педагогические инновации, региональное неравенство, методологическое обоснование, адаптивные системы, информационная прозрачность*

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EXPLORING ARTIFICIAL INTELLIGENCE TO PROMOTE THE DEVELOPMENT OF SENIOR EDUCATION IN CHINA

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Abstract. China is rapidly developing into an aging society, and traditional forms of senior education are facing development bottlenecks, including insufficient resources, a single mode, and limited outreach, which makes it challenging to meet the growing demand for senior education. The rapid development of artificial intelligence technology offers new ideas and solutions to address the challenges in senior education. Artificial intelligence can achieve personalized adaptation, support teaching, create an immersive learning experience, and optimize teaching through big data analysis, thus promoting educational equity and active aging. However, there are several challenges to the deep integration of AI and the education of older people, and China's education for older people has also engaged with AI. In the future, we need to strengthen the top-level design further, increase financial investment, improve the curriculum system, strengthen the construction of teaching personnel, and promote the deep integration of AI technology in senior education, to create a better learning life for older people, promote the high-quality development of senior education, and promote positive aging.

Keywords: *artificial intelligence, facilitation, China's senior education development, lifelong learning*

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Introduction

China has the largest elderly population in the world, and the aging rate continues to increase. According to the National Bureau of Statistics, "By the end of 2024, the elderly population aged 60 years and over will be 310.31 million, or 22.0 percent, of which 220.23 million, or 15.6 percent, will be 65 years and over." [1]. It is expected that the elderly population will exceed 400 million in 2035 and enter a period of severe aging. The aging of the population presents several challenges to China's socio-economic development, including a decline in labor supply, increased pressure on social security, and a rise in demand for services for older individuals.

Senior education is a vital component of the lifelong education system, holding significant importance for enhancing the quality of life

for the elderly and promoting social harmony and stability. Senior education can help older people update their knowledge, improve their skills, enrich their spiritual and cultural life, enhance their ability to participate in society, and gain a sense of dignity in learning, enjoyment, and fulfillment in old age. In 2021, the State Council advocated a positive attitude towards aging in its Circular on the Implementation of the Fourteenth Five-Year Plan for the Development of the National Aging Program and Pension System (Guo Fa [2021] No. 35). "The people's governments of all provinces, autonomous regions and municipalities directly under the Central Government, as well as the ministries and commissions of the State Council and the institutions directly under the Central Government, 'rely on the National Open University to prepare for the establishment of the National University for the Elderly and create a national platform for sharing resources for the education of the elderly and public services. Open universities across the country are encouraged to establish 'open universities for the elderly', and educational institutions for older adults are encouraged to offer online senior education. Innovative mechanisms have been established to promote the opening of senior universities operated by government departments, industrial enterprises, colleges, and universities to society." [2].

However, the development of senior education in China faces many bottlenecks [3, p. 1–8]. In recent years, artificial intelligence technology has developed rapidly, making breakthroughs in areas such as image recognition, speech recognition, and natural language processing. These advancements have been widely applied in various fields, including education, healthcare, and finance. Artificial intelligence technology has created new opportunities for the development of senior education.

The application of artificial intelligence technology is of great significance for promoting the development of senior education. Enhance the quality of teaching: AI technology can offer older individuals a more personalized, intelligent, and efficient learning experience, thereby improving the quality and effectiveness of education for this demographic. Promote educational equity: AI technology can overcome the limitations of time and space, enabling older people, especially those in rural and remote areas, to access high-quality educational resources and promote educational equity. Promoting active aging: Artificial intelligence technology can help older adults acquire new knowledge, learn new skills, expand their social circles, enhance their ability to participate in society, and achieve active aging.

The combination of artificial intelligence and senior education is a crucial direction for addressing the challenges of population aging and advancing the development of senior education. In the future, it will be necessary to strengthen high-level design, increase investment in research and development, explore sustainable business models, promote the application of AI technology in senior education, and create a more engaging learning experience for older individuals.

Advantages of artificial intelligence for senior education

With the rapid development of artificial intelligence technology, its potential applications in the field of education are becoming increasingly apparent. For senior education, the introduction of AI technology presents a new opportunity to address the numerous challenges faced by the traditional education model, creating a more personalized, intelligent, and efficient learning experience for the elderly and promoting the high-quality development of senior education.

The traditional education model for older people often employs a "one-size-fits-all" approach, which makes it challenging to meet the diverse learning needs and abilities of older individuals. Artificial intelligence technology can provide customized learning content and learning pathways tailored to the learning needs, interests, skills, and other personal factors of older people. Artificial intelligence offers opportunities for the education of older people:

Artificial intelligence enables personalization. This includes intelligent recommendations of learning resources, adaptive learning systems, and virtual learning partners. Artificial intelligence can analyze information about the learning history, interests, and hobbies of older individuals and recommend suitable learning courses, books, videos, and other resources, enabling them to acquire the knowledge they need efficiently. However, "no matter how we answer, these answers will gradually change with technological progress." [4, p. 30]. Artificial intelligence can dynamically adjust the learning content and difficulty level according to the learning progress and understanding of the elderly, providing a personalized learning experience and improving learning efficiency. It can simulate a real teacher or learning partner to interact and communicate with older individuals, providing them with individualized learning guidance and emotional support.

Artificial intelligence can support teaching. Enhance lesson efficiency, answer intelligent questions, automatically correct homework, and track learning progress. Artificial intelligence

technology can support teachers in teaching, reduce teachers' workload, improve teaching efficiency, and provide better educational services for older people. It can address the most common learning problems, offer a 24-hour online Q&A service, and resolve learning issues on time. Artificial intelligence can automatically correct the homework of older adults and provide detailed feedback and analysis to help them understand their own learning situation. It can track and record the learning progress and results of older adults, create personalized learning reports, and help teachers adjust their teaching strategies in a timely manner.

Artificial intelligence technologies can create immersive learning experiences, virtual tours, historical and cultural experiences, and skills simulation training. "Virtual reality (VR) and augmented reality (AR) technologies can create immersive and interactive learning experiences for older adults that increase interest and engagement." [5]. Without leaving home, older people can utilize VR technology to explore interesting places around the world, experience diverse cultures, broaden their horizons, and enrich their spiritual and cultural lives. Older people can experience historical events and traditional culture in an immersive environment, thereby strengthening their sense of cultural identity and national pride. Artificial intelligence technology can simulate various life scenarios and help the elderly practice skills such as using smartphones and operating household appliances, thereby improving their life skills.

Artificial intelligence technology can optimize teaching content and methods, analyze learning behavior, evaluate learning outcomes, and enhance teaching content through data-driven analysis. Artificial intelligence technology can analyze the learning data of senior students, identify the learning laws, optimize teaching content and methods, and enhance teaching efficiency. By examining the data on older people's learning time, content, and progress, we can gain insight into their learning habits and preferences and use this information to enhance teaching. By analyzing data such as older adults' learning performance and homework completion, we can assess the learning effect, identify learning problems in a timely manner, and provide targeted assistance. Based on the results of the learning data analysis, teaching content and methods are continually optimized to enhance the relevance and effectiveness of instruction.

Artificial intelligence technology can promote educational equity and reduce the digital divide. Artificial intelligence technology can transcend

the boundaries of time and space, leveraging the popularity of smart devices to enhance online education platforms for digital skills training. In this way, older adults, particularly those in rural and remote areas, can access quality educational resources and promote educational equity. Artificial intelligence technology can support the development of online education platforms, providing a wealth of online courses and learning resources for older adults and overcoming geographical limitations.

With the increasing popularity and decreasing prices of smart devices, a rising number of older people can now use smartphones, tablets, and other devices for online learning. "Artificial intelligence technology can help develop digital training for older people so that they acquire the ability to use smart devices and applications and overcome the digital divide." [6].

Artificial intelligence technology can promote active aging. It can help older people acquire new knowledge, develop new skills, expand their social circle, enhance their ability to participate in society, and achieve active aging. Artificial intelligence technology can support the development of a lifelong learning platform that enables older individuals to learn continuously, maintain enthusiasm for learning, and enhance their skills. Artificial intelligence technology can support the development of a social interaction platform that enables older adults to share their learning and life experiences, expand their social circle, and enhance their social participation. It can support the construction of a volunteer service platform that enables older people to participate in volunteer services, utilize their free time effectively, and recognize their social value.

Challenges of a Deeper Integration of Artificial Intelligence in Senior Education

Despite the numerous opportunities that AI technology offers for senior education, its application also faces several challenges that need to be taken seriously and addressed proactively.

