

Threats and risks from the digitalization of society and artificial intelligence: Views of generation Z students



Mikhail V. Vinichenko ^{1,*}, Galina Yu. Nikiporets-Takigawa ^{1,2}, Oksana L. Chulanova ³, Natalia V. Ljapunova ¹

¹Faculty of Humanities, Russian State Social University, Moscow, Russia

²The Old Schools, University of Cambridge, Cambridge, UK

³Department of State and Municipal Management, Surgut State University, Surgut, Russia

ARTICLE INFO

Article history:

Received 2 June 2021

Received in revised form

10 August 2021

Accepted 11 August 2021

Keywords:

Digitalization

Artificial intelligence

Threats and risks

Generation Z

ABSTRACT

The aim of this article was to identify the nature of threats and risks for people and society from the digitalization of society and the introduction of artificial intelligence from the perspective of Russian and Slovak students of Generation Z. The main empirical research methods were questionnaires, in-depth interview and focus group. In the context of the COVID 19 pandemic limitations, the research was conducted remotely using Google Form, Skype, and Zoom. 1857 GenZ students from 35 Russian universities and 316 GenZ students from two Slovak universities took part in the survey. When comparing the populations of Russian and Slovak GenZ by qualitative characteristics, a very high positive correlation was revealed with the Pearson correlation coefficient $R=0.962-0.9782$. The following trend was revealed: an increase in the rate of digitalization of society and the introduction of AI in comparison with the rate of study by society, a person of the possibilities of the digital environment, AI, and their mastery of technologies for using AI. The study revealed a stable connection: digitalization and AI create comfortable conditions for human life and at the same time generate a danger for human dependence on the digital environment. The main directions for the further development of this study can be studying this problem in other countries, the definition of a methodology for identifying threats and risks, and the development of a set of measures to overcome them.

© 2021 The Authors. Published by IASE. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

In the 21st century, digitalization and artificial intelligence are penetrating all spheres of life, new goods and services are being formed. Generation Z (GenZ) is increasingly becoming their main consumer. This is facilitated by the conditions for the development of youth and transformation in the social environment.

The modern generation is significantly different from the previous ones. The differences are of fundamental nature in terms of lifestyle, activity, and forms of using computer and communication tools, and career-building technologies. Generation Z has its own values, which only partially coincide with the moral principles and foundations of the older

generations. The sociological term "generation Z" in the scientific field has clear criteria and standards.

It should be noted that the generation theory of American researchers [Howe and Strauss \(1991\)](#) has its own characteristics in different countries. Some scientists have alternative or adapted approaches to defining Gen Z youth in a particular country.

In Slovakia, Generation Z includes people born between 1995 and 2020 ([Grencíková and Vojtovic, 2017](#)). Russia uses a different approach. Generation Z includes people born since 2000 ([Moran, 2016](#)).

Generation Z uses the latest achievements of science and technology in their daily life, personal development. The main characteristics of GenZ include long-term, continuous and comprehensive use in the work and personal life of digital gadgets, communication, and social networks. Sometimes the term "Digital natives" is applied to them.

Along with the positive effect, there is a certain danger posed by digitalization and the use of artificial intelligence for society and individuals. The threats and risks posed by the digitalization of society and the use of AI are diverse and pervasive.

* Corresponding Author.

Email Address: mih-vas2006@yandex.ru (M. V. Vinichenko)

<https://doi.org/10.21833/ijaas.2021.10.012>

Corresponding author's ORCID profile:

<https://orcid.org/0000-0003-1973-3485>

2313-626X/© 2021 The Authors. Published by IASE.

This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

The essence of the danger, the depth of socio-cultural impact, the breadth of coverage, and the systematic nature of their occurrence have not yet been fully studied (Saoud and Jung, 2018; Xu et al., 2019; Neri et al., 2019). The attention of scientists and practitioners today is attracted by threats and risks due to the possible unauthorized replacement of human-AI in the control system (Belciug and Gorunescu, 2020), the “overthrow” of a person as the main model of intelligence (Smith, 2020). Variants of displacing a person from the labor market are modeled (Shi, 2019; Veretekhina and Medvedeva, 2017). At the same time, in the context of digitalization, young people receive some advantages over other generations. With the development of Industry 4.0 in the Russian and Slovak labor markets, there is a transformation of the status of Generation Z (Karacsony et al., 2020), a change in their attitude towards work (Zimenkova et al., 2018). GenZ seeks to develop promising competencies (Libin, 2020) to change the relationship with the employer (Grencíková and Vojtovic, 2017), actively move between states (Karacsony et al., 2021), offer themselves in high-tech economic fields (Ovtšarenko et al., 2020), and in the Russian labor market still actively in the oil and gas sector. Remote work is increasingly in demand (Musinszki et al., 2020), as GenZ wants to minimize its resources, time for unprofitable activities, movements. This makes significant changes in management, business processes, and risks destabilizing the management system, both for the public sector, business, and for GenZ themselves.

