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Economic sciences

THE ROLE OF SPECIAL ECONOMIC ZONES IN INNOVATIVE TOURISM DEVELOPMENT

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Abstract

Special Economic Zones (SEZs) have emerged as significant catalysts for economic growth, especially in the tourism industry. These zones provide favorable conditions, such as tax incentives and simplified regulatory processes, which attract investments and stimulate economic activities. This paper examines the impact of SEZs on innovative tourism development, focusing on their role in enhancing infrastructure, improving service quality, and promoting sustainable tourism practices. SEZs create an enabling environment for the construction of modern tourism facilities, including hotels, entertainment complexes, and recreational areas, thereby boosting the appeal of tourism destinations. They also foster innovation by encouraging the adoption of new technologies and the development of unique tourist offerings. Moreover, the influx of investments into SEZs drives economic growth by creating jobs and improving the standard of living in the regions where they are established. The paper also highlights the importance of sustainable tourism within SEZs. By promoting ecotourism, agrotourism, and other sustainable practices, SEZs help minimize environmental impact while enhancing the long-term viability of tourism activities. Through these initiatives, SEZs not only contribute to the diversification and modernization of the economy but also play a crucial role in positioning tourism as a key driver of national economic growth.

Keywords: special economic zones (SEZs), tourism development, innovation, tourism, economic growth.

Introduction

Special economic zones (SEZs) are special areas with favorable conditions for business and investment. They play a significant role in the growth of various sectors, including tourism. Tourism, as one of the fastest-growing industries, can greatly benefit from the establishment and operation of SEZs. This paper explores the role of free economic zones in innovative tourism development. It analyzes their impact on the economy and provides examples of how they have been used successfully to promote the tourism industry. Free economic zones are territories that are created with the aim of stimulating economic growth by offering tax and customs advantages, simplified regulatory processes, and other benefits. They have become a popular tool for economic growth and integration into the global market. Their main objectives include attracting investment, boosting exports, creating employment opportunities, and improving a country's overall economic performance.

The main part of research

The first free economic zones emerged in the mid-20th century and have since grown in number. According to the United Nations Conference on Trade and Development (UNCTAD), there are currently approximately 6,000 such zones worldwide, with more than 1,000 having been established in the past five years. This figure is merely indicative, as it is based on an estimate of the number of active zones in 2018 and the number under development [1].

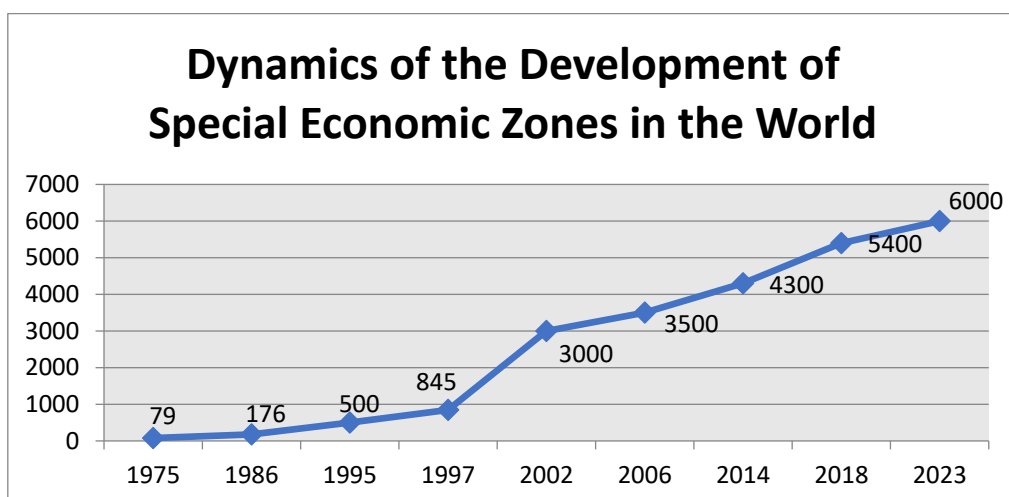


Figure 1 - Dynamics of the Development of Special Economic Zones in the World
Note - Compiled by the authors based on the source [1]

Special economic zones (SEZs) are typically classified based on their specific goals, industry orientation, location, or regulatory regime. For example, they can be classified as high-tech parks, service parks, port zones, or border zones. The type of regulatory regime can also vary, including free trade agreements (FTAs) and commercial free zones. UNCTAD experts have proposed a classification of SEZs based on their specialization, structural and managerial characteristics.

Table 1.

<i>Types of special economic zones</i>	
<i>Type of specialization of the SEZ</i>	<i>Description (purpose of creation, features of operation)</i>
Logistics hubs	<i>Provision of commercial, warehousing and logistics services; trade facilitation, transshipment and re-export services. They can be located near or within large industrial zones.</i>
Comprehensive	<i>General industrial development, non-specialized production.</i>
Specialized	<i>The activity is focused on:</i> - individual industries (services, mining or agriculture); - industrial sectors (automotive, electronics, clothing industry); - outsourcing of business processes, call centers, research centers)
Innovative	<i>The activity focuses on the modernization of industrial production and the creation of new types of activities (e.g., high-tech, biotechnological and tourist and recreational areas).</i>
<i>Note - Compiled by the authors based on the source [1]</i>	

The majority of special economic zones in the world are complex zones, accounting for 62% of their total number. These zones are often located in developed countries and function as logistics hubs, providing tariff benefits and reducing transaction costs in customs operations. This is essential for maintaining complex supply chains and is a key factor in attracting foreign direct investment (FDI) and stimulating economic growth. Special economic regimes are also introduced in regions with underdeveloped infrastructure and high unemployment, where they aim to attract FDI and diversify economic sectors. In these areas, SEZs play a crucial role in modernizing the economy and creating new jobs. In contrast, in developing countries, SEZs often focus on attracting FDI to stimulate economic growth and modernize sectors. Industrial production and technical zones are primarily located in these countries, while transit countries tend to have specialized and integrated SEZs that facilitate trade and transport.

Table 2.

Number of free economic zones by regions and countries of the world

Region	Total number of SEZs	SEZ under development	Planned SEZs
World	5383	474	507
Europe and North America	374	5	-
Asia	4046	371	419
Africa	237	51	53
Latin America	486	28	24
Transit countries	237	18	5
<i>Note - Compiled by the authors based on the source [1]</i>			

Special economic zones operate in more than 140 countries around the world. East Asia leads the region in the number of SEZs, with 2,645 (including 13 under development). Southeast Asia follows with 737 (167) zones. Latin America (including the Caribbean) has 486 (28) zones, while South Asia has 456 (167) SEZs. In the group of developed countries, the number of SEZs reaches 374. This includes 105 SEZs in Europe and 262 in North America. Transition countries have 237 FEZs, and least developed countries have 173. The vast majority of planned SEZs are in Asian countries. Southeast Asia has the highest number of planned SEZs, with 235, followed by South Asia with 184.

Kazakhstan has also had experience with the creation and development of special economic zones. The first attempts to establish SEZs date back to the 1990s, when they were created to accelerate the transition from a planned to a market-based economy and to promote the socio-economic development of certain regions of the country. Some of these zones included "Zhairem-Atasu" in Zhezkazgan, "Alakol" and "Zharkent" in the south, "Lisakovskaya" in the Kostanay region, "Atakent" near Almaty, and free economic zones in the Atyrau, East Kazakhstan, Karaganda, and Mangistau regions. Each zone had a validity period of 25 years, but due to inefficiencies in their development, they were abolished in 1996 with the exception of Lisakovskaya, which continued to operate. Reasons for their failure included regulatory shortcomings, lack of transparency, corruption, and the wrong choice of fixed territory [2, 3].

In 1996, the President of Kazakhstan issued a decree establishing special economic zones, which replaced the concept of free economic zones with special economic zones. The main goals of these zones were to attract foreign investment, create production capacity, accelerate the development of specific regions, produce competitive products, develop a market economy, and promote entrepreneurship. Along with changing the management structure of the zones, the decree also included provisions for annual adjustments to regulatory frameworks. However, all of the special economic zones created under this decree had been dissolved by the year 2000. Since then, several additional free economic zones and industrial zones have been established through special decrees issued by the government. For example, in 2001, a free economic zone called Astana-New City was established based on the decree issued by the President of Kazakhstan. This was followed by the establishment of other special economic zones and industrial parks, including Aktau Port (2002), Alatau Innovation Park (2003), Ontustik (2004), Burabay (2008), and industrial zones in Karaganda, as well as the international cross-border cooperation center "Khorgos" (2012). In 2007, a new law on special economic zones was adopted, which was revised in 2010. However, this law turned out to be restrictive and did not effectively attract new investments. Currently, all special economic zones in Kazakhstan are governed by the Law on Special Economic Zones of the Republic of Kazakhstan (2011), which aims to create an advanced industrial environment with high productivity and competitiveness, attract investment and advanced technologies in key industries and regions, and increase employment levels in the country. SEZs are considered a strategic tool for achieving the main goals of economic policy, including economic diversification, increased competitiveness, and technological modernization. To improve the effectiveness of FEZs, the law provides them with exemptions from compliance with certain regulations, such as tax, labor, and customs codes [4].

In 2022, President Kassym-Jomart Tokayev, in his message "A Just State. A United Nation. Prosperous Society", instructed to introduce new measures to improve the activities of free economic zones. In response, a roadmap has been developed to enhance the efficiency of SEZ operations and strengthen the management company personnel in order to implement new approaches. The roadmap includes amendments such as the implementation of a combined regime in the SEZ territory and the exclusion of unsecured land plots from the area. The combined regime involves providing land to investors

who are not engaged in priority activities without applying investment preferences [5]. Additionally, in his speech "The Economic Course of Fair Kazakhstan", delivered on 09/01/2023, President Tokayev emphasized the significance of tourism development and highlighted that this industry merits special attention and requires proactive growth. The impact of tourism on the improvement of the standard of living for the population in tourist regions, as well as the stimulation of cash flows and increase in income for tourism industry enterprises, are important aspects of this phenomenon [6].

The results and conclusions

For instance, the share of tourism in total output of goods and services has increased from 949.3 billion tenge in 2021 to 1,704.7 billion tenge in 2022, highlighting its contribution to the national economy. Additionally, the gross value added (GVA) generated by the tourism industry in 2022 was 3,270.1 billion tenge with a physical volume index of 101.8%. The direct GVA generated in tourism was KZT 1,001 billion, with an index of 151.8%, demonstrating a significant improvement in productivity within this sector [7].

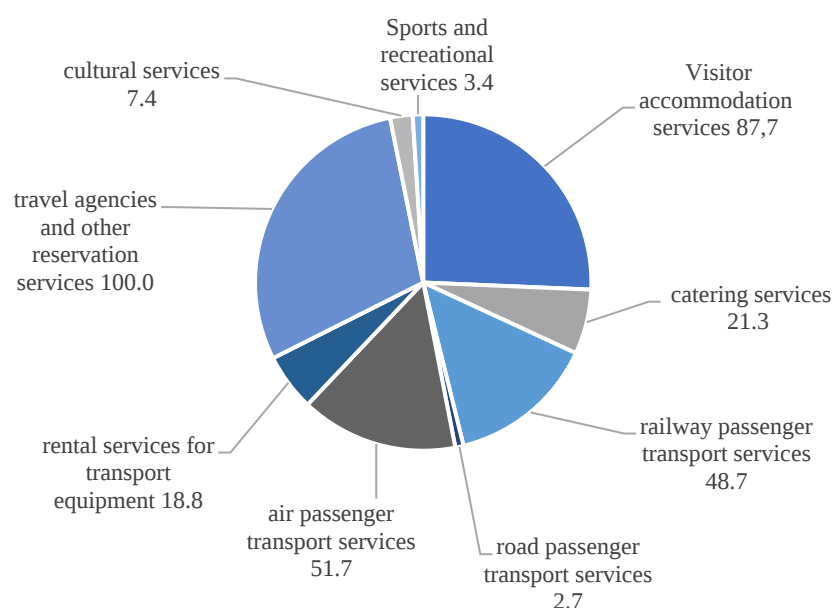


Figure 2. The share of tourism in the output of goods and services
Note - compiled by the authors based on the source [7]

The creation of special economic zones in the field of tourism promotes its innovative development in several key aspects. Firstly, SEZs provide the necessary infrastructure for the construction of modern hotels, entertainment complexes, and tourist centers, which enhances the quality of tourism services and makes the regions more appealing for visitors. Secondly, the favorable business environment in SEZs attracts significant investments into the tourism industry, allowing for the introduction of new technologies, improvement of existing services, and development of new tourist destinations.

Thirdly, the development of tourism infrastructure in SEZs creates jobs, contributing to the economic growth of the region and improving the living standards of the local population. Fourthly, marketing and advertising efforts are essential for promoting tourism in SEZs, attracting more visitors and increasing revenue for local businesses. By addressing these four aspects, SEZs play a crucial role in fostering sustainable tourism development and economic prosperity. FEZs can contribute to large-scale marketing and advertising campaigns aimed at attracting tourists from both within the country and abroad, which can help increase the tourist flow and revenue from tourism. Another important aspect is the development of sustainable tourism within FEZs. Projects for the development of this type of tourism are often implemented within the framework of FEZs, with the aim of minimizing negative impacts on the environment and preserving natural and cultural resources. These projects include the development of ecotourism, agrotourism, and medical tourism, among other types of sustainable travel. In Turkey, free economic zones play a significant role in the development of the tourism industry. They create favorable

conditions for the construction of modern hotels, resorts, and tourist complexes, such as Antalya, which is one of the largest tourist centers in the country. Antalya has several special economic zones that attract significant investments in tourism infrastructure, allowing for the improvement of service quality, the offer of new products, and the attraction of more tourists from all over the world. The United Arab Emirates (UAE) is a prime example of how special economic zones can be used for tourism development. Dubai and Abu Dhabi have created special economic zones with preferential conditions for businesses and investors, leading to the active development of tourist infrastructure. Modern hotels, entertainment complexes, shopping malls, and other facilities have been built in these areas, attracting millions of tourists each year. Due to this, the UAE has become one of the most popular tourist destinations in the world [8].

