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QUALITY EDUCATION IN THE DIGITAL AGE: ADAPTING TO 21ST CENTURY PRIMARY SCHOOL LEARNERS

OLEKSANDR BLYZNYUK, TETIANA KACHAK, TETYANA BLYZNYUK, STANISŁAWA KATARZYNA NAZARUK*

*Corresponding author: tetiana.kachak@pnu.edu.ua

Abstract. A concise summary of the article, highlighting the problem, methodology, key findings, and implications for education in the digital age. The rapid advancements in digital technology have significantly transformed education, presenting both opportunities and challenges for primary school learners in the 21st century. This article explores the concept of quality education in the digital age, emphasizing the need to adapt teaching practices and methodologies to meet the evolving needs of digital-native students. It examines the unique characteristics of 21st-century learners, including their reliance on technology, preference for interactive and personalized learning experiences, and ability to process information from multiple sources simultaneously. The study reviews existing literature on digital tools and techniques applied in primary education, highlighting global trends, innovative practices, and the benefits of technology in enhancing student engagement and learning outcomes. Additionally, it addresses challenges such as the digital divide, disparities in access to technology, and the need for teacher training and curriculum redesign to effectively integrate digital tools. Through a comprehensive analysis, this article identifies key strategies for adapting primary education to the digital age. These include fostering digital literacy, leveraging gamification and adaptive learning platforms, promoting collaborative online learning environments, and ensuring equitable access to digital resources. The findings underscore the importance of a holistic approach that combines technology with pedagogical innovation to create meaningful, inclusive, and future-ready learning experiences for primary school students. The article concludes with practical recommendations for educators, policymakers, and researchers to advance quality education in the digital age while addressing emerging challenges and opportunities.

Keywords*:* quality education, 21st-century learners of primary school, educational methodologies, digital technology, digital literacy.

1. INTRODUCTION

Quality education has long been recognized as a cornerstone of societal progress and individual empowerment (OECD, 2017). Moving to the middle of the 21st century, the concept of quality education is evolving significantly due to rapid technological advancements that have reshaped how knowledge is accessed, shared, and applied. Nowadays there is not a unified definition of the term "quality education", however, no one attempts to question that it should deal with the digitalization of education providing equal access to learning materials, ensuring skills development, guaranteeing inclusive and effective educational environments leading to relevant learning outcomes. Researchers Shabbir Ahmad et al. in their study "Education 5.0: Requirements, Enabling Technologies, and Future Directions" highlight that "Education 5.0 refers to the fifth industrial revolution in education, leveraging digital

technologies to remove learning barriers, improve teaching methods, and foster overall well-being" (Ahmad et.al, 2023). They emphasize that this concept aims to create a student-centered environment that utilizes cutting-edge technologies and teaching methodologies to ensure equal access to educational resources and skill development.

The conceptual foundations of digital transformation are systemic change, which takes into account the transformation of organizational culture, the introduction of new ways of making decisions based on digital data, improving the digital competencies of all employees of an educational institution, the use of tools to support and develop didactic innovations, conducting scientific activities, or establishing relationships with students using new communication channels (Sparyk, 2021, p. 65).

Digital transformation has introduced a wealth of opportunities to enhance teaching and learning, particularly in primary education, where the foundation for lifelong learning is established. All of these are specified in Sustainable Development Goals 4 Education approved by the leaders of the United Nations member states at the 70th session of the UN General Assembly in September 2015 (UNESCO, 2016).

Therefore, the integration of digital tools such as interactive platforms, adaptive learning software, and multimedia resources has transformed traditional classroom environments into dynamic, technology-rich learning spaces. "Similarly, educators use other digital tools and resources online to visualize the educational process, including distance learning, namely: word clouds, short instructional videos, presentations, interactive worksheets, posters, puzzles, etc. They increase students' motivation and interest, cognitive activities, and promote faster learning" (Panchenko et al., 2022, p. 18).

However, these advancements also bring new complexities. The digital age has given rise to a generation of learners who are accustomed to immediate access to information and interactive, multimodal experiences. This shift demands innovative teaching approaches that align with students' evolving needs while maintaining the core principles of holistic education. Ensuring that digital transformation contributes positively to education requires careful consideration of accessibility, equity, and pedagogical efficacy.

