

INTEGRATION OF THE LATEST INFORMATION AND COMMUNICATION TECHNOLOGIES INTO PEDAGOGICAL PRACTICE: IMPACT ANALYSIS, EFFECTIVENESS AND CHALLENGES ON THE WAY TO SUSTAINABLE IMPLEMENTATION IN HIGHER EDUCATION

INTEGRAÇÃO DAS ÚLTIMAS TECNOLOGIAS DE INFORMAÇÃO E COMUNICAÇÃO NA PRÁTICA PEDAGÓGICA: ANÁLISE DE IMPACTO, EFICÁCIA E DESAFIOS NO CAMINHO DA IMPLEMENTAÇÃO SUSTENTÁVEL NO ENSINO SUPERIOR

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Abstract. The present era of societal advancement is distinguished by a substantial proliferation and intensification of pedagogical research and development, spanning various domains and levels of society. Consequently, both established and emerging fields of knowledge, as well as cutting-edge technologies, are being cultivated. This pursuit has led to the formation of sophisticated and efficient tools for intellectual activities, yielding enhanced productivity. Furthermore, novel materials and alternative sources for the advancement of goods and services are being explored. This necessitates the effective utilization of capital, investments, innovations, material and technical resources, energy, information resources, and labor. In light of the aforementioned considerations, enhancing the management systems governing socio-economic, technical, and technological processes becomes imperative. Drawing upon advancements in education and science, and harnessing knowledge-intensive technologies, sophisticated devices, and tools, contemporary high-tech platforms are being developed and employed. These systems play a pivotal role in organizing and regulating activities, profoundly influencing the nature and outcomes of innovation endeavors. Moreover, they serve as a testament to the scientific and technological progress witnessed by civilization. The objective of this article is to ascertain the distinctive characteristics of the influence exerted by information and communication technologies on the educational process within higher education institutions. Additionally, it aims to evaluate the effectiveness of their implementation and address the challenges encountered by the educational system. The study employs a range of research methods, including general scientific methods such as analysis, synthesis, deduction, induction, and generalization. These methods facilitated the identification of the object, subject, purpose, and objectives of the investigation, as well as the analytical processing of scientific sources. Additionally, specific scientific methods, namely historical and structural approaches, were utilized to organize the existing pedagogical literature concerning the integration of the latest information and communication technologies into the educational process within higher education. The method of extrapolation was employed to extend the conclusions derived from the analysis. The study has successfully identified the fundamental theoretical aspects associated with the integration of the latest information and communication technologies for the enhancement of English-language communicative competence in higher education. Additionally, the study has addressed the pivotal practical considerations on this matter.

Keywords: information and communication technologies, innovative pedagogy, educational platforms, object-oriented programs, pedagogical software tools.

Resumo. A presente era de avanço social se distingue por uma substancial proliferação e intensificação da pesquisa e desenvolvimento pedagógico, abrangendo vários domínios e níveis da sociedade. Consequentemente, campos de conhecimento estabelecidos e emergentes, bem como tecnologias de ponta, estão sendo cultivados. Essa busca levou à formação de ferramentas sofisticadas e eficientes para atividades intelectuais, gerando maior produtividade. Além disso, novos materiais e fontes alternativas para o avanço de bens e serviços estão sendo explorados. Isso requer a utilização efetiva de capital, investimentos, inovações, recursos

