ACADEMIC JOURNAL OF SCIENCE, TECHNOLOGY AND EDUCATION

CONTENT

The Relevance of Green Technology Integration in International Governance Processes

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Abstract: This article examines the role of international governance in coordinating environmental policies and the relevance of implementing green technologies. In particular, international legal frameworks such as the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement are considered as key instruments for ensuring policy coherence across states. The main trends in the development of green technologies are illustrated through renewable energy, electric vehicles, the circular economy concept, and smart city initiatives. Using Uzbekistan as a case study, the article analyzes renewable energy projects, water-saving technologies, and international cooperation programs, while emphasizing the importance of adapting advanced foreign practices to national conditions. The conclusion argues that the coordinating role of international governance in environmental policy is a crucial factor for the widespread implementation of green technologies and the transition of national economies toward low-carbon development.

Keywords: international governance, green technologies, sustainable development

Introduction. International governance is a complex interconnection between states, international organizations, and transnational corporations, requiring political coordination in addressing global environmental challenges. The 2030 Agenda for Sustainable Development (SDGs), adopted by the UN in 2015 and endorsed by all UN member states, calls on countries to harmonize policies in areas such as climate action, sustainable energy, and efficient resource management. The SDGs clearly define the necessity of "global partnership" and the alignment of national policies with international objectives [1].

Analysis and Results. One of the most central legal instruments of climate policy is the Paris Agreement, adopted at the COP21 Summit in 2015 and entering into force on November 4, 2016. The Paris Agreement obliges states to reduce emissions through their nationally determined contributions (NDCs) and to introduce a global stocktake mechanism every five years to assess collective progress. This encourages the alignment of national policies with international requirements and scientific objectives [2].

In addition, international governance bodies - such as the OECD and other institutions - are strengthening policy coherence between countries and regions, promoting operational actions by monitoring climate finance flows, and grounding decisions in scientific evidence. According to OECD data, in line with IPCC recommendations, to limit global warming to 1.5°C by 2030, greenhouse gas (GHG) emissions must be reduced by approximately 43% compared to 2019 levels [3]. However, current national commitments do not fully bridge this gap, which underscores the urgent need to align national policies with the Paris objectives.

Another important aspect is the harmonization of regional and sectoral initiatives (for example, the European Union's European Green Deal) with national and corporate strategies, directing them toward green investments, technological transition, and carbon neutrality. Such block-level policies encourage the adoption of green technologies not only through regulatory pressure but also via economic incentives, such as subsidies, taxation, and green bonds [4].

The function of international governance in coordinating environmental policy is not merely a legal or diplomatic obligation but serves as a central mechanism for shaping practical changes through scientific objectives, financial flows, and regional strategies. Through this mechanism, it is possible to implement green technologies on a large scale and adapt national economies to low-carbon development [5]. Over the last decade, several significant trends have been observed in the development of green technologies.

Firstly, renewable energy sources are expanding. For instance, in 2021 nearly 80 percent of newly installed global power capacity came from renewable energy sources, with the largest share accounted for by solar and wind power plants [6]. China, the United States, and India are recognized as leaders in this field.

Secondly, the use of electric and hybrid vehicles in the transport sector is rapidly increasing. According to a BloombergNEF (2023) report [7], by 2030 more than 200 million electric vehicles are expected to be on the roads. This process not only reduces carbon emissions but also significantly decreases global demand for oil.

Thirdly, in the field of waste management, the concept of a "circular economy" is being widely implemented. This approach is based on the reuse and recycling of resources throughout the entire process - from production to consumption and disposal. In the European Union, for example, recycled waste accounts for 47 percent of total waste generated [8].

Fourthly, "smart city" projects are expanding. The smart city concept is based on the efficient management of energy, water, and transport systems through digital technologies. According to McKinsey Global Institute (2018) [9], the large-scale introduction of smart city technologies can reduce urban energy consumption by 20–30 percent. Overall, these trends outline the main directions that integrate international governance with ecological sustainability.

Transnational corporations (TNCs), as the largest players in the global economy, play a significant role in the widespread adoption of green technologies. Since the activities of TNCs impact many countries, their environmental strategies have become an integral part of the international governance system. For example, Tesla Inc., through the popularization of electric vehicles and renewable energy solutions, has provided a strong impetus for the automotive industry's transition to carbon neutrality [10]. Apple has announced its goal to achieve carbon neutrality across its entire value chain by 2030 and has already transitioned all of its offices and manufacturing facilities to 100% renewable energy [11]. Similarly, Toyota is taking the lead in green transportation through its "Hybrid Synergy Drive" technology and the development of hydrogen-powered vehicles [12].

In recent years, ESG (Environmental, Social, Governance) standards have emerged as the primary criteria for assessing the environmental responsibility of transnational corporations (TNCs). ESG indicators allow for the evaluation of companies' performance not only in terms of economic efficiency but also in ecological and social sustainability. For example, in its 2022 report, MSCI ESG Ratings assessed more than 2,800 major corporations worldwide, of which over 70 percent strengthened their commitments in at least one environmental indicator [13]. The World Bank also emphasizes that the adoption of ESG standards can facilitate the formation of sustainable financial flows [14].

Green technologies not only ensure environmental safety but also play an important role in enhancing economic efficiency.

Firstly, the efficient use of resources significantly reduces energy and raw material consumption in the production process. According to the International Labour Organization's estimates [15], the widespread implementation of the green economy concept could increase global GDP by 4.2 percent by 2030.

Secondly, green technologies create new opportunities in the labor market. For instance, in 2022 more than 13 million people were employed in the renewable energy sector, and this figure is projected to reach 38 million by 2030 [16]. This trend strengthens not only economic growth but also social stability.

Thirdly, green technologies are shaping new segments of financial markets. "Green finance" mechanisms, particularly the green bonds market, are rapidly expanding. In 2023, the global volume of green bonds exceeded USD 2 trillion, reflecting the growing interest of international investors in environmental projects [17]. Moreover, according to OECD (2022) [18], at least USD 6.9 trillion in annual investments will be required to achieve carbon neutrality by 2050 through the promotion of green investments.

Overall, green technologies are becoming a key factor not only in ensuring ecological sustainability but also in strengthening economic resilience through economic growth, employment generation, and the formation of sustainable investments.

In recent years, the development of green economy principles in Uzbekistan has become one of the government's priority policy directions. The "Green Economy Transition Strategy," adopted in 2019 [19], serves as the country's main conceptual framework for sustainable development. Within this strategy, a series of measures have been implemented to promote renewable energy sources, ensure efficient use of resources, and maintain ecological sustainability.

Significant projects for the construction of solar and wind power plants are being implemented. For example, in 2021, in cooperation with the Masdar company from the United Arab Emirates, the 100 MW Nur-Navoi Solar Power Plant was commissioned. Additionally, in 2023, large-scale wind power projects began in the Qashqadaryo and Bukhara regions [20].

Furthermore, water-saving technologies are being widely introduced. According to the 2022 report of the Ministry of Agriculture of the Republic of Uzbekistan, drip irrigation systems have been implemented on more than one million hectares, reducing water consumption by an average of 40 percent.

The adoption of international experience is also a key direction. For instance, China's investments in renewable energy, Germany's "Energiewende" program, and South Korea's "Green Growth" strategy serve as effective models for Uzbekistan. These experiences are applied in the country to implement environmentally friendly production, improve energy efficiency, and develop sustainable agriculture projects.

Overall, Uzbekistan aims to achieve sustainable development by expanding international cooperation in the green economy transition and integrating national experience with advanced foreign practices.

Conclusion. Integrating green technologies into the international governance system is one of the central issues of today's global economic and ecological agenda. Analyses indicate that cooperation among international organizations, states, and transnational corporations plays a decisive role in ensuring ecological security and achieving sustainable development goals. The United Nations' Sustainable Development Goals, the Paris Climate Agreement, and other international initiatives provide an important legal and institutional basis for coordinating national environmental policies.

Green technologies not only protect the environment but also enhance economic efficiency. Renewable energy, electric vehicles, waste recycling, and "smart city" concepts are creating new markets and investment flows. In this process, transnational corporations and ESG standards play a crucial role as practical expressions of international governance mechanisms.

The experience of Uzbekistan demonstrates that renewable energy projects, water-saving technologies, and resource-efficient initiatives implemented through international cooperation are important steps in aligning the national economy with low-carbon development. Therefore, the coordinating role of international governance should be considered one of the key factors in the widespread implementation of green technologies and the promotion of sustainable development at both national and global levels.

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Innovative approaches to teaching librarianship in the digital age

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Abstract: The digital age has transformed the landscape of librarianship, reshaping the skills, knowledge, and values required of professionals in the field. This article explores innovative approaches to teaching librarianship that respond to the evolving demands of the information environment. It emphasizes the integration of active learning, interdisciplinary collaboration, and the use of digital tools as both subject matter and pedagogical methods. The discussion highlights the importance of cultivating digital literacy, ethical awareness, research competence, and leadership skills among students in library and information science programs. Challenges such as unequal access to technology, the need for lifelong learning, and the preservation of core professional values are examined alongside opportunities for global collaboration and the development of resilient, adaptable graduates. By analyzing the pedagogical implications of technological and societal shifts, the article argues that teaching librarianship must be both innovative and deeply grounded in the enduring principles of equity, intellectual freedom, and service to communities. The conclusion underscores the necessity of preparing future librarians not only as skilled practitioners but also as imaginative leaders capable of shaping the profession in a rapidly changing digital environment.

Keywords: teaching librarianship, digital age, information literacy, digital literacy, innovation in library education, library pedagogy

Teaching librarianship in the contemporary era demands a constant re-examination of pedagogical approaches, curricular design, and the integration of technological advancements that are reshaping the information landscape. The digital age has altered how information is created, disseminated, accessed, and evaluated, and this transformation requires that those preparing future librarians adopt innovative methods of teaching. A profession that once centered primarily on cataloguing, classification, and the management of physical collections now faces the necessity of equipping students with competencies in digital literacy, data management, open access publishing, user-centered services, and emerging technologies such as artificial intelligence and machine learning. Consequently, teaching librarianship is no longer limited to the transmission of traditional professional knowledge; it involves nurturing adaptability, critical thinking, and the capacity to innovate within fluid and sometimes unpredictable informational environments.

At the heart of this shift is the recognition that libraries are not static repositories but dynamic spaces of knowledge exchange. Students in library and information science programs must be prepared to serve users whose needs are diverse, complex, and increasingly mediated by digital technologies. Teaching strategies that were once based on passive learning through lectures and rote memorization of classification systems are insufficient for cultivating the skills required to navigate and shape the digital information ecosystem. Instead, instructors must engage students in active, participatory learning experiences that mirror the real-world challenges of the profession. For instance, rather than simply learning the mechanics of a metadata schema, students can be guided through collaborative projects that involve designing digital collections or experimenting with linked open data. Such experiential learning enables them to understand not only the technical aspects but also the ethical, social, and cultural implications of their work.