The professional values of a modern teacher play an important role in ensuring the quality of higher education (Tsiuniak et al, 2024). Despite the potential of digital tools to enhance learning, educators face significant challenges in adapting to the needs of 21st-century digital learners. These include a lack of or poor quality training in technology integration, disparities in access to digital resources, and the difficulty of balancing technology use with traditional teaching methods. Many educators also struggle to create engaging and meaningful learning experiences that harness the full potential of digital tools while addressing the diverse abilities and backgrounds of primary school learners. In this context, the preparation of future primary school teachers to design and use digital educational content for working with students in online and offline learning environments is of great importance (Chervinska & Khimchuk, 2021).

2. THEORETICAL FRAMEWORK

The current generation of primary school learners, often referred to as "digital natives," or generation Alpha has grown up in an environment deeply intertwined with technology. These students exhibit distinct characteristics, such as a preference for interactive and multimedia-rich content, shorter attention spans, and a reliance on instant access to information. They are considered highly visual learners, accustomed to processing information through videos, images, and animations rather than traditional text-based methods. Additionally, digital-age learners are collaborative by nature, frequently engaging in online communities and group activities that promote shared learning. Deep research has been performed to understand this generation of students and efficient ways to better organize learning were proposed. Research on identifying effective teaching methods for the modern generation of primary school students is actively being conducted both in Ukraine and globally. Scholars such as T.

Blyznyuk (2020), O. Budnyk (2024), C. Chan (2023), I. Chervinska (2021), L. Iliichuk (2024), T. Kachak (2022), O. Kornuta (2017), K. Lee (2023), O. Shparyk (2021), O. Strutynska (2020), S. Topalova (2024), V. Topalova (2024), O. Tsiuniak (2024), E. Zelenov (2018) and others, have contributed significantly to this field. They explore various aspects, including the characteristics of contemporary schoolchildren, methods for effective pedagogical interaction, and the psychological dimensions of education with a focus on innovative learning technologies. However, limited attention has been given to analyzing the influence of digital technologies on the development of modern youth, primary school students, in particular. This study seeks to address this gap by examining the impact of digital tools on the younger generation.

3. RESEARCH OBJECTIVE

The purpose of the article is to explore how quality education can be achieved in the digital age by adapting teaching practices to the characteristics and needs of 21st-century primary school learners. It seeks to identify effective strategies for integrating digital tools into primary education while addressing existing challenges. By examining global trends, innovative practices, and the barriers to implementation, this study provides actionable insights for educators, policymakers, and researchers striving to create equitable and impactful learning environments and use digital open education resources (here and after OER).

4. RESULTS AND DISCUSSION

Technology has influenced not only the way students consume information but also how they think, communicate, and solve education problems. Access to digital tools fosters creativity and critical thinking, enabling students to explore concepts through simulations, games, and hands-on activities. Moreover, technology promotes personalized learning by adapting content to individual student needs, allowing them to progress at their own pace. However, the constant connectivity and exposure to digital media also present challenges, such as reduced focus and overdependence on technology for problem-solving.

The integration of digital tools in primary education has introduced a variety of innovative technologies, including interactive whiteboards, educational apps, gamified learning platforms, and virtual reality (VR) tools (Fig 1).

According to Fig. 1 and scientifically proven data, interactive whiteboards have become a staple in many classrooms. These tools allow teachers to deliver dynamic, multimedia-rich lessons that combine text, images, videos, and interactive activities. Students can engage directly with the content by writing or drawing on the board, fostering collaboration and hands-on learning. These tools are particularly effective for visual and kinesthetic learners.

Educational apps and gamified platforms are widely used to make learning fun and interactive. They incorporate gamification elements such as rewards, levels, and challenges to motivate primary school students. Math-focused apps provide game-based problem-solving exercises, while digital platforms encourage reading through engaging digital libraries.