The focus of the scientists is on the deepening of social inequality in the context of the digitalization and introduction of AI (Bowles, 2019), alarmingly decreasing social protection (Goldring and Azab, 2020; Aljukhadar et al., 2020; Frolova et al., 2016).

The nature of the impact of the digitalization of society and the introduction of AI on the spiritual state of a person in the context of the Fourth Industrial Revolution (4IR), which destroys the existing value systems, has not been sufficiently studied (Oliver, 2020). Research is underway on the nature of the impact of AI on the human psyche (Cha et al., 2020), human health (Burrell, 2019; Kalmady et al., 2019; Zhang et al., 2019). This problem is superimposed on ethno-social conflicts (Nikiporets-Takigawa, 2018).

Risks arise in the education system. The active digitalization of the educational environment causes changes in the social status of teachers (Ilina et al., 2018), worsens students' self-organization in the context of an increasing and more complex flow of information, and reduces interest in learning (Frolova et al., 2021). At the same time, GenZ students' interest in entertainment content, game-based learning methods are strengthened (Rodríguez et al., 2020a; Vinichenko et al., 2018), which causes risks of replacing learning with entertainment activities. In these conditions, the leadership of universities is striving to create a safe space for the introduction of AI into the educational

environment (Rogach et al., 2018), is carefully studying the consequences of digitalization in the context of the COVID 19 pandemic (Vinichenko et al., 2021). All this must be taken into account when teaching generation Z, building a career path.

In general, digitalization and the introduction of artificial intelligence have positive effects on the global community, but they also contain dangers and risks. They need to be identified and studied in a timely manner, which is the reason for the development of this article. This is especially true for young people, who, with all their activity, more extensive development of the digital space, do not have sufficient life experience, philosophical understanding of the essence of civilizational development, and understanding of systemic threats. Historical experience, the interaction of generation X of Russia and Slovakia in the second half of the last century has shown that they have a number of common features. To a certain extent, they are also inherent in the GenZ of both countries. In this regard, the youth of Russia and Slovakia was selected to study the threats and risks posed by digitalization and artificial intelligence.

2. Methods and methodology

The aim of the research is to identify threats and risks to the person and society from the digitalization of society and the introduction of artificial intelligence according to the views of Russian and Slovak students of generation Z.

- Scientific objectives:

1. To determine the nature of the impact of digitalization and artificial intelligence on the information security of society, the individual according to the views of Generation Z students in Russia and Slovakia.
2. To identify the extent to which it is possible to change a person, the formation of his dependence on AI from the perspective of Russian and Slovak students of Generation Z.
3. To determine the degree of danger of studying a person by artificial intelligence and his loss of independence.

- The hypothesis was put forward in the work:

H1. The impact of digitalization and artificial intelligence on a person, society is controversial, the threats and risks of which have not yet been studied and are not fully understood by students of generation Z.

The study was organized and conducted at universities in Russia and Slovakia from September 10, 2020, to April 10, 2021.

The methodology was based on general scientific and special methods. As empirical methods, we used a questionnaire survey (using the Likert method with a scaling of 5 to 1 points), in-depth interview,

focus group. Due to the limitations associated with the COVID 19 pandemic, all methods were applied remotely using Google Form, Skype VoIP, and Zoom's cloud-based conference platform.

In Russia, first-year GenZ students under the age of 22 took part in the research at 35 leading universities of the country (n=1857) with a general population of n=620,000 people. These included students from St. Petersburg State University, Lomonosov Moscow State University, National Research University "Higher School of Economics", Russian State Social University, Surgut State University, Togliatti State University, Pyatigorsk State University, and others. The universities were selected by the "snowball" method, depending on the willingness and activity of the students of the given university to take part in the study.

In Slovakia, GenZ students from two universities participated in the study: Janos Selje University (Komarno), Pan-European University (Bratislava) (n=316) under the age of 22, with a general population of n=10,500.

The sampling error was 4.75%, with a 95% confidence level. The main quota features in the selection were gender, age, and work experience.

Based on the fact that the answers of the respondents can be to a certain extent subjective, before the survey, they were given instructions on how to understand the main questions of the questionnaire correctly, how to answer them, how much they correspond to the experience gained and correspond to reality. Before the in-depth interview, a briefing was conducted to increase the degree of reliability of the received information.

The in-depth interview was conducted in order to identify the opinions and nature of feelings of Russian and Slovak students of Generation Z about the emerging threats and risks for the individual and

society that come from the digitalization of society and the introduction of artificial intelligence. This allowed for a first-level analysis.

Respondents for the in-depth interview were randomly selected. 20 respondents participated in the in-depth interview. The structure and questions of the in-depth interview were formed taking into account the results of the sociological survey. The obtained results were summarized and systematized. Typical problems were identified and the most important issues were highlighted.

The focus group was formed on the basis of inviting domestic and foreign experts- theorists and practitioners, specialists in the field- to discuss problematic issues. 25 invitations were sent. There were 8 experts in the focus group. Topical problems were identified and a reasoned discussion was organized on them. A second-level analysis was carried out for the focus group.

