



UDC: 330.3, 339.9

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PERSPECTIVES OF INNOVATIVE DEVELOPMENT OF SCIENCE DURING THE TRANSITION TO DIGITAL ECONOMY

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Received: 24.02.2023

Accepted: 04.08.2023

The article examines the steps taken to develop information and communication technologies and the digital economy during the Fourth Industrial Revolution, the work done to improve the efficiency of public administration, information security and living standards of citizens, and analyzes international statistics in detail. Also, in the document "Azerbaijan 2030: National Priorities for Socio-Economic Development" approved by the President of the Republic of Azerbaijan, in accordance with the importance of education in accordance with the requirements of the XXI century, the country's position in international assessments, International Science Rating and ICT Development Index. In accordance with the provisions of the Decree of the President of the Republic of Azerbaijan on improving governance in the field of digital transformation, a number of proposals were made in this direction, along with the possible results of the goals set in recent years for the development of science in our country. In addition, the article examines PISA (Programme For International Student Assessment), PIRLS (Progress in International Reading Literacy Study), TIMSS (Trends International Mathematics and Science Study) and ICILS (International Computer and Information Literacy Study), as well as the development of digital technology. There is also information on approaches.

Keywords: *Information and Communication Technologies, innovation, education.*

DOI: <https://doi.org/10.59849/2409-4838.2023.3.149>

INTRODUCTION

Thanks to the formation of the Fourth Industrial Revolution on the basis of new challenges, global advances in the field of digitization have been achieved, which has created a solid foundation for the development of new scientific fields in recent decades. Because high-quality, safe and efficient digital transformation in advanced practices, as well as effective use of resources in this field, is considered a driving force in the development of innovations. This driving force has become a great trend for the development of society in Azerbaijan, and has led to the taking of appropriate steps by the state in the direction of the development of this field. In order to increase the efficiency of the economy and state administration, information security and the living standard of citizens, the development of the broadband internet network that forms the basis of the Information and Communication Technologies infrastructure, "Government Cloud" (G-Cloud), "Big Data", "Smart City" Implementation of digital initiatives such as "Smart City" and "Smart Village" is one of the steps taken in the direction of turning our country into a digital center in the region.

In this regard, the Decree of the President of the Republic of Azerbaijan dated April 27, 2021 aims to effectively coordinate work in the field of managing the construction of modern telecommunications and digital architecture in the country, as well as developing a platform for digital services and solutions in various fields [1].



MAIN PART

Digitization, as in all fields in the world and in our country, took the field of economy and laid the foundation of a new stage in this field. The world has begun to take important steps towards the transition to the digital economy. From social relations to economic relations, from statistical data to assessment mechanisms, digital changes in our country led to the reduction of the "shadow economy" in the next period of activity. So, since the beginning of 2019, tax incentives have been defined for business entities to formalize their workplaces and salaries in the tax legislation. With this, the income tax (14 percent) on the salaries of individuals in the non-oil private sector up to 8,000 manats was canceled, which is 14 percent of the total tax payers.

As a result, the number of labor contracts in the private sector of the non-oil sector increased by 18.3 percent that year, and by 24 percent in 2020, compared to the period when tax incentives were introduced. At that time, the growth rates of the wage fund in that sector were 29.5 percent and 12.3 percent, respectively. Although this step caused an average annual tax loss of 300 million manats for the budget, in general, due to the "whitening" of the salary fund, it allowed more social insurance fees to enter the DSMF, which, as a result, made it possible to significantly reduce the subsidies allocated from the budget to the account of the fund. So, in 2019, the income from mandatory state social insurance payments increased by 26 percent compared to the previous year, and by 21.6 percent in 2020. Thus, in addition to compensating the state budget losses, it has succeeded in creating long-term sources of income for the budget [2].