Adaptive learning technologies use artificial intelligence to tailor educational content to each student's learning pace and skill level. These systems analyze student performance in real time, identifying strengths and weaknesses to provide targeted instruction and practice. This personalized approach ensures that students receive support where they need it most, helping to close learning gaps.

Collaborative tools and learning management systems facilitate collaboration between students, teachers, and parents. They support document sharing, real-time collaboration, and communication, making group projects and class activities more efficient (Kachak, & Kachak, 2022). LMS platforms streamline classroom management by providing a centralized hub for assignments, assessments, and feedback.

Interactive Whiteboards and Smart Displays

SMART Boards
Promethean Boards
Padlet
Miro
Jamboard

Educational Apps and Gamified Learning Platforms

Kahoot! Reading eggs
Quizlet National Geographic Kids
Duolingo Book Creator
Prodigy Pear Deck
SplashLearn LearningApps

Adaptive Learning Systems

DreamBox
i-Ready
Khan Academy
Achieve3000
Smarty Ants

Collaborative Tools and Learning Management Systems

Google Workspace for Education
Microsoft Teams
Seesaw
Moodle
Zoom

3D Printing and Robotics Technologies

LEGO Education sets
Scratch coding platform
Dash and Sphero MakerBot and Tinkercad

Digital Storytelling Tools

Book Creator
Storybird
My Story Book

Assessment and Feedback Tools

Formative
Kahoot!
Socrative
Classkick

Fig 1. Digital tools for primary education

Source: created by authors

Incorporating 3D printing, coding and robotics into primary education helps students develop computational thinking and problem-solving skills. Tools like these (see Fig.1) introduce students to the fundamentals of programming in a fun and accessible way. These tools prepare young learners for a technology-driven future while fostering creativity and critical thinking.

Storytelling platforms allow students to create and share their own stories through text, images, and audio. They promote literacy, creativity, and self-expression, making them especially valuable for language arts education. Digital assessment tools provide teachers with instant insights into student performance. These tools enable formative assessment during lessons, helping educators adjust their teaching strategies in real time. They also offer students immediate feedback, promoting a growth-oriented learning environment.

Globally, education systems are leveraging technology to enhance student engagement and learning outcomes. In Finland, for example, schools use gamification to make learning more enjoyable and interactive. Singapore has adopted blended learning models that combine traditional and digital methods, while the United States emphasizes integrating coding and STEM education into the curriculum. Best practices highlight the importance of balancing technology use with active teaching, ensuring that digital tools complement rather than replace traditional methods (Avsheniuk et al., 2018).

Based on generations review by C. Chan and K. Lee, the current generation of young learners has grown up immersed in the world of rapid technological advancements, where digital devices and the internet are an integral part of daily life. Endless access to digital environments has profoundly shaped their learning preferences and expectations. Unlike previous generations, present-time students prefer hybrid learning approaches that incorporate technology and multimedia content, images, videos, and audio material rather than traditional text-based information. Accustomed to instant and constant connectivity, primary school students thrive in educational experiences that mirror the fast-paced, interactive nature of their digital lives. They expect their education to be technology-driven, engaging, and directly relevant to the real world (what is mentioned in the concept of New Ukrainian School). Practical, hands-on learning opportunities that integrate technology are especially valued, as they allow students to apply their knowledge in meaningful and tangible ways. To meet the needs of this digitally native generation, educators must embrace innovative teaching strategies that blend traditional methods with digital tools, creating dynamic and engaging learning environments that prepare students for the demands of the contemporary era (Chan, & Lee, 2023). According to scholars (Kornuta, Pryhorovska, & Potiomkina, 2017), due to the peculiarities of way of thinking, representatives of the current generation of young learners master knowledge in a game form better, and rules, formulas, etc. are easier for them to perceive in the form of infographics (Strutynska, 2020), which is believed to be more understandable.

Additionally, initiatives to promote digital literacy and equitable access to technology are essential to fostering inclusive education (Budnyk, & Kotyk, 2024). Ensuring that all students, regardless of their socioeconomic backgrounds, have access to digital devices and reliable internet connectivity is essential for bridging the digital divide (Topalova, & Topalova, 2024). At the same time, teaching digital literacy skills such as navigating online platforms, critically evaluating information, and using technology responsibly, empowers learners to participate fully in modern learning environments. By integrating these elements into education, schools can create opportunities for every learner to engage, collaborate, and develop in a world driven by technology, thereby promoting equity and inclusion in the classroom and beyond.

