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The Use of Information and Computer Technologies in Preschool, Secondary and Higher Education Pedagogy

Abstract: The article examines the relevance and versatility of information and computer technologies in the educational process at different stages: preschool education, general secondary school, and higher education. The study subject is digitalising the educational process in preschool, general secondary, and higher education institutions. The study aims to identify the forms and methods of intensifying various levels of education through information and computer technologies. The potential of information and computer technologies for enriching the learning environment, increasing students' motivation, individualising learning, and developing key competencies is analysed. The specifics of the use of various digital tools and resources at each level of education are revealed, and their role in improving teaching methods, organising knowledge control, and stimulating the creative activity of children, pupils, and students is emphasised. Special attention is paid to the benefits of integrating information and computer technologies for developing the future generation's independence, critical thinking, and digital literacy.

Keywords: information computer technologies, preschool children, preschoolers, pupils, schoolchildren, students, preschool educational institutions, general secondary educational institutions, higher educational institutions, competencies, educators, teachers, lecturers, scientists.

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Використання інформаційних комп'ютерних технологій в педагогіці дошкілля, загальної середньої та вищої школи

Анотація: У статті розглядається актуальність та багатогранність використання інформаційних комп'ютерних технологій в освітньому процесі на різних етапах: дошкільній освіті, загальній середній школі та вищій школі. Об'єктом дослідження є цифровізація освітнього процесу у закладах дошкільної, загальної середньої та вищої освіти. Метою дослідження є виявлення форм та методів інтенсифікації різних рівнів освіти засобами інформаційних комп'ютерних технологій. Проаналізовано потенціал інформаційних комп'ютерних технологій для збагачення навчального середовища, підвищення мотивації здобувачів освіти, індивідуалізації навчання та розвитку ключових компетентностей. Розкрито специфіку застосування різноманітних цифрових

інструментів та ресурсів на кожному з рівнів освіти, підкреслено їхню роль у вдосконаленні методів викладання, організації контролю знань та стимулюванні творчої активності дітей, учнів і студентів. Окрему увагу приділено перевагам інтеграції інформаційних комп'ютерних технологій для розвитку самостійності, критичного мислення та цифрової грамотності майбутнього покоління.

Ключові слова: інформаційні комп'ютерні технології, діти дошкільного віку, дошкільники, учні, школярі, студенти, заклади дошкільної освіти, заклади загальної середньої освіти, заклади вищої освіти, компетентності, вихователі, вчителі, викладачі, науковці.

Abbreviations:

ICT is information and computer technologies.

Introduction

Modern processes of globalisation, digital transformation, the formation of a market economy, and the gradual integration of Ukraine's educational system into the European educational area necessitate the modernisation of the content and structure of professional higher, pre-tertiary, and preschool education. This highlights the need to improve the quality of teaching in the subject area and to develop learners' intellectual and psychological readiness to process large volumes of information and to continuously update their knowledge and competencies, particularly in the use of information and computer technologies to enhance the quality and effectiveness of the educational process.

The study subject is digitalising the educational process in preschool, general secondary, and higher education institutions.

The study aims to identify the forms and methods of intensifying various levels of education through information and computer technologies.

The study objectives are:

- examine how the informatisation of the educational process is addressed in academic literature;
- identify the main areas of application of information and computer technologies;
- outline the specific features of using online services, particularly the tools of Google Workspace;
- detail the potential for using tools such as Canvas Apps and Canva in the educational process for fostering learners' creative development;
- identify the multimedia opportunities available for the educational process across different levels of education.

Educators, psychologists, and researchers have explored key aspects of information and computer technologies, their structural components, and their significance for the educational process and personal development. This includes a historical overview of implementing digital technologies (O. Humennyi, V. Kapustnyk, N. Kiyanovska, V. Kovalenko, P. Kostiurulina, A. Sukhikh); the application of information and computer technologies in the educational process (S. Verezomska, O. Hevko, Yu. Zinkovskyi, M. Kademiya, L. Krukevych, T. Kuzmych, O. Pashchenko, V. Tatarintseva, O. Chaikovska, N. Shvadchak); the development of digital

competence and the use of digital services and tools for various forms of learning (H. Henseruk, Yu. Zaporozhchenko, Z. Zvynyatskivska, I. Kobernyk, S. Martyniuk, I. Fursov); and the use and significance of information and communication technologies in the formation of the educator (O. Hritchenko, V. Kuzmenko, O. Mekhed, V. Nazarenko, O. Ovcharuk, etc.).

This study will be of interest to educators, learners, and parents involved in preschool, general secondary, and higher education, as well as researchers and all those interested in current trends in education development.