There is a digital divide, characterized by difficulties in operating devices, barriers to using applications, and issues with network connectivity. The inability of some older people to use smart devices and applications has become the most significant challenge hindering the adoption of AI technology in senior education. "The complexity of the user interface of smart devices and the high learning curve for older people easily intimidates them. Older people are often unfamiliar with the functions and use of applications, making it difficult for them to operate them skillfully. The network infrastructure in some rural and

remote areas is imperfect, making it difficult for older people to access the Internet." [7].

Therefore, it is necessary to enhance digital skills training for older people. This can be achieved by providing various forms of digital skills training, such as community-based training, university courses tailored for the elderly, online learning videos, and more, to help the elderly master the use of smart devices and applications. Develop age-friendly products: Encourage companies to develop smart devices and application software that are suitable for older adults, such as those with large fonts, large icons, voice control, and other features to lower the threshold for use by older people. Provide technical support and assistance: Establish a system of technical support and assistance for older adults, such as through community volunteer services and support from their children, to help them resolve issues with using smart devices and applications.

Data security and privacy issues. Older adults often lack awareness of data protection regulations and the risks associated with data loss and misuse. The personal information and learning data of older learners must be effectively protected from data loss and misuse. Older learners' personal information and learning data are stored in the cloud, making them vulnerable to hacking and data loss. Some unscrupulous elements could use older learners' personal data to commit fraud and other illegal and criminal activities. Some older individuals lack awareness of their privacy and tend to share personal information without their consent.

It is therefore essential to strengthen data security protection, improve laws and regulations, and raise awareness of privacy protection. Establish a robust data security protection system, implementing data encryption, access control, and other technical measures to ensure the security of older students' personal information and learning data. "Formulate and improve relevant laws and regulations, clarify the standards for data collection, storage, and use, and other aspects, and strengthen the fight against data leakage and misuse. Strengthen privacy protection, publicity, and education for the elderly, and enhance their awareness and ability to protect their privacy." [8].

Ethical issues of technology. The use of artificial intelligence technologies can lead to the risk of algorithmic discrimination, the problem of emotionlessness, and the difficulty of determining responsibility. The use of AI technology must adhere to ethical standards to prevent issues such as algorithmic discrimination and to safeguard the legitimate rights and interests of older learners. Artificial intelligence

algorithms can be biased and lead to unfair treatment of older learners, e.g., in course recommendations and learning assessments. Artificial intelligence technology cannot fully replace the emotional communication and humanistic care provided by human teachers, which can result in a lack of emotional connection among older learners. When problems arise in the application of AI technology in senior education, it is difficult to determine responsibility, which can easily lead to disputes.

Therefore, it is necessary to adhere to the ethical bottom line, strengthen the ethical review of algorithms, prioritize humanistic care, and clarify primary responsibilities. Establish a sound mechanism for the moral evaluation of artificial intelligence algorithms to ensure the fairness, impartiality, and transparency of the algorithm. Focus on humanistic care in the application of artificial intelligence technology in geriatric education to address the emotional limitations of the technology. Clarify the main responsible parties for the application of artificial intelligence technology in geriatric education and establish a robust accountability mechanism.

The cost and development of popularity issues. The cost of applying AI technology is high, the cost of developing the technology is high, the cost of purchasing and maintaining the equipment is high, and the business model is immature, so it is necessary to create a sustainable business model to promote the popularization and application of AI technology in the field of senior education. The research and development of AI technology requires a large amount of human, material, and financial resources. The acquisition and maintenance costs of intelligent equipment and application software are high and may be difficult for some senior educational institutions to bear. The business model for applying AI technology in senior education remains immature, and a sustainable profit model needs to be explored.

Therefore, it is necessary to increase government investment, explore diversified business models, and strengthen cooperation between industry, academia, and research. The government increases financial support for the application of AI technology in senior education and encourages the participation of social capital. Explore diversified business models such as government-purchased services, corporate sponsorship, and user fees to promote the sustainable development of AI technology in senior education. Strengthen cooperation between universities, research institutions, and enterprises to jointly research and develop AI technologies and products that are suitable for senior education and reduce costs.

The application of AI technology in senior education faces challenges in areas such as the digital divide, data security, technical ethics, cost, and popularity. It requires joint efforts from the government, enterprises, society, and other stakeholders to actively address the challenges, promote the healthy development of AI technology in senior education, and create a better learning experience for older people.

Exploring Artificial Intelligence in Senior Education in China: The Case of Shanghai

China's senior education system has made initial progress in the application of AI. In Shanghai, for example, senior universities, online education platforms, and communities are actively exploring the integration of AI technology into senior education to provide a more innovative and more convenient learning experience for older people.

The 5G innovative campus project of the China Association of Universities for the Elderly serves 800 senior universities. It has been providing free innovative campus system services for 5 years, benefiting more than 2 million students from senior universities. By March 2025, the 5G innovative campus platform will be significantly improved and fully integrate AI access to DeepSeek. Meanwhile, the university actively participates in the activities of the China Association of Universities for the Elderly. It conducts national cultural and leisure activities for older people, such as the National Arts and Cultural Performance for Elderly Universities and the National Elderly Universities' Spring Festival Gala, among other national cultural and leisure activities, serving a total of more than 20 million learners. The China Association of Universities for the Elderly offers online senior courses, with nearly 400,000 elderly students participating. In 2025, the third round of public welfare courses for older adults will be held, with more than 100,000 hours already accumulated. At the same time, the China Association of Universities for the Elderly donated a "Golden Age Unimpeded Learning Card" worth 1,580,000 yuan to mark the 40th anniversary of the program [9].

The Shanghai University for the Elderly offers courses such as "Smartphone Applications," "Basic Computer Operation," and "Surfing the Internet" to help older people learn how to use smart devices and overcome the digital divide. The courses combine theory and practice. The teachers explain the basic operation of smart devices and the use of application software, guiding older people through practical exercises. The courses have been well-received by older adults and have helped many of them acquire skills in using smart devices, thereby improving

their quality of life and social participation. However, due to the limited reach of the courses, it has been challenging to meet the learning needs of all older people. Some older people are slow learners and require more individualized support.

The "Smartphone Applications" course at Shanghai Elderly University introduces the basic knowledge of smartphone operation, the use of commonly used applications, and an understanding of network security. The course is conducted in small classes, with no more than 20 participants per class, and combines the instructor's explanations with those of the participants. At the end of the course, participants were able to utilize their smartphones for various daily tasks, including making phone calls, sending WeChat messages, taking photos, and browsing the Internet. Participants generally felt that the course content was practical, the teaching method was flexible, and the learning effect was good.

Online education platforms have also developed educational programs for older people. Shanghai Open University has launched an online learning platform called "Silver-haired e-learning hall," which offers a wealth of courses designed for the education of older adults, covering a wide range of fields, including health and wellness, culture and the arts, and information technology. The platform uses artificial intelligence technology to recommend personalized learning courses for older people, offering online question-and-answer sessions, progress monitoring, and other features. The platform provides a convenient way for older individuals to learn, overcoming time and space constraints, and enriching the intellectual and cultural lives of older people. However, some older adults may struggle to use online learning platforms. Therefore, digital skills need to be better trained, the quality of platform content improved, and support increased.

Community-level training programs on innovative technologies for older people. Some streets in Shanghai have launched the "Smart Help for the Elderly" program to train older community members on how to use smartphones, operate WeChat, register online at hospitals, and other related skills. The program is based on a "one-to-one" or "one-to-many" teaching method, in which community volunteers or staff provide hands-on guidance to older individuals. The program has helped older people in the community learn basic skills in using innovative technologies to make their daily lives easier. However, the scale of the program is limited, so it is challenging to meet the learning needs of all older people in the community. The team of volunteers is unstable, and training and management need to be strengthened to ensure its effectiveness.

By 2022, Shanghai University for the Elderly will offer more than 100 courses on the use of smart devices, totaling over 100,000 training sessions. The “E-Learning Hall for the Elderly” at Shanghai University for the Elderly was opened on June 5, 2023. The platform has more than 500,000 registered users, with a total of over 10 million learning sessions. The “Smart Elderly Assistance” project has conducted over 100 training sessions and assisted more than 5,000 elderly individuals [10]. The “E-Learning Hall for the Elderly” adheres to joint construction and sharing, does a good job in building curriculum resources, promotes digital networking, does a good job in learning incentive mechanisms, strengthens urban areas to connect with each other, builds a strong network of innovative support services for older people, and strives to do a good job in creating a highly intelligent, age-friendly and integrated lifelong learning space for citizens so that more elderly people can enjoy the benefits of innovative city development.