While digital tools offer immense potential, their integration into primary education is faced with challenges. One significant barrier is the digital divide, where unequal access to technology prevents students from disadvantaged backgrounds from benefiting fully. Teachers often face difficulties in effectively incorporating technology into lesson plans due to a lack of training and support. Furthermore, the overuse of technology can lead to issues such as reduced interpersonal skills, cyber distractions, and screen-time-related health concerns (Blyznyuk, 2020).

It is perfectly clear key benefits of technologies in the classroom are students' engagement,

personalization of the education process and adapting to individual needs, collaboration, and skill development. To maximize the benefits of digital tools, curricula need to be redesigned to incorporate technology meaningfully (Zelenov, 2018). This involves creating learning objectives that align with digital competencies and promoting interdisciplinary approaches that combine technology with traditional subjects. Teacher training programs prioritize digital literacy and equip educators with the skills to use technology effectively. Additionally, schools need to develop policies that address the ethical and responsible use of technology, ensuring a balanced approach to digital integration. By addressing these challenges and gaps, educators can better harness the potential of digital tools to provide quality education that meets the needs of 21st-century primary school learners.

Considering the conducted research on the problem, we attempt to develop some practical recommendations for primary school educators, policymakers, and scholars which promise to be essential to advancing quality education in the digital age. They are provided in a Table ensuring that technological advancements effectively support learning rather than create new barriers (Tab. 1).

Tab. 1

Expanded recommendations for arranging quality education in primary school in the digital age

Category	Recommendations	Details
Integrating Technology Thoughtfully	1. Choose age-appropriate digital tools.	Use interactive whiteboards, learning apps (e.g., Kahoot, Duolingo, ABCmouse), and digital storytelling platforms.
	2. Blend traditional and digital methods.	Combine paper books with e-readers, digital simulations with hands-on activities, and teacher-led instruction with online collaboration.
	3. Align technology with learning objectives.	Ensure that digital tools enhance learning rather than replace foundational teaching strategies. Focus on skill-building.
Developing Digital Literacy	4. Teach basic digital skills.	Introduce file management, online research techniques, and digital communication.
	5. Foster critical thinking online.	Train students to assess the credibility of online sources, avoid misinformation, and recognize bias in digital content.
	6. Promote responsible digital citizenship.	Mention online etiquette, cyber safety, privacy protection, and the ethical use of digital resources.
Personalized Learning Approaches	7. Use adaptive learning platforms.	Leverage AI-driven tools (e.g., Kahoot, Prodigy, Nearpod) to customize lessons based on students' abilities and progress.
	8. Offer differentiated digital activities.	Allow students to choose digital projects, games, or assignments that align with their learning preferences.
	9. Track students' progress with data analytics.	Use digital assessment tools to identify learning gaps and personalize instruction.

