

REGARDING THE DEVELOPMENT OF EDUCATIONAL AND SCIENTIFIC POTENTIAL IN THE 21ST CENTURY: TECHNOLOGICAL CHALLENGES

SOBRE O DESENVOLVIMENTO DO POTENCIAL EDUCACIONAL E CIENTÍFICO NO SÉCULO XXI: DESAFIOS TECNOLÓGICOS

Oksana Bohomaz

National Pedagogical Dragomanov University, Kyiv, Ukraine

OBogomaz@i.ua

Inna Koreneva

Olexander Dovzhenko Hlukhiv National Pedagogical University, Hlukhiv, Ukraine

i.koreneva74@gmail.com

Valentyn Lihus

Kyiv National University of Culture and Arts, Kyiv, Ukraine

ligus-valentin@ukr.net

Yanina Kambalova

National Pedagogical Dragomanov University, Kyiv, Ukraine

novajava@ukr.net

Victoria Shevchuk

V.G. Korolenko National Pedagogical University (PNPU), Poltava, Ukraine

Kvitusik82@gmail.com

Hanna Tolchieva

Academy of Management and Administration in Opole, Opole, Poland

asergeeva29@gmail.com

ABSTRACT

Modern digital technologies contribute to the transformation of the social order and the integration of the latest information processing capabilities into everyday life. These trends are also characteristic of education and science as separate branches of the social whole. Therefore, the aim of the work is to analyze the technological challenges in the development of the educational and scientific potential of the XXI century. The methods of analysis and synthesis, comparativistic method, forecasting, modeling method were used in the study. The main empirical method was a survey in which 130 teachers and 100 scientific workers participated. It was found that the majority of teachers consider the use of digitalization achievements as inevitable and positive phenomena. Researchers are less optimistic - almost every third employee of the industry did not give a positive response to the impact of digitalization. It is determined that such a phenomenon is negatively perceived because of its ambiguous impact on academic virtue. Modern academics and educators equally understand the importance and significance of digital competence in today's globalized and informatized world. Among the problems, respondents named the technical equipment of educational and research institutions as relevant. Especially for scientists was the problem of insufficient funding. The conclusions noted the importance of conducting further research into the security of using digital tools in research and educational activities and defining a philosophical basis for the transformations, which will help to predict possible challenges in the future.

Keywords: Digitalization. Education. Science. Transformation. Educational and scientific potential.

RESUMO

As modernas tecnologias digitais contribuem para a transformação da ordem social e para a integração das mais recentes capacidades de processamento de informações na vida cotidiana. Essas tendências também são características da educação e da ciência como ramos separados do todo social. Portanto, o objetivo do trabalho é analisar os desafios tecnológicos no desenvolvimento do potencial educacional e científico do século XXI. Os métodos de análise e síntese, método comparativista, previsão, método de modelagem foram utilizados no estudo. O principal método empírico foi um inquérito em que participaram 130 professores e 100 trabalhadores científicos. Verificou-se que a maioria dos professores considera o uso de conquistas de digitalização como um fenômeno inevitável e positivo. Os pesquisadores estão menos otimistas - quase um em cada três funcionários da indústria não deu uma resposta positiva ao impacto da digitalização. É determinado que tal fenômeno é percebido negativamente por causa de seu impacto ambíguo na virtude acadêmica. Acadêmicos e educadores modernos compreendem igualmente a importância e o significado da competência digital no mundo globalizado e informatizado de hoje. Entre os problemas, os entrevistados apontaram como relevante o equipamento técnico das instituições de ensino e pesquisa. Especialmente para os cientistas foi o problema de financiamento insuficiente. As conclusões apontaram a importância de realizar mais pesquisas sobre a segurança do uso de ferramentas digitais em atividades de pesquisa e educação e definir uma base filosófica para as transformações, o que ajudará a prever possíveis desafios no futuro.

Palavras-chave: Digitalização. Educação. Ciência. Transformação. Potencial educativo e científico.

Introduction

Today's processes of digitalization and globalization have a decisive impact on social life. As a result of the spread of digital technologies, the way they are used and integrated into everyday life, the perception of the scientific and educational space has also changed. The global pandemic COVID-19 has demonstrated that the transition from the traditional form of learning to the use of distance education, due to the evolution of the corresponding means of information transfer, has become an everyday reality. In addition, researchers have noted the absence of negative manifestations and problems with information assimilation, which has also been confirmed empirically (RAJAB, 2018; MCINROY, 2019; SHUSTOVA, 2022; PARVEEN and ALAHMADI, 2023). This actualizes further discussions on the use of technological tools in the subsequent advancement of education and science.