Another important dimension of teaching librarianship in the digital age is the cultivation of digital literacy. While the concept of information literacy has long been central to the profession, the digital context requires librarians to engage with multimodal sources, algorithmic bias, data privacy, and the evaluation of information in networked spaces. Educators must therefore help students navigate the complex interplay between information and technology, ensuring they can support users in evaluating sources, recognizing misinformation, and understanding the invisible infrastructures of digital platforms. This can be achieved by embedding critical digital literacy across the curriculum, where students not only acquire technical skills but also interrogate the power structures and inequities embedded in digital systems. Such approaches allow future librarians to position themselves as advocates for equitable access to information and defenders of intellectual freedom in the digital environment.

The teaching of librarianship is also being reshaped by the demand for interdisciplinary knowledge. Librarians increasingly work alongside professionals from fields such as computer science, education, media studies, and the social sciences. Preparing students for these collaborations requires curricula that integrate elements of coding, instructional design, data science, and cultural studies into the traditional foundations of library science. Instructors must be prepared to adopt pedagogical approaches that are flexible and integrative, encouraging students to apply knowledge from diverse domains to library practice. For example, a course on information organization can include a component on database design, while instruction in reference services can incorporate training in educational technologies and user experience design. This interdisciplinary orientation ensures that graduates are capable of responding to the multifaceted needs of their communities.

One of the most innovative trends in teaching librarianship involves the use of technology not only as subject matter but as a teaching tool. Learning management systems, online collaboration platforms, and digital repositories enable instructors to create blended and fully online courses that expand access to library education. Simulation tools and virtual reality environments provide opportunities for students to practice reference interviews or collection management in immersive scenarios, preparing them for the realities of professional practice in a low-risk environment. Moreover, digital platforms allow for global collaboration, where students from different countries can work together on shared projects, gaining insights into international librarianship and the cultural diversity of information practices. Such methods enhance not only technical competence but also intercultural understanding, which is vital in a profession dedicated to serving diverse communities.

Teaching librarianship in the digital age also requires a focus on research skills and evidence-based practice. Students must learn to critically evaluate scholarly literature, design and conduct research studies, and apply findings to improve library services. This emphasis aligns with the broader academic environment, where libraries are increasingly recognized as partners in research and knowledge production. Instructors can foster these skills by incorporating research projects, encouraging students to publish their findings, and providing mentorship in scholarly communication. In doing so, library education contributes to the professionalization of the field and ensures that future librarians are not only consumers of research but active contributors to the knowledge base of librarianship.

An essential aspect of innovative teaching in librarianship is the integration of ethics and social responsibility into every aspect of the curriculum. The digital age raises profound ethical challenges related to surveillance, data privacy, intellectual property, and the digital divide. Librarians must be equipped to navigate these challenges thoughtfully and to guide their communities in making informed decisions. Teaching ethics cannot be confined to a single course; rather, it should permeate discussions of cataloguing, digital resource management, information literacy instruction, and public

service. By encouraging students to reflect critically on ethical dilemmas and to engage with issues of social justice, instructors help to cultivate professionals who are not only skilled but also conscientious in their service to society.

Another area of innovation in teaching librarianship is the emphasis on leadership and advocacy. As libraries face pressures of funding cuts, policy debates, and shifting user expectations, librarians must be prepared to advocate for their institutions and the values of the profession. Teaching future librarians to communicate effectively with stakeholders, to demonstrate the impact of library services, and to lead organizational change is therefore a critical component of modern curricula. Instructors can foster these abilities through project-based learning, community engagement, and opportunities for students to design and implement advocacy campaigns. Such experiences prepare graduates to become not only competent practitioners but also leaders who can influence the future of libraries in the digital age.

The rapid pace of technological change also underscores the importance of teaching adaptability and lifelong learning. No single curriculum can cover all of the tools and trends that students will encounter throughout their careers. Instead, educators must instill in students the capacity to learn continuously, to evaluate new technologies critically, and to integrate them thoughtfully into professional practice. This requires a pedagogical focus on metacognition, where students become aware of their own learning processes and develop strategies for ongoing professional development. Encouraging participation in professional associations, engagement with online communities of practice, and involvement in continuing education initiatives can further support this goal.

Despite the many opportunities afforded by digital innovations, teaching librarianship also faces challenges. The rapid introduction of new technologies can create disparities in access to resources among institutions, with some students benefiting from state-of-the-art tools while others lack even basic digital infrastructure. Instructors must navigate these inequalities by seeking creative solutions, such as open educational resources, partnerships with technology providers, and the use of freely available platforms. Furthermore, the pressure to adopt new technologies should not overshadow the enduring values of librarianship, such as the commitment to intellectual freedom, equity of access, and the preservation of cultural heritage. Teaching in the digital age requires a careful balance between embracing innovation and maintaining fidelity to these core principles.

The global dimension of librarianship adds another layer of complexity to teaching. As information flows transcend national boundaries, students must be prepared to understand international standards, participate in cross-border collaborations, and address the needs of multicultural communities. Teaching strategies that include comparative case studies, international exchanges, and exposure to global perspectives enrich the educational experience and prepare graduates for work in diverse contexts. This global orientation is particularly important in the digital age, where issues such as open access, digital preservation, and intellectual property are debated on an international scale.

Ultimately, innovative approaches to teaching librarianship in the digital age revolve around the creation of learning environments that are dynamic, interdisciplinary, ethically grounded, and responsive to the realities of professional practice. Instructors serve not merely as transmitters of knowledge but as facilitators of discovery, guiding students to become critical thinkers, problem-solvers, and innovators. By embracing active learning, leveraging technology, and fostering collaboration, educators can ensure that graduates are equipped not only with technical skills but also with the vision and resilience to lead the profession into the future. Teaching librarianship is thus both a challenge and an opportunity: a challenge because of the rapid pace of change and the complexity of the digital information landscape, but an opportunity because it allows educators to reimagine the

profession in ways that are more inclusive, more forward-looking, and more impactful than ever before.

As the digital age continues to unfold, the need for innovative teaching approaches in librarianship will only intensify. Emerging technologies such as artificial intelligence, machine learning, and blockchain will pose new questions about the organization, access, and authenticity of information. Societal shifts such as increasing polarization, the spread of misinformation, and the deepening of digital inequalities will require librarians to take on expanded roles as educators, advocates, and community leaders. Preparing students for these realities demands not only a mastery of current practices but also a willingness to envision future possibilities. In this sense, teaching librarianship in the digital age is not just about imparting knowledge but about cultivating imagination, resilience, and a deep sense of professional purpose.

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Methodological possibilities of aesthetic education of young students through cultural events

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Abstract: This article covers the theoretical and methodological foundations of aesthetic education of students and young people through cultural events. It analyzes the issues of forming an artistic and aesthetic worldview, developing creative activity, instilling aesthetic values, developing aesthetic perception and taste, improving personal qualities, and using the capabilities of information and communication technologies. The article reveals the role of cultural events in the process of aesthetic education, based on the fact that they are an important factor in revealing the creative abilities of young people, understanding and appreciating beauty, and achieving spiritual perfection.

Keywords: aesthetic education, cultural event, creative activity, aesthetic value, aesthetic perception, information and communication technology

Methodological possibilities of aesthetic education of students through cultural events

In the aesthetic education of students, cultural events serve as an important methodological tool that enriches the educational and upbringing process, forms creativity and artistic taste. Such events not only provide spiritual nourishment, but also increase the effectiveness of the educational process through various methodological approaches. Cultural events also open up wide possibilities of aesthetic education: they direct young people to the perception of art and culture, to the understanding and appreciation of beauty, and to active participation in creative activities. Below, the main methodological possibilities of this process are considered step by step.

- Formation of artistic and aesthetic worldview

To increase the ability of students to perceive art by involving them in theater, cinema, concerts, museums, exhibitions. Enriching aesthetic taste by introducing them to national and world cultural heritage. This stage is the process of developing in students the ability to see, understand, appreciate and enjoy the beauty in art, culture, nature and life. Simply put, it ensures that they have an aesthetic worldview, feel and apply it in their lives

- Development of creative activity

Creative activity is the process of a student creating a new idea, expressing his/her thoughts in a new way, and actively participating in art and culture. Its development means involving students directly in the creative process, not just as a simple spectator or listener. Active participation of students in stage performances, poetry evenings, musical or dance programs.

Organizing student creative clubs (drama club, singing, painting, design, etc.).

- Interactive methods

Interactive methods are a set of methods that involve students in the educational process not only as listeners, but also as active participants, forming their independent thinking, creative approach and practical attitude to aesthetic values. Through role-playing, students bring works of art, historical events or cultural images to life themselves. This process takes them not only to the level of spectators, but also to the level of creators. Debates and discussions teach them to consider art and aesthetic values from different perspectives, to justify their own opinions. This develops artistic thinking and a critical approach in students.

The importance of interactive methods in aesthetic education

1. Provides active participation - students become not spectators, but direct performers of the process.

2. Enhances creativity - allows not to master a work of art, but to recreate and apply it in practice.

3. Teaches a conscious perception of aesthetic values - forms the ability to not only see or hear beauty, but also to feel and express a personal attitude to it.

4. Develops cooperation and communication - students communicate with each other and learn aesthetic concepts together. For example, Role-playing exercise: Students dramatize the scene of the holiday "Navruz" - in this process they master aesthetic values through national costumes, songs, national traditions. Debate: A debate is organized on the topic "Is modern art important or traditional art?" Through this, students analyze aesthetic concepts and defend their views.

- Information and communication technologies (ICT) opportunities

Making aesthetic education more interesting through multimedia presentations, virtual exhibitions, online concerts and theater performances.

Multimedia presentations - combining color, sound, text, animation and video, convey aesthetic concepts in a lively and impressive way.

Virtual exhibitions - students expand their aesthetic worldview by visiting world museums and art galleries online.

Online concerts and theater performances - students get acquainted with the musical and theatrical art of different countries and feel global aesthetic values.

Practical methods - methods that are implemented in the aesthetic education of students by involving them not only as spectators, but also directly in performing and organizational activities.

• Students organize cultural events themselves: write scripts, distribute roles, select scenery and music.

• In the process, they not only learn aesthetic values, but also learn to apply them in practice.

• This method teaches young people independence, initiative and responsibility.

• Provides active participation - students sincerely enter the process because they do the work with their own hands.

• Develops creativity - each student participates according to their abilities (reading poetry, singing, drawing, staging).

• Teaches teamwork - students work together, learn from each other.

• Forms aesthetic taste - in the process of preparing an event, they become closely acquainted with the elements of art, culture and beauty. Practical methods form students as active creators who create and present art, not just viewers. This is one of the most effective ways of aesthetic education.

Cultural events provide rich methodological opportunities for aesthetic education. They teach students not only to feel beauty, but also to create, appreciate and apply it in everyday life. Therefore, cultural events play an important role in the formation of students as sophisticated, creative and well-rounded individuals.

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Effectiveness and development prospects of digital-pedagogical integration in English language education

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Abstract: This article analyzes the effectiveness of digital-pedagogical integration in English language education, the impact of modern technologies on the learning process, and prospects for future development. It discusses how digital platforms serve to increase students' motivation, foster independent learning, enhance creative thinking, and develop globally competitive competencies.