The results of empirical research became the basis for comparative analysis and discussion of the problem.

This article is a continuation of research on the subject, and artificial intelligence (AI) should be understood to mean intelligent computer programs, systems whose purpose is to recreate intelligent reasoning and action. They can be robots in human form. Digitalization is the process of introducing information and communication technologies in all spheres of public life (Vinichenko et al., 2020).

3. Research results

Russian and Slovak GenZ students see one of the main dangers posed by AI in the reduction of information security of society and individuals (Fig. 1).

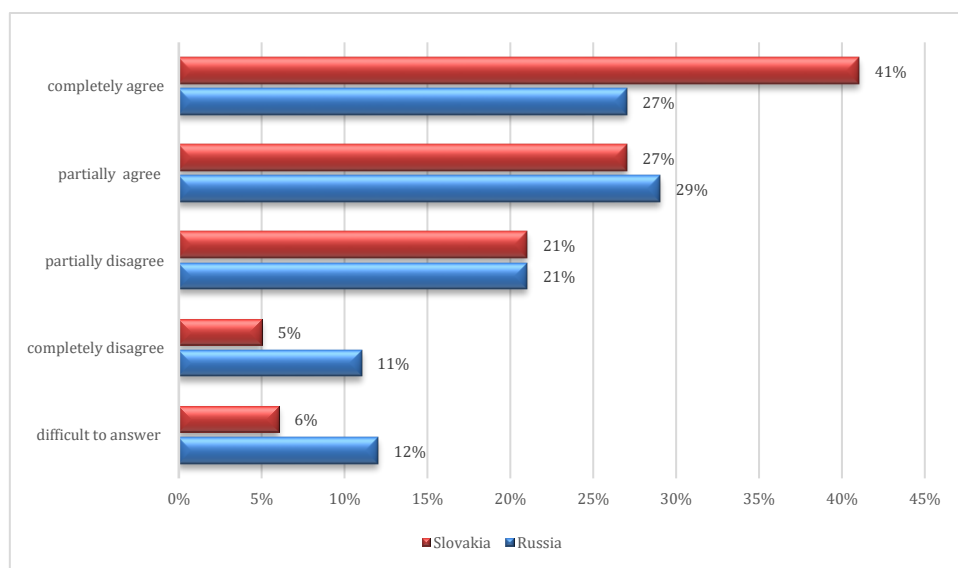


Fig. 1: Response options: "Digitalization of society and artificial intelligence will reduce information security of society, human beings"

They are unanimous that the digitalization of society and AI will reduce the information security of

society. In this case, the Slovak respondents were more- 68%, while the Russian respondents- 56%.

There were twice as many Russian GenZ respondents (11%) than Slovak respondents (5%) who did not agree in principle with the fact that there are risks to the information security of society, the person, coming from the digitalization of society and AI. A similar picture is observed with those who are undecided on this issue.

When comparing the populations of Russian and Slovak GenZs by qualitative characteristics (Pearson's chi-square test for arbitrary tables), a null hypothesis was put forward that there is no relationship between these populations. The study has shown that the comparison of the populations of Russian and Slovak students GenZ in terms of qualitative characteristics (Pearson's chi-square test

for arbitrary tables) has the following meanings: the number of degrees of freedom is 4; the value of the criterion χ^2 is 37.165, the critical value of χ^2 at the significance level $p=0.01$ is 13.277. The level of significance is $p<0.001$, which shows the statistical significance between the factorial and the effective indicators with a very high positive correlation. The value of the Pearson correlation coefficient is $R=0.9782$, the determination coefficient is $R^2=0.9569$. This allows the null hypothesis to be rejected in favor of the alternative hypothesis.

The growing dependence on artificial intelligence has been identified by the younger generation as one of the main risks of the introduction of digital technologies into human activities (Fig. 2).