Results

Content, Forms, Methods, Means, Tools, and Significance of the Use of Information and Computer Technologies in the Educational Process

ICT encompass a set of tools, methods, and approaches that facilitate data collection, processing, storage, and transmission through computer equipment and telecommunications. These technologies cover the key areas of their application, including:

- working with internet networks and utilising online resources (such as web platforms and cloud services) (*Sukhikh, 2021, pp. 157–160*) for data retrieval and communication;
- developing creative tasks (such as project-based research, interactive reports, educational sessions, and collaborative creative work involving two to several dozen participants, including students, lecturers, educators, parents of preschoolers, researchers, etc.), as well as the creation of presentation materials;
- employing multimedia tools of computer equipment as an effective means of problem-oriented visualisation.

ICT is being actively integrated into the educational process (*Krukevych, 2023, pp. 411–414*) at higher education institutions, as well as in general secondary and preschool education, and is regarded as one of the most promising innovations in this field. ICT engages the auditory and visual analysers of the individual, thereby enhancing emotional perception and the visualisation of educational content. The combination of images, illustrative examples, and text, along with the use of animation, sound effects, video clips, and other visual media, contributes to greater interest, improved comprehension, and better assimilation of educational material, making it more accessible and engaging for preschool children, school pupils, and university students alike.

An essential advantage of integrating information and computer technologies into the educational process lies in the development of educational resources in higher preschool education institutions and the effective use of online services (*Verezomska, 2022, pp. 165–167*), particularly the tools provided by Google Workspace:

- Document-oriented solutions (real-time collaborative editing of presentations by preschool education staff, as well as students and lecturers);
- Interactive assessment formats (creating tests for preschool children, school pupils, and students via Google Forms);
- Use of Google Sheets for data collection (among students, parents of preschoolers, and educators in both preschool and higher education institutions);

- Use of Google Classroom for course management (appropriate for creating and managing academic subjects in higher education institutions and for use in the methodological work of preschools);
- Use of Google Meet to organise online communication within the educational environment across various institutional levels (the platform's adaptability to higher education needs, including lectures, seminars, consultations, departmental scientific, methodological, and technological meetings and events; in preschool and general secondary education institutions it serves to optimise interaction among teachers, administrators, and parents through various video conferences for pedagogical-methodological and administrative-organisational tasks);
- Use of Google Drive for cloud storage of educational information, documents and other textual content, photos, videos, audio materials, images, and archived materials relevant to both preschool and higher education institutions;
- Availability of modern educational resources such as e-books, repositories, and online libraries accessible in real-time from any classroom, group, or home setting, including assembly and sports halls. These resources engage users by offering quick access to books, journals, and other publications, as well as to articles, scientific and archival materials, and research—both domestic and international—thereby enhancing the productivity of the educational process;
- Use of Jamboard as an interactive virtual whiteboard in the educational process—allowing for the display of diverse visual materials tailored to various age groups, including children and preschool pupils; the uploading and display of visual content in formats such as photographs, text notes, graphic images, as well as Word and PDF documents, Excel spreadsheets, and presentations created in Canva and PowerPoint; the organisation of group work among students or within a classroom (e.g., brainstorming sessions, projects, collaborative discussion of strategies, textual analysis, commenting) using various tools such as pens, handwriting recognition, and other functions; the creation of a "shared interactive banner (drawing/poster)" which enables a large number of participants (lecturers, educators, researchers, pupils, preschoolers) to simultaneously collaborate, draw, refine materials, and share creative ideas and solutions; accessibility not only via desktop computers and laptops, but also via mobile devices, smartphones, and tablets; the use of real-time adjustable visuals (drawings, sketches, tables, and diagrams) by educators through uploading various files from Google Drive to Jamboard; centralised collection of diverse information (personal data, individual work, tests, responses, suggestions) from all participants in one place;
- Use of the Skillshop platform, which offers an extensive collection of specialised learning materials focused on mastering the process of creating digital tools;
- Use of the Moodle distance learning system for students, lecturers, and educators (facilitating modular, individualised, and social learning, academic courses, professional development, programming, and testing; allowing lecturers, teachers, or institutional heads to configure moderation settings, access permissions, or participant access via password; enabling the publication of educational content in text, audio, and visual formats);

- Use of services for creating comics, such as Storyboard, and puzzle generators like Rebus1, which open new horizons for education at all levels—from preschool to higher education;
- Use of modern, interactive, and highly adaptive tools such as Canvas Apps and Canva, tailored to the needs of students, pupils, educators, teachers, and lecturers, to enhance the interactivity and visualisation of the educational process and automate procedures.