materiais e técnicos, energia, recursos de informação e trabalho. Diante das considerações anteriores, torna-se imperativo aprimorar os sistemas de gestão que regem os processos socioeconômicos, técnicos e tecnológicos. Com base nos avanços na educação e na ciência e aproveitando tecnologias de conhecimento intensivo, dispositivos sofisticados e ferramentas, plataformas contemporâneas de alta tecnologia estão sendo desenvolvidas e empregadas. Esses sistemas desempenham um papel fundamental na organização e regulação das atividades, influenciando profundamente a natureza e os resultados dos esforços de inovação. Além disso, servem como testemunho do progresso científico e tecnológico testemunhado pela civilização. O objetivo deste artigo é averiguar as características distintivas da influência exercida pelas tecnologias de informação e comunicação sobre o processo educativo nas instituições de ensino superior. Além disso, visa avaliar a eficácia de sua implementação e enfrentar os desafios encontrados pelo sistema educacional. O estudo emprega uma variedade de métodos de pesquisa, incluindo métodos científicos gerais, como análise, síntese, dedução, indução e generalização. Esses métodos facilitaram a identificação do objeto, sujeito, propósito e objetivos da investigação, bem como o processamento analítico das fontes científicas. Adicionalmente, métodos científicos específicos, nomeadamente abordagens históricas e estruturais, foram utilizados para organizar a literatura pedagógica existente relativa à integração das mais recentes tecnologias de informação e comunicação no processo educativo do ensino superior. O método de extrapolação foi empregado para estender as conclusões derivadas da análise. O estudo identificou com sucesso os aspectos teóricos fundamentais associados à integração das mais recentes tecnologias de informação e comunicação para o aprimoramento da competência comunicativa da língua inglesa no ensino superior. Além disso, o estudo abordou as principais considerações práticas sobre este assunto.

Palavras-chave: tecnologias da informação e da comunicação, pedagogia inovadora, plataformas educativas, programas orientados para os objectos, ferramentas de software pedagógico.

INTRODUCTION

The distinctive characteristics of societal processes across various domains give rise to a collection of substantive demands, needs, and constraints for social pedagogy. These factors intricately shape the static and dynamic functioning and development of the educational sector within society. Higher education institutions, in their endeavors, must duly consider the specificities, accomplishments, anticipated developmental patterns, limitations within their environment and requirements, such as an education seeker's high level of awareness about the existing social and technological achievements in his professional field, developed personal information and communication skills, possession of technical means and the latest ICT.. It is essential to rely on the prevailing conditions under which higher education operates and evolves in society, leveraging them to their fullest potential. Only through such considerations can the education system effectively address the educational aspirations of students and meet the socioeconomic demands of society. Furthermore, this approach ensures its harmonious progression within the context of a technologically advanced environment and a market-based economy, both on a national and global scale.

The theoretical section of this study provides a comprehensive rationale for the concept and constituent elements of the influence of ICT on the educational process within higher education institutions.

The practical segment of the study encompasses an evaluation of the overall efficacy of employing information and communication technologies to enhance the quality of the educational process in higher education. This assessment involves quantifying the extent of improvement in students' academic achievements, the augmentation of their motivation to learn, the enhancement of students' professional competence, satisfaction levels with the quality of education, and the overall reputation of educational institutions. The objective of this study is to ascertain the essential characteristics of the influence of information and communication technologies (ICT) on the effectiveness of pedagogical practice within the context of their integration into higher Education.

LITERATURE REVIEW

The development of the education system, characterized by its high-tech and innovative nature, facilitates the broadening of the scope of fundamental and applied research. Simultaneously, it fosters a deeper integration of science, education, and production, leading to the modernization of educational content, pedagogical technologies, and the learning environment. This evolution also necessitates changes in the organizational structure of the educational system and the management of educational activities, alongside targeted, adequate, and timely financing for training and professional development of personnel. The guiding principle underlying the implementation of new technologies in education primarily relies on the achievements of psychological and pedagogical sciences, scientific and technological progress, as well as the widespread adoption of these advancements in pedagogical practice. Additionally, it hinges upon the professional competencies of teachers, lecturers, and educational organizers, and their continuous

enhancement of professional expertise (Lemeshchenko-Lagoda, Kryvonos & Kolodii, 2020), (Kravets, 2023).

Presently, there is a growing significance placed on trends in the advancement of societal consciousness, recognizing the pivotal role of educational authorities in the socioeconomic progress of the country, and the economic efficacy of the state. Technologically, this phenomenon is characterized by the pervasive influence of informatization in education, the emergence of novel ICT-driven pedagogical and technological advancements, the utilization of state-of-the-art teaching aids, and the establishment and implementation of contemporary computer-oriented educational environments within pedagogical systems (Alenezi, Wardat & Akour, 2023), (Bui, 2022).