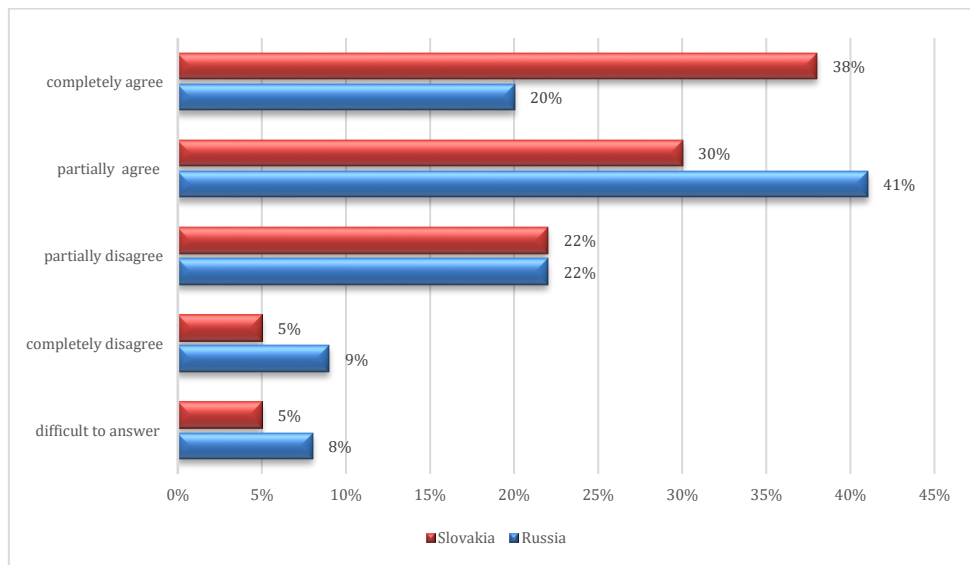


Fig. 2: Answer options: "Digitalization of society and AI will change a person and make him dependent on artificial intelligence"

More than half of GenZ respondents from Russia and Slovakia think so. At the same time, there are more Slovak respondents who agree with this statement (68%) than Russian (61%). In this combination of complete consonants, there were also more among the Slovak students of generation Z (38% versus 20%). Almost twice as many Russian as Slovak GenZ partially disagrees with the fact that a person will become dependent on AI. It was difficult to answer in about the same proportion- 8% of Russian and 5% of Slovak GenZ students.

As the study showed, comparing the totals of Russian and Slovakian students GenZ by qualitative criteria (Pearson Chi-Square test for arbitrary tables) has the following values: The number of degrees of freedom is 4; the value of criterion χ^2 is 55.029. Level of importance $p0.001$, which shows the statistical significance between factor and result characteristics with a very positive correlation. The Pearson correlation coefficient value is $R=0.962$ and the deterministic coefficient $R^2=0.9254$.

More than half of GenZ respondents in both countries see the danger of losing some autonomy in decision-making, life activities due to the deep learning of human desires, habits, and preferences by AI (Fig. 3). At the same time, the Slovak

representatives of Generation Z are slightly more numerous (by 7%).

The opinion of Russian and Slovak respondents in terms of disagreement and difficulty in answering was approximately the same, with a slight preponderance in favor of Russian GenZ students.

In the course of the study, it was established that by qualitative criteria (Pearson Chi-Square test for arbitrary tables) the comparison of the totals of Russian and Slovak GenZ has the following values: the number of degrees of freedom is 4; the value of criterion χ^2 is 27.628. Level of importance $p0.001$, which shows the statistical significance between factor and result characteristics with a very positive correlation. The Pearson correlation coefficient value is $R=0.9778$ and the deterministic coefficient $R^2=0.9561$. Thus, for the first time, the degree of correlation between the views of Slovak and Russian GenZ students in terms of the nature of threats and risks to humans and society arising from the digitalization of society and the introduction of artificial intelligence has been revealed. Their novelty lies in a certain degree of consistency in the views of GenZ students from Slovakia (European Union) and Russia in assessing digital threats and risks.

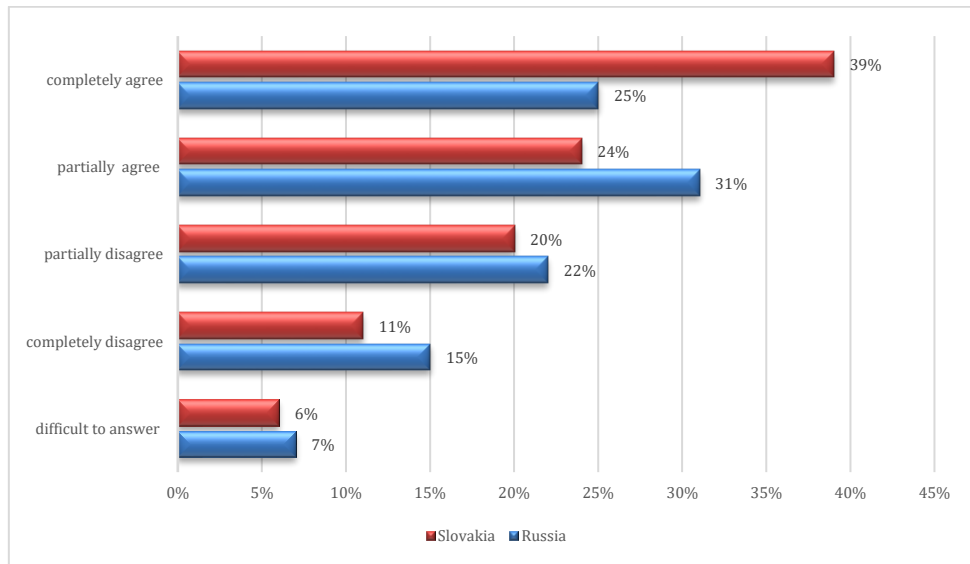


Fig. 3: Response options: “Artificial intelligence will study my desires, preferences and offer goods and services. This will create comfortable conditions for my life, but it is dangerous for me-I will be controlled by artificial intelligence, and I will lose my independence”