Let's take a look at some examples of successful tourism free economic zones that have contributed to the significant increase in tourism and infrastructure development in Kazakhstan. The Burabai Free Economic Zone is one of the most popular tourist destinations in Kazakhstan. Situated in the beautiful area of the Schuchinsk-Borovskoye resort, the Burabai SEZ captivates tourists with its natural scenery, unique climate, and rich cultural heritage. The main accomplishments of the Burabai SEZ include substantial infrastructure development, attraction of investments, increase in tourist traffic, and creation of jobs. Within the scope of the FEZ, numerous modern hotels, sanatoria, entertainment complexes, and other tourist facilities have been constructed. This has enhanced the quality of services and made the area more appealing to tourists.

Favorable business conditions have attracted significant investments in the tourism sector, leading to the implementation of major projects for the construction of hotels, resorts, and other facilities. Thanks to the development of infrastructure and an active advertising campaign, the number of tourists visiting the Burabai Special Economic Zone has increased significantly. This has contributed to the growth of tourism revenue and the development of the local economy. The development of tourism infrastructure within the SEZ has led to the creation of numerous new jobs, which has had a positive impact on the standard of living for the local population.

Turkestan, an important historical and cultural center of Kazakhstan, has been included in the program for creating special economic zones. The goal of the Turkestan Special Economic Zone is to develop tourism and preserve the cultural heritage of the region. The main achievements of the SEZ include the reconstruction of historical sites, development of a hotel chain, and significant investments in infrastructure. Work has been done to reconstruct and restore historical monuments and cultural heritage sites, attracting tourists' attention and increasing the cultural value of the area. New, modern hotels meeting international standards have been built, improving the quality of service and attracting more foreign tourists. Regular cultural events, festivals, and exhibitions held in the Turkestan SEZ also help to attract tourists and promote the region's cultural heritage. Attracting investors has made it possible to implement major projects for the construction of tourist infrastructure, including entertainment complexes, museums, parks, and other facilities. Based on this, it can be concluded that the creation and development of special economic zones in Kazakhstan and other countries is a strategic tool for achieving economic goals such as diversification, industrial modernization, and attracting foreign investment.

In particular, SEZs provide new opportunities for innovative growth, infrastructure development, and the creation of sustainable business models for the tourism industry in the national economy. These initiatives contribute to the diversification of the economy and the modernization of existing industries, which in turn attracts foreign investment and creates jobs.

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MANAGING EXPENSE ACCOUNTING IN PUBLIC SECTOR PROFESSIONAL EDUCATIONAL INSTITUTIONS

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Abstract

This article explores the intricacies of managing expense accounting in public sector professional educational institutions. It highlights the unique challenges faced by these institutions in tracking and controlling expenses, ensuring compliance with government regulations, and maintaining transparency. The discussion includes an examination of best practices for effective expense management, the integration of advanced accounting systems, and strategies for enhancing financial accountability. The ultimate goal is to optimize financial resources to support educational objectives while upholding the principles of fiscal responsibility and transparency.

Keywords: Expense management, public sector, educational institutions, financial compliance, accounting systems

Public sector professional educational institutions are vital pillars in the framework of societal development, tasked with the dual responsibility of advancing educational objectives and managing public funds with utmost integrity. The management of expenses within these institutions is not merely a function of financial necessity but a cornerstone of operational sustainability and public accountability. Given the complexities associated with government funding rules, diverse revenue streams, and strict compliance mandates, these entities encounter unique financial management challenges.

The core of effective financial management in these settings is prudent expense accounting. This involves meticulous tracking, categorizing, and reporting of expenditures to ensure they align with both educational goals and budgetary constraints. The challenge is amplified by the need to balance fiscal discipline with the quality of educational delivery, often under the scrutiny of multiple stakeholders including government agencies, regulatory bodies, donors, and the public.

Additionally, these institutions must navigate a landscape where financial missteps can lead to significant repercussions, ranging from reduced funding to reputational damage. Therefore, the adoption of sophisticated, transparent, and compliant financial practices is essential. This ensures that funds are not only spent wisely but are seen to be spent wisely, reinforcing stakeholder trust and institutional credibility.

The literature on expense management in public sector educational institutions underscores the complexities of financial stewardship, highlighting the need for stringent compliance, effective use of technology, and strategic resource allocation. Several key studies provide insights into best practices and challenges faced by these institutions.

Walker and Tims (2018) explored the implications of regulatory compliance on budgeting practices within U.S. public universities. Their research highlighted the burden of compliance costs and the strategies institutions employ to align their financial practices with federal and state regulations.

In a similar vein, Patel and Markovic (2020) analyzed the impact of financial accountability measures on public schools in the European Union, emphasizing the role of transparency and strict adherence to public financial management laws in maintaining public trust and securing funding.

A comprehensive study by Harrison and White (2019) demonstrated how the adoption of digital accounting systems has transformed expense management in Australian public colleges. Their findings suggest that technology not only enhances the accuracy and efficiency of financial reporting but also provides dynamic tools for financial forecasting and planning.

Furthermore, Zhao and Chen (2021) investigated the use of AI and machine learning in streamlining expense tracking and auditing processes in Chinese vocational schools. Their research underscores the potential for technology to reduce human error and increase processing speeds, thereby improving overall financial management.

The work of Gibson and Singh (2017) focused on the strategic allocation of financial resources in Canadian public educational institutions. They provided a detailed analysis of budgeting techniques that prioritize educational outcomes while adhering to fiscal constraints.

More recently, O'Neil (2022) addressed the challenges of resource allocation in times of budget cuts and financial uncertainty within UK universities, offering strategies for maximizing financial resources without compromising the quality of education.

In analyzing the expense management practices of public sector professional educational institutions, several key areas are identified for potential improvement:

Streamlining expense tracking: Many institutions still rely on outdated manual processes for tracking expenses, which can lead to errors and inefficiencies. Implementing modern accounting software that automates these processes can significantly reduce errors and improve the accuracy of financial reporting.

Enhancing compliance mechanisms: Compliance with financial regulations is critical in the public sector. Institutions often face challenges in keeping up-to-date with changing regulations. Regular training sessions and updates for financial staff on the latest regulatory changes can help institutions maintain compliance.

Optimizing resource allocation: Effective allocation of resources is essential for maximizing the impact of educational programs. By employing advanced analytical tools, institutions can better understand spending patterns and make informed decisions about where to allocate funds for the greatest educational benefit.

Increasing financial transparency: Stakeholders, including government bodies and the public, demand high levels of transparency in how educational institutions manage funds. Enhancing transparency can be achieved through regular financial reporting and making these reports accessible to all stakeholders.

Effective expense management is crucial for public sector professional educational institutions to fulfill their educational mandates while ensuring fiscal responsibility and transparency. By adopting advanced technologies, enhancing training programs, implementing robust audit processes, and fostering stakeholder engagement, these institutions can improve their financial management practices, ultimately supporting their mission to educate and train future professionals.

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Historical sciences

HAYDAR ALIYEV'S CONCERN FOR THE NATIONAL PRESS OF AZERBAIJAN

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Abstract

All the political and statesmanship activities of Haydar Aliyev are the history of the development and strengthening of modern Azerbaijan, our people, national statehood. The chronology of his life and activities reflects a bright page of a great historical period. The periods of Haydar Aliyev's leadership of Azerbaijan are distinguished by the upward and progressive tendencies in the economic, social-political, cultural-spiritual development of our country. He has shown by his practical activities that he is a world-renowned leader with a great influence.

In addition to all this, the role of the great leader in the formation of the national press of Azerbaijan, which has a rich history and progressive traditions, is undeniable. The great personality Haydar Aliyev said that the national press is able to provide exceptional services in the protection and enrichment of the national and moral values of our people, and in the development of the literary language of Azerbaijan.

In the modern era, when the Republic of Azerbaijan gained independence and went through the process of building a sovereign state, the mass media, including our national press, faced completely new tasks. However, in order to fulfill these ambitious tasks, great support was needed. Thanks to the care shown by the genius leader to the independent press, the mass media played an important role in building a civilized and democratic civil society, implementing economic and social reforms, ensuring social justice and transparency in the society, protecting human rights, creating an environment of solidarity and tolerance, national consciousness, political culture and overall healthy its role in the formation of moral values increased.

These issues are explained in the article.

Keywords: Haydar Aliyev, independent Azerbaijan, national press, modern development, historical decisions

At the end of the 19th century and the beginning of the 20th century, our progressive intellectuals played a leading role in the formation of the social and political movement in Azerbaijan and in the awakening of national self-consciousness. At that time, Hasan Bay Zardabi, one of the prominent intellectuals of Azerbaijan, as an educator, saw the main reason for Azerbaijan's social, economic and cultural backwardness in the lack of science and culture, the lack of secular educational institutions, and the widespread spread of religious fanaticism. For this reason, he considered the establishment of the national press to be one of the most important factors for the education of the people. Realizing that there is a great need for a newspaper in his native language, Hasan Bay applied to the government to print a newspaper. In this regard, he brought equipment for the press from Istanbul and finally, after a lot of hard work, the first issue of "Akinchi" newspaper was published on July 22, 1875. This newspaper, published in the Azerbaijani language at the governor's printing house in Baku, caused a wide response throughout the Caucasus.

On July 22, 1875, the newspaper "Akinchi" laid the foundation of the national press of Azerbaijan. "Akinchi", which was published by Hasan Bay Zardabi, was later followed by such media outlets as "Ziya", "Shargi - Rus", "Kashkül", "Irshad", "Fyuzat". When democracy in the West was still at the level of considerations, during the first democratic Republic of the East, the Azerbaijani press followed a path based on democratic values.

The great leader, who considers historical succession as the main line in all matters, considered freedom of speech and press to be the basic principles of society for Azerbaijan, which regained its independence at the end of the 20th century. Haydar Aliyev considered freedom of speech and information to be the basis of civil society. That is why he paid special attention to mass media - journalism. He approached not only modern, but also different eras of press history from this direction.

Appreciating the role of the "Akinchi" newspaper, which plays an indispensable role in the national awakening and national revival of the people, the great leader commented on the history of the road held in a meeting with journalists on the occasion of the 125th anniversary of the establishment of the national press in Azerbaijan as follows: "125 years ago, Hasan Bay Zardabi, Mirza Fatali Akhundov and others gathered together. several people (of course Hasan Bey Zardabi is the founder of "Akinchi" newspaper) came up with such an initiative. Now we have to think that it was not an easy thing at that time. It was an extremely difficult thing. If this has already happened and we are now remembering the "Akinchi" newspaper for 125 years, see how much patriotism these people showed, how brave they were who wanted the development of their nation. Because in those circumstances, creating such a newspaper in the Azerbaijani language was related to great principles, and they followed these principles" (1).

Saying that we cannot forget the past years, Haydar Aliyev characterized the newspaper "Shargirus" published by Mohammad Agha Shahtakhtinsky and the newspaper "Kaspi" published with the initiative and support of Haji Zeynalabdin Taghiyev as followers of Hasan Bay Zardabi. All this meant that the people of Azerbaijan are capable of creating and living democratic ideas and secular values. The great leader was rightly proud of this feeling. His approaches encouraged the development of the national press based on historical traditions. He called the stages of development an integral part of history, and considered it important to study them and pass them on to future generations. The ideas of "Akinchi" newspaper were later expressed in "Molla Nasreddin", the most popular magazine of its time.

"Molla Nasraddin" magazine has a special role in the life of Azerbaijan. The role of "Molla Nasraddin" magazine and Mirza Jalil's activities in the formation of national consciousness, national awakening and revival of our people is irreplaceable. According to the conditions of that time, it is no coincidence that J. Mammadguluzada published the magazine "Molla Nasraddin" at a level that could be read or familiarized with the majority of people. It is no coincidence that, using the opportunities of great artists, this magazine published pictures and caricatures on the same scale as the author" (2).

The national press can achieve greater results in the unity of history and modernity. That's why he paid special attention to this issue both during the first and second periods of the leadership of Azerbaijan. He took consistent and systematic measures for the development of mass media, and treated the press and journalists with special sensitivity. In the 70s and 80s of the last century, the relative reduction of ideological pressure on the press, the fact that newspapers and magazines boldly shed light on the flaws in society were due to Haydar Aliyev's decisive position.

Even during the period of independence, the mentioned direction was the main line for Haydar Aliyev. His deep familiarity with the press and journalism created great opportunities for defining a strategic course in this field. In this regard, the decree he signed in 1998 "On additional measures in the field of ensuring freedom of speech, opinion and information in the Republic of Azerbaijan" is considered an important event in the history of the press. The main department protecting state secrets in the press and other mass media was abolished by the decree that determined the main directions of the state policy regarding the press (4, p. 32).

The law "On mass media" adopted at the end of 1999 signaled the deepening of the strategic course of state policy regarding the press. The document paved the way for the elimination of a number of bureaucratic obstacles that hindered the development of the press. State registration was canceled and the rules for establishing new media outlets were simplified. In March 2000, by the Supreme Leader's decree, the program of measures to improve the material and technical condition of mass media in 2000-2001 was approved. The Ministry of Press and Information was abolished, the National Press, Television and Internet Council was established.

Haydar Aliyev paid special attention to the development of television and radio in addition to the written press. In July 1996, the opening of a new TV tower in Baku and the participation of the Great Leader in person at the ceremony revealed promising goals in the field of television and radio. In 1981, the construction of the tele tower started at the initiative of Haydar Aliyev, but was later left unfinished due to known reasons. The television tower, which became an event in the life of the country, also became one of the architectural symbols of the capital Baku. The national leader, who valued television and radio as an indispensable tool in human history, also treated journalists and employees working in this field with special care.

The great leader said: "The past of Azerbaijan television is also worthy of high appreciation. However, the tasks in the future will be more important, important and honorable. Therefore, I hope that you will continue to work. If you haven't left this art for 40 years, it won't be possible to leave you after that" (3).

Haydar Aliyev, who said that no one can imagine his life without television, called it the most mass media. He highly valued his role in the development of the country's life, economy, culture, science, social and political processes. It was because of this that he preferred television more in his direct contact with the people.

At the solemn anniversary evening of the 40th anniversary of the television in the Republic Palace, the Great leader said that there are bigger tasks ahead and he believed that these tasks will be fulfilled properly. "40 years is not a short period of time.

During 40 years, Azerbaijan television has achieved great achievements. However, the great future of Azerbaijani television lies ahead. As the independent Republic of Azerbaijan develops and strengthens, as the economy of Azerbaijan develops, and the well-being of the citizens of Azerbaijan improves, the capabilities of Azerbaijan television will increase, and Azerbaijan television will develop even more. However, Azerbaijani television should be at the forefront of this process, Azerbaijani television should be a very necessary tool for conducting these processes, and I hope that it will be so" (3).