In achieving these indicators, we can note the importance of the steps taken towards the wide application of digital technologies in the country, the establishment of digital service providers, e-commerce, and e-business networks. Because economic growth includes not only income from taxes, but all financial sources of the country. According to the 2017 reports, Azerbaijan ranked 65th out of 176 countries in the ICT Development Index with a score of 6.20, and according to the 2022 report, it rose to the 73rd place in the Economic Transformation Index (in 2020, this figure was 76, in 2018 and 85 in 2011) can be considered as one of the comprehensive measures taken in this field in the country [4, 5, 6] (Figure 1).

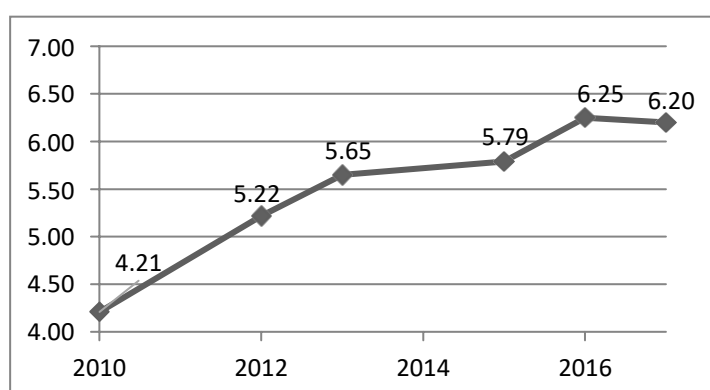


Fig. 1. ICT development index in Azerbaijan in different years between 2010-2017 (prepared by the author)

Of course, against the background of these processes, the development of science is reshaped by the influence of digital technologies, certain changes occur in the organization and methods of scientific research. The formation of digital platforms minimizes the time spent on conducting experiments, collecting and processing data, and plays a major role in building scientific infrastructure with the help of digital tools. It is no coincidence that in recent years, the scientific



databases that prevent plagiarism and further stimulate the activity of researchers are among the optimal methods for measuring the quantitative and qualitative indicators of scientific results. Considering that in the formation of these bases, two forms of activity evaluation approach (expert and statistical) are used, therefore, it is important to evaluate the creation of scientific databases such as "Scopus", "Web-Science", "Google Scholar" as an important step in the development of science with innovative methods[7].

If we conduct research based on international reports and statistics about the work done in the field of science in Azerbaijan, the International science rating is the main reference point for us. Thus, according to the number of published scientific works, Azerbaijan ranks 93 out of 240 countries, and according to the Hirsch index, it ranks 96. It should be noted that neighboring countries Russia (12th, 22nd places), Türkiye (20th, 36th places), Iran (21st, 40th places), Georgia (84th, 69th places) and Armenia (89th, 66th places), respectively, are in a higher position than our country in both ratings [8].

At the same time, the growth dynamics observed in the number of scientific works of Azerbaijani origin included in the "Scopus" scientific database between 1996 and 2020 indicates the success of the steps taken in this direction. In 1996, 251 of our scientific articles were included in "Scopus" during the year, but in 2020, this number increased to 1955 (Figure 2).

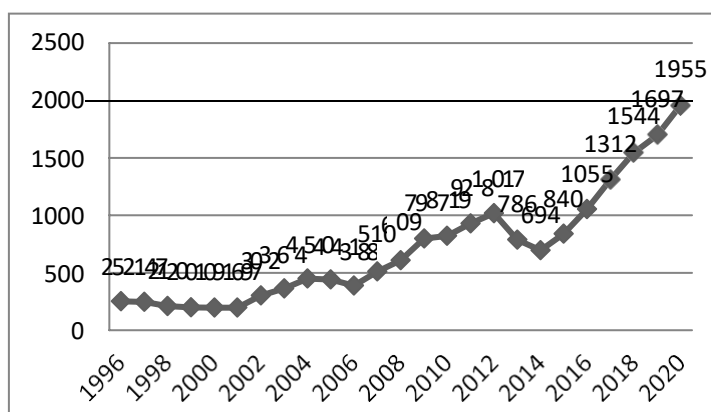


Fig. 2. The number of works of Azerbaijani origin included in the scientific database "Scopus" between 1996 and 2020 [3]

These statistics, in fact, challenge us to set bigger goals and move faster in our digital world. The document "Azerbaijan 2030: National Priorities for Socio-Economic Development" approved by the President's Order dated February 2, 2021 also emphasized the importance of education in accordance with the requirements of the 21st century and improved the country's position in international assessments (PISA, PIRLS, TIMSS, ICILS). is intended to be. Let's analyze the data in this direction and learn more about the position of our country.