4. Discussion

The results of a sociological survey indicate that most Russian and Slovak GenZ students are concerned about the information threats posed by the digitalization of society and artificial intelligence. This indicates similar societal processes in Russia and Slovakia and their assessment by young people. The Slovak respondents were more opposed to the safe introduction of AI and the digitalization of society than the Russian respondents. Along with this, a number of Russian GenZ students were more categorical, joining the ranks of supporters of AI, without fear of reducing the information security of society and the individual. At the same time, a very high degree of positive correlation between the opinions of these two studied populations was revealed. These results agree to some extent with Smith's (2020) proposal to create a system of human protection from AI. For this purpose, it is necessary to determine the existing types of AI and their capabilities to obtain the required information to rise above humans.

In an in-depth interview, it was possible to establish that the main aspects of reducing information security for society and a person are seen by the respondents in unauthorized access of external subjects to personal, confidential information, disclosure of personal data. They are worried about the danger of access to their intimate, confidential correspondence of third parties, unauthorized distribution on the Internet, social networks of intimate information about them, copyright protection. The risk of disclosing personal data affecting personal and physical safety was noted less frequently. Cyber-attacks and cyber defenses are also of little concern to individuals, GenZ students. Similar issues were raised at the International Conference on Cybersecurity (Xu et al., 2019).

The risks associated with information security in a digital society were discussed in a focus group.

Experts are more inclined to believe that there are many options for the development of events in which the digitalization of society and AI can significantly harm a person in terms of information. The events of recent years show how personal data from the digital environment with the help of AI falls into the hands of unscrupulous businessmen and competing government agencies. It harms individuals as well as groups, organizations, and States. On this issue, Russian and Slovak GenZ are in solidarity with the group of experts, although there are no fundamental differences between them. The European Commission report also expressed information security concerns, especially during the COVID 19 pandemic (EU, 2020).

Risks also come from the large flow of contradictory or false information appearing constantly on the Internet, social networks, and the media. It is periodically updated statements with admissions of errors are made rarely. Still, this leads to an imbalance between faith and knowledge (Zanotti, 2018). Getting reliable information is most important for healthcare workers in the context of the COVID 19 pandemic (Vizcaya-Moreno and Pérez-Cañaveras, 2020).

Another problematic aspect of human and social security in the context of the expanding digitalization of all spheres of life is the gradual adaptation of a person to the convenient services offered by the digital environment, AI. This makes a person dependent on AI and can cause a person to decrease motivation for their own development, simplify the thinking of the majority of the world's population, and as a result, gain an advantage of AI over humans. Such a prospect, this tendency, frightens most of the Russian and Slovak GenZ in varying proportions in the degree of confidence in this matter.

In an in-depth interview, respondents expressed concern about the varying rates of digitalization and adoption of AI and the pace at which the digital

environment, AI and AI technologies were being explored by society, by the individual. The extent and breadth of digital and AI coverage in all spheres of life makes it difficult to develop the potential of these processes in a synchronous, profound and qualitative way. This trend is not only characteristic of older generations but also partly of GenZ. It affects the human psyche (Kalmady et al., 2019; Zhang et al., 2019), and has a negative impact on the person and society (Burrell, 2019).

The experts at the focus group also highlighted the risks that a person in such conditions ceases to think, think systematically, and gradually turns into a search engine for satisfying his needs based on AI. The difficulty lies in the fact that the modern goals of business and government structures are to promote and provide more and more convenient and technologically advanced services for consumers. The digital environment and AI are among the most promising and effective tools for providing such services. This is reflected in the report on the development of the digital economy. Business and talented professionals with great diligence and enthusiasm create pleasant and useful things that can absorb a person, his mind, and humanity as a whole. At the present stage, such risks are not yet high, but it is difficult to determine the moment when they will become real and there will be no turning back.

In this matter, a certain danger is posed by the GAMification of all processes. From childhood, young people receive information from gadgets, play computer games, sometimes losing touch with reality (Rodríguez et al., 2020b). As a result, a new culture based on digital games is being formed (Rodríguez et al., 2020b; Frolova et al., 2019), and the gaming environment itself is transforming (Baldeón et al., 2016; Kirillov et al., 2016). There is a threat of loss of connection with the real world, sometimes leading to inappropriate and negative actions of young people.

AI-based services are being introduced more and more actively (as a rule, they are included in new gadgets), which monitor a person, study his desires, preferences and offer the desired goods and services. These include recruitment services, social media mavens (Goldring and Azab, 2020; Aljukhadar et al., 2020). A stable connection arises in the form of a contradiction: digitalization and AI create comfortable conditions for human life and at the same time generate a danger for the transformation of a person into a weak-willed consumer with primitive needs. Ultimately, humans will be suppressed, and AI will control not only a person but society as a whole. More than half of GenZ respondents fear this.