Haydar Aliyev had a very friendly relationship with journalists. He appreciated the successes and was sensitive to the problems he raised. The great leader, who said, "I want to be friends with you - journalists," acted as a supporter of sincerity in friendship. In 2002, he was presented with the "Friend of Journalists" award by the "Ruh" Journalists Protection Committee as a clear example of this friendship and an unusual event.

The great leader was a great friend of journalists and a patron of the Azerbaijani press. In our most recent history, his invaluable services in the formation of a free and independent press will be remembered from time to time. Thanks to his tireless work, a democratic, legal and secular state was established in Azerbaijan. The state where freedom of speech, opinion and press was guaranteed. That state created important conditions for comprehensive activity of mass media. The state that, based on historical traditions, shed light on today's journalism and national press.

Today, President Ilham Aliyev has successfully continued the policies and traditions of Haydar Aliyev in the state-press relations, creating normal conditions for the press in Azerbaijan, ensuring and increasing its influence on social life, and its role in the democratization processes, and taking appropriate measures in order to fully realize the right of citizens and journalists to receive information. set specific demands before the institutions.

Thanks to the attention and care of the head of the country, in the age of globalization and information, the cases of compliance with the principles of transparency as well as professionalism in the activities of all state bodies, and effective measures for the activation of their relations with the public have expanded. At the government level, state institutions are tasked with establishing normal, business relations with the mass media, respecting the rights of journalists to receive information, and fully cooperating with the media. In addition, it is declared that the state is interested in strengthening the independence, material base, and financial security of the press, raising the professional level and reputation of journalists, and concrete measures are being taken for this.

Now the representatives of the mass media proudly say that thanks to the struggle and determination of the national leader Haydar Aliyev, the process of democratic, legal and secular state building is being successfully implemented in our country. "In our country, the requirements of political pluralism are followed without hesitation. Ensuring freedom of speech, opinion and belief, comprehensive development of mass media, creation of necessary conditions for their free activity are among the important tasks facing me as the head of state of Azerbaijan" (1) said National leader Haydar Aliyev, providing irreplaceable services in the development of our national press, and solving the problems in the relevant field. eliminated in a timely manner.

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- 3. Haydar Aliyev's speech at the meeting with the employees of the television on the occasion of the 40th anniversary of Azerbaijan National Television. Baku city, February 17, 1999.*
- 4. Haydar Aliyev and the national press. Baku, 2003.*

A BRIEF LOOK AT THE HISTORY OF THE DEVELOPMENT OF THE AZERBAIJANI PRESS**Gurbanli Gurban Mammad**

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Abstract

The press in itself is a mirror of society, a mirror of social consciousness and spirituality. In this regard, from the first pages of the history of the national press of Azerbaijan, it has fulfilled a responsible mission as a carrier, active propagandist and protector of our national and moral values. Today, in Azerbaijan, which is progressing confidently through independence and comprehensively developing, serious steps are being taken to ensure freedom of speech and press, and a number of successful projects related to the development of this field are being implemented. Speech and press are considered as an indicator of the democratic development of the society and the state. The rich development path of the Azerbaijani national press is an important part of the history of our public opinion. Our national press continued the line of enlightenment, innovation, and modern cultural thinking that started with "Akinchi" and played an exceptional role in the national self-awareness of our people and in the process of national awakening.

The article provides information about the role and importance of the press in the social, political, and economic life of the country, the society, the press history of Azerbaijan is examined and interpreted in the form of stages. In the article, the "Akinchi" newspaper, which has an irreplaceable place in the history of the press of Azerbaijan and is considered the beginning of the history of the press, published in its native language, and the "Fuyuzat" newspaper, which played an important role in the development of the enlightenment and national awakening movement, criticized the colonial policy in the Muslim world and the Middle East, and the freedom preacher "Molla Nasreddin" magazine has been reflected.

Keywords: *press, national, newspaper, magazine, free*

It is known that the press plays an important role in informing, educating the society and forming public opinion. It is also considered as the "fourth estate" in democratic societies, that is, it performs the function of keeping the government and other power centers under control and informing the public about it. One of the main functions of the press is to inform society about local and international events, innovations and changes. This is done through news, articles, reports and documentaries. The press is one of the main means of improving political culture by providing balanced, objective, unbiased and complete information about various aspects of the political life of the society. According to national leader Heydar Aliyev, the press is a powerful tool that promotes political development. It is rightly noted in the sources of the history of the press that "Since the press was created, the desire of each individual to express himself separately has been the main essence of the struggle of humanity for democratic ideals for centuries. When establishing business and economic relations between states, the values they have are examined first. National and moral values of the country are evaluated before material values. Because material values are possible only if there are national and moral values with rich traditions" (3).

Throughout the centuries, struggles for the creation of intangible and spiritual values have been fought in Azerbaijan. The role of the national press of Azerbaijan in the socio-political and cultural life of the country is great and irreplaceable. The history of the national press of Azerbaijan has passed a rich and interesting path of development. The press has played an important role in the social, political and cultural life of the country in different periods in Azerbaijan. The development stages of the press, especially in the 20th century and during the period of independence, were closely related to various political and social changes. Let's take a look at the history of press development in Azerbaijan by stages:

The rapid development of Baku, which was the central city of Azerbaijan during the period of Tsarist Russia, makes the need to create a national press here urgent. Educator Hasan Bey Zardabi, who thinks that there is a need for a newspaper in his native language, appeals to the government and after a long effort succeeds in publishing the newspaper. Thus, the press history of Azerbaijan is considered to have begun with the "Akinchi" newspaper, created in 1875 by the prominent educator and publicist Hasan Bey Zardabi. The day when the first issue of the newspaper was published is celebrated as National Press and Journalism Day in modern Azerbaijan. On July 22, 2024, the 149th year of the national press in Azerbaijan will be completed. "Akinchi" is known as the first Azerbaijani newspaper and is of great importance in the history of the press. The main goal of the newspaper was to educate the people of Azerbaijan and raise their cultural and scientific level. The newspaper presented information and articles on the social, political and economic problems of that time. The language of "Akinchi" newspaper was simple and clear, which ensured that it was understood by a wide readership. In Azerbaijan, he played an important role in the development of enlightenment, artistic thinking, and the activities of new writers and intellectuals. The newspaper promoted women's freedom, women's education, and made sharp speeches against ignorance, superstition, and religious superstition. The most important thing was that these speeches in front of a large public were in the Azerbaijani language. It was no coincidence that the name of the newspaper was "Akinchi". There was a great symbolic meaning under that name. The main goal was to sow the seeds of science, education, culture in the hearts and minds of fellow citizens. In other words, one type was to play the role of a field for the enlightened farmer. Articles on agriculture, education, medicine, culture and other topics were published in the newspaper. Also, issues important for the welfare of the people were discussed here. This newspaper, which was published in the native language, caused an echo throughout the Caucasus. "Akinchi" newspaper was published for only two years (1875-1877). However, although it was for a short time, it played an important role in laying the foundation of the national press of Azerbaijan and today it has great historical importance. It is a fact that "Akinchi" newspaper During the period of its activity, it served the purpose of educating the people with merit. At the end of the 9th century, the newspapers "Ziya" (1879), "Kashkül" (1880), and "Kaspi" (80-90s) were published" (4).

"Fuyuzat" magazine was one of the other publications that played an important role in the development of the national press in Azerbaijan, and in the development of the enlightenment and national awakening movement. The journal was published on November 1, 1906, under the chief editorship of Ali Bey Huseynzade and financial resources of Haji Zeynalabdin Taghiyev. The purpose of the magazine was to promote the development of national consciousness and culture, as well as to spread the ideas of the Enlightenment. "Fuyuzat" magazine served as a platform to develop the national awakening, culture and literature of the Azerbaijani people. In addition to the Fuyuzat school of journalism, "Fuyuzat" magazine played an important role in creating the idea of independent statehood and constitutional free civil society in Azerbaijan. The language of the magazine was Azerbaijani Turkish. The style of the articles was scientific, journalistic and sometimes literary. "Fuyuzat" magazine covered many topics, including literature, history, linguistics, philosophy, medicine and education. The magazine also paid attention to the issues of protection and development of the national-cultural heritage. "Fuyuzat" magazine operated from 1906 to 1911.

This magazine, as one of the most important press agencies of its time, made a great contribution to the cultural and national development of the Azerbaijani people. The activity of the magazine has left a deep mark on the history of the press and literature of Azerbaijan. One of the most interesting newspapers of that time was "Molla Nasreddin" magazine. The founder and editor of the magazine was a great satirist, publicist, and writer Jalil Mammadguluzade. In 1906, the first issue was published in Tbilisi. The only satirical magazine with color and pictures in the Middle East and the Muslim world for that year was published once a week in the Azerbaijani language. The main goal of the publication of the magazine was to bring to attention the shortcomings in the society, to develop the social and political consciousness of the people, and to join the ranks of the most cultured nations. The magazine criticized the colonial policy and supported the struggle of the Muslim people for freedom. Each issue of this magazine, which featured color cartoons, consisted of 8 pages.

The importance of the first satirical magazine published in the Azerbaijani language in the history of printing is irreplaceable. During the 25 years of its publication, its field of activity gave impetus to the creation of many such magazines. During the years 1906-1921, 800 issues of the magazine were published.

During the period of the Azerbaijan Democratic Republic (ADR), the activity of the press constitutes one of the important stages in the history of the press of Azerbaijan. After the ADR was announced on

May 28, 1918, the conditions for press freedom and the development of democratic principles were created.

During this period, several important press organizations were active:

1. **"Azerbaijan" newspaper:** This newspaper, the official organ of the ADR, aimed to convey the official position and decisions of the government to the people. The newspaper contained information about the activities of the government, legislation, economic and cultural innovations.

2. **"Achiğ Söz" newspaper:** This newspaper operated as an independent press and mainly covered political issues as well as the events taking place in the country. The social and political situation of the time, economic and cultural events were widely covered in the newspaper.

3. **"İstiqlal" newspaper:** This newspaper, the press organ of the Azerbaijan Democratic Party, promoted the ideas of independence, the struggle for national unity and freedom.

Freedom of the press and pluralism of opinion were ensured during the ADR period. An appropriate legislative framework was created for the development of the press and conditions were created for the activities of journalists. During this period, the press played an important role in strengthening the independence of the country, protecting national and moral values and educating the people.

The press also acted as a mediator in conveying the people's views and aspirations to the government. During the period of ADR, the activities of the press contributed to the recognition of the independence of Azerbaijan and the development of the country both in the local and international world.

During the SSR, the Azerbaijani press operated under strict control. During this period, the main function of the press was to propagate the Soviet ideology and policy. Journalists and media outlets faced censorship and were forced to write within the framework set by the state. However, the press had certain positive aspects. For example, it contributed to increasing the level of literacy and public education. Also, in a certain sense, it supported the development of national culture and literature.

The main task of the press during this period was also to show the achievements and progress of the socialist society of the Soviet Union, and to promote the behavior of the population in accordance with the socialist principles. Therefore, the press played an important role in the formation of society and the spread of the ideology of the state.

Some of the main media outlets operating in Azerbaijan during the USSR were:

1. **"Communist" newspaper:** This newspaper, which is the official organ of the Central Committee of the Communist Party of Azerbaijan, propagated the Soviet ideology and communicated the decisions and policies of the party to the masses. Economic, social and cultural topics were also widely covered in the newspaper.

2. **"Baku" newspaper:** This newspaper mainly provided information about events, economy, culture and social problems in Baku city and its surroundings.

3. **"Literature and Art" magazine:** This magazine was devoted to literary and cultural topics. Articles on Soviet literature, art and culture were published here.

4. **"Azerbaijan" magazine:** This magazine was dedicated to literary, scientific and cultural topics. In accordance with the requirements of the Soviet era, Azerbaijani literature and culture were widely covered in the magazine.

Since the main purpose of the press during the USSR was to promote Soviet ideology and politics, there was no room for free journalism and independent opinions. Press agencies were kept under strict control by the censors, the publication of any information that did not correspond to the interests of the state was prohibited.

During the years of independence, the press of Azerbaijan went through important stages of development and played an important role in the social, political and cultural life of the country. After the restoration of independence in 1991, the Azerbaijani press faced many changes, a number of legal and institutional reforms were implemented in order to be able to operate freely and independently.

1992 Law on Press and Other Mass Media: This law was enacted to ensure freedom of the press and to eliminate censorship of the press.

Creation of new newspapers and magazines: In the first years of independence, many independent newspapers and magazines such as "Azadlig", "Yeni Musavat", "525th newspaper", "Zerkalo" were founded. These media outlets have become important platforms to cover the happenings in the country and present different points of view.

The creation and development of a free press in Azerbaijan has been a long and complex process. The press, which faced difficulties at various times throughout history, gained greater freedom during the years of independence and continued to play an important role in the development of society. In the

first years, there were various pressures on the free press, including arrests of journalists and closing of newspapers. The emerging media outlets faced financial difficulties, which prevented them from continuing their activities.

In the 2000s, some legislative changes took place in the Azerbaijani press. These changes brought some rules that limited the freedom of the press. However, during this period, some independent press organizations continued their activities and published critical articles. Azerbaijan also adheres to international normative acts and recommendations of organizations. Among the international organizations operating in this field, the Council of Europe, OSCE and UN play an important role. These laws, adopted with the aim of ensuring freedom of the press in Azerbaijan, support the development of a free and independent press in the country and are aimed at protecting the rights of journalists. However, there are some challenges and limitations in the field of press freedom, and these issues are constantly monitored and discussed by international organizations and local non-governmental organizations. Freedom of the press is one of the basic principles of democratic societies. This principle envisages freedom of activities of journalists and mass media, freedom from censorship and other restrictions. When freedom of the press is guaranteed, society is better informed and democratic processes are more transparent.

In those years, new television and radio channels began to operate. The Law "On Television and Radio Broadcasting" adopted in 2002 regulated the legal and ethical rules of television and radio broadcasting.

With the rise of the internet in the 2010s and beyond, online news sites, blogs, and social media platforms became widespread. These platforms allowed information to be delivered faster and to a wider audience.

Today, the national press in independent Azerbaijan is trying to find its way, benefiting from the experiences of the past and using the possibilities of modern technologies. Despite the challenges faced in the field of press freedom, journalists and media organizations continue to play an important role in the country's social and political life.