PISA-Programme for International Student Assessment is a worldwide study by the Organization for Economic Cooperation and Development that aims to evaluate education systems by measuring the school performance of 15-year-old students in member and non-member countries. These studies have been conducted every 3 years since 2000, and studies cover 3 different areas (literacy, science, and mathematics).

Azerbaijan joined the international assessment since 2018 and ranked 65th among the 79 countries participating in PISA (Figure 3) (57th in mathematics, 69th in science, 69th in reading and writing). Among neighboring countries, Russia ranks 32nd on average (31st in mathematics, 30th in science, 34th in reading and writing), Türkiye 41st (43rd in mathematics, 40th in science, 40th in reading and writing), and Georgia ranks 71st (67 in mathematics, 71 in science, 74 in reading and writing).

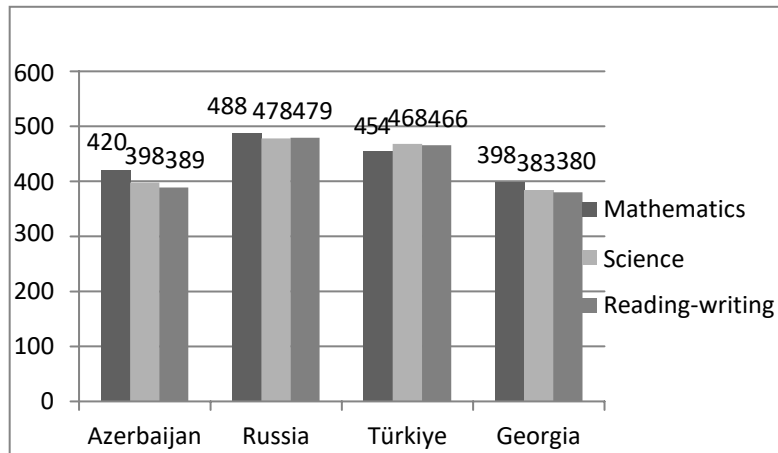


Fig. 3. Statistical data of Azerbaijan and neighboring countries on PISA 2018 assessment (prepared by the author) [9]

PIRLS - Progress in International Reading Literacy Study is an international study on the reading (comprehension) achievement of fourth graders. It is held every five years by the International Association for the Evaluation of Educational Achievement (IEA) since 2001. The main purpose of conducting the research is to measure children's reading literacy and collect information about different experiences of reading habits.

The most recent study was conducted in 2021, and the results will be made public in December 2022. Although our country joined the research in 2011 and ranked 37th with 462 points in the conducted research, in 2016 this number dropped to 39th with 472 points. According to the 2016 research, the neighboring countries - Russia ranked first (581 points), Georgia ranked 37th (488 points), and Iran ranked 45th (428 points). In 2011, Russia scored 568 points, 3 points behind Hong Kong and took the 2nd place. Georgia ranked 34th with 488 points, and Iran ranked 38th with 457 points [10] (Figure 4).