Shanghai’s exploration of artificial intelligence in senior education has yielded some results, but it still faces several problems and challenges. In the future, it is necessary to further strengthen top-level design, increase financial investment, improve the curriculum system, enhance teacher education, promote the deep integration of AI technology in senior education, and create a more effective learning experience for older individuals.

Development Strategies for Artificial Intelligence to Promote the Education of Seniors

With the rapid development of artificial intelligence technology, its potential applications in the field of education are becoming increasingly prominent. For senior education, the introduction of AI technology presents new opportunities to address the numerous challenges posed by the traditional education model. It creates a more personalized, intelligent, and efficient learning experience for older people and promotes the high-quality development of senior education. It is also necessary for future growth:

Strengthen high-level design and formulate development plans. Include AI-based senior education in the national development plan for the causes of aging and the development plan for artificial intelligence. Define the direction of AI technology application in senior education, key tasks, and safeguards, and provide policy support for AI-based senior education. Formulate standards and norms for the application of AI technology in senior education. Regulate the application of AI technology in senior education, protect the legitimate rights and interests

of senior learners, and promote the deep integration of AI technology and senior education.

Conduct teaching research. Improve the curriculum system, strengthen the construction of teaching personnel, and explore various teaching methods. Develop artificial intelligence courses tailored to the learning needs of older adults, covering the use of intelligent devices, network security, artificial intelligence applications, and other relevant topics. Cultivate a group of talents who understand both geriatric education and AI technology, and ensure a talent guarantee for the application of AI in senior education. Combine online and offline education and use AI technology to provide personalized and intelligent learning experiences for older people [11].

Increase investment in research and development and promote technological innovation. Encourage universities, research institutions, and companies to develop artificial intelligence technologies and products specifically tailored to the learning needs and capabilities of older individuals. Develop AI algorithms, models, and systems tailored to the cognitive characteristics and learning habits of older individuals, utilizing technologies such as speech recognition, natural language processing, computer vision, and other relevant fields. Develop intelligent devices and application software that are easy to use by older people. Design easy-to-understand and straightforward user interfaces, provide voice control, large fonts, large icons, and other features, and lower the threshold for older people to use smart devices and application software.

Improve digital skills training to reduce the digital divide. There are various forms of digital skills training for older people. For example, community training, university courses for the elderly, online learning videos, and more, to help the elderly master the use of smart devices and application software. Encourage family members and social forces to help older people overcome the digital divide. Children and grandchildren can patiently guide older people in the use of smart devices, and community volunteers can provide personalized technical support and assistance to older people [12].

Strengthen data security and privacy protection. Establish a robust mechanism to safeguard the personal information and learning data of older individuals. Utilize technical measures such as data encryption and access control to protect the security of older adults' personal information and learning data. Strengthen the ethical review of AI algorithms. Ensure the fairness, impartiality, and transparency of

algorithms, avoid issues such as algorithmic discrimination, and protect the legitimate rights and interests of older learners.

Explore sustainable business models. Encourage social capital to participate in AI-supported senior education projects. Guide social capital to invest in the field of senior education and develop AI products and services that meet the learning needs of older people. Explore the business model of collaboration between government, business, and society. For example, the government's purchase of services, corporate sponsorship, user payments, and other initiatives are aimed at promoting the sustainable development of AI technology in the field of senior education.

Artificial intelligence technology has opened up unprecedented opportunities for the development of senior education, providing new ideas and solutions to the challenges of the traditional education model. In the future, it is necessary to strengthen the top-level design further, increase financial investment, improve the curriculum system, strengthen the construction of teachers, promote the deep integration of AI technology in the field of senior education, create a better learning life for older people, promote the high-quality development of senior education, and contribute to positive aging.

It is believed that through the joint efforts of the government, enterprises, society, and other parties, AI technology will provide a new impetus for the development of senior education, helping older people overcome the digital divide and enjoy an intelligent life.

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ИССЛЕДОВАНИЕ РАЗВИТИЯ КИТАЙСКОГО ОБРАЗОВАНИЯ ДЛЯ ПОЖИЛЫХ ЛЮДЕЙ С ПОМОЩЬЮ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА

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Аннотация. Китай стремительно вступает в эпоху стареющего общества. Традиционные модели образования для пожилых сталкиваются с такими проблемами, как нехватка ресурсов, однообразие методов и ограниченный охват, что затрудняет удовлетворение растущих потребностей в обучении пожилого населения. Быстрое развитие технологий искусственного интеллекта (ИИ) предоставляет новые идеи и решения для преодоления этих трудностей. Искусственный интеллект способен обеспечить персонализацию обучения, ассистировать в преподавании, создавать погружающий учебный опыт, оптимизировать образовательный процесс через анализ больших данных, тем самым способствуя образовательной справедливости и активному старению. Однако глубокая интеграция ИИ в образование для пожилых сталкивается с рядом вызовов. Китай уже начал изучать применение ИИ в этой сфере. В будущем необходимо усилить стратегическое планирование, увеличить финансовые вложения, усовершенствовать учебные программы, укрепить преподавательский состав и углубить интеграцию технологий ИИ в сферу образования для пожилых. Это позволит создать более комфортные условия для обучения старшего поколения, повысить качество образования и реализовать концепцию активного старения.

Ключевые слова: *искусственный интеллект, содействие, китайское образование для пожилых, развитие*

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MANIFESTATIONS OF ESCAPISM AMONG YOUNG PEOPLE

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Abstract. This article explores the phenomenon of Escapism and examines its primary characteristics. It highlights the ambivalent and complex nature of Escapism and emphasizes its social, cultural, and psychological roots. The study examines the meaning of Escapism in real and virtual contexts. It argues that the life of a modern individual, especially a young person, unfolds in two parallel worlds – the real and the virtual – resulting in conflicting perceptions and ambiguous consequences for personal development and social interaction. It is noted that Escapism, as a way of living, thinking, and behaving socially, has occurred throughout human history and has been shaped by specific historical and cultural contexts. Both the real and virtual worlds have a complex and ambivalent influence on the cognitive abilities and behavioral strategies of adolescents and young people. The article explores the differences between Escapism in real and virtual environments, highlighting both the positive and negative aspects inherent in each of these worlds. Excessive immersion in the Internet and social media can lead to a decline in critical thinking and an inadequate awareness of events in the real world. The increasing complexity and uncertainty of modern life encourage individuals to seek solace in virtual environments full of illusions, which is very attractive to young people. For many young people, existence in such environments is becoming a mass trend and a core value. It is emphasized that virtual environments offer a way to escape the negative and traumatic aspects of real life that many teenagers and young adults do not want to accept. It is concluded that intense engagement in a virtual world, especially when accompanied by digital addiction, brings with it a variety of risks associated with Escapism. One of the most critical manifestations is loneliness, which becomes a seemingly convenient and effective survival strategy.

Keywords: *Generation Z, social media, hybrid existence, Escapism in the real world, virtual Escapism, digital addiction, loneliness, illusion*

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Introduction

Modern global and digital trends are giving rise to new social phenomena that necessitate interdisciplinary analysis in the social sciences and humanities. Among these phenomena, the phenomenon of

real and virtual Escapism is becoming increasingly important, making its study important from both theoretical and practical perspectives. The manifestations of Escapism are diverse, its nature is contradictory, and its consequences are ambiguous, especially for young people. The spread of virtual Escapism is closely linked to the development of IT technologies. The desire to escape the hardships of reality and immerse oneself in a world of illusions is not peculiar to modern times. Still, digital technologies have intensified this desire, so that both forms of Escapism – real and virtual – are linked and reinforce each other. The infinite possibilities of the internet trigger escapist tendencies, especially in today's world, which is characterized by uncertainty and contradictions. For many, virtual Escapism becomes a way of coping with the complexity of modern life.

The widespread use of digital tools and their integration into everyday life has led to the emergence of new social and psychological phenomena that are profoundly changing lifestyles, social values, ethical norms, and patterns of interpersonal interaction. While the Internet offers obvious benefits, it also contributes to the emergence of potentially questionable behaviors. These include Escapism and the growing problem of loneliness, which is becoming increasingly common among Generation Z. Paradoxically, despite the increase in various forms of virtual communication, people often find themselves in a state of loneliness.