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Jurisprudence

PROBLEMS OF FORCED MIGRATION

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Abstract

The article is devoted to the study of problems of forced migration. Forced migrants remain unprotected in their countries of arrival and, due to violations of migration laws, are considered violators and criminals, on par with the organizers of illegal migration. International instruments provide for individual provisions on the protection of the rights of forced migrants, but there is no comprehensive document on the protection of this category of migrants. The author believes that the adoption of a common document on forced migration and the definition of the status and means of protection of these migrants meets the requirements of respect for human rights under all circumstances. The adoption of these documents does not mean the legalization of all types of forced migration, but rather strengthens the humanization policy towards forced migrants.

Keywords: *forced migration, economic migrants. conflict-induced displacement migration of rural youth, illegal migration*

Conflicts, political upheavals, violence and natural disasters, as well as climate change, are also resulting in an increase in the number of forced migrants. The reasons for forced migration are the use of violence or persecution or the existence of a real possibility of being subjected to violence or persecution, as well as circumstances of an economic, natural, man-made or other nature.

According to experts, 2015 has been called the year of the European migration crisis [4]. The main flow of refugees to Europe comes from Africa, the Middle East and South Asia. Most often, arriving migrants do not have sufficient integrative resources. The search for work, housing, access to basic social services and adequate health insurance for them is accompanied by the need for legal determination of status in the legal space of the host state.

Based on the reasons for forced migration, the following types are determined.

1. forced economic migrants move voluntarily in search of better economic opportunities and a different way of life. These migrants move legally and illegally. Legalization of migration requires many documents, goes through certain procedures, the conditions depend on the receiving party. Migrants who cannot afford expensive, low-risk smuggling options are forced to use cheap, high-risk routes. Therefore, due to the difficulty or sometimes impossibility of legal movement, migrants choose illegal options for movement, using the services of organizers of illegal migrant smuggling at one or another section of their route. For some economic migrants, the results of migration include receiving a higher income than in their home country, which allows them to support their family in their home country, new professional knowledge and skills, getting to know the world, and expanding their horizons. For the host country, it is to satisfy the needs of the economy and non-production sector for cheap labor, including filling vacancies in hard, dirty, harmful, low-prestige jobs. Attracting migrant workers allows for the development of production, an increase in the gross domestic product, and the high competitiveness of enterprises due to the comparatively lower cost of labor. A migrant sometimes gives more to the host country than he receives in social benefits.

Migrants are a potential resource for agriculture and rural development as well as poverty reduction in their areas of origin. However, distress migration of rural youth can result in the loss of an important share of the most vital and dynamic part of the workforce, with obvious consequences for agricultural productivity. This infographic describes the root causes of rural youth distress migration and how out-migration and remittances can contribute to rural development, poverty reduction and food security [1].

2. The second group are refugees and asylum seekers who are forced to flee conflict, repression or persecution.

3. Conflict-induced displacement. This type is characterized by movements of people forced to leave their homes for one or more of the following reasons, when government authorities are unable or

unwilling to protect them: armed conflict, including civil war; mass violence; persecution on the grounds of nationality, race, religion or membership in a social group, or political opinion of the victim of persecution. As of January 2024, 6.5 million Ukrainians are seeking asylum abroad, of which 4.2 million are in the EU (possibly less) and about 5 million remain internally displaced persons – a total of 10.5 million. In Ukraine, 17.6 million people need humanitarian aid, although the economy is slowly recovering. The overall situation for Ukrainians both inside and outside the country is characterized by a protracted war and great uncertainty regarding its outcome, their legal status in host countries and the prospects for integration [3].

4. Disaster-induced displacement. This type is characterized by the movement of people as a result of natural (volcanic eruption, earthquake, flood, drought, etc.) and/or human-induced (man-made incidents, radiation, etc.) disasters.

During their journey, forced migrants often face life-threatening circumstances and, upon arrival at their destination, exploitation and abuse. They may become victims of extortion, beatings or rape, which in turn is associated with potential public health threats such as the spread of drug addiction and HIV/AIDS.

Forced migration also creates problems for the receiving party. In places with a high concentration of migrants, there are cases of increased social and national tension, increased competition in the labor markets, and a decrease in wages for local workers. The massive recruitment of low-skilled foreign labor may hinder the process of technical modernization of the economy.

For countries of origin, the problem of the departure of highly qualified personnel (the so-called "brain drain") is relevant, leading to a shortage of specialists in various fields, which affects the economic development of the "giving" states, medical care for the population, etc.

The Migration Code shall regulate the relations in the sphere of exit of citizens of the Republic of Azerbaijan from the country, their entry to the country, exit of foreigners and stateless persons from the Republic of Azerbaijan, their entry to the Republic of Azerbaijan and temporary stay in the Republic of Azerbaijan, issuance of permits for their temporary and permanent residence, their registration, rights and duties of participants of the migration process, labor migration, as well as state control over migration and fight against illegal migration (Article 4.1).

Large movements of people shape human mobility and spatial experiences, pushing immigrant-receiving countries to establish migration regimes at national and international levels on the grounds that they create instability.

It is an undeniable fact that illegal migration using illegal methods lays the foundation for the crime of smuggling. Mostly economically developed countries become part of the migration circulation as a country of origin, transit and destination.

Illegal migration is perceived as a threat to the sovereignty of states. Illegal migration means illegal exit from the country of origin and illegal entry from the transit country or the destination country. However, even if they enter legally, people who have failed to obtain a residence permit or have resorted to illegal work methods are considered illegal migration.

According to Article 318-1 of the Criminal Code of the Republic of Azerbaijan organization of illegal migration is the organization of illegal arrival of the foreigner or the stateless person to the Azerbaijani Republic, illegal stay of the foreigner or the stateless person in the territory of the Azerbaijani Republic, illegal transit passing of the foreigner or the stateless person through the territory of the Azerbaijani Republic or illegal departure of any person from the Azerbaijani Republic. These organizations aim to transport people who, for various reasons, are forced to leave their country to countries with better opportunities. Criminal organizations that profit financially from those wishing to migrate by using illegal means rather than in accordance with the law to affect that movement constitute the crime of immigrant smuggling. Immigrant smugglers find alternative routes using different methods and equipment, depending on the measure's countries take to facilitate border crossings or prevent illegal migration and immigrant smuggling.

Today, immigrant smuggling serves as a source of income from which large profits are generated. There is a growing number of businesses involved in immigrant smuggling on the international scene. Unfortunately, the measures taken have not been enough to stop immigrant smuggling. The immigrant smugglers, like a living organism, are reorganized in accordance with the new measures. Thus, while continuing to exist, they increase the illegal income they receive from illegal immigrants who are subject to immigrant smuggling. On the one hand, immigrant smugglers create a qualitatively stronger and more complex structure, and on the other hand, they gain more financial benefit due to increased costs.

National authorities may be unable to identify and assist smuggled migrants because they do not view migrants as victims in need of assistance, but as illegal migrants who have committed a "crime".

Responses in destination countries that focus solely on addressing "irregular migration" without addressing the criminal activity involved will not stop the smuggling of migrants. Forced migrants must be provided with adequate protection and assistance to ensure that criminals are brought to justice.

Returning detained migrants to their place of origin allows criminals to return to smuggling. Meanwhile, prosecution of migrant smugglers will be ineffective unless those who may testify against them are given a chance to participate in the process of bringing the criminals to justice.

International instruments contain provisions for the protection of forced migrants. For example, the Article 4 of the IV Geneva Convention relative to the protection of civilian persons in time of war of 12 August 1949: "Persons protected by the Convention are those who at a given moment and, in any manner, whatsoever, find themselves, in case of a conflict or occupation, in the hands of persons a Party to the conflict or Occupying Power of which they are not nationals". Protected persons are defined as certain categories of civilians who are granted special rights due to their greater vulnerability during armed conflicts, compared to other individuals. The Article 13 of the Convention says that, the provisions of Part II cover the whole of the populations of the countries in conflict, without any adverse distinction based, in particular, on race, nationality, religion or political opinion, and are intended to alleviate the sufferings caused by war. According to Part 4 of Article 45 of the IV Geneva Convention In no circumstances shall a protected person be transferred to a country where he or she may have reason to fear persecution for his or her political opinions or religious beliefs. Part 2 of Article 70 of the Convention guarantees protection against deportation from the territory of the occupying power to nationals of the occupying power who, before the war, had found refuge in the occupied territory.

Article 44 of the IV Geneva Convention of 1949 provides for the specific application of control measures by a belligerent party in relation to refugees as persons who do not enjoy the protection of any government. The humanitarian approach to the conditions of stay of refugees in host States in situations of armed conflict also means that warring parties do not have the right to arbitrarily deprive persons who already have refugee status.

We believe that forced migrants should be provided with appropriate protection. The position of the International Organization for Migration (IOM) is that receiving states are obliged to assess the real concerns of the person in the context of the general human rights situation in the state of departure and the specific, individual circumstances of the flight. At the same time, the principle of non-extradition and non-refoulement should be applied to all forced migrants, regardless of whether they have acquired refugee status [6].

"Mandatory quotas" for the reception of forced migrants within the EU were proposed. However, the EU summit held on 28-29 June 2018 did not adopt a document on such a quota and left the issue open, in the sense that states voluntarily accept forced migrants, create filtration centers, etc. [2].

We believe that a general international document on forced migrants should not be accepted, and the reasons for such compulsion should be clarified, each such person should be treated individually. In any case, the deception of treating them as criminals should be abandoned. The policy of treating all forced illegal migrants as criminals violates the human rights of these persons and requires a more humane treatment.

Determining the status of forced migrants and providing for their protection in international law stems from the principle of respecting the human rights of this group of persons. However, the international protection of forced migrants is not condoning the illegal actions of these persons, but humanizing the policy regarding forced migrants.

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Mathematical sciences

IT FOLLOWS FROM THE SPECIAL THEORY OF RELATIVITY THAT THE INVISIBLE AFTERLIFE WORLD, WHERE GODS AND SOULS OF THE DEAD DWELL, ACTUALLY EXISTS¹

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Abstract

Rightly recognized as a great scientific achievement of physics of the XX century, the special theory of relativity (SRT), however, turned out to be incorrect, because at that time there was no experimental knowledge necessary for its creation, which had to be replaced by postulates. But not everything was guessed. And this is quite natural. All new theories are always subsequently refined and corrected. However, none of the many subsequent corrections and experimental refutations of SRT was not accounted for and still is not taken into account. As a result, SRT has remained uncorrected.

It is in this form that SRT is now studied in all physics textbooks, used in the educational process even in the most prestigious universities.

However, a corrected version of SRT has already been created, in which instead of the incorrect principle of non-exceeding the speed of light, the experimentally proven principle of physical reality of imaginary numbers, which refuted this postulate, is used. The corrected version of SRT has allowed to solve many unsolved in the noncorrected version of SRT problems. And from relativistic formulas of the corrected version of SRT follows the existence of numerous mutually invisible parallel universes. In the corrected version of SRT also it is explained that these invisible universes about which it is spoken in all religions, and are invisible afterlife world in which Gods and souls of dead dwell.

Keywords: imaginary numbers; complex numbers, hypercomplex numbers, special theory of relativity, invisible parallel universes and antiuniverses, Multiverse, Hyperverse, Gods, invisible afterlife world, souls of dead.

Introduction

Created in the twentieth century by the works of Joseph Larmor [1], Nobel Prize winner Hendrik Anton Lorenz [2], Jules Henri Poincaré [3], Nobel Prize winner Albert Einstein [4] and other outstanding scientists, the special theory of relativity (SRT) [5]-[7] because of its use of the principle of relativity is rightly considered a very great scientific achievement. However, in the XXI century it was proved that this theory is incorrect, because:

- the relativistic formulas obtained in it are not correct;
- they've been incorrectly explained using the wrong principle of light speed non-exceedance;
- from them were made incorrect conclusions about physical unreality of discovered 400 years before creation of SRT by Scipione Del Ferro, Niccolo Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli¹ [8] imaginary numbers and the existence in nature of our only visible universe, in which all measurements are carried out only using real numbers.

As can be seen from the graphs (see Fig. 1a,b,c) of relativistic formulas of this version of SRT

$$m = m_0 / \sqrt{1 - (\frac{v}{c})^2} \quad (1)$$

$$\Delta t = \Delta t_0 \sqrt{1 - (\frac{v}{c})^2} \quad (2)$$

¹ And perhaps even before them imaginary numbers were discovered by Paolo Valmes [9], who was burned alive at the stake by the Spanish Inquisitor Tomas de Torquemada.

$$l = l_0 \sqrt{1 - \left(\frac{v}{c}\right)^2} \quad (3)$$

where m_0 is the rest mass of the moving body;

m - relativistic mass of the moving body;

Δt_0 - rest time of a moving body;

Δt - relativistic time of a moving body;

l_0 - rest length of a moving body;

l - relativistic length of a moving body;

v is the velocity of the moving body;

c - speed of light;

in the range of pre-light speeds $v < c$ all these quantities take values measured by real numbers, in the range of superluminal speeds $v > c$ take values measured by imaginary numbers, and at the speed equal to the speed of light $v = c$, the function $m(v)$ has a gap. Therefore, in the pre-light speed range formulas (1)-(3) have been explained. And in the superluminal range of speeds the results of calculations in the form of imaginary numbers the creators of SRT could not explain. And in modern textbooks of physics they are not explained till now. After all, what is 5 meters, 6 grams and 7 seconds is clear to everyone, but what is $5i$ meters, $6i$ grams and $7i$ seconds, where $i = \sqrt{-1}$, and now no one can explain.

Moreover, as can be seen from the graphs of formulas (1)-(3), in the superluminal range of velocities $v > c$ (see Fig. 1a,b,c) these formulas correspond to physically unstable processes that cannot exist in nature at all. Indeed, let us assume that the material body in the range $v > c$ for some reason began to move faster. Then its mass according to the function graph $m(v)$ in Fig. 1a will decrease. But because of this lighter body will move faster. This, according to the graph of the function, will lead to a further decrease in the mass $m(v)$ of the moving body. And this will again lead to an increase in the velocity v of the material body. And so on. Therefore, in the end this material body with zero mass and infinitely high speed flies to 'nowhere'.

And assuming that the material body on the graph of the function $m(v)$ in the range $v < c$ for some reason began to move slower and reasoning in a similar way, we will come to the conclusion that this material body moving slower and slower, will overcome the point of astrophysical singularity $v = c$ and, being in the range $v < c$ will, stop.