Keywords: digital-pedagogical integration, interactive learning platforms, digital technologies, interactivity, multimedia tools, online platforms

Introduction

In recent years, the processes of globalization, international cooperation, and increased migration flows have further strengthened the role and significance of English as a language of international communication. English is regarded not only as a key medium for diplomacy, business, science, and technology but also as an essential tool for everyday international communication. Therefore, special attention is given to advanced English language instruction in many countries, including education system of Uzbekistan.

Since the beginning of the 21st century, digital technologies have profoundly transformed the educational paradigm. The Internet, mobile devices, artificial intelligence, distance learning platforms, electronic libraries, and digital laboratories provide opportunities to enhance educational effectiveness and deliver knowledge quickly and conveniently. From this perspective, digital-pedagogical integration - i.e., combining traditional classroom methods with modern information and communication technologies - has become a pressing issue. The importance of this integration grows as technology advances. Digital-pedagogical integration offers several advantages in the learning process:

• Interactivity - enables active two-way communication between students and teachers.

• Flexibility - allows the selection of learning materials adapted to students' individual levels and needs.

• Motivation - makes lessons more engaging and effective, increasing students' interest in language learning through digital tools.

• Transparent assessment - online tests and automated grading systems help evaluate students' knowledge quickly, fairly, and analytically.

The relevance of digital-pedagogical integration lies not only in improving learning efficiency but also in strengthening collaboration between students and teachers, ensuring a student-centered and interactive educational process. Successful implementation requires developing teachers' digital competencies, revising pedagogical methods, and improving technical infrastructure.

In particular, Learning Management Systems (LMS), Massive Open Online Courses (MOOC), mobile applications (Duolingo, LingQ, Memrise), and virtual classrooms (Google Classroom, Moodle, Edmodo) are widely used in English language instruction. These tools not only complement classroom activities but also encourage independent study. Platforms such as Zoom, Google Classroom, and Microsoft Teams are successfully utilized for organizing remote English language learning, further enhancing teaching effectiveness through technological advancements.

Literature Review

In recent years, introducing digital technologies into Uzbekistan's education system has become a key state policy priority. In English language teaching, the use of modern digital tools plays an important role in increasing learning efficiency, strengthening students' motivation, and forming competencies that meet international standards. For this reason, the President of Uzbekistan has signed several decrees and resolutions to strengthen the role of digital technologies in education and integrate them into foreign language instruction to improve quality and effectiveness.

For instance, Decree of the President of the Republic of Uzbekistan DP-6079 on October 5, 2020, approved the "Digital Uzbekistan-2030" strategy, mandating the introduction of electronic textbooks, online platforms, and distance learning systems across educational institutions. National curricula for English teaching are being integrated with digital tools, and teacher training programs now include digital technology training [1]. Higher education institutions are creating electronic educational resource databases for English language courses. Furthermore, the Resolution of the President of the Republic of Uzbekistan RP-178 on May 15, 2024, provides for the establishment of "IT-towns" aimed at creating additional opportunities for youth to master digital technologies and foreign languages [2].

Professor Mark Warschauer of the University of California emphasizes that digital technologies enhance interactivity in language learning, promote independent study, and expand opportunities for intercultural communication. His research explores how digital technologies interconnect with language, culture, and society, while addressing issues of digital divide and inequality. He highlights the effectiveness of using multimedia and tools such as chat, forums, email, virtual exchanges, and tele-collaboration in practical language acquisition [4].

CALL (Computer Assisted Language Learning) researcher Phil Hubbard argues that digital technologies should be viewed not merely as a technical addition but as a fully integrated didactic system. When technologies are applied according to students' needs, goals, and individual learning styles, they yield maximum results. He notes that integrating digital technologies into language learning provides personalized learning paths, opportunities for independent study, and comprehensive language skills development [5].

Uzbek scholar I.M. Tukhtasinov has extensively studied the use of multimedia technologies in foreign language teaching and translation processes. His research highlights the role of multimedia tools in preparing future specialists to work with modern translation systems. According to Tukhtasinov, the use of multimedia technologies (audio, video, interactive programs, animations) in the learning process not only facilitates language acquisition but also enhances the effectiveness of translation training. He stresses the importance of teaching future translators and English teachers to use modern translation memory systems (e.g., SDL Trados, MemoQ, Wordfast). These tools enable consistent style in large-scale translations, automate glossary use, and speed up workflow. Multimedia-based lessons help students strengthen practical skills by simulating real translation processes, analyzing texts, practicing pronunciation, and expanding vocabulary [7].

A.I.Zoirova notes that interactive games are an integral part of digital technologies in foreign language teaching, and gamification techniques actively engage students in the learning process. Using digital games allows students to easily acquire new vocabulary, reinforce grammar rules, and develop communication skills. This approach makes lessons more interesting and motivating, freeing them from traditional, monotonous tasks [3].

In recent years, voice technologies have also gained importance in foreign language learning. For example, students can use Google Translate or other translation applications to hear correct

pronunciations, listen to and read dialogues, and practice speaking. Voice assistants such as Alexa and Siri engage students in conversations, helping them deepen their language skills.

Research Methodology

This study examined the effectiveness and development prospects of digital-pedagogical integration in English language education at higher education institutions, focusing on methods and approaches for achieving efficiency.

The theoretical and methodological basis of this article includes literature and scientific articles on the effectiveness and development of digital-pedagogical integration in English language teaching, as well as the analysis of studies conducted by educators, linguists, translation scholars, and IT specialists.

Analysis and Results

This research focused on the scientific-theoretical foundations, practical effectiveness, and promising development directions of digital-pedagogical integration in English language teaching. The findings show that integrating digital technologies into English instruction not only improves educational quality indicators but also enables a fundamental renewal of the modern education paradigm. In today's globalized world, language teaching requires equipping students not only with linguistic knowledge but also with digital competencies. Digital-pedagogical integration stands out for its flexibility, student-centered approach, interactivity, and advanced analytical assessment mechanisms.

The research revealed several key scientific-pedagogical advantages of digital integration:

• Adaptive learning and personalized pathways: AI-based platforms (e.g., ChatGPT, Grammarly, Duolingo, LingQ) automatically generate content tailored to students' individual needs, learning speed, and interests, promoting differentiated instruction and lifelong learning readiness.

• Multimedia-based cognitive development: Videos, audio, infographics, interactive games, gamification elements, and AR/VR technologies provide multi-channel information perception, enhancing retention and deepening the acquisition of semantic and pragmatic aspects of language.

• Intercultural communication and global competencies: Digital communication platforms (Zoom, Google Meet, Microsoft Teams, Moodle) allow students to engage with international peers in real-time, directly experiencing diverse cultural environments and accelerating English acquisition as a tool of global interaction.

• Innovative assessment mechanisms: Learning analytics, big data, and automated evaluation systems enable real-time monitoring of students' progress, identifying strengths and weaknesses, and developing personalized growth strategies.

Uzbek researchers have also addressed these issues scientifically. I.M. Tukhtasinov developed a methodology to prepare future English teachers for effective use of multimedia tools, translation memory systems, and modern translation technologies. N. Jurayev demonstrated theoretical and practical foundations for ensuring continuous education through digital platforms (Moodle, Google Classroom, Zoom) during the pandemic. A.I. Zoirova provided scientific justification for methods of increasing vocabulary and strengthening grammar through gamification, voice assistants (Alexa, Siri), and digital games.

However, the study also revealed emerging challenges alongside the development of digital integration:

• The need for continuous improvement of teachers' digital competencies.

• Issues of cybersecurity, personal data protection, and academic integrity.

• Social disparities in access to digital tools.

Future development directions will involve more complex technological approaches, such as the widespread implementation of AI-based adaptive learning platforms, conducting English lessons in the metaverse, and applying neurotechnologies for real-time automatic translation and pronunciation analysis.

Conclusion

In conclusion, digital-pedagogical integration in English language education is becoming one of the most effective approaches for improving the quality of teaching and creating a student-centered, flexible, and interactive learning environment. Digital platforms enable students to learn independently, control their learning pace, communicate in real time, and gain intercultural experience. This integration motivates teachers to continuously develop new methodologies, multimedia tools, and digital competencies while helping education meet international quality standards.

Today, it is advisable to continue systematic efforts to enhance the efficiency and sustainability of digital-pedagogical integration in English language teaching in higher education, elevate teaching quality to global standards, and strengthen the international competitiveness of Uzbekistan's education system.

First, it is necessary to develop national digital platforms - creating Uzbek-language interfaces for English learning platforms and mobile applications that meet international standards. This will increase interest in language learning even among students in non-philological fields and expand the community of language learners.

Second, in order to boost student motivation, encourage independent learning, and enrich interactive experiences, the use of digital games, simulations, and virtual laboratories should be widely implemented in language instruction. Such tools not only reinforce knowledge but also develop creative thinking, strengthen social cooperation skills, and prepare students for future professional activities, while providing teachers with opportunities to conduct dynamic, multimedia-based lessons tailored to each learner.

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The role of information and communication technologies in the educational process

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Abstract: The article highlights the issues of the spread of digital technologies, the accelerated development of the digital infrastructure of educational institutions, the training of specialists with modern digital competencies, the renewal of specialties and fields of study taking into account labor market trends, the formation of educational programs based on flexible learning trajectories, the development of the concept of lifelong learning, as well as the processes of introducing artificial intelligence systems into the educational environment.

Keywords: digital technologies, education system, online learning, distance learning, digital transformation, digital learning environment

Introduction. Today, the penetration of digital technologies into all spheres inevitably requires a new quality of education. It is worth noting that high-level changes are observed in the social sphere and in education. Although natural resources and cheap labor are important, they are becoming secondary factors of socio-economic development. The insufficient level of basic knowledge formed by the existing education system is becoming increasingly evident. A successful technological revolution always brings with it the means to solve the problems it creates, and the information (digital) revolution is no exception. Digitalization in education is not preparation for life and work, but lifelong learning and personal development. It should be noted that the widespread use of global information systems and artificial intelligence technologies is helping to implement the necessary changes. Achieving this goal is especially important in connection with the spread of cloud computing, high-speed Internet, the widespread introduction of smart digital tools and virtual technologies. In the era of digitalization, more attention should be paid to the formation of competencies and the development of adaptive skills. Reducing the number of topics required for study allows you to significantly deepen the development of the remaining material, to pay maximum attention to the formation of the necessary skills. As a result, students will have the opportunity to independently master any sections of the subject (if necessary).

International experience shows that the availability of digital technologies for participants in the educational process is a necessary, but not sufficient condition for increasing the effectiveness of educational work.

As a result of scientific research conducted by our scientists on the application of pedagogical technologies in the educational process in the higher education system of our Republic, opportunities are being achieved to find educational technologies that are suitable for the conditions of our Republic. The innovative activity of the teacher is considered a process of creativity and the result of creative activity. The use of existing opportunities for the correct organization of the educational process is the primary task of the teacher. Currently, conducting lessons using traditional and non-traditional lesson models is one of the main requirements for the lesson.