Materials and Methods

This article aims to explore the topic of Escapism, analyze its social and psycho-emotional nature, and examine its specific manifestations among adolescents and young adults. Escapism is a complex issue that has both positive and negative effects. It has an ambivalent impact on an individual's cognitive functioning and social behavior, potentially leading to disruptions in personal values and life experiences. The application of dialectical principles – systematicity, accuracy, completeness – together with general scientific research methods enables a holistic and multi-layered study of this socio-cultural issue. Referring to the works of Russian scientists such as E. Andreeva [1], V.I. Belov [2], O. Davydov [3], I. Kolesnikova [4], O. Lavrichenko [5], A. Kibalnik and I. Fedosova [6], O. Kolotova [7], N. Nyatina [8], K. Perepelkina and M. Cherepanova [9], E. Shapinskaya [10], A. Shchetinina [11], and others make it possible to analyze various aspects of Escapism and the loneliness associated with it.

The researchers note that both real and virtual Escapism are becoming a widespread lifestyle among young people, shaping their perception of the world. Traditional forms of communication and interaction are undergoing significant changes. Many people are no longer able or willing to engage with the real world due to virtual Escapism, which in turn deepens and broadens the experience of loneliness.

Results and Discussion

Escapism is a widespread social phenomenon that has existed throughout human history. The desire to escape life's hardships is common among specific individuals and can manifest in various ways. Modern Escapism is primarily driven by information and communication technologies, which offer far-reaching opportunities to extend real-life Escapism to virtual practices. The attraction of virtual images lies in their ability to "displace and compensate for the aggression and negativity of the physical and social world" [12, p. 141], which increases the likelihood that young people will adopt an escapist mindset. Such negative attitudes are caused by a general dissatisfaction with life, which is particularly pronounced among young people. Since real life often fails to meet their idealized expectations, many of them view the digital world as a safe space where anything seems possible. In this case, the likelihood of internet addiction among teenagers is high. After returning to the real world, they are once again confronted with stress, which can have harmful consequences. This is also facilitated by moral and ethical dissonance – the views of teenagers and society on social norms and standards often clash. When they do, "the problem of escapism inevitably arises" [13, p. 106].

Escapism is widespread among students today. The challenges they face – such as increasing alienation and the transformation of the education system into a service-oriented system that promotes utilitarian thinking – favor Escapism as a coping mechanism for psycho-emotional stress. Virtual Escapism plays a particularly important role as it often removes students from real-life experiences and makes it difficult for the education system to re-engage them in real-life social interactions.

Real and virtual Escapism are two interlinked trends that are having a profound impact on young people, particularly teenagers. The merging of online and real-life experiences creates a hybrid environment in which young people realize their ambitions and desires. The greater the dissatisfaction with real life, the stronger the desire to escape into an alternative reality unencumbered by moral expectations or social

responsibility. Escapism reveals its dual nature: it can help alleviate the ‘stress of monotony,’ but can also lead to a destructive immersion in virtual madness. This duality can lead to negative consequences that ultimately limit a person’s freedom in the real world.

These tendencies also extend to the field of education, which is expected not only to provide services but also to create conditions that reduce the risks associated with Escapism. The need to orient students to real life is a key challenge for modern education. Without this change, the risk of social infantilism and pragmatism grows, distorting socialization processes and negatively impacting learning and personal development. This is particularly critical as education must shape mature, socially responsible individuals. Educators face the complex task of reintroducing students to the world of authentic experiences and helping them develop a mindset that enables them to distinguish between reality and illusion. To achieve this, students need to be actively engaged in real-life activities that can significantly reduce the adverse effects of Escapism.

This problem is particularly relevant for special schools, where cases of social Escapism are more common. Escapism often serves as a defense mechanism and a way of coping with negative external influences. For young people, including those with disabilities, escaping into a fantasy world can provide a sense of security and reassurance. However, although fantasy provides them with relief, it also distances them from real life, which can have a detrimental effect, not only on their physical and emotional well-being, but also on the quality of their learning. Traditional forms of interaction are often lost and replaced by new, sometimes misinterpreted practices that are simply adopted because they are believed to be universally accepted. These patterns of behavior are usually widespread in the school environment, where students are more receptive to new trends. Without participation in such practices, there is a real risk of social isolation.

As a result, the individual’s awareness is split between the real and virtual worlds. This often isolates teenagers and young adults, with loneliness creating new anxieties and drawing them into a social void characterized by apathy and emotional distance. Many school-age escapists show high levels of social alienation and minimal interaction with peers. They often lead lonely lives, withdrawing from real life and seeking online communication with individuals who also feel lonely or excluded, forming bonds around socially unacceptable behaviors that are encouraged in cyberspace.

Many escapist students show a high level of social alienation and, at the same time, a low level of communication with peers; they are characterized by a solitary lifestyle, "away" from others. A so-called "withdrawal into oneself" occurs, which is overcome by searching for like-minded people who are lonely and unsuspecting. In doing so, they often resort to socially disapproved behaviors that are encouraged in cyberspace. In a situation of excessive passion for mobile tools, these processes are widespread, which has a direct impact on learning. In this context, the social responsibility of all those involved in the educational process is fundamental. No less important are the problems of adaptation of students, teachers, and parents to a rapidly changing social and cultural context, for which the education system must be prepared in the first place. First and foremost is the need to strengthen the role of the spiritual aspects of life, which form the basis of human aspirations and desires.

Excessive engagement with social media hinders young people's ability to adapt to the fast-paced and complex realities of modern life. Returning to reality becomes a complex challenge, as it requires accepting socially shared standards, ethical norms, and values while finding a balance between personal desires and societal expectations. Digital addiction distorts the individual's perception of reality, deepens social withdrawal, and hinders the development of relationships in real life. Although the virtual space offers extensive opportunities for interaction, it also promotes alienation, particularly among young people who are increasingly rejecting the norms of real life. The stronger the digital addiction, the more pronounced the feeling of loneliness, which affects the social, psychological, and emotional levels of socialization.

Escapism manifests itself differently in different age groups, but has the most significant negative impact during adolescence. In mild forms, it can help adolescents focus on personal problems; however, when it worsens, it leads to diminished cognitive abilities, behavioral changes, and a loss of interest in reality. Combating this problem requires joint efforts from educators and parents, as it is a systemic issue. Digital addiction leads to a loss of authentic perception and critical thinking. Escapists are increasingly relying on virtual trends and illusions, losing the ability to distinguish between reality and fiction. This undermines both personal and collective identity, posing a threat to psychological and social well-being. In search of stability, people are turning to the Internet and social media, where life's challenges are replaced by entertainment, fostering virtual Escapism.

Among adolescents and young people, Escapism often takes the form of an addiction to video games, which are seen as a way of escaping the anxieties of real life. The degree of Escapism varies with the level of immersion in the virtual environment: reality loses its value for those with a strong digital addiction, while moderate users tend to maintain a healthier balance. Such activities help young people to cope with internal conflicts between personal aspirations and societal expectations. This highlights the importance of paying closer attention to youth culture and the evolution of online and offline communication within the context of a hybrid lifestyle.

In adolescence, cases of Escapism are more pronounced due to the limited ability to evaluate social reality critically. False trends can easily influence teenagers, causing them to lose touch with reality and fall prey to imposed illusions. They either follow someone else's script or try to create their own alternative reality. The escape into the virtual world is often due to unfulfilled longings or an attempt to compensate for emotional discomfort. However, the digital environment merely imitates reality, replacing it with substitutes and artificial emotions, although the hope of returning to an authentic life remains. As the researchers note, young people generally have two paths ahead of them: "One is to escape into a reality invented by others… The other is to invent a new one themselves, to create their own game" [14]. The escape into the virtual world is often driven by unfulfilled longings and attempts to overcome these longings with the help of digital tools. However, "the triumph of net-based surrogates, second-hand experiences and counterfeit emotions will not go away" [15], despite the hope of a return to authentic life.

Digital environments play a crucial role in shaping digital identity, but maintaining a constant online presence carries significant risks, including manipulation, pressure, cyberbullying, and intimidation. These factors harm young people's mental health, leading to feelings of loneliness, anxiety, and depression. As a result, cognitive abilities are weakened and socialization is disrupted. Young people are particularly vulnerable, and the loneliness they experience affects all aspects of life, from emotional well-being to values. In a hybrid reality, this contributes to shifts in consciousness and thinking, the consequences of which often go unnoticed.