So, at any point in the range $v > c$ on the graph of the function $m(v)$ the ongoing process will indeed be unstable and therefore cannot exist.

And so the fate of SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that the formulas (1)-(3) in the superluminal range of speeds $v > c$ do not need to be explained, since imaginary numbers allegedly do not describe any processes that do not exist in nature.

So the fate of the SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that formulas (1)-(3) in the superluminal range of speeds

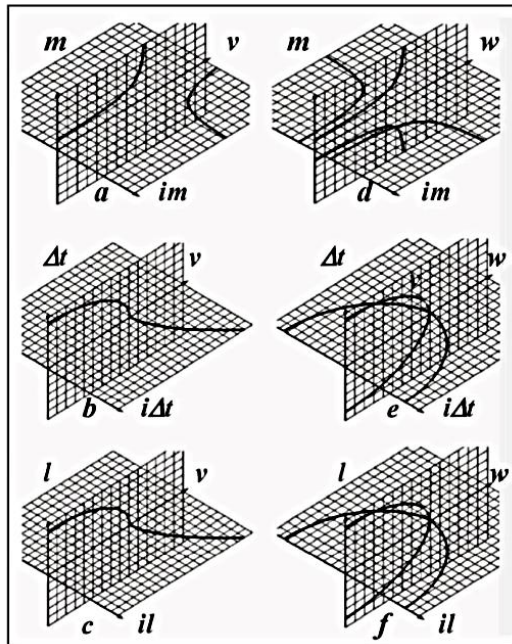


Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ and $l(v)$ corresponding to the existing and the corrected versions of the STR in the subluminal $v < C$ and superluminal $v > C$ ranges

could not be explained, as imaginary numbers no existing in nature processes are allegedly not described. Here in such a form the uncorrected SRT is studied in all textbooks of physics up to now.

Nevertheless, at the initial stage of creation of SRT such variant of its statement was quite acceptable, though it obviously contained, as well as all new theories, some misconceptions. However, at present, when it has been found out the fallacy of some assumptions used by its authors a hundred years ago, which are further explained, ignoring these circumstances is no longer justified. All the more that now such a corrected interpretation of SRT already hinders the development of the whole science.

Physical reality of imaginary numbers

But there are other sciences besides physics. Including electrical engineering and radio engineering created before SRT. And in these sciences the theory of linear electric circuits of alternating current is used, in which the fundamental is the Ohm's law discovered in 1893 in the interpretation of Steinmetz [10]. And a simpler version of this law for DC electric circuits [11], [12], studied now in school physics textbooks, was discovered by Ohm himself in 1826, when no electrical measuring device existed yet. About the physics of that time, the professor of the Imperial Moscow University, Alexander Grigorievich Stoletov wrote: "...physics especially seduced natural philosophers. What a grateful theme for the most unbridled fantasies were electrical phenomena... Beautiful and vague deductions were in the foreground: painstaking work of the experimenter, precise mathematical analysis were not in honor; they seemed superfluous and harmful in the study of nature...". Therefore, in 1828 Ohm was dismissed from his job by the Minister of Education for publishing about the law he had discovered. The high-ranking official believed that the use of mathematics and experimental research in natural philosophy was inadmissible.

And Ohm's law as interpreted by Steinmetz is now used daily in practice by millions of electrical and radio engineers all over the world. Thereby, of course, confirming that it is true.

But in SRT the existence of this law is ignored, because from the postulate about the non unexceeded speed of light the conclusion about physical unreality of imaginary numbers is made, which is obligatory not only for physics but also for all other sciences. Including electrical and radio engineering. After all, mathematics is the common language of all exact sciences. Therefore, mathematics cannot be one in physics and another in electrical and radio engineering. And in SRT it is stated (although it is not written anywhere) that Ohm's law as interpreted by Steinmetz is wrong, because it follows from this law that electrical resistances of capacitors and inductors (also called inductance coils) are measured by imaginary numbers, and only resistances of resistors are measured by real numbers. Due to this circumstance imaginary resistances of capacitors and inductors SRT proposes to consider actually imaginary, i.e. physically non-existent.

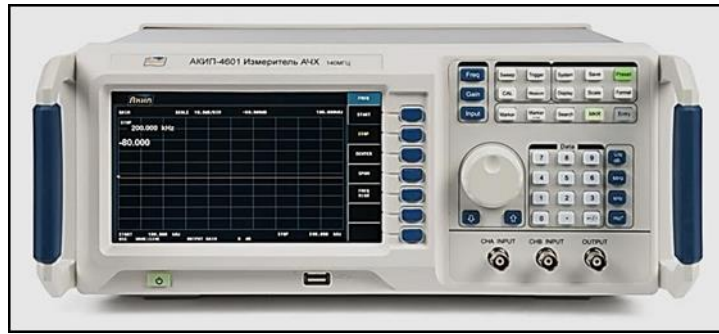


Fig. 2. In any radio-technical laboratory there are devices called frequency response meters, which prove the physical reality of imaginary and complex numbers by their mere existence

Note - the formulation of Ohm's law in Steinmetz's interpretation states that imaginary resistances are measurable. And in fact, any electrical and radio laboratory has been using commercially available devices for measuring imaginary resistances and other imaginary electrical quantities for many decades (Fig. 2)

But everything that can be measured always exists. This is the fundamental position of any science. If people in their activities did not use instruments, and relied on knowledge obtained only from their sensations, then science would not exist. And physicists can't help but know this. And since in electrical and radio engineering the resistances of capacitors and inductors, which someone unsuccessfully called imaginary, are in fact measured by existing devices, then they are not imaginary at all, but the most real physically existing ones.

Nevertheless, in SRT, in accordance with the principle of non-exceeding the speed of light, it is actually asserted that imaginary resistances of capacitors and inductors, since they are called imaginary, should not really exist. Therefore, electrical and radio engineering also should not exist [13]-[32].

In fact they existed even before the creation of SRT by publications of Einstein and Poincaré in 1905. But physicists of that time probably did not know and/or did not understand these sciences. They don't want to understand them now, since the theory of linear AC electric circuits is not taught to physics students.

Nevertheless, since in electrical and radio engineering the used imaginary quantities - resistances, transfer functions, etc. - correspond to real physical entities (since they are measured), it proves in the most indisputable way that the named imaginary numbers contrary to the postulate of SRT about non-exceeding the speed of light not only in electrical and radio engineering, but always and everywhere in all sciences are physically real. And it is time to realize that mathematics cannot be one for Einstein, another for Steinmetz, another for someone else. So imaginary numbers are physically real in all sciences. Textbooks on different sciences (for example, physics textbooks and radio engineering textbooks) should not contradict each other. And it is unethical to teach schoolchildren and students using such textbooks.

There are other experimental proofs of the general scientific principle of the physical reality of imaginary numbers [33]-[44]. And no experiments are never refuted by postulates. And since the following from the postulate about not exceeding the speed of light SRT statement about physical unreality of imaginary numbers turned out to be incorrect, this postulate itself is incorrect. Therefore the generally accepted version of the SRT itself also turned out to be incorrect. There are also other proofs of the incorrectness of the version of SRT [45]-[65] still studied in all physics textbooks

Corrected version of SRT

Since the principle of the physical reality of imaginary numbers has been experimentally proven in the most indisputable way, the relativistic formulas must now be explained for the super-luminal speed range [66]-[73]. But for these relativistic formulas to be explainable, they must first be corrected. To their graphs in the superluminal speed range $v > c$ (Fig. 1a, b, c) were similar to the graphs of the same quantities in the sublight speed range $v < c$, as shown in Fig. 1d,e,f. And for this, it is necessary to introduce the factor i^q into formulas (1)-(3). After which they will take the form

$$m(q) = m_0 i_1^q / \sqrt{1 - (\frac{v}{c} - q)^2} \quad (4)$$

$$\Delta t(q) = \Delta t_0 i_1^q \sqrt{1 - \left(\frac{v}{c} - q\right)^2} \quad (5)$$

$$l(q) = l_0 i_1^q \sqrt{1 - \left(\frac{v}{c} - q\right)^2} \quad (6)$$

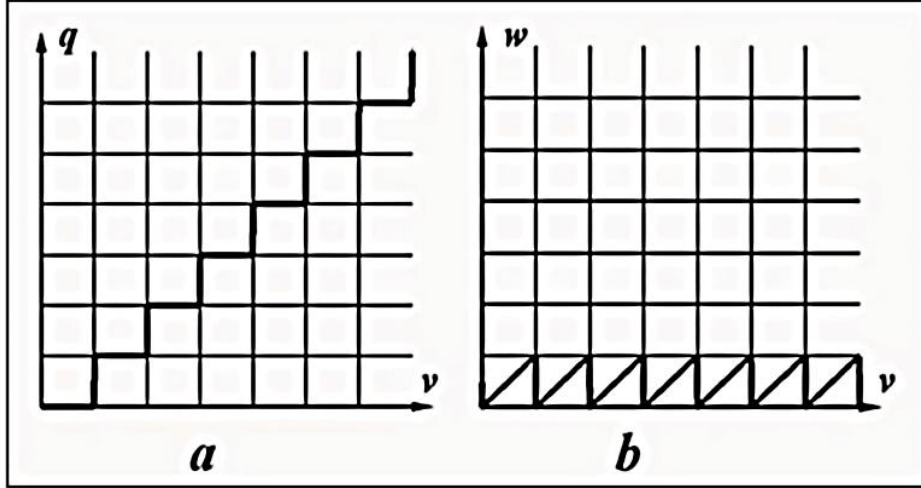


Fig. 3. Graphs of functions $q(v)$ and $w(v)$, illustrating the meaning of the "floor" function of discrete mathematics

where $q(v) = \lfloor v/c \rfloor$ is the "floor" function of discrete mathematics of the argument v/c (its graph is shown in Fig. 3a), which is the fourth spatial dimension;
 $w(v) = v - qc$ is the local velocity for each universe (its graph is shown in Fig. 3b).

Therefore, the function i^q for successive values of $q(v)$ equal to 0, 1, 2, 3, 4, 5, ... takes the values $+1, +i, -1, -i, +1, +i, \dots$. And the value $q(v)=0$ in formulas (1)-(3) for the speed range $v < c$ corresponds to our visible universe, which for definiteness we will call the tardyon universe. The value $q(v)=1$ in the speed range $v > c$ corresponds to the invisible universe, since it is beyond the event horizon. For definiteness, we will call it tachyon. The value $q(v)=2$ will then correspond to an invisible tardyon antiuniverse, the value $q(v)=3$ will correspond to an invisible tachyon antiuniverse, the value $q(v)=4$ will correspond to another (and therefore also invisible) tardyon universe, the value $q(v)=5$ will correspond to another tachyon universe. Etc.

Thus, from the corrected relativistic formulas (4)-(6) it follows that in reality in nature there exists a Multiverse, which contains, in addition to our visible universe, also many other mutually invisible parallel (since they do not intersect) universes², since relative to each other they are all located beyond the event horizon. And such a Multiverse, which we will therefore call hidden, has an opened screw structure (as, for example, in Fig. 4).

² In other dimensions, therefore on Earth invisible

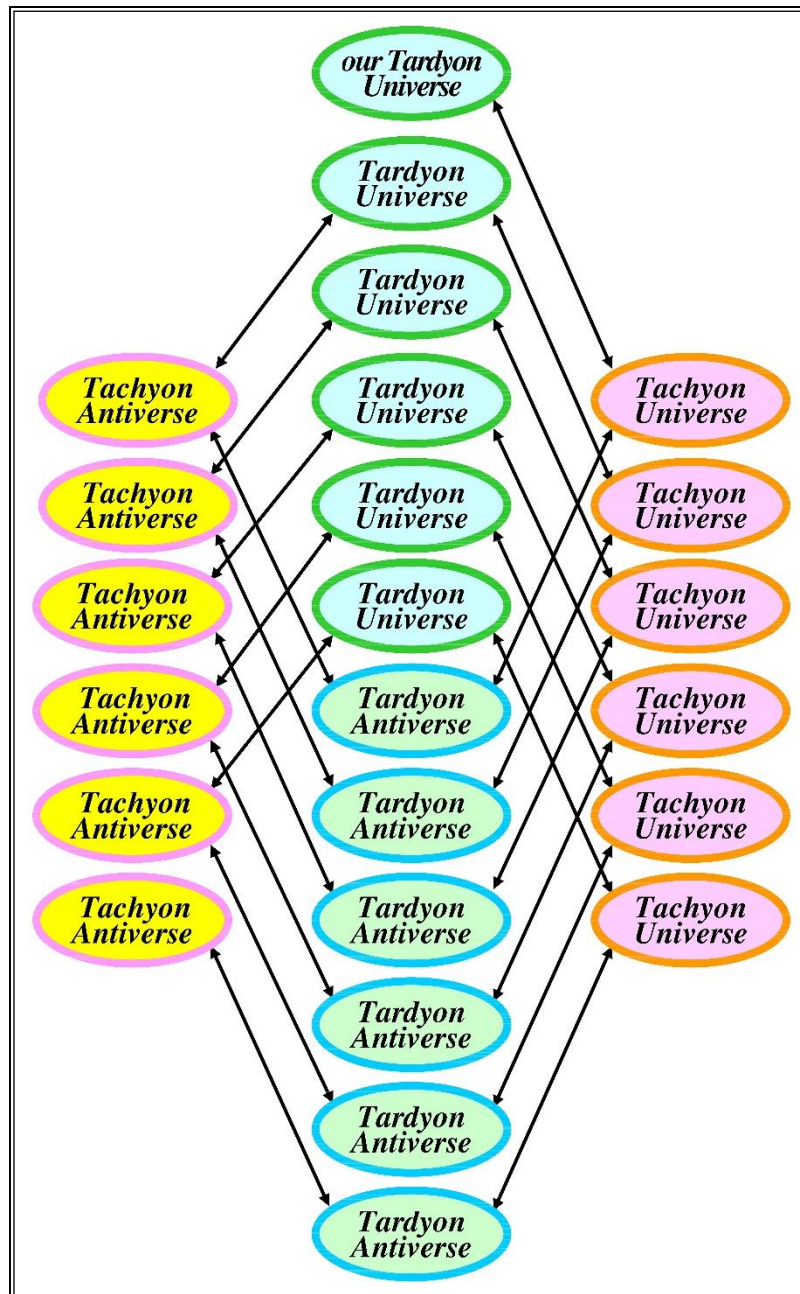


Fig. 4. Structure of the hidden Multiverse corresponding to the principle of physical reality of complex numbers

And in this structure of the hidden Multiverse the distribution of material contents in each three-dimensional parallel universe will be determined by its function $f_q(x,y,z)$, and the value iq is the coordinates of these universes. I.e. the structure of the hidden Multiverse is described by the formula $f_q(x,y,z)+iq$. The same formula can be used to describe, for example, our apartment, since all rooms in it are never visible to us at the same time.