In the current conditions of society, culture and educational development, there is a need for innovative activities of teachers. The effective implementation of innovative activities of teachers depends on a number of conditions. Currently, it is necessary to pay great attention to the fact that in higher educational institutions, specialists who meet the requirements of the time are not only deeply

studied theoretical knowledge, but also highly skilled specialists who have great human qualities, are able to communicate, and master their work.

The use of digital technologies is associated with cloud computing, the spread of public high-speed Internet, the widespread introduction of smart digital tools, the use of artificial intelligence methods, and the widespread introduction of virtual technologies.

Analysis of literature on the topic. According to the research of A.Yu. Uvarova, "personalized learning, or the personalized organization of the educational process, is the dream of many generations of professors and teachers". Here, the learner is not an object that is presented with educational material and "learns knowledge". He acts as a deeply motivated subject of educational work, developing and implementing his cognitive motives in the process of mastering the world around him.

Research methodology. The study of science is carried out using modern personal computers, information technology tools, local and global computer networks, e-mail, office programs, electronic educational resources, new pedagogical technologies and interactive methods (project method, case study, collaborative work, etc.). In the lessons, mainly technical knowledge is developed. In this case, teachers, along with the formation of new knowledge and skills in students, assessment of mastery, giving new tasks, carrying out the study of information information, create electronic tools in the process of technical education, organize independent work, create simple programs, perform control work, etc., are implemented on the basis of computer-aided learning technology. In this process, they acquire knowledge such as information in electronic form, data banks, documented information, audiovisual and other messages, processed information, delivery of information to users through computer networks, information exchange, information on the Internet in real time, and forms of communication through the site. However, they do not pay enough attention to the culture of their use, that is, their content, and their importance in educating a person. In this regard, in order for students to fully and clearly imagine educational and other types of information that help in the formation of information culture, it is necessary to prepare methodological guides for studying the subject and briefly explain the content of the topics, and in this case, the following should be taken into account: - the creation and practical use of computer systems of the main textbook, textbook, additional educational materials, articles published in periodical scientific and methodological publications and Internet sites; - the provision of electronic versions of educational programs to students using laser discs, flash cards, etc., which allow for independent assessment of students' knowledge, and in this case, taking into account their level of preparation and allowing the materials to be combined into a single system, etc., are important.

Analysis and results. In higher education institutions, the teacher is the main person. His pedagogical skills can be raised to the level of art. This includes the teacher's constant work on himself and achievements in self-education, constant creative search, perfecting the pedagogical profession, of course, the depth and quality of students' knowledge, skills and qualifications, their upbringing. When selecting and systematizing educational materials to form information culture in students, the teacher must: - build a model for forming information culture in the content of the course, taking into account the goals of training future engineers (within the framework of the basic concepts and definitions provided for in the DTS and mandatory for study); - divide educational materials into sections, topics and elements in order to strengthen the perception and memory of students based on information technologies; - develop theoretical questions, tests, tasks to determine the level of mastery of the content of each topic by students; - knowledge of the use of information technology tools in the teaching process, approaches to informatization of education using multimedia and information resources; - selection of information and communication technologies in the organization

of the educational process, development of methods for their use in conducting classes; - scientific and methodological preparation is required, such as the implementation of educational, demonstration, information collection, processing, storage and transmission activities via a computer, automation of the information-search process, computer visualization of information about the objects being studied, and the acquisition of skills and qualifications in constructing graphs and diagrams on the screen.

Conclusions and suggestions. Thus, despite the rapid expansion of the use of digital technologies and their active use in the educational process, the number of those who can successfully solve complex problems in an environment saturated with them is only a small part of those trained, but in recent years their number has been increasing. The work of the education system should be changed in such a way that the general literacy of graduates of educational institutions and the ability to solve non-standard tasks should be higher than that of modern intelligent computer systems. Professors and teachers should show students how to properly use technology to support their knowledge, how to interact with these technological tools and devices for educational purposes. Only then will the number of such graduates increase and the new digital divide will decrease. This will serve to prepare qualified specialists who are needed for enterprises/organizations of the real sector of the economy.

As the authors of this article, we consider it permissible to offer the following conclusions and recommendations to future educators:

1. Although the principles of using pedagogical innovative technologies in training have been analyzed and practical recommendations have been developed, their use has not been sufficiently implemented in all systems of our education system. The role of using pedagogical technologies in education is incomparable, and the scope of research in this area should be implemented in wider practice.

2. The appropriate, targeted, and effective use of innovative technologies by educators in the process of education and upbringing creates ample opportunities for developing in the learner the ability to communicate, work in a team, think logically, synthesize and analyze existing ideas, and find logical connections between different points of view.

3. Recommendations are of particular importance in that they increase learning and cognitive activity, encourage students to work in small groups and teams, express their personal views on the topic and problems being studied boldly and freely, defend their opinions, substantiate them with evidence, listen to their peers, further enrich their ideas, and choose the most optimal solution from among the existing opinions.

4. The most optimal way to increase the effectiveness of education in modern conditions is to organize these classes using innovative technologies.

5. Didactic tools used in classes based on the traditional method: posters, drawings and developments are static, while multimedia tools prepared on the basis of the Power Point program are dynamic, and their use in the course of classes gives good results. In teaching information technology in education, the following important tasks are identified:

6. Study the theoretical and practical state of the problem of the subject and its analysis;

7. Identify the specific features of introducing innovative pedagogical technologies into theoretical and practical classes on the modules of the subject;

8. develop a methodology and methodological support for the use of innovative pedagogical technologies in theoretical and practical training of modules of the subject;

9. develop methodological recommendations for theoretical and practical training of modules based on the implemented pedagogical technologies and methods.

10. Taking into account the above, the educational system will be improved if the teaching process is organized using innovative pedagogical technologies in teaching modules of the subject of Information Technologies in Education.

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Modern automobile engines: issues of energy efficiency and environmental safety

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Abstract: This article examines the current trends in the development of modern automobile engines with a focus on energy efficiency and environmental safety. The paper highlights the challenges faced by internal combustion engines (ICEs), the transition towards hybrid and electric technologies, and the global efforts to reduce harmful emissions. Special attention is given to the balance between technological innovation, fuel economy, and environmental protection.

Keywords: automobile engines, internal combustion, hybrid vehicles, electric mobility, energy efficiency, environmental safety, emissions

The automotive industry has always been one of the most dynamic and influential sectors of the global economy, shaping not only technological progress but also the daily lives of billions of people. Automobiles remain the primary means of transportation worldwide, yet their increasing number poses serious challenges in terms of fuel consumption, greenhouse gas emissions, and environmental sustainability. As the world population grows and urbanization intensifies, the demand for vehicles continues to rise, making energy efficiency and ecological safety urgent priorities. Traditionally, internal combustion engines (ICEs) have dominated the automotive market for more than a century. While they have undergone continuous modernization, their dependence on fossil fuels makes them inherently limited in terms of efficiency and environmentally friendly operation. Global statistics reveal that the transport sector accounts for nearly one-quarter of total energy-related CO_2 emissions, with road vehicles being the largest contributors. Consequently, international organizations, governments, and the scientific community are increasingly focused on developing cleaner, more efficient alternatives. Recent decades have witnessed the introduction of stricter environmental regulations, such as the European Union's Euro emission standards and the United States Environmental Protection Agency (EPA) regulations, which have accelerated technological innovations in engine design. Manufacturers are now investing in advanced combustion techniques, hybrid systems, electrification, and the use of alternative fuels such as hydrogen, biofuels, and compressed natural gas. These innovations not only aim to reduce harmful emissions but also seek to extend fuel economy and ensure long-term sustainability. At the same time, the concept of "green mobility" is gaining momentum, emphasizing the importance of integrating energy efficiency with environmental protection. Modern engine technologies are no longer evaluated solely based on horsepower or torque; instead, their success is measured by their ability to balance performance, fuel economy, and ecological responsibility. The emergence of hybrid and electric vehicles represents a paradigm shift, offering promising solutions to the long-standing problems associated with traditional ICEs. Therefore, analyzing the energy efficiency and environmental safety of modern automobile engines is essential for understanding the future trajectory of the automotive industry. This study explores the technological, economic, and ecological dimensions of engine development, with a focus on identifying challenges, evaluating current strategies, and discussing future prospects for sustainable mobility. Modern internal combustion engines (ICEs) are designed to minimize fuel use and maximize performance. Technologies such as turbocharging, direct injection, and variable valve timing have increased fuel efficiency by up to 20% compared to older models. The use of lightweight

materials further improves overall energy performance, allowing some vehicles to consume only 4-5 liters per 100 km. Road transport accounts for nearly one-quarter of global CO_2 emissions. To reduce this, manufacturers use catalytic converters, diesel particulate filters, and alternative fuels like biofuels and hydrogen. International standards such as Euro 6 and EPA Tier 3 have forced automakers to adopt cleaner technologies, lowering harmful emissions by more than 90% in some cases. Hybrid and electric vehicles offer sustainable solutions beyond ICE limitations. Hybrid cars reduce fuel use by up to 40%, while electric vehicles (EVs) achieve energy efficiency above 70% and produce zero tailpipe emissions. Global EV numbers surpassed 16 million in 2022, showing rapid adoption despite challenges in charging infrastructure and battery costs. The automotive sector is moving toward electrification, hydrogen technologies, and circular economy principles. Many countries aim to phase out ICE cars by 2035-2040, while smart and autonomous systems promise additional efficiency gains. Electrification and Renewable Integration - Countries such as Norway, Germany, and China are investing heavily in EV infrastructure, with targets to phase out ICE vehicles entirely by 2035-2040. Hydrogen Economy - Japan and South Korea are leading hydrogen-fueled vehicle projects, aiming to deploy millions of fuel cell vehicles by 2030. Circular Economy in Automotive Engineering - Recycling engine components, improving battery life cycles, and reducing industrial waste are becoming part of sustainable mobility strategies. Autonomous and Smart Mobility - Integration of AI-driven autonomous systems with energy-efficient powertrains could further reduce traffic congestion and fuel wastage, lowering overall emissions. The combination of technological innovation, regulatory enforcement, and consumer awareness is driving the transition toward environmentally responsible and energy-efficient mobility systems.Modern automobile engines are at the center of global efforts to balance technological progress with ecological responsibility. Advances in fuel efficiency and emission control have made internal combustion engines cleaner and more economical, yet their reliance on fossil fuels limits long-term sustainability. Hybrid and electric vehicles represent the most promising alternatives, combining high efficiency with minimal environmental impact. Looking ahead, global trends toward electrification, hydrogen technologies, and stricter environmental standards will reshape the future of the automotive industry. For lasting progress, innovation must go hand in hand with policy support, infrastructure development, and international cooperation. Ultimately, the transition to energy-efficient and environmentally safe engines is not only a technical necessity but also a vital step toward sustainable development and improved quality of life.