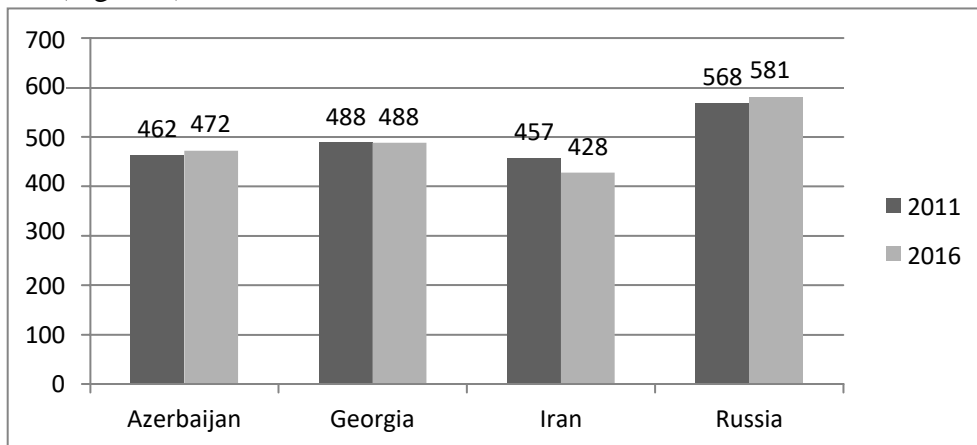


Fig. 4. Statistical data of Azerbaijan and neighboring countries on PIRLS assessment by year (prepared by the author)

TIMSS - Trends in International Mathematics and Science Study is an international assessment series of mathematical and scientific knowledge of students around the world. The students participating in the study are students of different educational systems in terms of economic development, geographical location and population size. A minimum of 4,000-5,000 students are evaluated in each country or regional jurisdiction during the study period. Assessments



are collected through contextual questionnaires from students, as well as their parents and teachers.

TIMSS is another study created by the International Association for the Evaluation of Educational Achievement (IEA) that allows education systems around the world to compare the educational achievements of students and learn from the experiences of other participating countries in developing effective education policies. This assessment was conducted for the first time in 1995, and after that every four years, covering 4th and 8th grade students of educational institutions [11].

The most recent study on Trends in International Mathematics and Science Study (TIMSS) was conducted in 2019, and Azerbaijan participated in the assessment of this study among 4th graders. In addition to Azerbaijan, which ranked 28th in mathematical knowledge with 515 points, and 50th in scientific knowledge with 427 points, other neighboring countries, except Georgia, participated in the assessment. The results are as follows: Russia ranks 6th (567 points) and 3rd (567 points), Türkiye ranks 22nd (523 points) and 19th (526 points), Armenia ranks 38th (498 points) and 43rd place (466 points), while Iran is 50th (443 points) and 48th place (441 points) [12] (Figure 5).

ICILS - International Computer and Information Literacy Study (International Computer and Information Literacy Study) assesses the knowledge of information and communication technologies (ICT) of students and teachers around the world. This test was created in June 2010 by the International Association for the Assessment of Educational Achievement. The research was conducted twice - in 2013 and 2018. The next stage of the research is planned to be held in 2023.

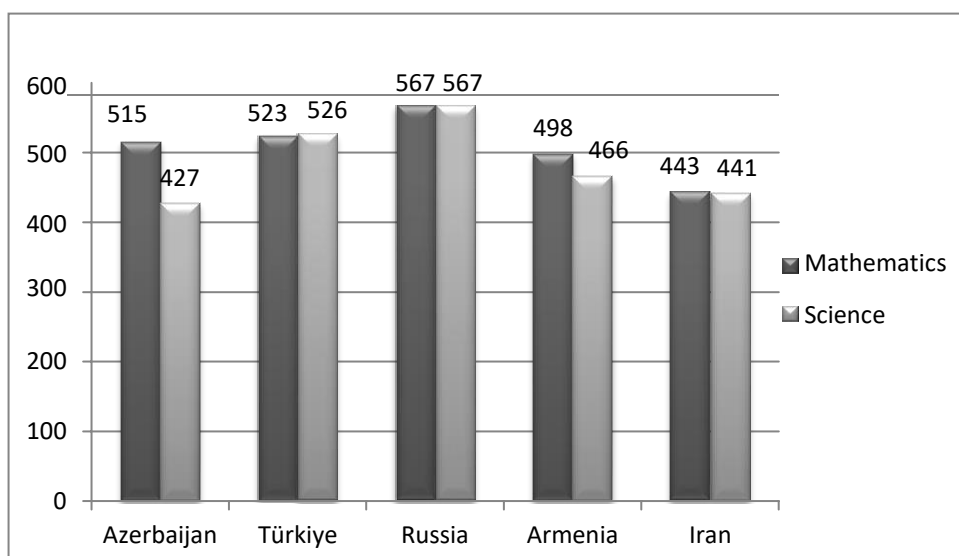


Fig. 5. Statistical data of Azerbaijan and neighboring countries on TIMSS 2019 assessment (grade 4) (prepared by the author)