Let us examine in more detail the potential of creatively using Canvas Apps and Canva tools to foster the creative development of preschoolers, pupils, students, educators, teachers, lecturers, and researchers, to organise collaboration among educational process participants, and to improve learning efficiency at all levels of education.

In the early years of educational institutions, the use of Canvas Apps and Canva enables the organisation of:

1. Interactive games and exercises through the creation of simple applications with tasks focused on recognising colours, shapes, numbers, and letters. Children can interact with on-screen elements, which supports the development of fine motor skills and logical thinking.
2. Virtual albums and portfolios to store children's creative works and photos from events, educational activities, excursions, celebrations, performances, competitions, and recreational activities. These collections also document children's achievements and can be viewed by their parents and educators.
3. Electronic mood diaries that record a child's emotional state throughout the day help educators better understand children's feelings, desires, and needs.

In general, in secondary education institutions, the use of Canvas Apps and Canva can support:

1. Visualise educational content by creating interactive diagrams, infographics, and presentations to explain complex topics (e.g., cell structure, human anatomy, historical events and facts, or mathematical, physical, and chemical formulas, algorithms and processes).
2. Organisation of group projects and posters, allowing pupils from one or more classes and teachers to collaboratively create posters, flyers, and presentations for performances, competitions, or school events.
3. Create and administer tests and surveys, enabling teachers to collect student responses in real time and automatically assess their knowledge.
4. Improved and faster organisation of school events, including developing apps for event registration, participant list management, timetable planning, and conducting surveys regarding celebration arrangements.
5. The setup of "virtual laboratories", where dedicated apps simulate physical, chemical or biological experiments. Pupils can independently adjust specific parameters and observe the outcomes.

In higher education institutions, the application of Canvas Apps and Canva also has a wide range of uses:

1. Management of student projects, where Canvas Apps provides a convenient platform for planning, tracking progress, and sharing files and comments within a study group or academic department.

2. Automation of administrative processes, such as creating apps for submitting applications, course registration, booking rooms for educational or leisure purposes, and maintaining electronic records.
3. Visualisation of research: This allows the creation of interactive graphs, charts, and presentations of scientific findings using built-in or custom tools.
4. Student portfolio development, including dissertations, bachelor's and master's theses, coursework, diplomas, and certificates of participation in conferences and seminars—facilitating future employment opportunities.

Key advantages of using Canvas Apps and Canva across all levels of education include:

- User-friendly drag-and-drop interface, offering an intuitive and accessible design that enables users to create apps and learning materials without requiring in-depth programming knowledge;
- Interactivity for participants, engaging educators across early years, secondary, and higher education, as well as researchers, parents, pupils, and students in active interaction with the material, thus enhancing motivation to learn;
- Visualisation of informational content, making complex topics taught in nurseries and primary and secondary schools more comprehensible through the use of diagrams, charts, and infographics—particularly beneficial for STEM education;
- Collaborative work, enabling shared editing by all participants, group discussions, and results presentations.

A significant advantage of these web-based applications is their accessibility via any web browser without additional software installation, which supports their reliability provided a stable internet connection is available.

Traditional methods of delivering educational material from early childhood to higher education—such as storytelling, discussion, lectures, and static presentations—often limit engagement and opportunities for the practical application of knowledge. Interactive presentations offer a significantly broader pedagogical possibility, highlighting active audience involvement. Integrating multimedia components, such as dynamic video clips, visually rich imagery, and audio accompaniment, diversifies the learning process and enables deeper immersion into educational content. Moreover, the possibility of direct interaction with the material through interactive elements stimulates active learner participation, transforming them from passive listeners into co-creators of the educational experience.

Interactive presentations in group settings also serve as a powerful tool for developing social skills, fostering effective collaboration, and nurturing a sense of teamwork among children, pupils, and students. The educational process becomes more dynamic and informative with the inclusion of multimedia tools—videos, clips, illustrations, graphs, tables, sound effects, and animations. A key advantage of such presentations lies in their interactive nature, which allows learners in early years, primary and secondary schools, and higher education to observe and actively explore the presented material, thereby reinforcing their acquired knowledge.

In addition to individual benefits, interactive presentations prove to be an effective means of organising group work for acquiring new information and applying it practically. They

encourage the exchange of ideas, development of communication and cooperation skills, mutual support, teamwork, and collective achievement of set goals.