The progressive establishment and evolution of computer and technology platforms within the realm of information and educational space, as well as the provision of content and procedural support through electronic information and educational resources and network services, constitute a vital foundation for the advancement of higher education. Moreover, the nature and rate of development of higher education institutions are significantly shaped by contemporary and forward-looking approaches and technologies for organizing educational activities. Primarily encompassing open education, electronic distance learning (e-D) systems, and electronic distance learning technologies (e-DL), these innovative methodologies have a profound influence on the evolution of higher education (Liu, Zhang & Gao, 2023), (Vereitina, Popel & Dobrovol'ska, 2018).

The incorporation of open education principles represents an amalgamation of contemporary perspectives from both researchers and practitioners, as part of the ongoing quest for the most effective methods of educational development within the information society. This approach enables the utilization of the latest advancements in psychological and pedagogical science, as well as educational practice. Concurrently, scientific and technological progress facilitates the emulation and dissemination of highly effective global trends in educational system development, fostering the integration of higher education institutions within the global educational landscape. This approach underscores the high-tech, innovative, and investment-driven nature of educational institutions' functioning and development, promoting the dissemination of societal values, democratic principles, and social progress. Integral to this is the comprehensive integration of ICT methods and tools across all social security subsystems, generating and responding to the demand for the advancement of cutting-edge technologies within the information society. Ultimately, this path paves the way for the knowledge society of the future (Bizami, Tasir & Na, 2023), (Zakaryia, Khaled & Mohammad, 2021).

Simultaneously, contemporary scholars emphasize the significance of computer-oriented pedagogical systems' models, tools, and technologies in reflecting a human-centered approach. These systems should ensure the realization of the paradigm of equitable access to quality education and be grounded in the principles of open education (Siripongdee, Pimdee & Tuntiwongwanich, 2020; Santos, Figueiredo & Vieira, 2019).

The rapid advancement of educational computerization has greatly expanded the domain of modern information technologies. As a result, the most successful and dynamically evolving applications of these technologies in education have become discernible. This includes the utilization of pedagogical software tools, such as problem-based, object-oriented, and subject-oriented software, which serve as instrumental aids for teaching, research, object analysis, assessment, communication, and information processing (Cacheiro-Gonzalez et al., 2019).

Both domestic and international experiences in the utilization of modern information technologies demonstrate that the implementation of the aforementioned approaches provides effective means for researching, constructing, and formalizing knowledge about the objective world. Simultaneously, it enables exploration of the active facets of the objective world through the utilization of measurement tools, reflection, and influence (Oseredchuk et al., 2023). This expansion of the independent range of activities for educators is made possible by the organization of various types of educational activities, including experimental and research activities, educational and game-based activities, informational and educational activities, as well as information processing activities that encompass audiovisual elements (Cano, Murray & Kourouklis, 2022; Odit-Dookhan, 2018).

In recent years, the advent of cutting-edge information and communication technologies has led to an upsurge in the trend of individualization and differentiation within the learning process. This is achieved through the implementation of interactive dialogues, providing learners with the autonomy to choose their preferred types of educational activities and organizational forms of learning. Additionally, tutors are equipped with strategies for facilitating material comprehension and problem-solving specific to each class,

capitalizing on the opportunities presented by these technologies. These advancements contribute to the development of an information-rational culture and foster the cultivation of individual participants' cultural components. This is accomplished through outreach activities, the utilization of object-oriented software tools, enhancing learning motivation through computer-based visualization of studied objects and phenomena, managing the objects of study and the learning situation, as well as incorporating game-based scenarios (Cui, French & O'Leary, 2021), (Mourato & Patricio, 2019).

The process of incorporating information technologies into education, known as informatization, brings about transformations not only in the organizational forms and instructional methods but also in the continuous emergence of novel educational resources. The appropriateness of employing technical tools for learning and assessment within the classroom setting is contingent upon specific criteria. Such tools should enhance labor productivity and the efficacy of the educational process by actively reinforcing the accuracy of students' learning actions, promoting their awareness and interest in learning, facilitating prompt feedback, and enabling post-assessment of all learners' actions. Furthermore, these tools should allow for the rapid input of answers without the need for protracted encoding or obfuscation (Coman et al., 2020), (Germain-Alamartine et al., 2021).