Enhancing Engagement Through Interactivity	10. Implement gamification elements.	Use points, leaderboards, digital badges, and quizzes to motivate students.
	11. Utilize virtual and augmented reality (VR/AR).	Arrange virtual trips, explore 3D models, and engage students in immersive simulations.
	12. Encourage collaboration through online platforms.	Use Google Classroom, Padlet, Flipgrid or Mentimeter for group projects, discussions, and peer feedback.
Teacher Professional Development	13. Participate in ongoing online/offline training.	Take part in workshops, webinars, and hands-on practice sessions on digital pedagogy.
	14. Be ready to connect with educators online.	Encourage participation in professional learning networks (PLNs) like Edutopia, Coursera, and NaUrok, Prometheus, EdEra.
	15. Facilitate peer-sharing of best practices.	Create a school-based knowledge-sharing hub where teachers can exchange strategies and experiences.
Creating an Inclusive Digital Learning Environment	16. Ensure equal access to technology.	Provide school-based digital resources (e.g., tablets, laptops) and support for students from disadvantaged backgrounds.
	17. Use assistive technologies.	Incorporate text-to-speech tools, audiobooks, speech recognition, and closed captioning for students with disabilities.
	18. Design non-tech alternatives for digital lessons.	Offer printed materials, offline activities, and hands-on experiments to ensure inclusivity.
Balancing Screen Time with Offline Activities	19. Implement structured screen time limits.	Follow recommended screen time guidelines and integrate breaks between digital activities.
	20. Encourage movement-based learning.	Incorporate physical activities, outdoor learning, and kinesthetic tasks alongside digital assignments.
	21. Combine technology with traditional learning.	Blend traditional lessons with storytelling, digital drawing with art projects, and interactive e-books with printed materials.
Engaging Parents in the Digital Learning Process	22. Educate parents on digital tools.	Conduct workshops, send guides, and provide access to online resources explaining classroom technology.
	23. Offer guidance on managing screen time at home.	Share best practices for balancing screen time, monitoring digital usage, and setting online safety rules.
	24. Involve parents in digital	Encourage participation in digital

	learning activities.	storytelling, coding workshops, or online collaborative projects with their children.

Source: created by authors

Tab. 1 provides a structured approach to enhancing quality education in primary schools in the digital age by outlining key recommendations for educators. It highlights the importance of integrating technology thoughtfully, fostering digital literacy, and using personalized learning strategies to cater to diverse student needs and abilities. Additionally, it emphasizes the role of teacher professional development, inclusivity, and parental involvement in creating an effective digital learning environment. By implementing these recommendations, educators can maximize the benefits of digital tools while addressing challenges such as screen time management, equitable access, and student engagement. Policymakers also play a crucial role in establishing supportive frameworks, ensuring access to technology, and addressing ethical concerns such as data privacy and digital literacy. At the same time, researchers contribute by analyzing the impact of digital education, identifying best practices, and exploring innovative solutions to emerging challenges. As technology continues to reshape education, well-informed recommendations help bridge the gap between potential opportunities such as personalized learning and global connectivity and challenges like overuse of online applications, platforms, digital divides, and teacher training gaps. By aligning efforts across key stakeholders, we can create a more effective, inclusive, and future-oriented education system.

4. CONCLUSIONS

The rapid integration of digital technologies into primary education has transformed traditional teaching and learning methods, presenting both significant opportunities and pressing challenges. On the one hand, digital tools have enhanced student engagement, fostered personalized learning experiences, and enabled access to vast educational resources. The rise of adaptive learning platforms, gamification techniques, and collaborative online environments has reshaped how young learners interact with information, making education more dynamic and interactive. However, despite these advancements, the effective implementation of digital education remains complex, requiring careful consideration of pedagogical strategies, infrastructure development, and teachers' training and readiness. Ensuring that technology complements rather than replaces fundamental educational principles is key to fostering high-quality learning experiences.

At the same time, disparities in digital access and literacy continue to pose significant barriers to equitable education. The digital divide, stemming from socioeconomic differences, inadequate technological infrastructure, and limited access to quality digital resources, risks deepening existing educational inequalities. While some students benefit from cutting-edge tools and high-speed internet, others struggle with outdated devices or a lack of connectivity. Moreover, many educators face challenges in adapting to digital teaching, lacking the necessary training and support to integrate technology effectively. Addressing these issues requires systemic reforms, including investments in digital infrastructure, professional development programs for teachers, and policies that promote inclusive and accessible education for all students.

Beyond accessibility, another critical challenge lies in managing the balance between digital and traditional learning approaches. Excessive screen time, reduced face-to-face interaction, and potential cognitive overload are concerns that must be addressed to ensure a well-rounded education. While digital tools offer flexibility and efficiency, they should not replace essential aspects of primary education, such as hands-on activities, social interaction, and critical thinking development. Schools must also prioritize digital literacy education, equipping students with the skills to navigate online platforms safely, critically evaluate digital information, and engage responsibly in digital spaces.