An engaging, interactive learning tool for preschoolers, schoolchildren, and university students is the use of comics, which aid in visualising knowledge and developing creativity. *Storyboard* comic creation platforms provide a captivating and effective way of conveying information to learners. These platforms are powerful didactic tools, offering an intuitive interface for creating visual stories that combine imagery and text. Their application in the educational process is highly versatile and suitable for all age groups—preschoolers, schoolchildren, and university students.

For preschool children, comics can be an excellent means of illustrating fairy tales, learning letters and numbers, and introducing behavioural norms. Visual representations help young learners better retain information and develop their imagination and creativity.

For schoolchildren, creating comics can be used to visualise historical events, scientific concepts, literary plots, and more. This approach contributes to a deeper understanding of the material, developing retelling skills and creative thinking. Pupils can create comics individually or collaboratively, thereby enhancing their teamwork skills.

In higher education, comics can be employed to visualise complex theoretical concepts, present research findings, and create educational resources. This can make learning more engaging and facilitate better information retention.

Using Storyboard and similar services enables educators to design unique teaching materials tailored to the needs of specific audiences. Learners, in turn, gain the opportunity to comprehend information and actively contribute to its creation, which significantly increases their interest and motivation to learn.

The use of *rebus puzzles* in education also promotes the development of logical thinking and attentiveness and reinforces and revises learned material. Rebus puzzles are brainteasers that use drawings, letters, numbers, and other symbols to encode words or phrases. The *Rebus1* platform is a convenient tool for generating a variety of rebuses that can be effectively employed at different stages of the educational process.

In early years education, simple rebuses with bright illustrations can be used to develop phonemic awareness, attention to detail, and early reading skills among young learners. Solving rebuses in a playful context makes learning enjoyable and unobtrusive.

In secondary education institutions, rebuses can be used to reinforce material studied across various subjects, develop logical thinking, and expand pupils' vocabulary. Creating their rebuses can be an engaging creative task for pupils, allowing them to reveal their abilities across different fields.

Even in higher education, rebuses may find application, e.g., to activate prior knowledge before introducing a new topic, to stimulate mental activity at the beginning of a lesson, or as a component of interactive assessment. More complex rebuses can foster the development of non-standard thinking.

Rebus1 and similar platforms allow educators to easily generate rebuses of varying complexity, tailoring tasks to suit the proficiency level of preschool children, school pupils, and university students. Solving rebuses provides entertainment and promotes the development of key cognitive skills such as analysis, synthesis, deduction, and attention to detail.

The use of platforms such as *Storyboard* and *Rebus1*, along with the integration of comics and rebuses into the educational process, presents significant advantages and prospects:

- Increased engagement among children, pupils, and students, as the visual appeal of comics and the intellectually stimulating nature of rebuses help to capture learners' attention and maintain their interest in studying.
- Enhanced cognitive activity, as both the creation and solving of comics and rebuses require active mental effort, information analysis, and knowledge application.
- Development of creativity and imagination, with the process of creating one's visual stories and encoded messages encouraging imaginative and creative thinking.
- Improved understanding and retention since visual imagery and interactive tasks help learners absorb and memorise educational material more effectively.
- The creation of a positive learning atmosphere, as the use of unconventional teaching methods makes the learning process more engaging and emotionally enriched.

Thus, integrating computer technologies with multimedia capabilities opens up unprecedented opportunities for educators and learners at various levels, elevating lessons to a qualitatively new standard. The application of multimedia does not merely enrich lessons with visual and audio effects but fundamentally transforms approaches to learning, knowledge assessment, and the development of creative potential. It enables illustrative support throughout the learning process—from static images to dynamic content.

One of the key benefits of using computer-based information technologies with multimedia is the considerable expansion of options for illustrative support during lessons. Instead of static posters or chalkboard drawings, teachers can utilise dynamic presentations, interactive diagrams, video clips, animations, and virtual tours. This diversity of visual content helps explain complex concepts more effectively, retains audience attention, and activates multiple channels of information perception. For instance, the study of historical events or plant growth can be accompanied by chronological videos, while understanding cell structure can be aided by interactive 3D models.

Multimedia technologies offer flexibility in organising the learning process, enabling the effective combination of different forms of learning and types of activity within a single lesson. Lecture material can seamlessly transition into interactive exercises, discussions, thematic video viewings, practical assignments, virtual research, experimental, and laboratory work. This approach supports high levels of engagement among children, school pupils, and university students, considers their characteristics and abilities, learning styles, preferences, and inclinations, and facilitates deeper assimilation of material. For example, to help preschoolers pronounce sounds correctly in words, audio recordings of speech therapists or teachers may be used; in foreign language learning, students can benefit from listening to audio recordings, watching context-relevant videos, taking interactive grammar tests, and using online platforms to communicate with native speakers.