MATERIAL AND METHODS

The present study employed a practical research approach to investigate key aspects of the effectiveness of integrating the latest information and communication technologies into pedagogical practice within higher education institutions. The research was conducted through interviews with the administrators of linguistic higher education institutions located in Chernihiv and Kyiv oblasts of Ukraine.

The interviews were carried out in two stages during the years 2022 and 2023. The initial stage involved interviews conducted before the implementation of various information and communication technologies, such as blended learning and the flipped learning model. The subsequent stage involved interviews conducted after the integration of these information and communication tools into the pedagogical processes of higher education institutions.

The selection of participants for this study was based on the age, gender, and educational distribution of the teaching staff within the respective HEIs. A total of 10 heads of higher education institutions were included in the study.

Among the participants, 70% possessed more than 20 years of teaching experience. This deliberate inclusion of individuals with extensive teaching experience allows for the examination of perspectives from both those who have not actively utilized the latest teaching tools and those who have embraced such tools in their pedagogical practice.

RESULTS

The survey aimed to investigate the correlation between the degree of interactivity and the resultant positive changes observed in the learning process. Specifically, the study focused on assessing the impact of interactivity on various aspects, including the enhancement of student's academic achievements, the augmentation of learning motivation, the advancement of students' professional competencies, the satisfaction with the quality of training provided to prospective foreign language teachers, and the overall reputation of educational institutions.

In the initial phase of the investigation, we computed the teachers' subjective evaluations concerning the degree of integration of information and communication technologies before and after the implementation of the latest teaching tools. To determine whether there are significant differences between these measures, it is imperative to perform Student's t-test for independent samples.

The outcomes of the study at both stages are presented in Table 1:

Table 1. Subjective assessment of heads of educational institutions on the level of integration of ICT

Respondent	Before the introduction of the most recent teaching tools (Stage 1)	After the introduction of the most recent teaching tools (Stage 2)
1	20	6
2	21	19
3	8	5
4	27	21

5	8	11
6	16	10
7	12	29
8	9	37
9	15	4
10	13	28

Source: developed by the authors

The calculation of the arithmetic mean, standard deviation, and sample size for each stage is essential.

For stage 2, the arithmetic mean is $M_1 = 17.0$, while for stage 1, the arithmetic mean is $M_2 = 14.9$. The corresponding standard deviations are 11.57 for stage 2 and 6.26 for stage 1.

These calculated values are presented in Table 2:

Table 2. Results of calculations at all stages of the study.

Stage 2 indicators	Stage 1 indicators
$M_1=17,00$	$M_2=11,57$
$\sigma=11,57$	$\sigma=6,26$
$N_1=10$	$N_2=10$

Source: developed by the authors

Hence, the evaluation of the integration of information and communication technologies by the group of respondents after the introduction of the latest teaching aids is 17 ± 11.57 , whereas the evaluation of the integration of ICT by the same respondents before the introduction of the latest teaching aids is 14.9 ± 6.26 , indicating a significantly lower level.

The formula for calculating the empirical value of Student's t-test for independent samples is as follows:

$$t_e = \frac{|M_1 - M_2|}{\sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}}$$

where M_1 is the arithmetic mean of the first sample; M_2 is the arithmetic mean of the second sample; σ_1 is the standard deviation of the first sample; σ_2 is the standard deviation of the second sample; N_1 is the size of the first sample; N_2 is the size of the second sample.

$$t_c = (17,00 - 11,57) / \sqrt{(17^2 / 10 + 11,57^2 / 10)} = 5,43 / \sqrt{(28,9 + 13,4)} = 5,43 / 6,5 = 0,83$$

Let's determine the level of significance using the table of critical values of the Student's t-test.

The calculated value of 0.83 is less than the critical value of 2.101 for the given degrees of freedom and a significance level of 0.05. Therefore, the level of significance is less than 0.05.