During the in-depth interview, respondents expressed the view that they didn't not yet fully trust all the services offered to them from the digital environment and AI. However, GenZ students are pleased when the digital environment and/or AI offer them useful and desirable products or services. This avoids wasting extra time and energy searching

for what they want. They are increasingly resorting to this during their studies at a university. This, to some extent, contradicts research by Mouton and Grange (2020), who claimed that GenZ freshmen are increasingly involved in scientific work. A team of scientists led by Matraeva et al. (2020) believed that creativity requires more technological approaches to a digital environment and AI than mindless consumption of digital goods and services. At the same time, it is important to take into account the dynamics of change in value orientations (Valtere, 2013).

The experts in the focus group expressed their opinion on the prospects and the nature of the development of the relationship between natural and artificial intelligence. Lanier (2017) believed it was important to remember the basic things that drive Gen Z behavior. This correlates with the results of the study.

The following questions arose: "Who will follow whom (what) and will the primacy of control pass from humans to AI?"; "Which human will have the primary controls for AI?" The danger lies in the fact that many of the AI control levers (primarily administrative and economic) will be in the hands of a very limited circle of people, mainly business representatives - producers of goods and services.

There is no guarantee that they will use them correctly, that they will act in the interests of humanity, and not for obtaining super-profits. This approach will contribute to the spiritual, intellectual, emotional, and physical degradation of a person and society. Ultimately, this will lead to the catastrophe of human civilization. This correlates to some extent with research by Burrell (2019).

At the current stage of the development of society, information technology, it is difficult to determine how a person will behave with regard to AI and how AI will affect the individual and society as a whole. The person actively introduces AI into science and production, service sector, gradually adjusts to such technological assistant. It is difficult to predict how they will communicate further, although a person himself seeks to do everything for a person and in the name of a person. It turned out that in general, the students of GenZ do not fear AI in terms of information. Apparently small life experience, active use of the Internet, electronic and digital technologies since a young age has caused an addiction to such service, a versatile assistant in information acquisition.

5. Conclusion

The study revealed that the impact of digitalization and artificial intelligence on a person and society is controversial, the threats and risks of which have not yet been studied and are not fully understood by generation Z students. This confirmed the research hypothesis.

When comparing the populations of Russian and Slovak GenZ by qualitative characteristics (Pearson Chi-Square test for arbitrary tables), a very high

positive correlation was revealed with the Pearson correlation coefficient $R=0.962-0.9782$. This allowed the null hypothesis to be rejected in favor of the alternative.

The following trends were revealed: The rate of digitalization and adoption of AI has increased compared to the rate at which society, people, are learning about the possibilities of the digital environment, AI and how they use AI; gradual adaptation of a person to convenient AI services with the risk of a decrease in motivation for their own development, simplification of thinking and gaining an advantage of AI over humans.

The study revealed a stable relationship: digitalization and AI create comfortable conditions for human life and, at the same time, create a danger for human dependence on the digital environment. There are risks of reducing the intellectual capacity of the human being while expanding and deepening the scope of the services provided, digital inclusion, and artificial intelligence of the entire social environment. There are risks of the dominance of AI in the system of management of society, risk of loss of a certain autonomy in decision-making, activity. The danger of finding many AI control levers (primarily administrative and economic ones) in a very limited circle of people has been identified.

In general, Russian and Slovak students of Gen Z see the risks and dangers posed by the digitalization of society and AI. At the same time, risks and dangers have not yet reached their peak values for GenZ. The obtained results can be used for further research to assess the nature of the impact of digitalization and artificial intelligence on humans, society and identify the threats and risks emanating from them in other countries to form a more complete and objective picture. The results of the study can also be used to develop a set of measures to overcome threats and risks.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