Escapism as a behavioral strategy can have a positive effect, especially when combined with active involvement in educational, scientific, or playful activities, and stimulates mental effort and creativity. It helps to think beyond the "familiar, the ordinary, the

everyday" [16, p. 126] and to overcome the limits of "primitive thinking and simple rationality" [17]. In this form, Escapism supports adaptation to modern life, deep self-knowledge, and the development of new skills. Some researchers describe it as 'life as creativity' and 'life as a dream' [18, p. 10]. It creates a pleasant emotional environment and provides "relaxation by breaking the monotonous routine and stress of everyday life" [19, p. 22]. Virtual Escapism compensates for unfulfilled longings, transforms fantasy into a quasi-reality, and facilitates the hybrid lifestyle of youth.

The need for self-expression often drives the desire to escape into an alternative reality, as the virtual environment requires unconventional thinking, new experiences, and digital communication skills. Online information can be educational, but it cannot replace real knowledge, which requires intellectual effort and critical evaluation. A lack of digital literacy often pushes people back into the offline world, where authentic human interactions are more prevalent.

Although many young people spend the majority of their time online and on social media, they are still prone to feelings of loneliness. The success of others can trigger feelings of jealousy and inferiority. This can lead to extreme social behaviors and even suicidal thoughts. Feelings of inferiority often promote insecurity and make loneliness seem like a source of comfort. Today's youth are significantly different from previous generations. As digital natives, they are characterized by greater independence, ambition, and activity. Their worldview is in stark contrast to traditional norms. However, digital addiction encourages both virtual and real Escapism, which increases loneliness and expands individualism.

Conclusion

Escapism, in both real and virtual forms, has a complex and ambivalent impact on the consciousness, thinking, lifestyle, behavior, and emotional state of young people. As a behavioral strategy, it is shaped by a complex combination of objective and subjective factors, making Escapism a social, cultural, and psychological phenomenon. Hybrid existence, characterized by living simultaneously in both real and digital environments, contributes to the development of escapist tendencies and often reinforces feelings of loneliness. This life at a crossroads can lead to a loss of connection with the real world and weaken one's social identity. Ultimately, reality itself becomes dependent on virtual space, which is filled with simulacra and illusions

that can profoundly affect the still-forming minds of young people and young adults.

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ПСИХОЛОГИЯ

ПРОЯВЛЕНИЯ ЭСКАПИЗМА В МОЛОДЕЖНОЙ СРЕДЕ

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Аннотация. В статье исследуется феномен эскапизма, рассматриваются его основные свойства. Подчеркивается сложный и амбивалентный характер эскапизма как социального, культурного и психологического явления, анализируется характер его востребованности реалиями подлинной и виртуальной жизни. Прослеживается идея о том, что жизнь современного индивида, в особенности молодого, протекает в пространстве двух миров – реального и виртуального, что придает существованию противоречивые смыслы и неоднозначные по своим воздействиям последствия. Обращается внимание на то, что эскапизм, как образ жизни, мышления и соответствующие социальные действия, всегда присутствует в человеческой истории, испытывая влияние специфики исторического и культурного контекста. Гибридное существование в реальном и виртуальном мире противоречивым образом сказывается на когнитивных способностях молодых людей и подростков, выборе ими поведенческих стратегий. Исследуются отличия между реальным и виртуальным эскапизмом, показываются содержащиеся в каждом из них позитивные и негативные смыслы. Отмечается, что чрезмерное пребывание в пространстве Интернета и социальных сетей приводит к минимизированию способностей к критическому мышлению, адекватному восприятию процессов, происходящих в подлинном мире. Указывается на то, что неопределенность современных форм жизни, их все большее усложнение имеют своим следствием «бегство» от реалий мира в мир иллюзий и симулякров, которыми изобилует виртуальность, столь привлекательная для молодежи. Обращается внимание на то, что бытие в виртуальном мире становится для многих молодых людей своеобразным мейнстримом и ценностным ориентиром. Подчеркивается, что с помощью цифровых инструментов становится возможным преодоление негативных аспектов реальной жизни, обладающих травмирующим эффектом, с чем не желают мириться многие подростки и молодые люди. Прослеживается мысль о том, что бытие в виртуальности, и в особенности цифровая зависимость, создают многочисленные риски эскапизма, одной из форм выражения которого становится одиночество как наиболее комфортная и эффективная стратегия выживания.

Ключевые слова: *«Поколение Z», социальные сети, гибридное существование, реальный эскапизм, виртуальный эскапизм, цифровая зависимость, одиночество, иллюзия*

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PSYCHO-PEDAGOGICAL ANALYSIS OF THE ACCESSIBILITY OF DIGITAL LEARNING ENVIRONMENTS FOR VISUALLY IMPAIRED STUDENTS

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Abstract. In the era of global digitalization, it is becoming increasingly essential to create web content that meets the needs of a diverse audience, including people with visual impairments. In Russia, these issues are regulated by the state standard GOST R 52872-2019 and guidelines of the Ministry of Digital Development. Nevertheless, visually impaired users continue to face difficulties in accessing educational, recreational, and social platforms, as compliance with accessibility standards for digital educational environments is voluntary. The accessibility limitations identified necessitated a comprehensive review of online platforms for blind and visually impaired users, as well as the development of targeted solutions to enhance digital educational environments for these users. The following methods were used in the study: Heuristics, data analysis, testing, generalization of the results obtained, statistical data processing (Kolmogorov-Smirnov criterion), methods for evaluating the customer effort index (Customer Effort Score), and elements of a Customer Journey Map (CJM).

The study involved 20 participants (10 blind and 10 visually impaired students aged 15–20 from Moscow, Ulyanovsk, and Cheboksary) who voluntarily completed eight standardized user tasks. The study expands our understanding of how blind and visually impaired users interact with digital learning environments. The findings highlight the need to incorporate both international and local experiences, develop a uniform accessibility standard across countries, evaluate the accessibility of web tools, consider how blind and visually impaired users perceive information and interact with digital spaces, and establish common accessibility standards for developers.

These findings are relevant for developers and researchers working on digital tools for visually impaired users and other accessibility needs.

Keywords: *visual impairment, accessibility, digital learning environment, development*

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Introduction

One of the most critical trends driving progress in various sectors is the rapid introduction of digital tools. Global digitalization also has a decisive influence on the development of education systems. The COVID-19 pandemic has accelerated the introduction of new learning

formats and expanded the range of web tools used in education. Distance learning and digital education formats are now widespread in the modern education market. As these platforms seek to reach a wider audience, they increasingly include students with visual impairments. At first glance, this format appears ideal compared to traditional special or inclusive schools: the teacher works one-on-one with the students, addresses their individual needs, and strives to achieve good academic results. However, such teaching often takes place on self-developed or third-party platforms without considering the accessibility standards for digital learning environments (DLEs) that cater to students with visual impairments.

In this context, the development of DLEs tailored to the needs of visually impaired users is significant. Addressing this challenge can help regulate the work of online educational platforms, improve the quality of their services, and further develop the design and usability of DLEs for both visually impaired people and other vulnerable groups. The experience gained can be applied to other online services frequently used by blind and visually impaired users.

Scientific Novelty

This study employs an integrated approach to addressing the accessibility of DLE for visually impaired users, combining educational, psychological, technological, and legal perspectives. For the first time, empirical data were collected through a multi-parameter assessment of users' experiences with varying degrees of visual impairment when interacting with online school platforms. The main parameters of accessibility – perceptibility, usability, clarity, and reliability – are analyzed from psychological and pedagogical perspectives.

According to international and Russian researchers (Yu. Ivashkina, E. Kosova, O. Miroshnichenko, K. Redkokosh, T. Polilova, A. Solovyeva, M. Charmatz, V. García-Morales, A. Garrido-Moreno, R. Martín-Rojas, Z. Meleo-Erwin, B. Kollia, J. Fera, A. Jahren, C. Basch, C. Mullin, R. Gould, S. Parker Harris, O. Nass, I. Bapiyev, O. Skuliabina, S. Nass, L. Shawn, S. Weissman), an accessible DLE is a DLE that is easily accessible to all learners, regardless of their disability, and meets their specific needs [1–11]. In contrast, a DLE is considered inaccessible if it contains barriers that prevent even a single user from meeting their learning needs.

The design of an accessible DLE is based on the principles of the Access For All and WCAG frameworks, which provide technical guidelines to ensure that platforms and their tools are precise, reliable,

operable, and perceivable [12]. These standards complement each other and should not be applied separately. WCAG defines the mandatory minimum requirements, while Access For All provides optional, user-oriented recommendations for personalization and flexibility.