If the significance level is less than 0.05, it can be concluded that there are statistically significant differences between the two stages. Therefore, in this study, we find differences in the level of subjective assessment of the integration of information and communication technologies between stage 2 and stage 1. As predicted, participants in stage 2 exhibit a significantly higher level of subjective assessment of the integration of ICT compared to participants in stage 1.

To assess the percentage of positive changes in the educational process for each scale, we calculated the ratio of the number of matches with the key to the total number of questions on the scale, multiplied by 100%. The results of these calculations are presented in Figure 1.

It is evident from the data that the respondents who reported the highest ratings for the professional development of students and satisfaction with the quality of education also exhibited the highest level of integration of information and communication technologies in the educational process. Specifically, this pattern was observed among respondents numbered 7, 8, and 10 in Stage 2, as well as respondent number 4 in Stage 1.

On the other hand, participants who scored high in terms of increased motivation to study at their respective educational institutions demonstrated an average level of integration of information and communication technologies. This finding applies to respondents numbered 2 and 4 in Stage 2, and respondents numbered 1, 2, 6, 9, and 10 in Stage 1.

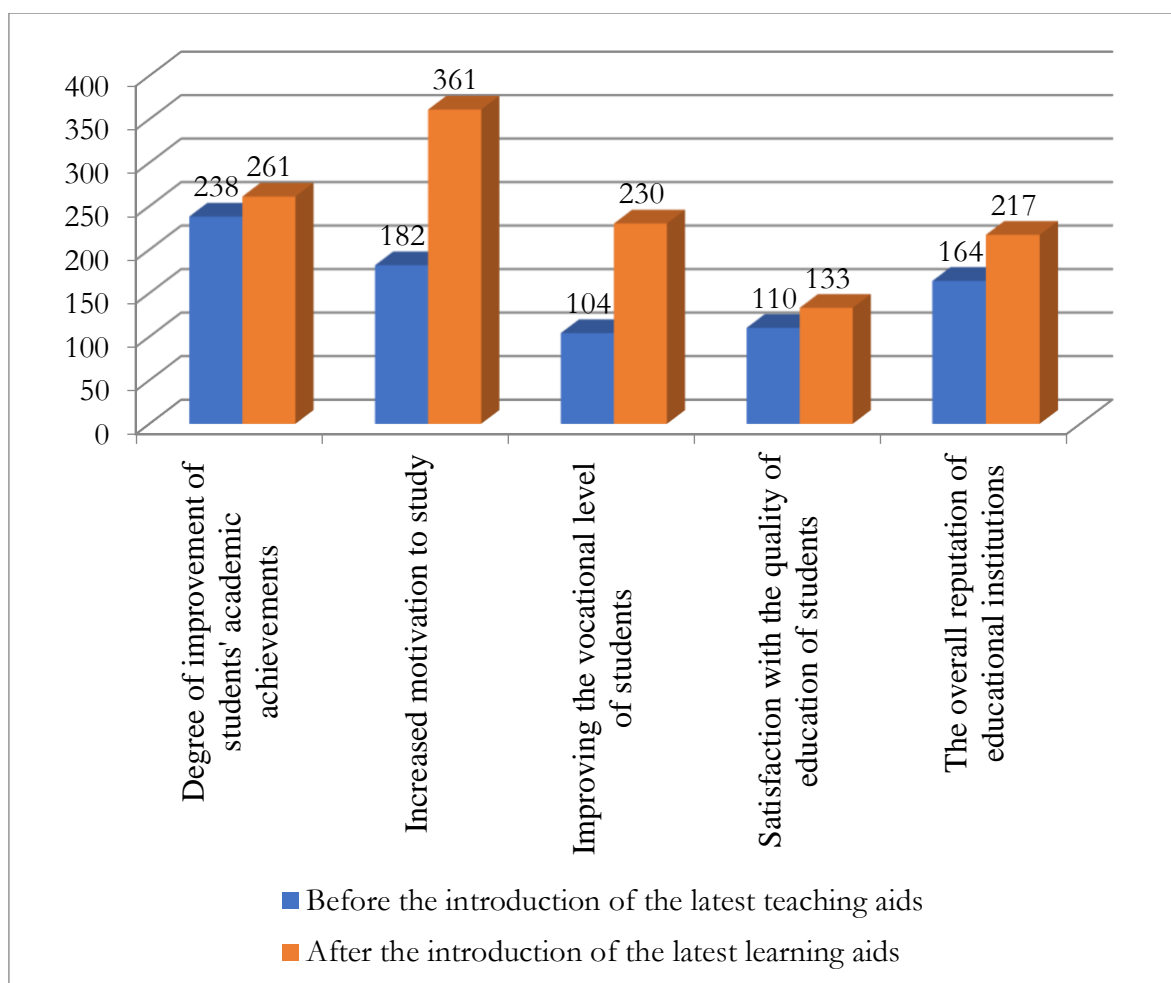


Figure 1. The degree of positive changes in the educational process. Source: developed by the authors

Table 3 presents the data regarding the degree of significance of indicators reflecting positive changes in the educational process among respondents at two stages of the study. Based on the critical values provided in the table of Student's t-tests, all calculated t-values are found to be less than 2.228, indicating a significance level of $p \leq 0.05$.

Table 3. Indicators of positive changes in the educational process ($M \pm m$)

Indicator	Groups		t	p
	1	2		
Degree of improvement in students' academic achievements	26,1±23,4	23,8±24,14	0,04	$p \leq 0,05$
Increased motivation to study	18,2±25,02	36,1±31,7	0,22	$p \leq 0,05$
Improving the professional level of students	23±27,9	10,4±15,5	0,39	$p \leq 0,05$
Satisfaction with the quality of education of students	11±7,04	13,3±8,86	0,15	$p \leq 0,05$
The overall reputation of educational institutions	21,7±17,09	16,4±16,3	0,14	$p \leq 0,05$