How to calculate the function i^q for non-integer argument values?

But the function i^q which was very convenient and understandable in the presentation of the previous section, is not currently used in the theory of functions of a complex variable. Therefore, it is useful to clarify this situation. The i^q function is not used because it is now known how to calculate it only for integer values of the argument - you just need to multiply by i the original value, equal to one, q times. But in the case of non-integer values of q , this algorithm does not work. That's all.

Nevertheless, this situation is completely solvable. After all, the values $+1, +i, -1, -i$, etc. are the same as the function i^q for integer argument values 0, 1, 2, 3, etc. function $e^{iq\pi/2}$ also accepts in Euler's formula $e^{iq\pi/2} = \cos(q\pi/2) + i\sin(q\pi/2)$, which allows you to calculate its values for non-integer values of the argument. Therefore, it is acceptable to assume that these two formulas i^q and $e^{iq\pi/2}$ are identically equal to each other. And then we get the formula

$$i^q = \cos(q\pi/2) + i\sin(q\pi/2) \quad (7)$$

by which for the function i^q one can find its values for both integer and non-integer values of the argument q .

Thus, the last mathematical operation from algebra, which until now was not feasible in the theory of functions of a complex variable, has now also become feasible.

Analysis of experimental data obtained by the WMAP and Planck spacecraft

In order to obtain more information about the possible structure of the hidden Multiverse and to verify that it is correct, we will analyze the data obtained by the WMAP [74] spacecraft, launched in 2001 by the National Aeronautics and Space Administration (NASA), which operated until 2010, and Planck [75], launched by the European Space Agency (ESA) in 2009, which operated until 2013.

According to the data obtained by the WMAP spacecraft, the entire universe (in fact, the entire hidden Multiverse) consists of 4.6% baryonic matter, 22.4% dark matter, and 73.0% dark energy. And according to more recent data obtained by the Planck spacecraft, the entire universe (again, in fact, the entire hidden Multiverse) consists of 4.9% baryonic matter, 26.8% dark matter, and 68.3% dark energy. As you can see, these results differ little from each other, which proves their truth. But what dark matter and dark energy themselves are has never been explained.

It is for this incomprehensibility that these physical entities were called dark. Therefore, Stephen William Hawking wrote: "The missing link in cosmology is the nature of dark matter and dark energy."

And since it was proven above in the most indisputable way that in nature there is not a monoverse, but a hidden Multiverse, then dark matter and dark energy must somehow be present in it [76]-[80]. Consequently, the structure of the hidden Multiverse discussed above, shown in Fig. 4, must be accordingly corrected.

But how? To do this, we will abandon the assertion of the version of STR presented in textbooks that explanations for the phenomena of dark matter and dark energy must certainly be sought in our visible Universe. And we will look for them in the hidden Multiverse, since its existence has been proven. Let us assume that these phenomena are somehow generated by the very structure of the hidden Multiverse and are caused by the mutual influence of invisible parallel universes on each other. And then it's possible it is quite clear and convincing to explain the hitherto inexplicable main features of these phenomena - their invisibility and undetectability of corpuscular contents:

- dark matter and dark energy are actually not some kind of material physical entities, but just phenomena (presumably a gravitational shadow) generated by the existence, in addition to our visible tardion universe, of other invisible ones parallel universes of the hidden Multiverse;
- moreover, dark matter is a phenomenon generated by the existence of invisible parallel universes of the hidden Multiverse adjacent to our visible universe;
- and dark energy is a phenomenon generated by the existence of the rest, in addition to our visible universe and the invisible universes adjacent to it, the remaining invisible parallel universes of the hidden Multiverse;
- and precisely because dark matter and dark energy are just phenomena, they have no material content, as a result of which they themselves are invisible.

Then it becomes obvious that some unusual material content in dark matter and in dark energy in nature probably does not actually exist. Just as there is no material content in our shadow on a sunny day. Therefore, attempts to detect some subatomic particles of dark matter and dark energy by the ongoing research at the Large Hadron Collider are probably not very promising.

This explanation of these phenomena also makes it possible to clarify the structure of the hidden Multiverse. Indeed, assuming the mass of different invisible parallel universes in the hidden Multiverse with a high degree of accuracy due to the presence between them of a large number of portals that have existed for billions of years is almost identical³, it is possible to determine:

³ according to the law of communicating vessels

• how many parallel universes form the hidden Multiverse. And in accordance with the above data obtained by the WMAP spacecraft, their number is $100\% / 4.6\% = 21.74$. And in accordance with the data obtained by the Planck spacecraft, their number is $100\% / 4.9\% = 20.41$. Consequently, their real number is equal to 20...22 universes. Those in addition to our visible universe, there are also 19...21 invisible universes.

• how many parallel universes are neighboring our universe and give rise to the phenomenon of dark matter. According to data obtained by the WMAP spacecraft, their number is $22.4\% / 4.6\% = 4.87$. And in accordance with the data, received by the Planck spacecraft, their number is $26.8\% / 4.9\% = 5.47$. Therefore, their real number is most likely equal to 5...6 parallel universes.

• how many parallel universes give rise to the phenomenon of dark energy. And in accordance with the data obtained by the WMAP spacecraft, their number is $73.0\% / 4.6\% = 15.87$. And according to data obtained by the Planck spacecraft, their number is $68.3\% / 4.9\% = 13.94$. Consequently, their real number is presumably equal to 14...16 parallel universes.

Corrected version of SRT (continued)

As can be seen, the experimental data obtained by the WMAP and Planck spacecraft did not confirm the above conclusions about the structure of the hidden Multiverse, since our visible universe in this structure should have not two neighboring invisible universes - more precisely, one tachyon universe and one tachyon antiuniverse - but five or six.

Therefore, it is logical to assume that there was some error in the previous reasoning. And this error is that earlier, for the sake of simplicity, we assumed in the hidden Multiverse⁴ the existence of only one additional dimension q and, consequently, its correspondence to physically real complex numbers containing only one imaginary unit. And in order for our universe to be neighbors of six other parallel universes⁵ - three tachyon universes and three tachyon antiuniverses - it is necessary to have three additional dimensions q, r, s , which will determine their position in space. Consequently, the space of such a hidden Multiverse will be six-dimensional (see Fig. 5). And its structure will correspond to quaternions $\sigma + i_1\omega_1 + i_2\omega_2 + i_3\omega_3$, i.e. hypercomplex numbers [81], containing three imaginary units i_1, i_2, i_3 , which are related to each other by the relations

$$i_1^2 = i_2^2 = i_3^2 = -1 \quad (8)$$

$$i_1i_2i_3 = i_2i_3i_1 = i_3i_1i_2 = -1 \quad (9)$$

$$i_1i_3i_2 = i_2i_1i_3 = i_3i_2i_1 = 1 \quad (10)$$

In such a quaternion structure of the hidden Multiverse [82], [83] the distribution of material content in each three-dimensional parallel universe will be determined by some the function $f_{q,r,s}(x, y, z)$ and the quantities i_1q, i_2r, i_3s and are the coordinates of these universes. Those. the structure of the hidden Multiverse is described by the formula $f_{q,r,s}(x, y, z) + i_1q + i_2r + i_3s$. This is exactly what Lisa Randall predicted: "We could be living in a three-dimensional slit of higher dimensional space."

⁴ Just like in the single visible universe in the generally accepted version of STR

⁵ Or less. Then some parallel universes of our hidden Multiverse may be absent and replaced by universes of neighboring Multiverses.

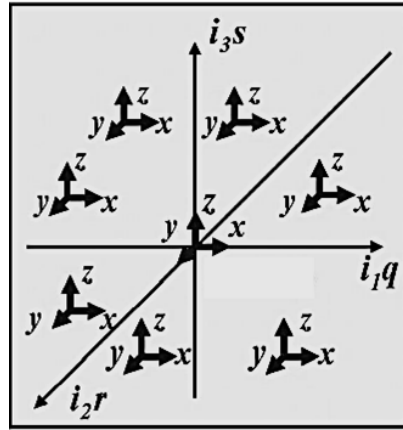


Fig. 5. Six-dimensional space of the hidden Multiverse, where q, r, s are the coordinates of invisible parallel universes, and x, y, z are the coordinates of the matter content in each parallel universe

And therefore the relativistic formulas (4)-(6) must be corrected once again as follows

$$m(q, r, s) = \frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1 - [\frac{v}{c} - (q + r + s)]^2}} \quad (11)$$

$$\Delta t(q, r, s) = \Delta t_0 i_1^q i_2^r i_3^s \sqrt{1 - [\frac{v}{c} - (q + r + s)]^2} \quad (12)$$

$$l(q, r, s) = l_0 i_1^q i_2^r i_3^s \sqrt{1 - [\frac{v}{c} - (q + r + s)]^2} \quad (13)$$

Information about the helical structure of such a hidden Multiverse is contained in formulas (11)-(13). It follows from them that it is possible to move from a tardion universe to a tardion antiuniverse and from a tardion antiuniverse to a tardion universe in different ways, but not in an arbitrary way, but only in such a way (see Fig. 6) that the quantity $i_1^q i_2^r i_3^s$ will successively take on the values $+1, +\oplus + \oplus +, -1, -\oplus - \oplus -, +1, \dots$ etc., where $\oplus$ is the symbol of the logical operation of discrete mathematics 'exclusive OR'. In this case, different trajectories of movement from one universe (or antiuniverse) to another can differ only due to the replacement of some tachyon universes $i_1^q i_2^r i_3^s$ with others and some tachyon antiuniverses $i_1^q i_2^r i_3^s$ with others. Consequently, the tachyon universes $i_1^q i_2^r i_3^s$ in the hidden Multiverse are located parallel to each other. The tachyon antiuniverses $i_1^q i_2^r i_3^s$ for the same reasons are also located parallel to each other. And therefore, in the hidden Multiverse, when moving from any tardyon universe to a tardyon antiuniverse and then to another tardyon universe, parallel universes and anti-universes must alternate in the following sequence – 'tardyon universe', 'one of the tachyon universes', 'tardyon anti-universe', 'one of the tachyon anti-universes', 'tardyon universe', 'one of the tachyon universes', etc.

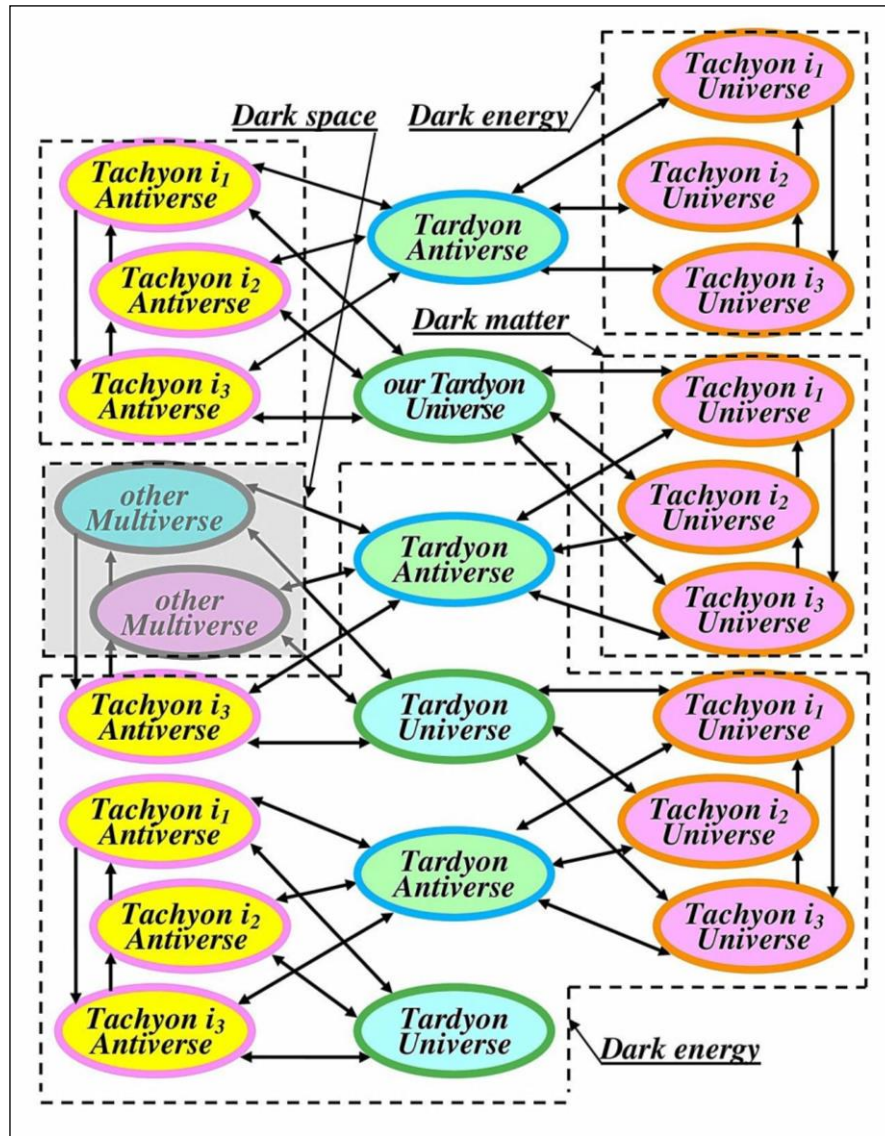


Fig. 6. Possible quaternion structure of the hidden Multiverse containing twenty-two parallel universes, including six invisible universes adjacent to our visible universe

The simplest such quaternion structure of the hidden Multiverse to explain is shown in Fig. 6. However, it is possible that more complex structures exist in nature, formed by the interweaving of many (perhaps even infinitely many) sequences of tardion and tachyon universes and antiuniverses in the hidden Multiverse and located beyond it in the Hyperverses. But we will not consider them, since we do not have any experimentally obtained knowledge for this, and one can assume a great many such hypothetically possible structures.