It should be noted that from the neighboring countries, Russia took part in both studies, and Türkiye took part in one study (2013). In the ICILS 2018 study, which took place with the participation of 13 countries, in addition to Russia, only Kazakhstan participated in the CIS region (Figure 6).

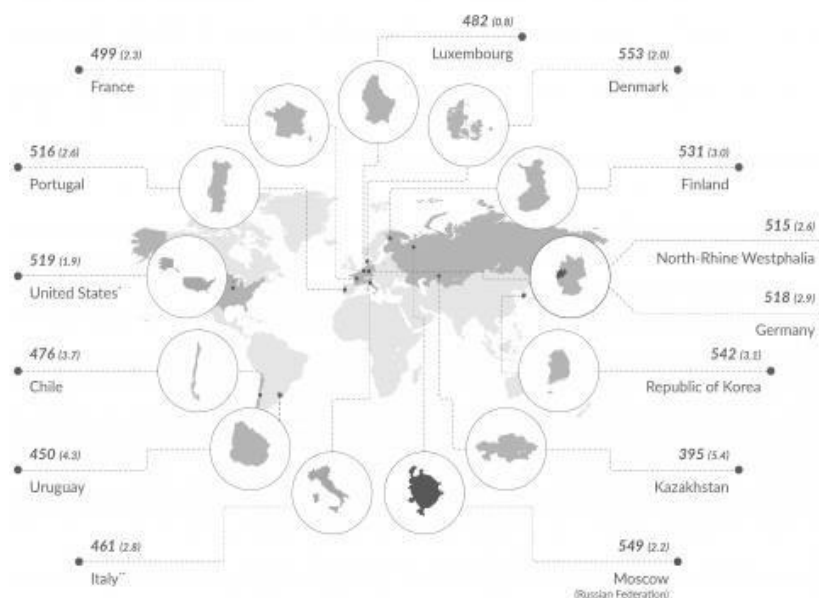


Fig. 6. Countries participating in the ICILS 2018 study and information literacy indices [13]

Key findings from the ICILS 2018 study are:

1. Young people cannot acquire digital skills by using digital devices alone, as they need to demonstrate functional working knowledge of these tools;
2. It is not enough to provide only ICT equipment to improve the digital skills of students or teachers, as there is a need for education in this area;
3. There is a digital divide related to the socio-economic status of students, as the information literacy index of students with poor socioeconomic status is quite low.

CONCLUSION

The results of all these studies once again reveal the necessity of Azerbaijan's development in this field. In the future, taking into account that the innovative development of the field of science will indirectly depend on young scientists and researchers, in order to improve the scientific research work in the country, stimulating the activity of scientific research centers and student scientific societies in higher education institutions, including in the direction of the development of science both in the field of ICT and in general in secondary schools It is very important to educate the youth.

Only in this way, Azerbaijan will be able to achieve great success in the field of science in a short period and the higher education and scientific research institutions operating in our country can raise their ranks in the international rating lists. Because the world's prestigious higher education institutions such as Massachusetts Institute of Technology, Harvard, Oxford, and Cambridge University are in the first ranks not only in terms of the quality of education, but also in terms of their contributions and contributions to world science.

ACKNOWLEDGEMENTS

I express my gratitude to the rector of Azerbaijan State University (UNEC), doctor of economic sciences, Professor Mr. Adalat Muradov, for the publication of this research work in the "Young Researcher" journal of Azerbaijan National Academy of Sciences (ANAS) Young Scientist and Specialist Council.