International practices in designing accessible DLE for visually impaired users are governed by legal frameworks [13]. In the United States, this work is governed by the Americans with Disabilities Act and the Rehabilitation Act (Sections 504 and 508). In the United Kingdom, it is based on the Disability Discrimination Act and the Disability Act (1995, 2005). In Scotland, the accessibility of DLE is guaranteed by the Equality Act. Japan regulates this area through the Basic Act on the Formation of an Advanced Information and Telecommunications Network Society. In China, developers are required to follow the Law on the Protection of Persons with Disabilities. In Switzerland, the relevant legislation is the Federal Act on the Elimination of Inequalities for Persons with Disabilities.

Additionally, the Russian Law on Social Protection of Persons with Disabilities (No. 181, dated November 24, 1995, revised on March 1, 2025), specifically Article 15, which regulates access to social, technical, and transportation infrastructure, does not mention digital accessibility [14]. If digital environments are considered part of the broader social environment, one could assume that these standards also apply to web content.

Since 2019, Russia has been using GOST R 52872-2019 (approved by Rosstandard Order No. 589 of August 29, 2019), which is based on the Web Content Accessibility Guidelines (WCAG) 2.1 [15]. This standard regulates digital accessibility, including for users with visual impairments. However, according to the Law on Standardization in the Russian Federation (June 29, 2015, No. 162), compliance with this standard is voluntary [16]. As a result, its requirements are often followed only superficially.

According to Decree No. 931 of the Ministry of Digital Development, dated December 12, 2022, state websites, municipal platforms, and affiliated organizations are required to provide an alternative version of their websites for users with visual impairments [17]. However, with Decree No. 957 (November 7, 2023), which came into force on September 1, 2024, the obligation for websites to provide tools for the alternative display of web content was lifted [18].

Russian researchers have also studied various aspects of digital environments. A. Kondakov and I. Sergeev consider the digital

environment as a convergent educational space that promotes students' socialization, effective communication, and professional development [19]. According to T. Noskova, achieving these goals requires an interdisciplinary approach to digital environments [20]. The issue of web content accessibility for people with disabilities is comprehensively addressed by A. Guseinova, O. Ilyin, V. Manuilova, N. Polyakova, M. Chetvergova, and others [21–29]. Their solutions can be considered as a starting point for designing digital learning environments for users with visual impairments.

Methodology, Materials, and Methods

This study aims to present a possible approach for designing a digital learning environment (DLE) that is accessible to individuals with visual impairments. The research hypothesis states that the goal can be achieved by fulfilling several vital conditions: Integration of international and national best practices for the accessible design of DLE, development of a unified legal framework, use of analytical data from online school environments, and analysis of how blind and visually impaired people perceive and interact with online content.

Data reflecting the current state of online school platforms is needed to design DLEs that are accessible to visually impaired users. The need to identify general trends in accessible web content shaped both the structure of the 2024 experiment and the selection of diagnostic tools.

Using a random sample, we selected three online schools (the authors did not disclose the names). It is assumed that their students could include people with visual impairments.

Ten blind and ten visually impaired participants, aged 15 to 20, from Moscow, Ulyanovsk, and Cheboksary, took part in the study. Five of the ten blind participants were students in educational institutions for visually impaired children, while the other five attended a vocational school that trains medical masseurs. All blind participants had a residual vision of 0.01% to 0.04%. Of the visually impaired participants, six were students in institutions for visually impaired children, and four were enrolled in a vocational school for medical massage therapy. Their corrected central visual acuity ranged from 0.06% to 20%. According to self-report, all participants had an adequate level of digital literacy.

The DLE test was based on a series of user tasks. This informed the choice of methods, which included a heuristic approach with blind and visually impaired users, content analysis of websites, task-based testing through sequences of related operations, synthesis of results, and statistical analysis using the Kolmogorov–Smirnov test. Additionally,

the study employed the Customer Effort Score (CES) method and elements of the Customer Journey Map (CJM), commonly used in marketing, to assess the user experience.

The user tasks were real-life scenarios in which the participants had to perform a sequence of actions. They were asked to: 1) access the platform; 2) register an account; 3) log in to their account; 4) select one of the areas (e.g., 'Assignments', 'Theory', 'Practical tasks', 'Calendar', 'Lesson plan', 'Additional materials'); 5) complete a task using the platform's tools (e.g. search for lessons, work with additional information sources in text, audio and video formats, etc.); 6) check their answers and compare them with the answers suggested by the system; 7) communicate using the platform's integrated tools; 8) evaluate the accessibility of text, audio and video content and other features.

Tasks 1 to 7 were rated on a 5-point scale: 1 point – the task is not solvable; 2 points – the task can only be solved with the help of a sighted assistant; 3 points – the task is partially solvable; 4 points – the task is solvable but requires a lot of time and effort; 5 points – the task is easily solvable.

Task 8 was evaluated based on the participants' assessment of the platform's accessibility in terms of the perceptibility of materials, user-friendliness of content and tools, clarity of the interface and materials, and the reliability of the platform. A 3-point scale was used: 1 point – the web content does not fulfill the main principles; 2 points – the web content partially fulfills the principles; 3 points – the web content fully fulfills all principles.

To test the accessibility of the DLE, all participants used their PCs with Windows 10 and the screen-reading software JAWS (Job Access With Speech) and NVDA (NonVisual Desktop Access).

Research Results

The analysis of the tasks (1–7) that required a sequence of user actions reflects the typical workflow of an average user. The data indicate that the needs of users with visual impairments are often overlooked in the development of DLE. Specifically:

1. All blind and visually impaired participants (100%) were able to access the platforms without significant difficulties. This task did not take much time.

2. The majority of participants had difficulty registering. Without the help of commonly sighted people, 60% of the blind users (4 pupils and 2 students) and 50% of the visually impaired users (3 pupils and

2 students) were unable to complete the task. They lacked the time given by the web developers to enter an SMS verification code. The participants stated that the limited time caused stress, which negatively impacted their ability to use the keyboard.

40% of the blind users (1 pupil and 3 students) and 20% of the visually impaired users (1 pupil and 1 student) required considerable effort to complete the task. They had to request and re-enter the SMS code several times. The limited time had a negative impact on their performance, and despite repeated attempts, they were unable to complete the registration successfully.

Only 30% of the visually impaired participants (2 pupils and 1 student) completed the task with ease, as their central visual acuity in the better-sighted eye was approximately 20%. They relied mainly on their residual vision to solve the task.

3. All blind and visually impaired participants (100%) were able to access their accounts on the tested platforms successfully. This task did not require much effort from them.

4. When selecting one of the available sections (‘Assignments’, ‘Theory’, ‘Practical tasks’, ‘Calendar’, ‘Lesson plan’, ‘Additional materials’), 100% of the blind participants had difficulties.

Seventy percent of the blind participants (5 pupils and 2 students) had trouble navigating the websites. They first had to guess the purpose of the different sections or tools, relying on some context, and then test these assumptions through trial and error. Many reported that the fear of making mistakes significantly slowed down their actions. In contrast, sighted users with sufficient digital literacy usually perform such tasks automatically by relying on visual cues.

30% of the blind participants (3 students) used the arrow keys to navigate the platform. They stated that they needed a lot of time to understand how the navigation worked. None of the blind users were able to solve the task independently.

When selecting sections on the platforms, 100% of the visually impaired participants initially relied on their eyesight. All participants reported physical discomfort due to the lack of adapted content, which harmed both the speed and quality of their work.

Only 30% of the visually impaired participants used screen reader software to complete the task. Most avoided such aids, probably because they deliberately did not want to identify themselves as visually impaired.

One hundred percent of the visually impaired participants completed the task.

5. Completing the task that required the use of platform tools was a particular challenge for all participants. All blind users required a significant amount of time to locate the desired lesson in the course list and access its content. They found that one of the three platforms had no semantic labeling, which made navigation particularly difficult. When a lesson was selected, a new tab often did not open, forcing users to navigate aimlessly. Further complications arose when tools and text were moved down the page and replaced with new content. This significantly impaired navigation and substantially slowed access to the lesson material.

Users had problems with the lessons because the theoretical content and the exercises were not separated from each other. Navigation through the text and tools was done with the up and down arrow keys. These actions were time-consuming and demanding, as users had to filter out irrelevant information to find the relevant data.