The difference between the structure shown in Fig. 6 structure from the structure shown in Fig. 4 is the presence in it of several different tachyon universes and antiuniverses corresponding to three imaginary units i_1^q , i_2^r , i_3^s . Another difference is the presence in such a structure of the Multiverse of not only bidirectional portals corresponding to formula (8) and designated by double-sided arrows, but also unidirectional portals⁶, corresponding to formulas (9), (10) and designated by single-sided arrows.

Moreover, naturally, the movement from our tardyon universe to the tardyon antiuniverse through some tachyon universe – for example i_1 – does not necessarily have to proceed further through the

⁶ Due to what circumstances in such portals movement is possible only in one direction - from entrance to exit - it is difficult for us, living in a space in which movement in nature is possible in any direction, even to imagine. And the processes that make such movement possible in nature are yet to be understood. But they are more dangerous for visitors who have fallen into such unidirectional portals than bidirectional portals, because it is impossible to return to one's own universe from them. And while there is one-way travel on escalators in the subway, the subway is not nature,

tachyon antiuniverse $\mathbf{i}_1$. It can proceed further through the tachyon antiuniverses $\mathbf{i}_2$ and $\mathbf{i}_3$. The same reservation applies to the situation if the movement from the tardyon universe to the tardyon antiuniverse begins through the tachyon universes $\mathbf{i}_2$ or $\mathbf{i}_3$.

In Fig. 6 all these transitions are shown. Moreover, since the data obtained by the WMAP and Planck spacecraft correspond to the open spring-like structures of our hidden Multiverse, united through the corresponding portals with other Multiverses, then all together they form the Hyperverse.

And there may be many other similar structures. And to clarify which of them really exists in our hidden Multiverse, additional experimental research is naturally necessary.

Physical reality of invisible universes

But this is not the main thing for us now.

The main thing is to prove experimentally, in an indisputable way, that there is a Multiverse in nature, and not the only visible universe in nature, as it is asserted not only in the generally recognized version of SRT, but also in string theory and in quantum physics.

And for this purpose, without wasting time on analyzing complex theories, it is necessary to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. And it is possible to do it, if to see on a starry sky corresponding to them other constellations [84]-[89]. But that can only be done where no one has ever seen them before. And these other constellations⁷ (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring with our visible room, in which we are now, neighboring invisible room (or at least its edge to be convinced of its existence), only if you go into the corridor between the rooms. Portal are such corridor between universes.

And for this purpose, without wasting time on the analysis of these complex theories, let us try to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. Then theoretical considerations on this subject will become unnecessary. And it can be done, if to see on a starry sky corresponding to other universes other constellations. But this can only be done where no one has ever seen them before. And these other constellations (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring to our visible room, in which we are now, the neighboring invisible room (or at least its edge to make sure of its existence), only if you go into the corridor between these rooms. Such corridors between universes are portals [90]-[92]. And the entrances to the portals are the so-called anomalous zones, of which there are many on our planet - more than a hundred thousand [93]-[96]. And in some of these anomalous zones even already placed observatories. As, for example, the Main Astronomical Observatory of the National Academy of Sciences of Ukraine, which is located in the Goloseevsky forest just 12 km. from the center of the capital of Ukraine, Kiev.

But people avoid going into portals. And rightly so, because portals are invisible labyrinths. That's why it's almost impossible to get out of them after accidentally entering them. But it is possible to create equipment for orientation in portals. It is also possible to use unmanned remote-controlled robotic means to explore portals. You just need to want to do all this.

⁷ During the transition from one universe to another, the map of the starry sky in the portal, continuously changing all the time, smoothly transforms from the map of one universe into the map of the neighboring universe. But at the same time it will naturally differ from the map of the starry sky on the Earth outside the portal at any place in the portal

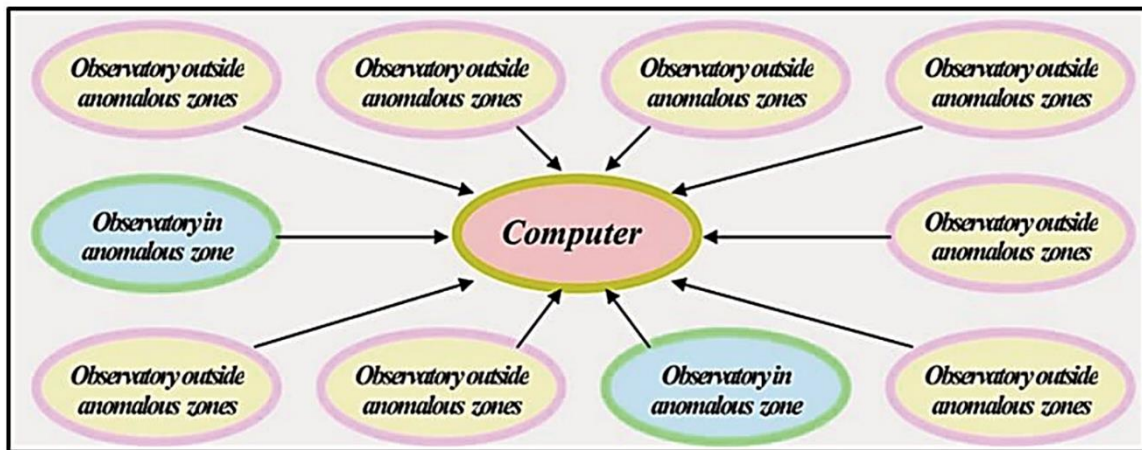


Fig. 7. Scheme of an astronomical experiment to detect invisible universes

It is even possible not to go far into the portals, but to limit ourselves to the use of anomalous zones (e.g., the above-mentioned Main Astronomical Observatory of the National Academy of Sciences of Ukraine). Although in anomalous zones, i.e., at the very edge of the portals, the change in the appearance of familiar constellations is very small, they can still be detected with modern equipment, comparing on the computer (Fig. 6) observations of the same areas of the starry sky by different observatories located both in the anomalous zones and outside the anomalous zones in the same region.

After all, the English astrophysicist Sir Arthur Stanley Eddington [97] was able to his famous experiment, similar to the one described above in Fig. 7, back in 1919 to confirm the predicted by the general theory of relativity deviation of light rays in the gravitational field of the Sun. That's what it means to actually want to.

Civilizations and supercivilizations

But even if there were only our visible universe, then, despite the big bang theory, when exploring the cosmos it is impossible not to take into account that different stars with their planets arose in our visible universe at different times. And they still continue to arise. According to modern estimates, the number of galaxies in our visible universe alone is about $2E11$. And each galaxy contains about $1E8$ stars. Of these, at least $8E9$ contain Earth-like planets on which life is possible. And the ages of the stars are very different. For example, the star HE1523-0901 is $13.2E9$ years old, the Sun is $4.6E9$ years old, Sirius is $2.3E8$, and the recently discovered star Swift J1818.0-1607 is only about 240 years old. For comparison, recall that the age of our visible universe is about $13.8E9$ years. In the invisible universes of the hidden Multiverse and Gi-universe this diversity is surely even greater. And even the invisible universes themselves, contrary to the Big Bang theory, probably did not appear in nature at the same time. Consequently, at least on some planets, the age of the super-civilizations existing there exceeds the age of our earthly human civilization by billions of years. And comparing our civilization of the XXI century with the human civilization, for example, of the IXX century, i.e. existing only 200 years ago⁸ it is not difficult to understand how much our civilization is surpassed by super-civilizations.

Therefore, the inhabitants of supercivilizations are real all-powerful Gods for us. And some information about these supercivilizations is contained (though in a in allegorical form to be somehow understandable to people) in the church books of all world religions.

But other civilizations also exist on Earth. These are numerous communities of living beings - mammals, birds, dolphins, even ants and bees - which form hierarchical structures united by common vital interests and coordinate their activities for the benefit of the whole community as a result of exchange by information between these living beings. Only these civilizations, unlike human civilization, are not machine civilizations. Although primitive human civilizations, still existing now according to some reports in some remote areas of the Earth, are not machine civilizations either.

And these non-machine civilizations are also of great interest for people, because due to the fact that other living beings have sensory organs different from those of humans, they possess knowledge about nature unknown to humans. For example, cats feel geopathogenic zones, which are not registered by any existing equipment. Consequently, there are some other physical fields unknown to people in the

⁸ When russian writers A. S. Pushkin and M. Yu. Lermontov lived, there were no computers, no Internet, no cars, no rail transport, no aviation, and many other things that have become familiar to us in the 21st century.

nature, besides electromagnetic and gravitational fields known to people. Cats can also cure people in some unknown way. But people don't know how they do it. And how to learn it from them.

Fermi paradox, which proves the existence of supercivilizations in other spatial dimensions.

The Fermi paradox is a statement of a seemingly paradoxical situation in which, on the one hand, it is known that there are many star systems suitable for life in the cosmos, and on the other hand, despite all the efforts of scientists, no signs of life have been found in this cosmos. And it would seem very strange [98]-[100].

But in fact there is nothing strange about this. After all, what are we looking for? What signs of life do we expect to see? The same as on Earth now? So that the same radio stations as on Earth would work, which, when transmitting signals, would spend most of their energy on transmitting signals to nowhere due to the use of a non-optimal directional diagram? So that, in addition, these radio stations would also spend a considerable part of their energy on out-of-band radiation? So that aliens would detonate atomic and hydrogen bombs? And so on.

But first of all, these are all defects of our imperfect civilization, which supercivilizations have long ago got rid of. And that's why they're invisible. And secondly, why not assume that we do not see their ships in space also because they have different logistics as a result of using their super knowledge. Even on Earth, people on their way to work in big cities often use the subway. And then their movement underground cannot be detected from space. But then it is necessary to recognize the existence of invisible parallel universes, portals between them and admit that the generally accepted version of SRT is wrong.

Besides, they certainly know stealth technology or some other super stealth technology. So the cost of all the searches for signs of life in space is money wasted.

And finally, why do we assume that as soon as people want to establish contacts with the inhabitants of supercivilizations, for example, on the Moon or on Mars, their inhabitants will immediately want to contact us? Always and everywhere to be or not to be contacts are decided by the masters of the situation. To be sure of it try to meet your director or minister at least. That is why in this situation the inhabitants of supercivilizations make decisions, not us. After all, we also do not seek contact neither with wild animals, nor with insects, nor with snakes that try to get into our dwellings. For example, rats are very smart and even in some situations, out of gratitude for the fact that the miners fed them, they sometimes saved their lives. Nevertheless, no one keeps rats as pets. And we lock our houses even from people we don't need.

And the inhabitants of supercivilizations are perfectly capable of protecting themselves to protect themselves from unnecessary human contact, even on Earth. For example, presumably in Shambhala. Or Antarctica. Or at the bottom of the oceans.

And another thing. Why do we seek contact with supercivilizations? We won't understand anything. After all, they have been sending us messages in the form of crop circles for centuries. But we don't have enough intelligence to read them. So we should not try to solve problems that are beyond human intellect. We need to increase our intelligence. And first we have to read the crop circles in the margins. And what to do next will be clear late

The phenomenon of déjà vu, which proves the existence of super civilizations in other time dimensions

This is an extremely interesting phenomenon [101]. Déjà vu from French translates as "already seen". There have even been 84 films made on this topic at different times and in different countries.. The essence of the phenomenon is that practically every person (more precisely, about 97% of people) sooner or later, at least once in his life, found himself in a situation in which he had already been once before. Or so it seems to him. Psychologists have offered many medical explanations for this phenomenon. But all of them are not very convincing, since science does not know of any disease, much less a mental one, with which 97% of the world's population could have been infected (and how?).

So let's offer another explanation, but this time a physical one. It is also quite unusual. Let's assume that this phenomenon is explained by interference in our life by our descendants from the distant future, who have unusually perfect computers capable of calculating our behavior down to the smallest detail, as well as time machines, with the help of which our descendants can move both to the past and future time. Which is plausible. And then these descendants of ours, in order to correct their existence in their future, go by time machines (and for them it is easier and cheaper than other variants of obtaining the same result) to our past and correct this past by algorithms created by supercomputers of the future (for example, Hitler's mother is married to another man). Then the inhabitants of the future, naturally, get to

another future, which they like better. And in order not to lose any of their relatives, who have many other relatives and friends, etc., they have to interfere in the lives of all the people currently living on Earth. That is why the above-mentioned figure of 97% appeared.

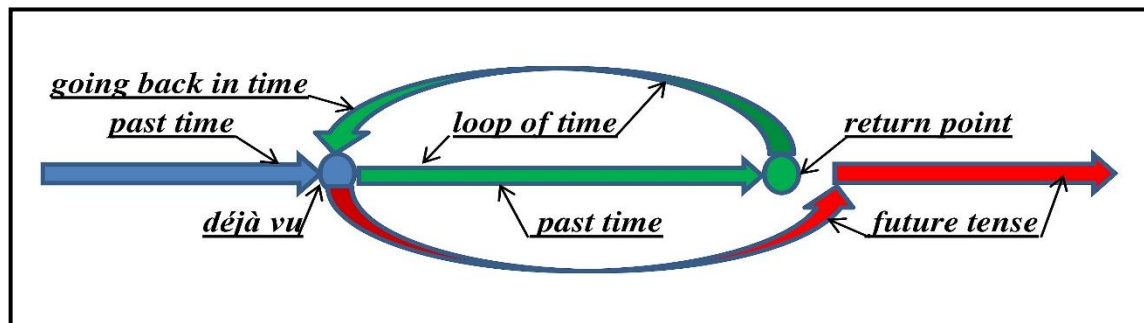


Fig. 8. Explanation of the phenomenon of déjà vu occurring as a result of intersection of timelines "going back in time" and "past time" with the formation of a "loop of time"

And people of our time on Earth because of this interference in our lives of aliens from the future make a journey through a time loop (see Fig. 8). Which they then forget. Or our descendants from the distant future erase it from our memory. But because of the existence of the time loop, they have to actually visit the 'déjà vu' point twice. And this is not erasable from their memory.

The invisible afterlife world, where the Gods and souls of the dead dwell, really exists

But religions, unlike many modern scientific hypotheses that have not been confirmed experimentally, which for some reason in the twentieth century unreasonably began to be called theories, do not try to deceive people. At least because all world religions, without collusion, actually tell people about the same thing.