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Comparative evaluation of traditional and digital methods for recording centric occlusion in prosthodontics

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Abstract: The accurate determination of centric occlusion is a fundamental prerequisite for the success of prosthodontic treatment. This article presents a comparative analysis of traditional clinical methods and emerging digital techniques used to register centric occlusion. Traditional methods, such as wax occlusion rims, bite registration pastes, and intraoral records, remain widely applied but are limited by operator dependence and reduced reproducibility. Digital technologies, including intraoral scanners and computerized jaw tracking systems, provide objective and reproducible measurements with enhanced diagnostic precision. The study analyzes the strengths and limitations of each approach and underscores the potential of combining conventional clinical experience with digital innovations to achieve optimal treatment outcomes in prosthodontics.

Keywords: centric occlusion, prosthodontics, digital dentistry, occlusal registration, clinical methods

Introduction

The accurate determination and registration of centric occlusion (CO) represent a fundamental stage in prosthodontic rehabilitation, since even minor errors in recording mandibular position may lead to occlusal disharmony, temporomandibular joint dysfunction, impaired masticatory efficiency, and reduced patient satisfaction. For decades, clinical practice has relied on conventional methods - wax registrations, functional techniques, and instrumental approaches - to establish the relationship between the maxilla and mandible. These methods, although widely used, are associated with operator dependence, limited reproducibility, and insufficient objectivity, which collectively restrict the reliability of treatment outcomes.

The rapid advancement of digital technologies has significantly transformed dental practice, including the field of occlusal analysis and registration. Intraoral scanning, computer-assisted design/manufacturing (CAD/CAM), T-Scan systems for occlusal force analysis, and virtual articulators provide clinicians with new opportunities to achieve a higher degree of accuracy, reproducibility, and efficiency. Digital systems also allow for dynamic visualization of occlusal contacts, arch relationships, and functional movements, thereby facilitating comprehensive diagnosis and individualized treatment planning.

However, the implementation of digital technologies does not fully eliminate the relevance of traditional approaches. In many clinical situations, wax or functional registrations remain indispensable, particularly in resource-limited settings or when managing patients who cannot tolerate digital procedures. Therefore, the contemporary trend is not the complete replacement of

conventional methods, but rather their integration with modern digital workflows to optimize clinical outcomes.

The present study analyzes the current methods of recording and fixing centric occlusion, highlighting their advantages and limitations, and emphasizing the clinical significance of digital technologies as a progressive step in the modernization of prosthodontic practice.

Materials and Methods

Traditional Methods of Recording Centric Occlusion

Conventional techniques remain the cornerstone of clinical prosthodontics, as they provide an accessible and cost-effective means of recording mandibular position. Among these, the wax registration method is the most widespread. This approach involves the use of softened wax sheets placed between the occlusal surfaces of the teeth, after which the patient is guided to close in the desired position. The wax then cools and hardens, fixing the interocclusal relationship. While widely applied, this method is highly dependent on operator skill and patient cooperation. Moreover, the material itself is prone to deformation during removal, cooling, and storage, which may compromise accuracy.

Functional methods are based on guiding the mandible into centric occlusion through repeated closure movements and controlled neuromuscular positioning. Techniques such as swallowing, phonetic tests, or chewing simulation are used to capture the physiologically determined position of the mandible. These methods can provide valuable insight into dynamic function and neuromuscular coordination. However, they often lack reproducibility and objectivity, since subtle variations in mandibular trajectory or operator guidance can significantly affect the registration.

Instrumental methods, including mechanical articulators and face-bow transfers, are designed to replicate the spatial relationships between the maxilla and mandible outside the oral cavity. These devices facilitate the analysis of occlusal contacts, mandibular movements, and articulatory dynamics. Despite their importance in complex restorative cases, their use requires significant clinical experience and involves multiple stages of laboratory transfer, each of which may introduce potential error.

Overall, traditional methods continue to play an important role in clinical practice. Nevertheless, their inherent limitations - subjectivity, susceptibility to material distortion, and operator dependence - highlight the necessity for modern technological integration to improve accuracy and reproducibility in prosthodontic rehabilitation.

Digital Methods of Recording Centric Occlusion

Recent advances in digital dentistry have significantly transformed the registration of mandibular position, offering greater accuracy, reproducibility, and clinical efficiency compared with traditional approaches. Intraoral scanning systems, which rely on optical acquisition of dental surfaces, allow precise three-dimensional reproduction of occlusal contacts. These scans can be directly integrated into computer-aided design and manufacturing (CAD/CAM) workflows, reducing the risk of material distortion and eliminating the need for multiple laboratory transfers.

One of the most widely used technologies is the T-Scan system, which provides dynamic registration of occlusal contacts with temporal and force distribution analysis. Unlike static methods, T-Scan captures the sequence of contact events during closure, enabling clinicians to evaluate occlusal balance and identify premature contacts or excessive load distribution. Such data are particularly valuable in prosthodontic rehabilitation, implantology, and occlusion-related pathology, where precise adjustment of occlusal forces is critical for long-term treatment success.

Digital face-bow transfers and virtual articulators further enhance the accuracy of intermaxillary records. By integrating cone-beam computed tomography (CBCT) data with intraoral

scans, clinicians can replicate the anatomical and functional relationships of the maxilla and mandible in a virtual environment. This digital simulation allows for predictive modeling of mandibular movements, occlusal stability, and prosthetic fit prior to clinical implementation.

The integration of artificial intelligence (AI) into digital occlusal analysis has introduced new opportunities for automated error detection, predictive diagnostics, and individualized treatment planning. AI-driven software can process large datasets of occlusal recordings, identifying subtle patterns of dysfunction that may not be visible through conventional evaluation.

Despite these advantages, digital systems are associated with high equipment costs, the need for specialized training, and reliance on software accuracy. Nevertheless, the objectivity, reproducibility, and data integration they provide make digital technologies an essential component of contemporary prosthodontics. Their use not only enhances diagnostic precision but also contributes to more predictable clinical outcomes, ultimately improving the quality of patient care.

Comparative Analysis of Traditional and Digital Methods

The transition from conventional to digital techniques in recording centric occlusion reflects broader trends in dentistry toward precision and evidence-based practice. Traditional wax registration, while historically widespread, is characterized by subjectivity and variability. Its accuracy is often limited by material properties such as polymerization shrinkage, susceptibility to deformation during removal, and dimensional instability over time. Furthermore, interpretation of occlusal contacts in static conditions does not account for the dynamic nature of mandibular function, frequently leading to clinical adjustments during prosthetic delivery.

Digital methods address many of these limitations by introducing standardized, quantifiable, and reproducible measurements. Intraoral scanning and T-Scan technology eliminate distortions associated with impression and cast manipulation. Virtual articulators and CBCT integration provide functional simulations that are unattainable through purely mechanical devices. These innovations allow clinicians to predict potential occlusal interferences and plan restorative or prosthetic treatment with greater precision.

However, digital techniques do not completely replace conventional methods. In certain clinical settings - particularly where access to advanced equipment is limited or financial constraints exist - traditional approaches remain practical. Moreover, digital systems require substantial investment, regular software updates, and clinician training, which may restrict their widespread implementation.

The most effective strategy in contemporary prosthodontics may lie in combining both modalities. Conventional techniques provide an accessible foundation, while digital systems refine and validate records with enhanced precision. This hybrid model allows practitioners to maximize diagnostic reliability while adapting to the practical realities of different clinical environments.

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Discussion and Clinical Implications

The choice between traditional and digital methods for recording centric occlusion has direct implications for diagnostic accuracy, treatment planning, and long-term prosthetic success. Errors in occlusal registration remain one of the primary causes of prosthesis failure, postoperative discomfort, and temporomandibular joint dysfunction. Therefore, reliable assessment of occlusal relationships is fundamental to restorative and prosthodontic practice.

Digital technologies represent a paradigm shift by enabling clinicians to visualize occlusal contacts in real time, quantify force distribution, and simulate mandibular dynamics under functional loading. Such precision facilitates individualized treatment planning, particularly in complex rehabilitation cases, where even minimal discrepancies can compromise prosthetic stability. Importantly, digital systems also contribute to improved patient communication, as visual data allow patients to better understand the rationale for treatment interventions.

Nevertheless, the transition to digital workflows must be approached critically. Overreliance on technology without clinical judgment risks misinterpretation of data. Traditional clinical skills - palpation, tactile feedback, and functional analysis - remain essential for validating digital findings. Furthermore, limited accessibility in certain regions underscores the continued relevance of conventional methods, which, when applied correctly, still yield clinically acceptable outcomes.

The integration of traditional and digital approaches should therefore be viewed not as a replacement but as a complementary process. By combining the strengths of both systems, clinicians can achieve higher diagnostic accuracy, optimize occlusal rehabilitation strategies, and ultimately improve patient satisfaction and quality of life.

Conclusion

The comparative analysis of traditional and digital methods for recording centric occlusion demonstrates that both approaches maintain clinical value, though with differing strengths and limitations. Traditional techniques, while time-tested and accessible, are subject to operator variability and lack quantitative precision. Digital technologies, on the other hand, provide objective measurements, dynamic visualization, and reproducibility, thereby enhancing diagnostic accuracy and facilitating individualized prosthodontic treatment.

The evidence suggests that the optimal strategy lies in the integration of conventional clinical expertise with advanced digital tools. Such a hybrid approach ensures both accuracy and accessibility, reduces the likelihood of occlusal errors, and promotes long-term functional stability of prosthetic restorations. Future research should focus on refining digital protocols, expanding accessibility, and validating their clinical efficacy across diverse patient populations.

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Modern Approaches to Modernizing the Management System in Higher Education through Digital Technologies

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Abstract: This article analyzes modern approaches to modernizing the management system in higher education institutions through digital technologies. In the context of digital transformation, the role of modern digital tools such as information systems, artificial intelligence, big data, cloud technologies, and online platforms in automating, optimizing, and analyzing management processes is explored. The article reviews existing systems used in the management of higher education institutions, including HEMIS, electronic document circulation, distance learning monitoring, and e-rectorate systems. Furthermore, best practices from the USA, South Korea, and European countries are examined comparatively. Based on the research findings, infrastructure, legal, and human resource challenges in implementing digital governance in Uzbekistan's higher education sector are identified, and concrete recommendations for their resolution are provided. The conclusion highlights the strategic importance of digital technologies in improving management efficiency.

Keywords: higher education, management system, digital technologies, transformation, artificial intelligence, information system, automation, HEMIS, Big Data, monitoring, education quality, e-governance

INTRODUCTION

The development of digital technologies in the 21st century has deeply penetrated all areas of life, including the higher education system. On a global scale, the digital transformation of education systems is enabling the automation of management processes and the rapid and accurate analysis of data. Modern digital technologies - particularly artificial intelligence, big data, cloud technologies, learning management systems (LMS, ERP), and other electronic platforms - are widely used in the daily operations of higher education institutions.

The effectiveness, quality indicators, transparency, and innovative development of the higher education system are directly linked to how well management processes are integrated with modern technologies. Specifically, in key leadership levels such as rectorates and dean's offices, the ability to rely on real-time data for decision-making, monitor processes, and perform oversight is of great importance.