The problem of the emergence and widespread use of new digital ways of communicating information to higher education applicants also demonstrates perspectives that require detailed reflection. At the same time, it is also said to take into account the constant development of technology, which contributes to the formation of new methodologies. For this reason, the level of study of the general state of the issue at the present stage is not exhaustive, because new technologies also generate new ways of using them in pedagogical practice and in research. A separate subject for consideration becomes, therefore, not only the most possible changes in the perception of the new but also the individual opinions of scientists and the ways of their argumentation, which should refute or on the contrary prove a certain theory or vision.

The aim of the work is to analyze the development of the educational and scientific potential of the 21st century through the prism of modern technological challenges.

Research Methodology

Design

An experimental study of the key aspects and directions of the development of education and science in the conditions of digitalization was carried out in stages. At the first stage (theoretical) were characterized based on current changes in education and science, caused by the technological transformation of these spheres. At the second stage (experimental-experimental) an experiment was realized in order to determine the problems and prospects of development of the educational-scientific sphere. Initially, the attitude of scientific and educational employees to the modern digital changes in their professional spheres was determined. Then, through the prism of the experiment, the readiness of scientists and educators for further use of modern technologies in professional activities was investigated. Later, against the background of the data obtained and the analysis of modern literature, the main prospects for the development of the scientific and educational sphere were determined. The third stage (generalizing) summarizes the results obtained, compares them with the opinions of the world's leading researchers, characterizes further ways of development of science and education.

Participants

In order to implement the goal of the study a pilot survey of teachers and researchers was carried out. 130 teachers (various institutions of higher education in Ukraine) and 100 research workers from the National Academy of Sciences of Ukraine took part in the experiment. All of them were of different age from 29 to 82 years old and had different scientific and pedagogical experience. The study was anonymous. In addition, the participation of participants in the experiment was based on the principles of free, voluntary, and non-discriminatory elements.

Instruments

In order to determine the main prospects for the development of education and science through the prism of technological challenges, a survey of teachers and researchers was conducted through the use of modern Internet platforms. It took place on Google-forms. Likely respondents could use the online form by clicking on the appropriate link from social networks (Facebook, Telegram, Instagram, Viber, etc.). The processing of the responses was based on the use of Excel.

Data collection

Diagnostic data were collected during the academic year 2022-2023 (September 2022-January 2023). In order to identify the main problems for the further development of the educational and scientific sphere, surveys developed by the authors were used, which contained both open and closed questions. The survey was held on a mixed system: it combined closed and open questions, in particular, it was offered to characterize based on the problems of development of the branches under consideration, to define the personal attitude to the modern technological changes in education and science. The survey involved both giving specific scores (on a 12-point scale) and writing detailed answers, where key words, which acted as the main markers of the respondents' opinions, were taken into account.

Analysis of data

The work is formed based on the use of analysis, synthesis. In particular, based on the analysis the main subject of the research is divided into structural elements for a better understanding of the content of the research topic. Through the prism of synthesis, these elements are combined and conclusions about the problem of education and science development are formulated. Using the comparative method, the general and similar opinions of the respondents about the future of science and education are identified. The perspectives and vectors of development of two important branches of human activity were characterized

based on forecasting. As a result of modeling, the directions and ways of further transformation of the spheres under consideration were determined.

Ethical criteria

The study took into account the following ethical criteria: academic ethics of research implementation, absence of conflict of interest, and discrimination on any grounds. A mandatory element was respect for the life and professional positions of the participants in the experiment, which allowed for an impartial assessment of the consequences of their statements and responses. All participants in the experiment were proclaimed voluntarily and signed an appropriate letter of consent to participate in the study and the subsequent processing of their responses.

Results

As a result of the survey the attitude of scientific and pedagogical employees to the modern process of digitalization of social spheres was established. Among teachers, 89.8% consider these changes as inevitable and a positive and important phenomenon. At the same time, 97.8% of the interviewed teachers said that they use modern innovative methods and technologies in their activities. At the same time, the attitude of scientific workers to the introduction of digital technologies in the scientific sphere was not so unequivocal: 68% of respondents said that the digitalization of the scientific sphere is a positive process, which can effectively affect the development of science. However, 11% of the surveyed scientists still believed that digitalization could have a negative impact on the development of science because it could lead to a transformation in the basic principles of scientific research implementation, could have a negative impact on the academic virtue of educators and scientists in general (See Figure 1).