Source: developed by the authors

As evident from the provided data, students in stage 2 exhibit a more significant degree of improvement in students' academic achievements (26.1 ± 23.4 compared to 23.8 ± 24.14 in stage 1, $p \leq 0.05$), an enhancement in the professional level of students (23 ± 27.9 compared to 10.4 ± 15.5 in stage 1, $p \leq 0.05$), and an overall higher reputation of educational institutions (21.7 ± 17.09 compared to 16.4 ± 16.3 in stage 1, $p \leq 0.05$). Conversely, stage 1 demonstrates a lower degree of increased motivation to study (36.1 ± 31.7

compared to 18.2 ± 25.02 in stage 2, $p \leq 0.05$) and satisfaction with the quality of education of students (13.3 ± 8.86 compared to 11 ± 7.04 in group 1, $p \leq 0.05$).

Having established earlier, that participants in Stage 2 exhibit a significantly higher level of subjective assessment regarding the integration of ICT in the educational process of their respective educational institutions compared to Stage 1, it follows that the conducted study employing Student's t-test demonstrates the positive influence of information and communication technologies on favorable changes in the educational process.

To validate the obtained results, we will calculate the correlation between the severity of positive changes in the educational process and the level of integration of information and communication technologies.

The measure of linear correlation is a statistical metric that considers the strength and direction of the relationship between two variables. It is represented by a coefficient that ranges from -1 to +1, where a positive sign indicates a positive correlation and a negative sign represents a negative correlation. A perfect positive correlation is denoted by +1, while a perfect negative correlation is represented by -1. Alternatively, variables may exhibit positive correlation, negative correlation, or no correlation.

Table 4 presents the results of calculating these correlation coefficients.

Table 4. Interrelationships between the intensity of indicators of positive changes in the educational process and the level of integration of ICT, (r).

Indicators of positive changes in the educational process		Degree of improvement in students' academic achievements	Increased motivation to study	Improving the professional level of students	Satisfaction with the quality of education of students	The overall reputation of educational institutions
Level of ICT integration	Group 1	-0,798	0,15	0,852	0,905	-0,892
	Group 2	-0,655	0,333	0,725	0,734	-0,767

Source: developed by the authors.