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RƏQƏMSAL İQTİSADİYYATA KEÇİD DÖVRÜNDƏ ELMİN İNNOVATİV İNKİŞAF PERSPEKTİVLƏRİ

A.R. Rəhimli

Məqalədə Dördüncü Sənaye İnqilabı dövründə İnformasiya-Kommunikasiya Texnologiyalarının və rəqəmsal iqtisadiyyatın inkişafı istiqamətində atılan addımlar, dövlət idarəetməsinin səmərəliliyinin, informasiya təhlükəsizliyinin və vətəndaşların yaşayış səviyyəsinin yüksəldilməsi məqsədilə görülmüş işlər araşdırılaraq, beynəlxalq statistik göstəricilər ətrafı təhlil edilib. Həmçinin Azərbaycan Respublikasının Prezidenti tərəfindən təsdiq edilən “Azərbaycan 2030: sosial-iqtisadi inkişafa dair Milli Prioritetlər” sənədində XXI əsrin tələblərinə uyğun təhsilin əhəmiyyətinə uyğun olaraq, ölkənin beynəlxalq qiymətləndirmələrdə, Beynəlxalq elm reytingi və İKT-nin İnkişafı İndeksində ölkəmizin mövqeyi ətrafı öyrənilib. Rəqəmsal transformasiya sahəsində idarəetmənin təkmilləşdirilməsi haqqında Azərbaycan Respublikası Prezidentinin Fərmanında qeyd olunan müddəalara uyğun olaraq ölkəmizdə elmin inkişafı istiqamətində son illər ərzində qarşıya qoyulan hədəflərin gələcəkdə mümkün ola biləcək nəticələri ilə yanaşı bu istiqamətdə bir sıra təkliflər verilib. Bununla yanaşı məqalədə PISA (Beynəlxalq Şagirdlərin Qiymətləndirilməsi Proqramı), PIRLS (Beynəlxalq Oxu Savadlılığının Tədqiqi Proqramı), TIMSS (Beynəlxalq Riyaziyyat və Elm Tədqiqatında Trendlər) və ICILS (Beynəlxalq Kompüter və İnformasiya Savadlılığı Tədqiqatı) tədqiqatları, habelə rəqəmsal texnologiyaların inkişafı fonunda müasir elmin tətbiq etdiyi yanaşmalar barədə məlumatlar da yer alır.

Açar sözlər: *İnformasiya-Kommunikasiya Texnologiyaları, innovasiya, təhsil.*



ПЕРСПЕКТИВЫ ИННОВАЦИОННОГО РАЗВИТИЯ НАУКИ ПРИ ПЕРЕХОДЕ К ЦИФРОВОЙ ЭКОНОМИКЕ

А.Р. Рагимли

В статье рассматриваются шаги, предпринятые для развития информационно-коммуникационных технологий и цифровой экономики в период Четвертой промышленной революции, проделанная работа по повышению эффективности государственного управления, информационной безопасности и уровня жизни граждан, подробно анализируется международная статистика. Также в документе «Азербайджан 2030: Национальные приоритеты социально-экономического развития», утвержденном Президентом Азербайджанской Республики, в соответствии с важностью образования в соответствии с требованиями XXI века, подробно изучено положение нашей страны в международных оценках, Международном научном рейтинге и Индексе развития ИКТ в соответствии с требованиями XXI века. В соответствии с положениями Указа Президента Азербайджанской Республики о совершенствовании управления в сфере цифровой трансформации, в этом направлении был внесен ряд предложений, наряду с возможными результатами, поставленных в последние годы целей для развития науки в нашей стране. Кроме того, в статье рассматриваются исследования PISA (Международная программа оценки учащихся), PIRLS (Международная программа исследований грамотности чтения), TIMSS (Международные тенденции научных исследований в области математики и естественных наук) и ICILS (Международные исследования компьютерной и информационной грамотности), а также на фоне развития цифровых технологий информация о подходах, применяемых современной наукой.

Ключевые слова: *Информационно-Коммуникационные Технологии, инновации, образование.*