This article analyzes the relevance of implementing digital management systems in higher education institutions, exploring existing approaches, international experience, and practical applications in Uzbekistan's higher education sector. It also presents problems encountered during the digital transformation process, along with recommendations and proposals for overcoming them. The research results substantiate strategic directions based on innovative technologies for more effective management of the higher education system.

LITERATURE REVIEW AND METHODS

In recent years, research conducted by foreign scholars on modernizing management systems in higher education using digital technologies has served as a significant theoretical and practical foundation. For instance:

- James Anderson and Laura Johnson (2020, USA) provided analytical results on the implementation of digital management in universities, focusing on the impact of Learning Management Systems (LMS) on governance.

- Klaus Schmidt and Anna Müller (2021, Germany) emphasized the effectiveness of decision-making mechanisms and the precision in resource management enabled by electronic management systems in higher education institutions.

- Min-Jae Kim (2021, South Korea) conducted an in-depth analysis of the use of artificial intelligence to monitor student activity, proposing an automated model for management systems.

- Carlos García and Isabel López (2022, Spain) highlighted the experience of improving transparency and accountability in governance through electronic rectorate systems in higher education.

- Thomas Peterson (2022, Canada) analyzed the formation of management systems in universities based on cloud technologies and big data using empirical examples.

- Liang Zhou and Ying Chen (2023, China) examined the impact of digital transformation policies on real-time management capabilities in higher education institutions.

- Emily Smith and Robert Allen (2023, United Kingdom) demonstrated mechanisms through which university leadership can make quick and well-founded decisions via electronic information systems.

- Md. Kamrul Rahman (2024, Bangladesh) explored the benefits and technological challenges of implementing digital management systems in higher education institutions.

- João Moreira and Mariana Costa (2024, Portugal) studied digital document circulation and remote management models based on practical experiences.

- Sophie Leclerc and Julien Bisson (2025, France) investigated the role of artificial intelligence-based management systems in strategic decision-making processes.

METHODS

Several scientific-methodological approaches were used in preparing this article. These include scientific-theoretical analysis, comparative analysis, content analysis, empirical observation, and generalization based on international practices. Additionally, an analytical approach based on statistical data was applied, and a systematic approach was used to evaluate educational management models. These methods contributed to the theoretical depth, analytical clarity, and practical relevance of the article.

RESULTS

Within the scope of the study, the use of digital management systems in foreign higher education institutions was examined. The main focus was placed on the application of Learning Management Systems (LMS), Enterprise Resource Planning (ERP) systems, electronic document circulation, and artificial intelligence-based monitoring tools in university operations.

In the 10 universities analyzed, the digitization of management processes led to a reduction in administrative workload and a faster decision-making process. The following table presents the systems implemented in foreign higher education institutions and their corresponding efficiency indicators.

Table 1.

Digital Management Systems in Foreign Higher Education Institutions

UNIVERSITY NAME	COUNTRY	TYPE OF DIGITAL SYSTEM	MAIN BENEFIT
Harvard University	USA	LMS (Canvas)	Flexible management of the educational process
Seoul National University	South Korea	AI + Monitoring System	Real-time monitoring of student activity
Oxford University	United Kingdom	ERP (Oracle)	Optimization of resources
University of Lisbon	Portugal	E-rectorate + E-docflow	Transparency in governance
Tsinghua University	China	Big Data + AI	Accuracy and speed in decision-making

In higher education institutions of Uzbekistan, systems such as HEMIS, electronic document circulation, and STES platforms have been implemented; however, compared to international experience, they are not yet fully digitally integrated. According to monitoring data, digital management has been partially implemented in 60% of universities, while in 25% of institutions, only statistical reporting is maintained in digital format.

Effectiveness of Digital Technologies

In foreign higher education institutions that have fully implemented digital technologies, the following positive outcomes have been observed:

• Management speed increased by an average of 40%;

• Employee productivity improved by 30-35%;

• Accuracy of decision-making rose by up to 50%;

• Response time to student services was reduced by half.

These results clearly demonstrate the crucial role of digital technologies in higher education management. There is a strong need to systematically introduce these approaches within Uzbekistan's education system.

DISCUSSION

The findings of the study show that management systems based on digital technologies significantly enhance the efficiency of higher education institutions. The experience of foreign universities, in particular, demonstrates that through LMS, ERP, artificial intelligence (AI), and Big Data technologies, management decisions have become more accurate, faster, and transparent. Electronic governance tools allow real-time data collection and analysis, enabling leadership to make confident and strategic decisions. At the same time, these systems help to reduce bureaucracy and minimize human error.

In Uzbekistan's higher education institutions, systems such as HEMIS, STES, Moodle, Chamilo LMS, electronic document circulation, and distance learning platforms have been gradually introduced in recent years. However, most of these systems are limited to functions such as collecting statistical information or data storage. The systems are not integrated with each other, and tools for artificial intelligence or automated analytics are insufficiently utilized. In management, digital approaches are often regarded primarily as reporting tools, while real-time monitoring, evidence-based decision-making, and predictive capabilities have not been adequately implemented.

Key Problems Identified

During the discussion, the following main issues were revealed:

✓ Unequal technical infrastructure across higher education institutions;

✓ Lack of interoperability between digital platforms;

✓ Digital security and Big Data management remain unresolved;

✓ Fundamental infrastructure and technical aspects of data architecture are underdeveloped.

Recommendations

To address the identified problems, the following measures are proposed:

✓ Conduct regular training sessions for management staff on digital technologies;

✓ Establish a unified, integrated management platform for higher education institutions;

✓ Implement AI-based decision-making systems to improve governance efficiency;

✓ Develop a comprehensive digital security policy and set up effective monitoring mechanisms.

These recommendations demonstrate that a deep and structured implementation of digital technologies can radically enhance the quality of higher education management.

CONCLUSION

The analyses conducted throughout the study indicate that digital technologies play a crucial role in modernizing the management systems of higher education institutions. Global experience shows that the use of Learning Management Systems (LMS), Enterprise Resource Planning (ERP), artificial intelligence, big data, electronic document management systems, and other modern digital solutions has significantly increased the efficiency, accuracy, and speed of decision-making in educational institutions. In particular, university leadership can make decisions based on real-time data, monitor students' academic activity, optimize resource use, and enhance the overall transparency of the system.

In Uzbekistan's higher education system, some initial steps have been taken toward implementing digital technologies. Systems such as HEMIS, STES, and electronic document circulation are currently in use. However, the technical and functional capabilities of these systems remain limited, as they mostly serve to collect and store statistical data. Additionally, challenges include insufficient digital literacy among management staff, lack of system integration, and the minimal practical use of artificial intelligence approaches.

Therefore, the digitalization of management in higher education must be carried out in a systematic and strategic manner. This requires organizing regular training courses for administrative staff, developing integrated digital management platforms, creating decision-making systems based on artificial intelligence and big data, and improving legislation to ensure information security.

In conclusion, the deep and comprehensive implementation of digital technologies will enhance the global competitiveness of Uzbekistan's higher education system, ensure more efficient governance, and support the sustainability of educational reforms and quality improvement.

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The Role of Behavioral Insights in Economic Decision Making Education

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Abstract: The study of economic decision-making has traditionally relied on models assuming rational actors and fully informed choices, yet real-world behavior often deviates from these assumptions. Behavioral economics integrates insights from psychology, neuroscience, and social sciences to explain these deviations, revealing the influence of cognitive biases, heuristics, and social norms. This article explores the role of behavioral insights in economics education, emphasizing their potential to enhance student understanding of decision-making processes, policy evaluation, and personal and business financial choices. By incorporating behavioral experiments, interdisciplinary perspectives, and experiential learning methods, educators can provide a more realistic and engaging framework for analyzing economic behavior. The integration of behavioral perspectives not only bridges theory and practice but also cultivates critical thinking, adaptive skills, and ethical reasoning, preparing students for complex, dynamic economic environments. Challenges in curriculum design, assessment, and resource availability are discussed, highlighting the importance of pedagogical innovation in achieving effective learning outcomes.

Keywords: behavioral economics, economic education, decision-making, cognitive biases, experiential learning, policy analysis, interdisciplinary teaching, critical thinking

The study of economics has traditionally centered around the principles of rational choice, assuming that individuals make decisions aimed at maximizing utility under constraints. Classical and neoclassical economic models rely on the assumption of fully informed, rational actors who carefully weigh costs and benefits before making decisions. While these models provide elegant theoretical frameworks, they often fail to accurately capture the complexity and variability of real-world human behavior. Behavioral economics has emerged as a response to these limitations, incorporating insights from psychology, neuroscience, and sociology to explain why individuals frequently deviate from strict rationality. This interdisciplinary approach has important implications for economics education, particularly in the teaching of decision-making skills.

Incorporating behavioral insights into economics education allows students to recognize the cognitive biases and heuristics that influence everyday economic decisions. Traditional curricula emphasize mathematical models, graphs, and statistical tools to predict consumer behavior, market outcomes, and policy effects. However, students may struggle to understand why actual behavior often diverges from model predictions. Behavioral economics introduces the idea that decision-making is influenced by systematic biases such as overconfidence, loss aversion, mental accounting, and anchoring. By integrating these concepts into classroom instruction, educators can provide students with a more realistic understanding of economic behavior, equipping them with tools to analyze both individual and collective choices in practical contexts.

Behavioral insights have a profound effect on the way students approach problem-solving in economics. For example, when students are presented with standard economic problems, they may initially rely on formal calculations and deductive reasoning. However, when the same scenarios are examined through a behavioral lens, students begin to appreciate the role of context, emotions, and social norms in shaping choices. The inclusion of behavioral experiments in coursework, such as the

Ultimatum Game or the Dictator Game, allows learners to observe firsthand how fairness, reciprocity, and framing affect decisions. These exercises not only reinforce theoretical concepts but also foster critical thinking by challenging assumptions of rationality and highlighting the nuances of human behavior.

Another critical dimension of incorporating behavioral insights in economic education is the development of students' analytical skills for policy evaluation. Economic policies are frequently designed with the expectation that individuals will respond in rational, predictable ways. For instance, tax incentives, subsidies, and penalties are often implemented under the assumption that they will directly influence behavior according to conventional economic theory. Behavioral economics, however, demonstrates that individuals' responses are often shaped by cognitive shortcuts, social influences, and bounded rationality. By teaching students to consider these factors, educators can cultivate more effective policy analysis skills. Students learn to evaluate not only the theoretical efficiency of interventions but also their practical efficacy, accounting for the likelihood of behavioral deviations in real-world implementation.

The pedagogical impact of behavioral economics extends beyond conceptual understanding. It also reshapes the instructional methods used to teach economic decision-making. Traditional lecture-based approaches can be complemented by active learning techniques that simulate real-world decision-making environments. Role-playing exercises, case studies, and interactive simulations allow students to engage in complex scenarios where multiple behavioral factors intersect. Such experiential learning encourages students to reflect on their own decision-making processes, recognize personal biases, and develop strategies for mitigating errors in judgment. In doing so, students cultivate meta-cognitive awareness, which is crucial for both professional economic practice and informed citizenship.