- Aljukhadar M, Senecal S, and Bériault Poirier A (2020). Social media mavenism: Toward an action-based metric for knowledge dissemination on social networks. *Journal of Marketing Communications*, 26(6): 636-665. <https://doi.org/10.1080/13527266.2019.1590856>
- Baldeón J, Rodríguez I, and Puig A (2016). LEGA: A LEarner-centered GAmification design framework. In the 17th International Conference on Human Computer Interaction, Association for Computing Machinery, Salamanca, Spain: 1-8.
- Belciug S and Gorunescu F (2020). A brief history of intelligent decision support systems. In: Belciug S and Gorunescu F (Eds.), *Intelligent decision support systems-A journey to smarter healthcare*: 57-70. Springer, Cham, Switzerland. https://doi.org/10.1007/978-3-030-14354-1_2
- Bowles N (2019). Human contact is now a luxury good. *The New York Times*, New York, USA.
- Burrell L (2019). Artificial intelligence brings out the worst and the best in us. *MIT Sloan Management Review*, 60(2): 1-1.
- Cha YJ, Baek S, Ahn G, Lee H, Lee B, Shin JE, and Jang D (2020). Compensating for the loss of human distinctiveness: The use of social creativity under human-machine comparisons. *Computers in Human Behavior*, 103: 80-90. <https://doi.org/10.1016/j.chb.2019.08.027>
- EU (2020). The digital economy and society index (DESI). European Commission, Brussels, Belgium.
- Frolova EV, Medvedeva NV, Kabanova EE, Kurbakova SN, and Vinichenko MV (2016). Social partnership in Russia: Prerequisites, problems and trends. *Journal of Advanced Research in Law and Economics*, 2(16): 232-239.
- Frolova EV, Rogach OV, Tyurikov AG, and Razov PV (2021). Online student education in a pandemic: New challenges and risks. *European Journal of Contemporary Education*, 10(1): 43-52. <https://doi.org/10.13187/ejced.2021.1.43>
- Frolova EV, Ryabova TM, and Rogach OV (2019). Digital technologies in education: Problems and prospects for "Moscow electronic school" project implementation. *European Journal of Contemporary Education*, 8(4): 779-789. <https://doi.org/10.13187/ejced.2019.4.779>
- Goldring D and Azab C (2020). New rules of social media shopping: Personality differences of US Gen Z versus Gen X market mavens. *Journal of Consumer Behaviour*, 20: 884-897. <https://doi.org/10.1002/cb.1893>
- Grenciková A and Vojtovic S (2017). Relationship of generations X, Y, Z with new communication technologies. *Problems and Perspectives in Management*, 15(2): 557-563. [https://doi.org/10.21511/ppm.15\(si\).2017.09](https://doi.org/10.21511/ppm.15(si).2017.09)
- Howe N and Strauss W (1991). *Generations: The history of America's future, 1584 to 2069*. Quill, New York, USA.
- Iliina IY, Oseev AA, Vinichenko MV, Kirillov AV, Kaurova OV, and Nakhratova EE (2018). Transformation of social status of teachers of Russian universities. *Modern Journal of Language Teaching Methods*, 8(3): 381-392.
- Kalmady SV, Greiner R, Agrawal R, Shivakumar V, Narayanaswamy JC, Brown MR, and Venkatasubramanian G (2019). Towards artificial intelligence in mental health by improving schizophrenia prediction with multiple brain parcellation ensemble-learning. *NPJ Schizophrenia*, 5(1): 1-11. <https://doi.org/10.1038/s41537-018-0070-8>
PMid:30659193 PMCID:PMC6386753
- Karacsony P, Vinichenko MV, Antalík I, Dávid LD, and Vasa L (2021). Analysis of cross-border commuters' spatial mobility between western regions of Hungary and Slovakia. *Geographia Technica*, 16(1): 128-140. https://doi.org/10.21163/GT_2021.161.11
- Karacsony P, Vinichenko MV, Demchenko TS, Szabo S, and Demchenko MV (2020). Examining the characteristics of the leaders in non-profit organizations. *Economic Studies*, 29(4): 148-165.
- Kirillov AV, Vinichenko MV, Melnichuk AV, Melnichuk YA, and Vinogradova MV (2016). Improvement in the learning environment through gamification of the educational process. *International Electronic Journal of Mathematics Education*, 11(7): 2071-2085.
- Lanier K (2017). 5 things HR professionals need to know about generation Z: Thought leaders share their views on the HR profession and its direction for the future. *Strategic HR Review*, 16(6): 288-290. <https://doi.org/10.1108/SHR-08-2017-0051>
- Libin E (2020). Future competencies for digitally aligned specialties: Coping intelligently with global challenges. In the 6th International Conference on Higher Education Advances,