Using computers with multimedia significantly expands the tools available for assessing pupils' and students' knowledge, skills, and competencies. Instead of traditional written tests and oral questioning, educators can use interactive quizzes with automated feedback, online competitions, multimedia presentations as a form of reporting, simulations of real-life situations,

and other innovative assessment methods. This makes the assessment process more objective, efficient, and engaging for students and also provides immediate feedback, helping learners better understand their strengths and areas for improvement.

Multimedia technologies are crucial in facilitating and enhancing the development of creative works, projects, and essays. Pupils and students gain access to a wide range of tools for creating multimedia presentations, videos, podcasts, interactive posters, and other creative products. This makes the task completion process more engaging and fosters the development of their digital skills, creativity, and ability to work with information and present the outcomes of their work in innovative ways. For instance, a literature project may be offered as a book trailer, while research on environmental topics can take the shape of an interactive infographic.

Computer-assisted learning is an integral component of modern, quality education. It makes the learning process more engaging and visual and enables effective differentiation. It also supports the development of independence and creativity in children and students, intensifies the educational process, and strengthens cross-curricular connections. Collectively, these aspects open new opportunities for improving the quality of education and preparing competent and competitive professionals.

One key advantage of computer-supported lessons is their ability to spark and sustain a high level of interest among preschoolers, pupils, and students. Interactive programmes, multimedia presentations, educational games, virtual laboratories, and online resources transform the learning process from passive observation into exciting interactive engagement. The novelty of technologies, the visual appeal of the content, and the opportunity for direct involvement in the educational process stimulate intellectual curiosity and motivate learners to delve deeper into the subject matter.

Information and communication technologies provide unique tools for effectively implementing a differentiated approach in the educational process. Software can be adapted to the individual learning pace of each preschool or school-aged child or student, offering tasks of varying complexity, additional support materials for those who need them, and advanced challenges for more gifted learners. This enables educators to account for different learning styles, levels of preparedness, and individual needs, ensuring the most effective knowledge acquisition and skill development.

Information and communication technologies in education are essential in fostering independence and creativity in children and students. Providing access to diverse informational resources, tools for creating multimedia projects, platforms for collaborative work, and online services encourages individuals to seek information independently, think critically, experiment, and express themselves creatively. They are empowered to determine the pace and direction of their learning, explore topics of personal interest, and present the outcomes of their efforts in original and imaginative ways.

Information and communication technologies do not merely complement traditional teaching methods but enable a qualitative transformation of the educational delivery model. Lessons and lectures become more illustrative through visualisations, animations, video materials, and interactive models. Interactive exercises and games—including board games (*Bokarieva & Shypov, 2024, p. 56*), online tests, virtual excursions, and simulations—promote active participation from children, pupils, and students alike. Furthermore, computer

technologies broaden access to education by enabling remote learning, facilitating online resources, and fostering collaboration among participants in the educational process regardless of their geographical location.

The application of information technologies intensifies the activities of educators, children, pupils, and students. Educators have powerful tools for planning and conducting lessons, automating routine tasks, organising knowledge assessments, and ensuring feedback. In turn, learners benefit from the ability to interact with information more dynamically and effectively, utilising various educational resources and tools to complete assignments. Additionally, computer technologies enhance interdisciplinary links by integrating knowledge from multiple subjects within a single educational project or task.

Conclusion

Thus, all the aforementioned advantages of computer-assisted learning ultimately contribute to developing an individual's overall giftedness. Engagement in active learning, the opportunity for independent inquiry, the development of creative abilities, individualised instruction, and the intensification of the educational process create favourable conditions for unlocking the potential of every participant in the learning environment. As a result, integrating information and computer technologies into the educational process is a powerful driver for improving the quality of education at all levels.

Hence, implementing information technologies, particularly using computers with multimedia, is not merely a trend but a necessary condition for ensuring high-quality and competitive education at every level. It allows the learning process to become more dynamic, interactive, personalised, and focused on developing an individual's key competencies (*Henseruk & Martyniuk, 2019, pp. 158–162*). Multimedia tools are becoming a powerful catalyst for transformation within the educational environment, opening up new horizons for effective learning and the holistic development of individuals. The successful use of these technologies requires educators to be technically literate and open to experimentation, creative approaches, and continuous self-improvement. Consequently, integrating multimedia into education is an investment in the future, ensuring the intellectual development of the younger generation from early childhood to higher education and preparing highly qualified professionals capable of acting effectively in an information-driven society.

Conflict of interest

The author declares that there is no conflict of interest.

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