Ultimately, achieving quality education in the digital age requires a collective effort from current and would-be educators, policymakers, researchers, and communities. A forward-thinking, evidence-based approach is necessary to harness technology's full potential while mitigating its risks. By fostering digital equity, promoting teacher capacity-building, developing and implementing pedagogically sound digital learning recommendations, we can create an education system that not only adapts to the needs of 21st-century learners but also prepares them for future challenges. In doing so, we ensure that digital transformation serves as a tool for empowerment rather than exclusion, fostering an inclusive, engaging, and future-oriented educational environment for primary school students in Ukraine and worldwide.

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Oleksandr Blyznyuk, PhD student, recipient of the third (educational and scientific) level of Doctor of Philosophy in the Department of Primary Education and Educational Innovations, Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, Ukraine;
ORCID ID: 0009-0000-3885-0420
Tetiana Kachak, Doctor of Philosophy, Professor in the Department of Primary Education and Educational Innovations, Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, Ukraine;
ORCID ID: 0000-0002-6863-1736
Tetyana Blyznyuk, PhD in Education, Associate Professor in the Department of Primary Education and Educational Innovations, Expert in the use of educational innovations in teaching at the Center of Innovative Educational Technologies 'PNU-EcoSystem', Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, Ukraine;
ORCID ID: 0000-0002-0558-2201
Stanisława Katarzyna Nazaruk, Doctor of Pedagogical Sciences (Ph.D.), Faculty of Social Sciences and Humanities, Department of Pedagogy, John Paul II University in Biała Podlaska, Poland;
ORCID ID: 0000-0001-5620-3980
Address: Oleksandr Blyznyuk, Tetiana Kachak, Tetyana Blyznyuk, Vasyl Stefanyk Precarpathian National University, 57 Shevchenko St., Ivano-Frankivsk, 76018, Ukraine.
Stanisława Katarzyna Nazaruk, John Paul II University in Biała Podlaska, 21-500 Biała Podlaska, Sidorska 95/97, Poland.
E-mail: oleksandr.blyzniuk.22@pnu.edu.ua, tetiana.kachak@pnu.edu.ua, tetyana.blyznyuk@pnu.edu.ua, s.nazaruk@dyd.akademiabialska.pl
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У статті висвітлено ключові аспекти проблеми організації якісної освіти та адаптації навчального матеріалу до потреб учнів початкової школи XXI століття. Стрімкий розвиток цифрових технологій суттєво трансформував сучасний освітній процес, відкриваючи нові можливості та створюючи водночас виклики для здобувачів початкової освіти. Концепцію якісної освіти в цифрову епоху досліджено з акцентом на необхідності адаптації методів навчання та педагогічних підходів до потреб цифрового покоління. Особлива увага приділена аналізу унікальних характеристик сучасних учнів, зокрема їхній залежності від технологій, схильності до інтерактивного та персоналізованого навчання, здатності одночасно опрацьовувати інформацію з кількох джерел. У роботі здійснено ґрунтовний огляд наукової літератури щодо використання цифрових інструментів у початковій освіті, що дозволяє виокремити глобальні тенденції, інноваційні практики та переваги технологій у підвищенні залученості учнів і покращенні їхніх навчальних результатів. Водночас розглядаються ключові виклики цифровізації освіти: цифровий розрив, нерівномірний доступ до технологій, необхідність підготовки вчителів і перегляду навчальних програм для ефективного впровадження цифрових інструментів. У результаті комплексного аналізу визначено ключові стратегії адаптації початкової освіти до цифрової епохи, серед яких: розвиток цифрової грамотності, впровадження гейміфікації та адаптивних навчальних платформ, створення інтерактивних онлайн-середовищ для спільного навчання, забезпечення рівного доступу до цифрових ресурсів. Отримані результати підкреслюють важливість комплексного підходу, який поєднує технології з педагогічними інноваціями, створюючи змістовний, інклюзивний і орієнтований на майбутнє освітній простір для учнів початкової школи. Подано практичні рекомендації для педагогів і науковців щодо вдосконалення якісної

освіти в умовах цифрової трансформації.

Ключові слова: якісна освіта, учні початкової школи XXI століття, освітні методики, цифрові технології, цифрова грамотність.