Figure 1 – Attitudes of educators and scholars toward digitalization

Attitudes of educators and scholars toward digitalization		
Group name	Answers	%
Educators	<i>Digitalization is an inevitable and positive process of educational development</i>	89,8%
Scientists	Digitalization is an inevitable and positive process of scientific development	68%
Educators	<i>Use modern innovative technologies in professional activities</i>	97,8%
Scientists	Apply innovative technologies in the implementation of professional work	76%
Educators	<i>Negative attitude to the use of innovative technologies in education</i>	4%
Scientists	Negative about the digitalization of the professional sphere	11%
Educators	<i>It is necessary to use innovative technologies in education</i>	97,8%

Scientists	It is necessary to use innovative technologies in science	76,2%
<i>Educators</i>	<i>Want to improve digital competence</i>	85%
Scientists	Want to improve digital competence	79%

Author' development

When asked if they use modern innovative resources, platforms for organizing scientific activities, the majority (76%) responded that yes. The rest - 24% prefer to get information from traditional sources: libraries, archives. A positive answer to the use of modern digital archives and media libraries provided 62%.

The survey revealed that 97.8% of teachers and 76.2% of scientists believe it is necessary to use modern innovative technologies in their work. However, 83% of the participants in the experiment noted that they would like to cover their digital competence. In particular, taking into account teachers 67% noted that despite the systematic and long-term use of digital technology, it is still necessary for them to improve their digital competence. Consequently, we can affirmatively state that today's academics and educators understand the importance and significance of digital competence in today's globalized and informatized world.

Separately, we examined the key reasons that make it difficult for teachers and scientists to use innovative technologies in the professional sphere. In particular, 31 teachers and scientists surveyed noted an insufficient level of preparedness for extensive use of innovative technologies. At the same time, 62% of the respondents noted the lack of appropriate digital equipment in the institutions where they work. Consequently, an important problem for the further digital development of education and science is the technical equipment of these institutions. In addition, the majority of respondents noted insufficient funding. This requirement became especially acute for scientists: 87% noted that as a result of the

implementation of martial law, the government began to reduce funding for the development of education, which in turn limits the opportunities for researchers.

Therefore, conducting a survey among scientists and educators, it is possible to identify several problems affecting the development of education and science in today through the prism of technological, digital changes.

Among the challenges of technological development, the lack of digital literacy and information competence among educators and scientists remains a significant problem (KELLY, 2021). This problem is especially acute for the employees of scientific institutions, who have a lot of experience and out of habit refuse to use modern methods of obtaining information. A separate problem is the lack of readiness to widely use innovative technologies in education and science. This is due to several reasons: insufficient motivation of employees and inadequate technical equipment of workplaces. This problem is also relevant for scientists. Most scientific institutions do not have modern means, tools for organizing research. This is especially true in the humanities. Another technological challenge is that the rapid development of technology can lead to the loss of jobs, changes in the qualification requirements of workers, and the need to constantly update knowledge.

As it was found out a separate problem in the way of digitalization of education and science, not enough funding because now there is a process of allocation of insufficient funds for science and education, which limits the opportunities of researchers and teachers, as well as worsens the quality of education. Another thing that negatively affects the further development of education and science is the unstable political situation. Wars, conflicts, and other political turbulence can cause scientific and educational institutions to shut down, as well as reduce the flow of financial investment into science and education. A separate problem for the development of the education industry is high competition. Increasing competition in educational institutions and the labor market can create great challenges for students and graduates, who must exhibit a high level of knowledge and skills in order to have an advantage (Essex, 2020). This highlights the negative phenomenon of unequal access to educational services. With

digitalization, many people face challenges related to access to quality education due to economic, social, and geographic disparities. Although there are many educational resources available today, most of them are for a fee.

Scientists see the educational and scientific potential of the 21st century as very large and multifaceted (70% of respondents). New technologies, the growing amount of data and access to information, the development of artificial intelligence, biotechnology, energy, climatology, and other branches of science and technology are opening up new opportunities for human development. With the spread of digital technology, new forms of learning have emerged, such as online courses, video lessons, virtual laboratories, etc. These technologies allow for distance learning and the development of independent learning skills, but may also require new approaches to learning and assessment of knowledge (RAK-MŁYNARSKA, 2022).

The use of distance education will look promising in the future implementation of the educational process. Already today it is noticeable that such a system allows for flexibility, that is, applicants for higher education were given the opportunity to learn at their own pace and at a convenient time (NURHAKIM; SUNHAJI, 2022; HNYDIUK et al., 2023). This has made it possible to schedule one's own world process in such a way as to make it as efficient as possible. Digital distance learning is available, meaning that applicants can take relevant courses from anywhere in the world (RAJAB, 2018). The learning will take place online, so a lot of money can be saved because there is no need to travel to the location of the class (RANI et al., 2022).