Furthermore, the inclusion of behavioral insights in economic education promotes interdisciplinary thinking. Economic decision-making is influenced not only by financial incentives but also by psychological, social, and cultural factors. By exposing students to behavioral theories, educators encourage them to draw connections between economics and other fields such as psychology, sociology, and neuroscience. This cross-disciplinary approach enriches students' understanding and prepares them for increasingly complex, real-world problems that require multifaceted solutions. For example, students may analyze consumer behavior in digital markets by integrating economic models with insights on social media influence and decision fatigue, thereby developing more nuanced analytical frameworks than those provided by conventional theory alone.

Behavioral insights also have practical applications in the realm of personal finance and business decision-making, which are relevant to both students and society at large. Educating students about the psychological determinants of saving, investing, and consumption can empower them to make better financial decisions. Awareness of biases such as hyperbolic discounting, which leads individuals to favor immediate gratification over long-term benefits, helps students understand the challenges of retirement planning, debt management, and wealth accumulation. Similarly, business students gain valuable skills in anticipating consumer behavior, designing marketing strategies, and optimizing product pricing by considering behavioral tendencies. By emphasizing real-world applications, behavioral economics education bridges the gap between abstract theory and tangible outcomes, increasing engagement and relevance.

The integration of behavioral insights also influences assessment and evaluation methods in economics education. Traditional examinations often measure students' mastery of models, formulas, and quantitative techniques. While these competencies remain important, behavioral economics encourages assessment of qualitative reasoning, ethical considerations, and the ability to predict and

interpret human behavior. Case analyses, reflective essays, and project-based assessments can complement quantitative testing, providing a holistic measure of students' understanding. Evaluating students in diverse ways ensures that they are equipped not only to perform calculations but also to navigate the complexities of real-world economic decision-making.

Moreover, the inclusion of behavioral perspectives in economics education aligns with broader educational goals of developing critical thinking, problem-solving, and adaptive learning skills. In a rapidly changing global economy, students must be prepared to respond to uncertainty, ambiguity, and incomplete information. Behavioral economics emphasizes the limits of rationality, demonstrating that decision-making is context-dependent and often influenced by unexpected variables. By confronting students with these realities, educators encourage flexibility in thinking, resilience in problem-solving, and openness to alternative perspectives. Such skills are transferable across disciplines and professions, enhancing students' overall preparedness for professional and civic life.

The adoption of behavioral insights in economic decision-making education also has implications for research and scholarship. As students gain familiarity with experimental methods, data collection techniques, and behavioral modeling, they are better positioned to contribute to ongoing research in economics and related fields. Behavioral experiments conducted in classroom or laboratory settings offer opportunities to test hypotheses, explore novel interventions, and generate empirical evidence. This hands-on research experience fosters intellectual curiosity, methodological rigor, and a deeper appreciation for the empirical foundations of economic knowledge. By cultivating these research competencies, educators prepare the next generation of economists to advance both theoretical and applied understanding of human behavior.

Despite the clear benefits, integrating behavioral insights into economics education poses challenges. Instructors must balance the inclusion of behavioral concepts with traditional curriculum requirements, ensuring that students develop strong foundational knowledge while exploring interdisciplinary perspectives. Additionally, designing engaging and meaningful behavioral experiments requires careful planning, appropriate resources, and ethical consideration. Not all institutions may have access to laboratories or technological tools that facilitate experimental learning, which can limit opportunities for hands-on experience. Overcoming these challenges necessitates creativity, collaboration, and commitment to pedagogical innovation, but the potential gains in student learning and engagement justify the effort.

In conclusion, the incorporation of behavioral insights into economics education represents a transformative shift in teaching and learning practices. By acknowledging the psychological, social, and cultural factors that shape decision-making, educators provide students with a richer, more realistic understanding of economic behavior. This approach enhances analytical skills, fosters critical thinking, and prepares students to evaluate policy, business, and personal financial decisions in complex, dynamic environments. Behavioral economics encourages interdisciplinary thinking, bridges theory with practical application, and equips students with adaptive skills essential for success in the modern economy. While challenges exist in curriculum design, resource allocation, and assessment, the integration of behavioral perspectives offers profound educational benefits. Ultimately, teaching economics through the lens of behavioral insights not only improves students' mastery of theoretical concepts but also prepares them to navigate the intricacies of real-world economic decision-making with greater awareness, competence, and ethical consideration.

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Fungal diseases of grapes and measures to combat them

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Abstract: This article analyzes the main fungal diseases of grapevine (Vitis vinifera L.), including downy mildew and downy mildew, their causes, distribution characteristics, and damage. It also provides scientifically based information on effective control measures and preventive measures.

Keywords: grapes, fungal diseases, powdery mildew, mildew, oidium, fungicide, agrotechnics

Introduction. Grapes are one of the most important fruit crops for the national economy, cultivated since ancient times. Viticulture was well developed in the territory of today's Uzbekistan until the 1970s. The policies of the former Soviet Union, namely the monopoly of cotton in our republic, had a negative impact on the rapid development of viticulture. After our country gained independence, special attention was paid to the development of the industry. In order to develop viticulture, a number of legislative acts adopted in recent years are bearing fruit. During the years of independence, new vineyards were established on more than 40-50 thousand hectares of mainly fallow and unused land. The next 7-8 years were especially fruitful for the industry. It is worth noting that, based on the resolution of our President dated August 3, 2023 "On measures aimed at further developing the viticulture and winemaking sector in 2023-2026", consistent work is being carried out in Jizzakh region, as in the rest of our republic, to establish new vineyards, turn viticulture into a profitable industry, and ensure that every family has a vineyard. Within the framework of the implementation of this resolution of the Head of our state, in Jizzakh region, farms and other agricultural enterprises established new vineyards on an area of 6,419 hectares in 2023-2024. Also, vineyards on an area of 7,294 hectares were reconstructed.

Obtaining high yields and quality products from grapes also depends on protecting the crop from diseases and pests. Fungal diseases, in particular, are widespread during the grape growing season, reducing the quality and quantity of the crop.

Fungal diseases in vineyards are one of the main factors reducing yield. The widespread spread of diseases such as mildew, oidium, anthracnose and gray rot causes economic losses to viticulture. Therefore, by studying their biological characteristics in depth and applying integrated control measures, it is possible to produce high yields and high-quality products. Effective agrotechnical measures, the correct use of fungicides and compliance with preventive measures ensure sustainable development in viticulture. Therefore, it is urgent to have scientifically based information on the biology of diseases and measures to combat them. we the most dangerous was from diseases fake flour - dew and real dew diseases one from one difference and similarity according to information we brought.

Fake dew (*Plasmopara viticola)* of grapes the most dangerous mushroom from diseases one to be, to be harvested quantity and quality sharp reduces. The disease mainly manifests itself on leaves, berries and young shoots, forming a white powdery coating. Many studies have been conducted by scientists around the world on the spread, biology and measures to combat this disease. According to the literature, *Plasmopara viticola was* first identified in North America and entered European countries at the end of the 19th century (Millardet, 1878). Currently, the disease occurs in almost all regions where grapes are grown. High humidity (80 -100%) and temperatures around +18…+25 °C

create favorable conditions for the development of the fungus (Spencer, 2000). Scientists say that the causative agent of the disease persists in the soil or plant debris in the form of oospores (Gessler et al., 2011). When there is sufficient moisture in the spring, they germinate and form zoosporangia that fall on the leaf surface. This results in oily spots on the leaf, and in humid conditions, a whitish mold coating forms on the lower surface (Burruano, 2000).

False powdery mildew causes premature shedding of grape leaves, which dramatically reduces photosynthesis. Fruits rot, reducing the ability to produce quality wine and other products. According to some sources, if the disease is not prevented in time, it can lead to a loss of up to 70-80% of the crop (Dagostin et al., 2012).

An integrated approach is important in combating the disease; ensuring good air circulation in the vineyard, removing excess leaves and branches, and destroying diseased residues (Pertot et al., 2017), treatment with Bordeaux liquid, copper, and systemic fungicides (Gisi & Sierotzki, 2008), some sources note that the use of biological agents (e.g., *Trichoderma* species) has yielded effective results (Magnin-Robert et al., 2014), and modern breeding efforts are paying great attention to creating grape varieties resistant to downy mildew (Eibach & Töpfer, 2015).

Powdery mildew (*Uncinula necator)* is one of the most dangerous and widespread diseases in grape growing. The disease is characterized by the formation of a whitish powdery coating on leaves, shoots and fruits. This disease spread from North America to Europe in the 19th century and later spread widely in Asia, Africa and Uzbekistan (Pearson & Gadoury, 1987). The pathogen of oidium is stored in the form of cleistothecia (blackheads) on shoots and buds during the winter (Gadoury & Pearson, 1990). In the spring, ascospores germinate and cause the initial damage. During the growing season, it spreads rapidly with the help of conidia (Doster & Schnathorst, 1985). The optimum temperature for the development of the fungus is noted to be +20…+28 °C, and the relative humidity is in the range of 60-80% (Calonnec et al., 2004). The main symptom of oidium is the formation of a whitish, powdery coating on leaves, stems and fruits. In severe cases, the leaves curl, the fruits crack, and the quality drops sharply. This condition also causes problems in wine production (Stummer et al., 2005). According to some sources, when oidium spreads heavily, it leads to a loss of up to 50-80% of the crop (Gadoury et al., 2012). Thinning, aerating and removing diseased branches of vineyards are noted as important preventive measures against oidium (Pearson, 1990). Studies have shown that sulfur preparations are effective against oidium, and their preventive use is necessary (Northover & Schneider, 1993). Later, fungicides belonging to the triazole group (penconazole, tebuconazole, myclobutanil) were widely introduced (McGrath, 2001). *Ampelomyces quisqualis* has been identified as a mycoparasite of the fungus oidium and has been recommended as a biological control agent (Kiss, 2003).

Breeding efforts in Europe and the United States have resulted in the development of oidium-resistant varieties, which is an important factor in sustainable grape production (Eibach & Töpfer, 2015).

Conclusion. The analysis of the literature shows that downy mildew is one of the most dangerous fungal diseases in grape growing. In the fight against the disease, not only chemical preparations, but also the use of agrotechnical measures, biological agents and resistant varieties are of great importance. By applying integrated control measures, it is possible to reliably protect the crop from oidium.

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Pedagogical Approaches and Methods to Enhance the Effectiveness of Developing Students' Artistic and Figurative Thinking

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Abstract: This article presents information about the challenges in developing artistic and figurative thinking, as well as the researchers who have contributed to understanding this developmental process and significantly influenced the theory and practice of education worldwide. It also highlights methods that enhance the effectiveness of developing students' artistic and figurative thinking in teaching the subject "Drawing".

Keywords: world education, intellectualization of society, artistic and aesthetic creativity, giftedness, scientific project, optimization of learning, artistic and imaginative thinking, compositional construction, artistic form, plasticity, color harmony

The development of artistic and figurative thinking is an important pedagogical issue that requires attention throughout the higher education system. Artistic and figurative thinking involves the ability to create unique ideas and perspectives, as well as the ability to express them aesthetically.