- Editorial Universitat Politècnica de València, Valencia, Spain.
<https://doi.org/10.4995/HEAd20.2020.11210>
- Matraeva AD, Rybakova MV, Vinichenko MV, Oseev AA, and Ljapunova NV (2020). Development of creativity of students in higher educational institutions: Assessment of students and experts. *Universal Journal of Educational Research*, 8(1): 8-16.
<https://doi.org/10.13189/ujer.2020.080102>
- Moran K (2016). *Millennials as digital Natives: Myths and realities*. Nielsen Norman Group, California, USA.
- Mouton M and Grange RL (2020). Scientific discourse: Can our first-year students express themselves in science? In the 6th International Conference on Higher Education Advances, Polytechnic University of Valencia, Valencia, Spain.
<https://doi.org/10.4995/HEAd20.2020.11110>
PMCID:PMC7291938
- Musinszki Z, Vallasek M, Mélypatakí G, Csolák EH, and Lipták K (2020). Workaholism and a new generation-labour market survey among Hungarian and Romanian youth. *Amfiteatru Economic*, 22(14): 1227-1242.
<https://doi.org/10.24818/EA/2020/S14/1227>
- Neri E, de Souza N, Brady A, Bayarri AA, Becker CD, Coppola F, and Visser J (2019). What the radiologist should know about artificial intelligence-An ESR white paper. *Insights Imaging*, 10: 44.
<https://doi.org/10.1186/s13244-019-0738-2>
PMid:30949865 PMCID:PMC6449411
- Nikiporets-Takigawa G (2018). Youth and youth policy in the UK: Post-Brexit view. *Contemporary Europe-Sovremennaya Evropa*, 80: 47-58.
<https://doi.org/10.15211/soveurope120184758>
- Oliver WH (2020). The bible in the fourth industrial revolution: 'What's in it for me?'. *HTS Teologiese Studies/Theological Studies*, 76: 4. <https://doi.org/10.4102/hts.v76i4.6020>
- Ovtšarenko O, Makuteniene D, and Timinskas E (2020). Virtual technologies possibilities for improving background knowledge of civil engineering education. In the 6th International Conference on Higher Education Advances, Editorial Universitat Politècnica de València, Valencia, Spain: 509-517. <https://doi.org/10.4995/HEAd20.2020.11097>
- Rodríguez I, Puig A, Tellols D, and Samsó K (2020a). Evaluating the effect of gamification on the deployment of digital cultural probes for children. *International Journal of Human-Computer Studies*, 137: 102395.
<https://doi.org/10.1016/j.ijhcs.2020.102395>
- Rodríguez I, Salamó M, and Puig A (2020b). Design and evaluation of gamification experiences in computer science studies. In the 6th International Conference on Higher Education Advances, Editorial Universitat Politècnica de València, Valencia, Spain: 1137-1145.
<https://doi.org/10.4995/HEAd20.2020.11212>
- Rogach OV, Frolova EV, and Ryabova TM (2018). Theory of "Trust" in the focus of expectation study concerning educational space key actors. *European Journal of Contemporary Education*, 7(2): 392-399.
<https://doi.org/10.13187/ejced.2018.2.392>
- Saoud J and Jung T (2018). An ethical perspective of the use of AR technology in the tourism industry. In: Jung T and Dieck MC (Eds.), *Augmented reality and virtual reality*: 33-46. Springer, Cham, Switzerland.
https://doi.org/10.1007/978-3-319-64027-3_3
- Shi Y (2019). The impact of artificial intelligence on the accounting industry. In *The International Conference on Cyber Security Intelligence and Analytics*, Springer, Shenyang, China: 971-978.
https://doi.org/10.1007/978-3-030-15235-2_129
- Smith CB (2020). Artificial intelligence and ultimate questions. *Toronto Journal of Theology*, 36(1): 90-92.
<https://doi.org/10.3138/tjt-2020-0055>
- Valtere L (2013). Perspective on generations: Their impact on higher education marketing. *Changes in Social and Business Environment*, (05): 213-219.
- Veretekhina SV and Medvedeva DT (2017). Self-marketing of graduates of high schools and young specialists in the system of personnel policy of the organization. *Modern Journal of Language Teaching Methods*, 7(9): 58-65.
- Vinichenko M, Melnichuk A, and Makushkin S (2018). Implementation of game methods in the preparation of management personnel. In the 4th International Conference on Higher Education Advances, Editorial Universitat Politècnica de València, Valencia, Spain: 373-380.
<https://doi.org/10.4995/HEAD18.2018.8000>
PMid:29420477
- Vinichenko MV, Melnichuk AV, and Karácsony P (2020). Technologies of improving the university efficiency by using artificial intelligence: Motivational aspect. *Entrepreneurship and Sustainability Issues*, 7(4): 2696-2714.
[https://doi.org/10.9770/jesi.2020.7.4\(9\)](https://doi.org/10.9770/jesi.2020.7.4(9))
- Vinichenko MV, Vinogradova MV, Nikiporets-Takigawa GY, and Rybakova MV (2021). The impact of the pandemic on the quality of education and the image of a university. *XLinguae*, 14(1): 17-37. <https://doi.org/10.18355/XL.2021.14.01.02>
- Vizcaya-Moreno MF and Pérez-Cañaveras RM (2020). Social media used and teaching methods preferred by generation z students in the nursing clinical learning environment: A cross-sectional research study. *International Journal of Environmental Research and Public Health*, 17(21): 8267.
<https://doi.org/10.3390/ijerph17218267>
PMid:33182337 PMCID:PMC7664855
- Xu Z, Choo KKR, Dehghantanha A, Parizi R, and Hammoudeh M (2019). *Cyber security intelligence and analytics*. Volume 928, Springer, Berlin, Germany.
<https://doi.org/10.1007/978-3-030-15235-2>
- Zanotti A (2018). La post-verità come volto di una nuova inquisizione. *AIB Studi*, 58(3): 439-453.
- Zhang Q, Yu H, Barbiero M, Wang B, and Gu M (2019). Artificial neural networks enabled by nanophotonics. *Light: Science and Applications*, 8(1): 1-14.
<https://doi.org/10.1038/s41377-019-0151-0>
PMid:31098012 PMCID:PMC6504946
- Zimenkova AA, Paramonova TA, and Lobacheva AS (2018). The problem of the introduction of artificial intelligence in HR. In the 2nd International Proceedings of the Scientific Forum and Management Revolution: New Digital Economy or New World of Machines, State University of Management, Moscow, Russia: 292-297.