All blind users (100%) had difficulties with almost all information sources on the platforms. Presentations were inaccessible: slides could not be manually advanced, and background music interfered with the screen reader software. As hearing is the primary source of information for blind users, problems with audio settings negatively affect their concentration, efficiency, and understanding of information.

Users also had difficulties with video content: The player on the first platform did not support keyboard control. Illustrations and videos lacked audio descriptions. Blind users were not able to complete this task independently.

Only 60% of blind participants (2 pupils and 4 students) completed the lesson. In comparison, 40% (3 pupils and 1 student) failed the task due to difficulty understanding the material, controlling the content, and feeling physically uncomfortable.

All visually impaired users (100%) experienced difficulty searching for the desired lesson, navigating through its components, and accessing additional information. The lack of an alternative control panel caused physical discomfort, slowed task completion, and increased workload. All participants struggled to distinguish between a pen and a pencil on a virtual whiteboard on one of the platforms. For visually impaired users, it is a challenge to perceive dashed lines on screen drawings and notes. This high visual load leads to rapid fatigue.

Fifty percent of the visually impaired users (1 pupil and 4 students) completed the lesson. The remaining 50% (5 pupils) were unable to

complete the lesson due to difficulties with content perception, navigation, and physical discomfort.

6. All three platforms presented a challenge for 100% of blind and visually impaired users when checking their answers. Blind users, in particular, struggled with page navigation. On one platform, for example, the text moved to the top and was replaced by the system-generated answer. As blocks such as 'teaching material', 'tasks', 'student response', and 'system response' were not separated, blind users had to analyze the text line by line to identify the individual sections. This made interacting with the content time-consuming and tedious.

On another platform, the correct answer was indicated by a color only. Since screen readers cannot recognize color-based cues, blind users had to rely on external help. None of the blind participants were able to solve this task independently.

All visually impaired users had difficulties due to the poor formatting and the large amount of information. Although the task required considerable physical effort and time, they were eventually able to solve it.

7. Only the visually impaired participants (100%) were able to communicate successfully via the tested platforms. They reported no significant difficulties in completing the task.

In contrast, 60% of the blind users (5 pupils, 1 student) had difficulties with the unlabeled menu buttons, which the screen readers identified as "button without label 1", "button without label 2", etc. They were unable to solve the task.

To solve this task, 30% of the blind users (3 students) relied on their logic. They navigated between buttons labeled with symbols using the arrow keys and activated actions utilizing the spacebar. If they were unsuccessful, they returned to the home page. Despite their efforts, none of them managed to solve the task.

Additionally, 10% of blind users (1 student) encountered technical difficulties and required assistance from sighted individuals.

From the results, it can be concluded that blind and visually impaired people, unlike sighted users, often have to guess the function of digital aids while keeping track of various navigation information, focusing on details, and seeking help from sighted users. Their success in completing user tasks also depends on their ability to navigate the keyboard, visualize the page structure, choose appropriate problem-solving strategies, and respond quickly to changing conditions. All these factors,

together with the quality of the content, have a direct impact on the efficiency and speed of their work.

The results of Task 8, summarized in Table 1, indicate that developers of digital learning environments frequently overlook key accessibility principles.

Table 1

Accessibility of Text, Audio, Video Materials, and Other Tools

Parameter	Initial Condition	Accessibility Assessment
Perceptivity	• Button icons lack text labels. • Icons are small and faint; • Fonts are small, light gray on white or light blue background; • Overuse of emojis, overlapping images; • Central control panel in gray; • Smartboard lines are low contrast and dashed	Web content does not meet the perceptivity principle
Operability	• No alternative version of the site for visually impaired users; • Navigation using Tab and Enter is difficult; • Pages lack subheadings; • “Notification” and “Interactive Control” buttons are not voiced; • Video player buttons are labeled in English; • Hard to adjust settings like “change content” or “theme”; • Few hyperlinks are available; • Smartboard tools (pen, pencil) look identical	Web content does not meet the operability principle
Clarity	• Excessive and redundant information; • No text alternatives for audio and video content; • Many sections per page; navigation requires the arrow keys; • Overloaded with text; • Inconsistent design across sections; makes it harder to navigate through web pages	Web content does not meet the clarity principle
Reliability	• Platform functionality is unclear and unpredictable; • Content is largely incompatible with screen readers	Web content does not meet the reliability principle

According to the data presented in Table 1, the degree to which content meets the criteria of perceptibility, usability, clarity, and reliability influences the motivation of blind and visually impaired users to work with digital tools and affects their self-esteem and desire for autonomy compared to sighted people.

A statistical data analysis method was used to validate the results obtained when solving user tasks. The analysis of statistical differences

between the two independent groups, performed using the Kolmogorov-Smirnov test, is shown in Table 2.

Table 2

Statistical Data Analysis

Parameter	Category		$p_{k\text{-}s}$
	Blind	Visually Impaired	
Percentage of the Tasks Completed Independently	0.37 ± 0.49	0.83 ± 0.38	$p < 0.001$

The value of the Kolmogorov-Smirnov test is below the threshold ($p < 0.05$), indicating a statistically significant difference between the two groups. Therefore, the results of the multiparametric assessment of the user experience of blind and visually impaired participants can be considered reliable.

Discussion. Based on the data we obtained while testing digital learning environments (DLE) of online schools, we highlight important points that we believe should contribute to the development and adaptation of web tools for people with visual impairments, both in our country and internationally.

1. The development of DLEs that are accessible to people with visual impairments cannot be done effectively by developers working in isolation or relying on the experience of a single company or country. This results in valuable international knowledge being overlooked, often perceived as unattainable. As a result, developers usually rely on subjective experience and limited information, which can lead to impractical solutions.

On a global scale, this situation leads to an imbalance in internet access between countries, which inevitably affects the quality of online education worldwide. A viable solution would be to create an international database of the most effective and inclusive designs for digital platforms.

2. The design of accessible DLEs should be based on uniform standards established by international law and ratified by individual countries. An example of such an approach is the Convention on the Rights of Persons with Disabilities. This step would help eliminate the legal ambiguity that exists in some countries where specific regulations formalize accessibility efforts, while others treat such regulations as optional. The legal systems of countries with extensive experience in regulating accessibility issues could serve as a basis for such a normative framework. This approach would help standardize national regulations

and make their implementation mandatory, promoting greater consistency and inclusivity across all digital platforms.

3. The design of accessible DLEs requires the adoption of a uniform accessibility criterion. It can be based on the Web Content Accessibility Guidelines (WCAG), which are also supported by the Russian GOST R 52872-2019. According to the WCAG, there are three levels of accessibility for visually impaired users: Level A (basic), Level AA (improved), and Level AAA (optimal). Platforms are generally suitable for visually impaired users if the developers declare that they meet accessibility level AA. If the highest level (AAA) is claimed, the content is designed to be suitable for blind users with residual vision or for users with tunnel vision. However, the official guidelines make it clear that the AAA level is not a mandatory standard for all DLEs, as not all materials can realistically meet all AAA requirements.

4. Developing an accessible DLE requires a unified algorithm that aims to solve common problems that occur on many web platforms. As such:

A. Simplify the registration process or extend the time to enter a user verification code.

B. Develop a unified platform builder that allows flexible customization of components to individual user needs and supports content variability, different visualization formats with identical content. The design should be based on the Russian GOST R 52872-2019, which follows the WCAG framework. The platform builder should be an open-source program (e.g., a cross-platform editor such as Visual Studio Code (VS Code), developed by Microsoft, could be used [6]). The modern programming language JavaScript, which can interact directly with HTML in the browser, offers a wide range of functions. It enables dynamic, interactive content and improves the user's interaction with DLE.

C. he design of the DLE should be adapted to the needs of visually impaired users, taking into account current standards for the adaptation of visual elements. A standards-based design approach ensures the correct display of content on different screen sizes.

D. Severely visually impaired users (0.05–0.09% visual acuity) should have access to an alternative 'low vision' version of the website, along with the ability to return to the default view. Although this is often considered optional, we argue that such a version will increase the flexibility and effectiveness of the learning process. Most importantly, work productivity is ensured by a straightforward interface and easy

management of tools. These are crucial factors for blind and visually impaired learners, whose digital literacy is often still low, even in adolescence. A standardized model, which some government agencies have already adopted, can serve as a basis for this approach. According to the guidelines, access to the alternative version of the platform must be possible from the homepage. The button, which is often represented by a graphic symbol, should be accompanied by high-contrast text. The alternative page should include a special settings panel that allows users to customize the following parameters: Font size: standard, medium or large; Color filter; Font: switch to Arial or Times New Roman; Letter spacing (kerning): Standard, medium or wide; color scheme options: white text on black background, dark blue text on light blue background, brown text on beige background, green text on brown background; visual content: turn images on/off; brightness and contrast of all elements; cursor adjustment: size and color of mouse pointer and text cursor; screen magnifier; screen reader: adjustable speech speed, pitch and volume. To improve usability, the alternative version should be accessible across multiple platform pages while the content remains identical.