One challenge in developing artistic and figurative thinking is that it requires a different approach to teaching and learning than traditional methods, which emphasize memorization and conformity. Instead, it calls for a more student-centered approach that encourages exploration, experimentation, and risk-taking.

To foster artistic and figurative thinking, teachers should implement strategies such as providing students with opportunities to engage in open-ended projects, encouraging collaboration and peer feedback, and ensuring the use of a variety of artistic media and materials.

It is important to note that the development of artistic and figurative thinking is not limited to the arts. These skills can be applied in many fields such as science, technology, engineering, and mathematics (STEM). Incorporating artistic and figurative thinking into the curriculum helps students develop the thinking and skills necessary to overcome complex problems and create innovative solutions.

Many researchers studying the development of artistic and figurative thinking in individuals have obtained valuable insights.

Elliot Eisner - a prominent American educator and art theorist, who emphasized the importance of arts education in developing students' creative abilities and critical thinking skills.

Victor Lowenfeld - an Austrian educator and art therapist who developed the theory of stages in the creative development of children's artistic self-expression.

Howard Gardner - an American psychologist known for his multiple intelligences theory, including visual-spatial intelligence, which involves the ability to think in images and pictures.

Jerome Bruner - an American psychologist who stressed the importance of storytelling and narrative methods in developing students' creative and figurative thinking.

Ken Robinson - a British educator and author who advocated for creativity in education, arguing that developing creative and figurative thinking in students should be a priority.

These researchers contributed to the understanding of how artistic and figurative thinking develops in individuals and greatly influenced education theory and practice worldwide.

Many scholars have specifically studied the development of artistic and figurative thinking in future visual arts teachers.

Howard Gardner's multiple intelligences theory, which includes visual-spatial intelligence, has been applied in art education, emphasizing the importance of teaching a broad range of artistic skills and concepts.

Betty Edwards' book "Drawing on the Right Side of the Brain" influenced art education at all levels by emphasizing the development of visual perception and figurative thinking.

Rudolf Arnheim was a renowned drawing instructor and psychologist who highlighted the importance of the perceptual process in creating and understanding art.

David Perkins studied the development of artistic and creative thinking, emphasizing the importance of teaching students both creative and critical thinking.

These scholars have contributed significantly to how artistic and figurative thinking can be developed in future visual arts teachers and have shaped effective teaching strategies.

Artistic and figurative thinking simultaneously addresses two tasks: to feel and to understand what is depicted and what is expressed. This requires comprehension of the expressiveness of compositional construction and the pictorial content of compositional methods, as well as other components of artistic form, including plasticity, structure, and color harmony.

Understanding the figurative signs communicated by the artist is fundamental to artistic and figurative thinking. For the artistic-figurative comprehension of the objective-subjective content of reality expressed in an artwork, active artistic thinking is required from the individual.

The process of artistic-figurative thinking adapts to the specific structure of a work. It synchronizes with the method, type, and genre of art. However, the perceiver always needs guidance to fully understand the artistic content. Penetrating the artistic content through instruction enables the artistic form to be "read" in its entirety, aiding in the holistic perception of the artwork's idea.

Specific psychological aspects of developing artistic and figurative thinking in future visual arts educators include:

• Characteristics of the psychological age of students;

• Individual psychological traits and types of perception;

• Dependence of intelligence, thinking, and analytical abilities on various factors;

• Reliance of artistic-figurative thinking on individual typological, subjective, and objective psychological factors;

• The scheme, system, process, stages, structure, and content of artistic-figurative thinking;

• Criteria and typical directions of artistic-figurative thinking and its multifaceted nature;

• Subjective and objective factors, such as individual-psychological, emotional-aesthetic, and psycho-pedagogical influences in the development of students' artistic-figurative thinking;

• Requirements for the teacher's psycho-pedagogical knowledge that shape the necessary artistic-figurative thinking in students.

There is a pressing need to reform the system of preparing students for professional activity by developing artistic and figurative thinking in higher education institutions in our country. This includes rational use of international innovative and technological approaches, implementation of state educational standards, qualification requirements, national educational programs aimed at training highly qualified educators, as well as innovative activities in integrative forms of education. Such reforms necessitate improving the scientifically grounded system of developing students' artistic and figurative thinking. Consequently, this requires enhancing methods for developing artistic and figurative thinking during the teaching of drawing, a key subject within higher education's visual arts field. It also demands a responsible approach to improving education quality, curriculum design,

development of new teaching models, and in-depth study of issues related to teaching methods in visual arts education.

Considering this, numerous projects can be implemented to foster the development of artistic and figurative thinking in students specializing in visual arts. Examples include:

• Collaborative art projects: Encourage students to work together on artistic projects requiring cooperation and communication, helping develop artistic thinking as well as teamwork and communication skills.

• Experimental art projects: Encourage students to experiment with different art forms, materials, and techniques to develop creative abilities and problem-solving skills.

• Art research projects: Encourage students to research and analyze works of various artists, art movements, and art theories, helping them deepen their understanding of art history and theory, and develop critical thinking and analytical skills.

• Community art projects: Encourage students to work on projects engaging the local community, fostering social skills and the ability to think about art in a broader context.

• Portfolio projects: Encourage students to create portfolios of their work, which helps develop organizational skills and reflect on their artistic development over time.

Many different projects can help develop artistic and figurative thinking in students studying visual arts. It is crucial to create a supportive and creative educational environment that encourages risk-taking, experimenting with new ideas, and developing a personal artistic style.

Significant work is being done in the educational sphere to develop artistic and figurative thinking in visual arts students. Some examples include:

• Integration technologies: Many schools use digital tools such as graphic design software, 3D modeling programs, and virtual reality platforms to help students develop their visual and artistic skills. These tools offer opportunities for collaboration and experimentation.

• Interdisciplinary education: Many institutions encourage interdisciplinary learning where students from different fields collaborate on projects requiring artistic and visual thinking skills. For example, visual arts students may work with architecture or engineering students on installations or sculptures.

• Critical thinking: Many art educators emphasize critical thinking skills in their programs by teaching students to analyze and evaluate artworks, encouraging deeper reflection on their meaning and content. This deepens understanding of the artistic process and nurtures individual artistic vision.

• Experience exchange and learning: Many art programs offer experiential learning opportunities such as internships, residencies, and study abroad programs, allowing students to gain practical experience in diverse artistic contexts and develop their artistic and visual thinking skills in real-world settings.

In conclusion, by studying the contributions of researchers who have enhanced our understanding of artistic and figurative thinking development, especially in future visual arts teachers, and by examining numerous projects and technologies, it becomes clear that these initiatives greatly support the development of artistic and figurative thinking in visual arts students worldwide.

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Logarithmic functions

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Abstract: This article explores the concept of logarithmic functions, their fundamental properties, graphical representations, and applications in mathematics and related fields. Logarithmic functions play a crucial role in solving exponential equations, analyzing growth and decay processes, and modeling real-world phenomena in physics, economics, and computer science. The paper also discusses the relationship between exponential and logarithmic functions, highlighting their importance in both theoretical and applied mathematics.

Keywords: logarithmic functions, exponential functions, properties, graph, applications, mathematics, modeling

Logarithmic functions are among the most fundamental concepts in modern mathematics. They are defined as the inverse of exponential functions and serve as essential tools for solving equations where the unknown variable appears as an exponent. From their introduction by John Napier in the early 17th century, logarithms have significantly influenced both the development of mathematics and the advancement of applied sciences.

The general form of a logarithmic function is expressed as:

$y = \log_a(x), \quad a > 0, \; a \neq 1, \; x > 0$

where is the base of the logarithm. This definition establishes a direct connection between exponential and logarithmic expressions:

$a^y = x \quad \Longleftrightarrow \quad y = \log_a(x).$

Logarithmic functions exhibit unique characteristics. They are strictly increasing when the base, and strictly decreasing when. Their graphs approach the -axis asymptotically and pass through the point. These properties make logarithmic functions indispensable for studying growth, decay, and scaling behaviors.

In applied mathematics, logarithms appear in diverse areas such as:

Physics: modeling radioactive decay, sound intensity (decibels), and earthquake magnitude (Richter scale).

Economics: representing compound interest, growth rates, and elasticity of demand. Computer science: complexity analysis of algorithms, particularly in sorting and searching processes.Thus, the study of logarithmic functions is not limited to theoretical mathematics but extends to multiple disciplines that rely on their properties for accurate modeling and problem-solving. Understanding their behavior and applications provides students and researchers with a solid foundation for both abstract reasoning and real-world analysis. Logarithmic functions possess several important mathematical properties that make them highly useful in algebra and analysis:

$\log_a(a^x) = x, \quad a^{\log_a(x)} = x.$

Product rule:

$\log_a(xy) = \log_a(x) + \log_a(y).$

Quotient rule:

$\log_a\left(\frac{x}{y}\right) = \log_a(x) - \log_a(y).$

Power rule:

$\log_a(x^n) = n \cdot \log_a(x).$

Change of base formula:

$\log_a(x) = \frac{\log_b(x)}{\log_b(a)}$.

These properties allow logarithms to simplify complex calculations, particularly in exponential equations and numerical analysis. The graph of has the following features: Range: all real numbers.

Intercept: the function passes through.

Asymptote: the vertical line is a boundary the graph approaches but never crosses. These properties make logarithmic graphs useful in understanding scaling relationships and transformations in applied sciences.

Logarithmic functions are widely used in various fields:

Physics: Measuring sound intensity with the decibel scale. Describing earthquake magnitudes using the Richter scale. Modeling radioactive decay and half-life calculations.

Economics and Finance: Calculating compound interest. Modeling economic growth rates. Representing price elasticity of demand.

Computer Science: Analyzing the efficiency of algorithms (e.g., binary search runs in time). Data compression and information theory, where logarithms measure information entropy.

Biology and Medicine: Modeling population growth and bacterial decay. Expressing pH values in chemistry and medicine as negative logarithms of hydrogen ion concentration. These diverse applications highlight the importance of logarithmic functions not only in theoretical mathematics but also in real-world problem solving. Logarithmic functions are a cornerstone of modern mathematics, linking theoretical concepts with practical applications. As the inverse of exponential functions, they provide essential tools for solving equations, analyzing growth and decay, and interpreting real-world phenomena. Their unique properties - such as the product, quotient, and power rules - make logarithms powerful instruments in algebra and higher mathematics. Graphical analysis shows that logarithmic functions describe natural scaling behaviors, which explains their widespread use in sciences, economics, and technology. From measuring sound intensity in decibels to evaluating algorithmic efficiency in computer science, logarithmic functions play a key role in understanding both natural and artificial systems. Ultimately, the study of logarithmic functions is not only a matter of mathematical theory but also a gateway to interdisciplinary applications. By mastering their properties and applications, students and researchers gain deeper insights into how mathematics can model, explain, and predict complex processes across various domains.

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