The continued use of digital technologies will allow education in new fields that were previously considered closed or cost prohibitive. Turning to innovative teaching methods will lead to learning new subjects and developing one's own professional skills (PROKOPENKO, 2021). Also, digitalization can cost less because it makes it cheaper and faster to access information, eliminates the need for long-term rentals of study or meeting rooms, saves fuel, etc. (Rajab, 2018). Technological innovations also allow for higher-level human interaction, making it more

comfortable. These include new discussion forums, virtual conferences, video conferencing, etc.

One of the key aspects of educational-scientific potential will be interdisciplinarity. The problems and challenges that humanity faces today are often complex and multifaceted, so solving them requires cooperation and fusion of knowledge from different fields of science and technology. Also, an important aspect is the training of a new generation of scientists and specialists in view of new challenges and opportunities (MICK, 2023). Modern education must provide students not only with knowledge of their industry, but also develop critical thinking, creativity, and teamwork skills (MUMFORD; MCINTOSH, 2017). Skills requirements will change: as technology advances and economic conditions change, there will be new demands on workers' skills. For example, programming and data analysis skills are becoming important due to the growth of automation and artificial intelligence. This will challenge the education system to train the right people (ZAHORODNA et al., 2022). At the same time, access to education will increase: technology will allow many more people to be educated. The emergence of new technologies and the increase in scientific data will create new challenges for scientific research. For example, there is a need to develop new methods of data processing and use artificial intelligence to provide more efficient analysis.

Discussion

The results of this study have established that there is a consensus among higher education scholars and teachers about the importance of using modern technology in research and teaching. This is confirmed by the general trends of the importance of this vector for the future, in particular, it is demonstrated in the research. At the same time, it is important to understand the challenges that the development of technology poses to educators and scholars (SEIS, 2023). In particular, there is a consensus among researchers about the importance of deepening one's own knowledge, especially towards acquiring additional digital

competencies (MCINROY, 2019). The importance of mastering them is confirmed by ongoing surveys. According to RIDEI (2021) an important vector for further educational improvement is the development of digital literacy in teachers. This view is confirmed by a number of other researchers (KELLY, 2021; MĂRĂȘOIU, 2023). However, the study shows that today's teachers and academics are generally aware of the importance of digital literacy and the improvement of digital skills through various workshops, conferences, courses, etc. Other researchers (RAK-MŁYNARSKA, 2022; NURHAKIM AND SUNHAJI, 2022) confirm these claims. According to TYTOVA and Mereniuk (2022) digital competence is a major future employee of the education industry. The need for continuous self-improvement it is said about permanent education, lifelong learning (Tait, 2017) - can be considered a positive point. Such a vector is relevant for the scientific and educational medium of the leading European countries and the USA.

On the other hand, surveys have shown a disregard for other components of the use of technology. First of all, we are talking about elements of security. For scientists and researchers from leading countries, it is quite understandable to actualize their own knowledge in this area. As shown by the survey among Ukrainian colleagues, this element is not in the priority (OSOKINA, 2022; PATLASHYNSKA et al., 2022; GAJDA et al. 2017). In general, the interest in digital competence also takes into account countering criminal intentions (PROKOPENKO, 2021). However, this element in the context of the digitalization of public life becomes very relevant.

At the same time, a problematic episode, poorly represented in the results of the study, is the prediction of the future of digital technology in education and science. These assertions are also confirmed in contemporary studies. However, we note that on this issue there is a considerable diversity of thought even among the world's leading scientists, the neglect of prognostic functions among Ukrainian researchers and teachers can be considered an alarming symptom. Taking into account the vices of the development of modern information society can minimize losses in the future. Paying detailed attention to the formation of the image of

technological progress and its importance in the future looks promising direction for future research.

Conclusions

Consequently, the educational and scientific potential of the XXI century can be used to solve the complex problems of humanity and the development of new branches of science and technology that can change the world. As a result of the study, it was found that teachers consider the use of modern technologies in professional activities as an important element of the present. Almost every teacher in Ukraine turned to innovative methods and technologies in the performance of their duties.

At the same time, scientists turned out to be more conservative in the perception of innovative methods and technologies. Virtually a third of the interviewed scientific workers did not notice firmly that digitalization could be called a positive phenomenon for science and education. We were talking about the consequences of this process - the transformation of the basic principles of implementation of scientific research, which can have a negative impact on the academic virtue of educators and scientists in general.

Researchers and educators paid particular attention to improving their own digital competencies. The desire for self-improvement and continuing education is fully in line with modern paradigms and labor market demands. At the same time, for Ukrainian employees of pedagogical and scientific spheres became much less relevant without the challenges associated with digitalization. Neglecting such elements can lead to negative consequences in the future. Just as little attention is paid to the ontological understanding of digital transformation. This issue will require additional research in the future, as it will contribute to a proper assessment of technological challenges in the future.

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