The aforementioned calculations indicate a weak positive correlation between the increase in motivation to learn and the level of integration of information and communication technologies. Furthermore, the use of information and communication technologies has a significant impact (ranging from 70% to 90%) on the professional development of students and their satisfaction with the quality of education. Additionally, a significant association exists between the adoption of modern teaching technologies and the degree of improvement in students' academic achievements, as well as the overall reputation of educational institutions. The indicators of thinking quality and their interdependence with the level of integration of information and communication technologies differ between the two groups, but the differences are not statistically significant.

DISCUSSION

The formulation of contemporary educational objectives occurs not only at the national level but also at the intergovernmental and international levels. International conventions and documents play a pivotal role in defining the primary educational priorities and goals, serving as overarching strategic guidelines for the global community's development (Beerkens, 2018).

International experts and scholars substantiate the significance and imperative of integrating ICTs in higher education. The utilization of these technologies has an extensive positive influence across various domains, with education experiencing the greatest benefits. It enables the adoption of innovative teaching and learning approaches. The widespread integration of computer technologies in all areas, the establishment of new communication tools, and the development of highly automated information environments mark not only the commencement of transforming the conventional education system but also the initial strides toward shaping an information society (Moscardini, Strachan & Vlasova, 2022).

The primary determinant of the significance and viability of modernizing the existing education system, including the Ukrainian context, is the imperative to address the key challenges confronting humanity in the twenty-first century. These challenges include the imperative for societies to transition to new development strategies based on knowledge and highly efficient information and communication technologies. Additionally, the dependence of our civilization on the competencies and qualities nurtured

through education, the imperative of utilizing ICTs for the successful advancement of society, and the recognition that the close linkage between the well-being of a nation, national security, and the level of education is facilitated through the integration of ICTs (Sadeghi, 2019).

The clear trajectory of rapid advancements in computers and information and communication technologies (ICTs), particularly in the digital realm, will persist in the foreseeable future. This trajectory entails their extensive integration across all domains of public life, fostering accelerated integration and communication processes within society. Consequently, new and more efficient prospects for electronic data processing will emerge, presenting enhanced opportunities for productivity (Kleimola & Leppisaari, 2022).

Currently, the education system serves as a reflection of societal development, evident in the manner and speed of its informatization. The process of informatization in education represents a systematic and inclusive approach to the innovative development of the educational system. However, it is worth noting that the full potential of available resources for informatization remains underutilized (Hazen et al., 2018).

The rise of the information society not only directly affects the modernization of education but also indirectly influences the emergence of a new way of life and changes in its quality. The rapid advancement of ICTs and the widespread adoption of new methodological educational systems create an environment that enables unrestricted access to electronic information and educational resources (EER) for all stakeholders in the academic community. This process is expanding in both scope and intensity, and its outcomes leave no doubt that ICT is indispensable in the modern world. Enhancing the level of computer science education in higher education institutions necessitates substantial improvements across all pedagogical systems, particularly computer-oriented methodological teaching systems (Hou et al., 2022), (Gasevic, Tsai & Drachslar, 2021).

In conjunction with the development of new textbooks, pedagogical materials, and the provision of relevant training, retraining, and professional development opportunities for teachers, lecturers, and educational administrators, it is imperative to foster the advancement of state-of-the-art information-oriented pedagogical technologies and their integration into the educational process (Burac et al., 2019).

CONCLUSION

The analysis of scientific literature and the findings of the questionnaire survey indicate that addressing challenges in enhancing teaching practices in higher education institutions involves the cultivation of computer literacy and ICT competencies among the younger generation. Presently, there is a consensus that the overarching conceptual principles guiding the advancement of education and science globally should center around the extensive utilization of computer-based learning tools, such as MIP, EOR, and open adaptive computing services, within the educational process.

Based on the survey results, it was revealed that a direct correlation exists between the augmentation of motivation to learn and the extent of integration of information and communication technologies. Moreover, the utilization of information and communication technologies was found to have a substantial impact (ranging from 70% to 90%) on the professional growth of students and their overall satisfaction with the quality of education.

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