E. Ensure compliance with the contrast standards defined by WCAG and GOST R 52872-2019, as text contrast significantly affects readability for visually impaired learners. For accessibility level AA, the visual presentation of text and text embedded in images must have a contrast ratio of at least 4.5:1. An exception applies to large-format text (enlarged text or graphic text), for which a minimum contrast ratio of 3:1 is required. According to the highest contrast requirements of accessibility level AAA, the visual presentation of text and graphic text must have a contrast ratio of at least 7 : 1. Exceptions apply to large-format text, which must have a minimum contrast ratio of 4.5 : 1. The standards also emphasize that the size and weight of the font influence the perceived contrast. According to current standards, the following parameters should be observed: Large font sizes should be between 18 and 24 points, while bold text should maintain a size of 14 points. For optimal readability, fonts must have a minimum contrast ratio of 3 : 1 for good accessibility and 4.5 : 1 for excellent accessibility. Designers can verify these parameters using specialized tools, such as the Contrast Checker, which analyzes hexadecimal color codes for text/background combinations.

F. Special attention should be paid to font families, i.e., fonts that differ in weight and size but have the same design characteristics.

Instructional materials for visually impaired students are usually printed in sans serif fonts, such as Arial, which do not contain distracting details and reduce visual fatigue. The same principle should apply to web content, as sans serif fonts are generally easier to read on screens. For large sections of text on web pages, it is recommended to use sans-serif fonts for headlines and serif fonts for the body text.

G. When designing accessible DLEs, horizontal scrolling should be avoided. Students with severe visual impairments often struggle to control the cursor within the standard scroll range, which can result in limited page functionality and the loss of some content. However, there is not yet enough data to determine how such losses affect overall comprehension of website content. This approach aligns with the WCAG and GOST R 52872-2019 guidelines on text resizing. According to AAA-level accessibility standards, text should be scalable up to 200% without requiring assistive technologies. This allows visually impaired users to read the content in full-screen mode without relying on horizontal scrolling.

H. A standardized text layout should be implemented on all DLE pages. According to WCAG and GOST R 52872-2019, text blocks must be arranged to ensure readability for users with visual impairments. The following formatting rules apply for accessibility level AA: Letter spacing should be 0.12 times the font size; word spacing should be 0.16 times the font size; line width should not exceed 80 characters in a 14-point font; line spacing within a paragraph should be 1.5 times the font size; and spacing between paragraphs should be twice the font size. According to accessibility level AAA, the width of a line of text in a standard 18-point font or a bold 14-point font should not exceed 80 characters. Additionally, the text should not be aligned both left and right at the same time.

I. Blind users should have unrestricted access to PDF files and graphical content on websites with the help of screen reader software. These programs convert screen information into speech and/or a tactile Braille display. To ensure accessibility, PDF files must contain a readable text layer. Decorative graphic elements are exempt from this requirement. Newer versions of screen readers can describe simple images, but excessive descriptions can distract blind users from the actual content.

J. It is essential to ensure stable synchronization between DLE and assistive technologies such as screen readers and screen magnifiers that are intended to support interaction with visual information. To achieve

this, developers should increase their knowledge of the functions of these assistive technologies, understand how the information is displayed, and ensure compatibility with major operating systems and browsers. Including visually impaired people in the development of DLE is also an important step towards creating accessible platforms.

5. Accessible DLEs must offer explicit content. This applies to both the clarity of the textual information and the user interface. Educational and reference materials should be written with the needs of learners in mind. It is necessary to maximize the use of web technologies and APIs, from proper language markup to interaction with screen access programs, to ensure that the content is understandable and the user interface is user-friendly for visually impaired users.

As mentioned above, the highest accessibility standards (AAA level) apply to the entire website, although it is not always possible to meet all criteria for every single element. According to the AAA guidelines, developers should provide explanations for unusual expressions, idioms, jargon, abbreviations, and complex content. This requirement is particularly relevant in educational contexts for users with visual impairments, as their language is often characterized by verbalism – that is, they know the dictionary meanings of words without fully understanding their applications in real-life situations. One possible solution is the use of tooltips or pop-up hints, which can be implemented in HTML. However, this method is not readily applicable to PDF documents. In addition, the practical applicability and technical feasibility of such explanations remain open questions.

Conclusion. The proposed approach to developing digital learning environments (DLEs) that are accessible to users with visual impairments is a complex process. As the analysis of currently operating online school platforms shows, this issue has not yet been fully addressed.

The development of accessible DLEs requires the consideration of international and national experiences as well as the creation and ratification of a uniform legal framework based on existing laws. It also involves consideration of how blind and visually impaired users process web-based information, navigate digital environments, and interact with screen-reading and screen-magnification programs. The study highlights the urgent need to establish standard web content accessibility criteria for all developers.

The information presented broadens the understanding of how to design content that is accessible to people with visual impairments and

the challenges these users face on websites. The proposed framework can be utilized by developers creating digital tools designed not only for individuals with visual impairments, but also for other vulnerable groups.

It is a global issue because digitization involves not only the creation of a web space accessible to all users regardless of their psychophysical abilities, nationality or educational background, but also the preparation of qualified professionals and developers, the training of educators who can teach users how to use these tools, the promotion of skills for socialization and communication in the digital environment and the creation of a legal framework that regulates interactions on the Internet.

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ПСИХОЛОГО-ПЕДАГОГИЧЕСКИЙ АНАЛИЗ ДОСТУПНОСТИ И ПРОЕКТИРОВОЧНЫХ РЕШЕНИЙ ЦИФРОВОЙ ОБРАЗОВАТЕЛЬНОЙ СРЕДЫ ДЛЯ ОБУЧАЮЩИХСЯ С НАРУШЕНИЯМИ ЗРЕНИЯ

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Аннотация. В эпоху глобальной цифровизации особую актуальность приобретают проблемы проектирования веб-контента, ориентированного на потребности разных категорий пользователей, в том числе и лиц с нарушениями зрения. В России данная деятельность регламентируется ГОСТ Р 52872-2019 и приказами Минцифры России. Однако в нашей стране соблюдение норм, определяющих проектирование доступной цифровой образовательной среды, носит добровольный характер. В результате слепые и слабовидящие пользователи нередко сталкиваются с трудностями, возникающими у них при доступе к цифровым образовательным, развлекательным и социальным сервисам. Сложившаяся ситуация обусловила необходимость выявления актуального состояния доступности онлайн-платформ для слепых и слабовидящих пользователей, поиска оптимальных решений, обеспечивающих доступность цифровой образовательной среды лицам с нарушениями зрения. При работе свое применение нашли методы (эвристический, анализ данных, тестирование, обобщения полученных результатов, статистической обработки данных (критерий Колмогорова-Смирнова), методики оценки индекса клиентских усилий (Customer Effort Score) и элементы построения карты-пути пользователя (Customer Journey Map, CJM). Пользователям предлагалось решить 8 стандартных пользовательских задач. В исследовании на добровольной основе задействовались 10 слепых и 10 слабовидящих обучающихся в возрасте от 15 до 20 лет из городов Москва, Ульяновск и Чебоксары. Результаты исследования позволяют расширить представления об особенностях работы слепых и слабовидящих пользователей в условиях цифровой образовательной среды. Согласно полученным данным, проектирование цифровой образовательной среды предусматривает необходимость учета международного и отечественного опыта; создание общей нормативной базы для всех стран; анализа доступности веб-инструментов; ориентации на особенности восприятия информации слепыми и слабовидящими, их навигации в цифровом пространстве, функционирования программ экранного доступа и программ увеличения экрана; принятия общих для всех разработчиков критериев доступности контента. Представленные данные найдут применение у разработчиков и исследователей, решающих проблемы создания цифровых инструментов для лиц с нарушениями зрения и других категорий пользователей.

Ключевые слова: *лица с нарушениями зрения; доступность; цифровая образовательная среда; разработка*

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