That there are Gods. Well, it's true. It was explained above that the Gods are all-powerful inhabitants of super-civilizations in star systems that appeared billions of years before our solar system. And who help humans to become more civilized and advanced. Gods also through Religions somehow allegorically (and otherwise people would not understand anything and this information was not preserved to the next generations) explain to us the structure of the world in which they and we actually live. Church books are therefore invaluable teaching aids for us to learn the science of the distant future. They also try to instill in us a more humane morality of these super-civilizations (e.g., in the form of Christ's commandments), in contrast to the far from perfect morality that people live by today. And largely due to the efforts of Religions, people are becoming more and more humane.

But Gods and the souls of the dead also have to be somewhere. The invisible world in which they dwell in religions is called beyond the grave. And as it is shown above in the hidden Multiverse and Giperuniverse there are many (perhaps even infinitely many) mutually invisible parallel universes in which there are inevitably super-civilizations. Which therefore may be this invisible afterlife world.

Religions also tell us that people have an immortal soul that passes into this afterlife world after death. There are many testimonies of this from people who have been in a state of clinical death. And the author believes that this is also true. Therefore, the author is happy that after his death he will be able to reunite with his beloved parents, his wife and his wife's parents.

But in the version of STR, studied in physics textbooks, the existence of an invisible afterlife is denied for quite understandable reasons. It and its inhabitants - Gods, souls of the dead and others - simply have no place in this, the only one existing in nature according to the generally accepted version of STR, our visible Universe.

Conclusion

Thus, in the article it is experimentally proved and theoretically explained that up to now studied in all textbooks of physics the version of SRT, created in the XX century, is incorrect, because:

- the relativistic formulas obtained in it are incorrect;
- these formulas are incorrectly explained using the incorrect postulate called the principle of non-exceeding of the speed of light;
- from these formulas wrong conclusions about physical unreality of imaginary numbers and about existence in the nature of our only visible universe in which everything is measured only by real numbers are made.

But in the XXI century, a corrected version of the STR was created, in which, instead of the incorrect postulate about not exceeding the speed of light, an experimentally proven principle of the physical reality of imaginary numbers is used. And the physical reality of such numbers is proven by the existence of not only electrical engineering, radio engineering and computer technology (which was written about above), but also by the existence of the natural phenomenon of tsunamis and even swings swinging on playgrounds, as well as music created by pianos and other musical instruments. What more convincing refutations are needed? After all, these refutations have not been refuted by anyone.

Thus, naturally, the postulate of the generally accepted version of STR about not exceeding the speed of light, from which this conclusion about the physical unreality of imaginary numbers was made, is also experimentally refuted. For the same reasons, the conclusion about the existence in nature of our only visible universe is also refuted. And instead, it is asserted that in fact, in addition to our visible universe, there are many other mutually invisible parallel universes. The corrected version of STR also explains that the existence of these invisible universes can be experimentally proven by astronomical observations in the starry sky in the portals of constellations that are invisible outside the portals.

But the significance for science of the principle of physical reality of imaginary numbers is not limited to the possibility of correcting the generally recognized version of SRT. From this principle follows the necessity of corresponding correction in exact sciences of all theories and hypotheses in which imaginary numbers are used.

It also follows from this principle that around us there exists not only the visible world known and clear to us, but also a much larger almost completely unknown and not yet completely cognized by us invisible world [102]-[111]. Including the invisible afterlife world [112]-[123], where Gods, souls of the dead and numerous other inhabitants of supercivilizations dwell.

The author hopes that the realization of all this will encourage Science and Religion to cooperate mutually beneficially in their activities for the benefit of people.

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CERVICAL CANCER: THE COMPLEXITY OF THE PROBLEM

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Abstract

This scientific work purposefully analyzes modern world and regional data on incidence, mortality and five-year survival rate of the most common oncogynecological pathology - cervical cancer. In addition to the issues of etiology and pathogenesis, the features of distribution, clinical manifestations, modern principles of early diagnostics and prognosis of this formidable disease for the coming decades are shown. The article reflects in detail the achieved successes and modern directions of development of prevention of this pathology in the form of vaccination against HPV and applied screening programs. A multifactorial epidemiological characteristic of this pathology in our republic is given in the context of the regions of the country.

Keywords: *oncology, cervical cancer, epidemiology, incidence, human papilloma virus, screening, diagnostics, Pap test, smear for oncocytology, mortality, five-year survival rate, prognosis.*

Cervical cancer (CC) is a disease that is related to visually accessible localizations, in connection with which aspects of early diagnostics have been worrying the entire oncological community for several decades. To do this, it is enough to correctly use accessible and informative methods of morphological

and endoscopic diagnostics. In addition, timely detection and treatment of background and precancerous processes of the cervix can prevent the development of CC. It is known that CC is preceded for many years and even decades by precancerous lesions - cervical intraepithelial neoplasia (CIN). Timely diagnosis and treatment of CIN become the prevention of invasive CC. CIN initiates in the cervical transformation zone and is maintained by persistent infection caused by human papillomaviruses (HPV) of high carcinogenic risk. In 1980-1990, the connection between HPV and dysplasia and squamous cell cancer was clearly shown. Using hybridization methods, it was found that 80-100% of CC contain HPV DNA. A rough correlation was found between the frequency of CC and the detection of HPV in the population. Moreover, in squamous cell cancer, HPV type 16 was most often encountered (in more than 50% of cases), while HPV type 18 was more often associated with adenocarcinoma and poorly differentiated cancer. In 95% of cases, HPV is localized in the zone of transitional epithelium, where about 90% of dysplasias, which are classified as cervical precancer, occur. It is precancerous diseases, in which HPV types 16 and 18 are detected, that have the greatest risk of developing into invasive CC. Intraepithelial lesions are, in fact, stages of cervical carcinogenesis. Conventionally, three degrees are distinguished: CIN 1 (mild dysplasia); CIN 2 (moderate dysplasia); CIN 3 (severe dysplasia and pre-invasive cancer - carcinoma in situ, CIS). At the same time, there are two concepts of the occurrence of CC against the background of persistence of HPV of high carcinogenic risk. The first, classic, reflects the sequential change of CIN 1, 2, 3 to invasive cancer. The second, more recent one, suggests that CIN 2-3, which are severe intraepithelial lesions, can occur bypassing CIN 1 [1].

The diagnostic criteria for CC are as follows [2]: 1) complaints of acyclic bloody, watery, purulent discharge from the genital tract; pain in the lower abdomen and lumbar region of a pulling nature; bleeding due to menopause; 2) anamnesis: there are no pathognomonic complaints; as a rule, the disease has a pronounced pre-invasive stage, which can last from 1 year to 5 years or more; microinvasive cervical carcinoma is most often discovered during accidental presentation; the reason for women diagnosed with CC in stages Ib1-IIa2 to visit a gynecologist is bloody discharge from the genital tract; in later stages (IIb-IVa) there are complaints of pain in the lumbar region, lower abdomen; 3) physical examinations: gynecological examination (condition of the external genitalia; examination of the vagina and cervix on speculum (presence of vaginal infiltration, metastatic foci on the vaginal walls, size, condition of the cervix); presence of pathological discharge (purulent, bloody); bimanual examination (size and shape of the uterus; condition of the appendages; infiltration of the anterior and posterior vaginal fornix); 4) laboratory tests: cytological examination with Papanicolaou staining - PAP test (increase in cell size up to giant, change in the shape and number of intracellular elements, an increase in the size of the nucleus, its contours, different degrees of maturity of the nucleus and other elements of the cell, changes in the number and shape of nucleoli (pronounced cellular polymorphism, increase in cell size, pronounced hypochromia, large nuclei contain one or more nucleoli, there are glandular structures); from cancer cells in the form of rosettes, many cells in a state of mitosis); 5) instrumental studies: ultrasound of the pelvic organs (if CC is suspected, the size of the cervix will be normal or increased, its structure is heterogeneous, the condition of the uterus and ovaries is also assessed); magnetic resonance imaging of the pelvic organs (with CC, the size of the cervix will be normal or increased, its structure is heterogeneous, the condition of the uterus and ovaries is also assessed); computed tomography of the chest, abdominal cavity and pelvis (assessment of pelvic lymph nodes and retroperitoneal space, organic changes in the chest and abdominal organs); cystoscopy according to indications (for the purpose of diagnosing the germination of the tumor process into the bladder); sigmoidoscopy or colonoscopy according to indications (for the purpose of diagnosing the spread of the tumor process to the colon or rectum); skeletal scintigraphy (prescribed for suspected bone metastases); positron emission tomography of the whole body (performed to diagnose the extent of the tumor process or to assess the dynamics of the effectiveness of special treatment).

GLOBOCAN estimates that in 2020, there were 604,000 new cases and 342,000 deaths from CC worldwide, of which 80% occurred in low- and middle-income countries, mainly in sub-Saharan Africa, South-East Asia, and Latin America and the Caribbean [3].

As noted by Torres-Roman J.S. et al. [4], CC remains a major public health problem in low- and middle-income countries. Due to the high burden of this disease, in 2020 the World Health Organization (WHO) adopted a global strategy to decrease the number of new CC cases, with the aim of maintaining an incidence rate below 4 per 100,000 women. Currently, 29 of the 47 countries (and territories) in the Latin American and Caribbean region have implemented vaccination programs for girls and almost all countries have screening services in place, and while certain screening programs in the region achieve considerable coverage, the ambitious goals set by the CC elimination strategy have yet to be achieved.

Researchers evaluated the mortality trends of CC among young women from 16 Latin American and Caribbean countries (and territories) and predicted mortality rates until 2030. Downward trends were observed in Chile, Colombia, Cuba, El Salvador, Mexico, Nicaragua, Panama, and Peru for the entire period; whereas Brazil, Argentina, Chile, and Costa Rica showed initial downward trends from – 0.9% to – 6.2% followed by significant upward trends from 2.5 to 4.8% (for the period~ 2006-2017). In the last 4 years of study (2014-2017), Paraguay and Venezuela had the highest mortality rates, whereas Puerto Rico had the lowest mortality. By 2030, authors projected that mortality for CC will increase in some countries that were examined. Colleagues considered CC mortality in young women only because of the lack of research in the Latin American and Caribbean region, which has focused on CC mortality in general. They point out that because HPV infection is the most important risk factor for CC, younger women are likely to have experienced higher rates of HPV infection compared to older women. The authors also note that CC mortality rates among young women in Latin America and the Caribbean are higher than in Eastern Europe. While Western and Southern Europe recorded rates below 2 deaths per 100 000 population in 2017, rates were below 6 deaths per 100 000 population in Northern and Eastern Europe. In conclusion, the researchers emphasize that most countries in Latin America and the Caribbean experienced a decline in mortality rates between 1997 and 2017. The variations of the mortality rates between countries during the last period of observation can be largely explained by the timing of implementation of nation-wide screening campaigns in different time periods and the variation of public health programs within each country, among others. Despite favorable downward trend, the mortality rate in some Latin America and the Caribbean countries remains high. HPV vaccination, screening, and early diagnosis and treatment are necessary to accelerate a rapid decline in CC mortality by 2030.

As noted by Abu-Rustum N.R. et al. [5], an estimated 13,960 new cases of carcinoma of the uterine cervix (ie, CC) will be diagnosed in the United States in 2023, and an estimated 4,310 people will die of the disease. Overall, CC rates are decreasing in the United States, although incidence remains high among Hispanic/Latino, Black, and Asian populations. In 2020, the global new cases of and deaths from CC were estimated to be 604,127 and 341,831, respectively. It is the fourth most common cancer in individuals assigned female at birth worldwide, with 85% of cases occurring in developing countries, where CC is a leading cause of cancer death in individuals assigned female at birth. Squamous cell carcinoma (SCC), adenocarcinoma (AC) or adenosquamous carcinoma (ASC) are the 3 common histologies of CC. SCC accounts for approximately 80% of all CCs and AC accounts for approximately 20%. In developed countries, the substantial decline in incidence and mortality of SCC of the cervix is presumed to be the result of effective screening and higher HPV vaccination coverage, although racial, ethnic, and geographic disparities exist. However, AC and ASC of the cervix have increased over the past 3 decades, probably because cervical cytologic screening methods are less effective for AC/ASC because the lesions are located deeper than the ectocervix. The ASC subtype is rare and accounts for approximately 5% to 6% of all cervical carcinomas. Presently, there is no difference in treatment between SCC and AC/ASC CC subtypes, although the clinical features and prognosis of disease vary considerably between these subtypes. Persistent HPV infection is a major factor in the development of CC. The incidence of CC appears to be related to the prevalence of HPV in the population. In countries with a high incidence of CC, the prevalence of chronic HPV is approximately 10% to 20%, whereas in low-incidence countries it is 5% to 10%. Screening methods using HPV testing may increase detection of adenocarcinoma. Vaccination with HPV vaccines may also decrease the incidence of both SCC and AC. In 2020, the WHO updated the Female Genital Tumors classification of CC by subdividing the CC lesions into HPV-associated and HPV-independent tumors based on new pathologic findings. Among these subtypes, HPV-associated SCC is the most prevalent, with very rare occurrences of HPV-independent SCC. The HPV-independent AC subtype has a less favorable prognosis compared with HPV-associated AC. The NCCN CC Panel acknowledges that although the prior versions of the WHO classification discussed these tumors based on morphologic features, the integration of the immunohistochemical and molecular profiles has led to a better classification system, which is now adapted in the 2020 WHO Classification of Female Genital Tumors for CC.

Screening plays an important role in improving early diagnosis and treatment outcomes for CC. According to the Guidelines for Early Diagnosis of Cancer by Ilbawi A. et al. [6], screening aims to detect unrecognized cancer or its prior lesions in a typically healthy, asymptomatic population through tests (e.g., HPV test), screenings (e.g., visual inspection of VIA with acetic acid), or other procedures that can be applied quickly and are widely available to the target population. In screening, the target population is assessed for unrecognized cancer or precancer, and most people tested will not be diagnosed with the disease. Screening should be seen as a process and not as the performance of a specific test, examination,

or procedure. The screening process includes a system of informing and inviting the target population to participate; administering the screening test; following-up with test results and referral for further testing among those with abnormal test results; ensuring timely pathologic diagnosis, staging and access to effective treatment with routine evaluation to improve the process. A screening programme encompasses the process from invitation to treatment and requires planning, coordination and monitoring and evaluation.

As pointed out by Pimple S.A., Mishra G.A. et al. [7], CC is highly preventable and can be easily treated if detected at early stages. However, there is disproportionate high burden of CC incidence and mortality in low-middle income country settings that lack organized screening and prevention programs. Robust evidence for prevention and screening of CC is currently available. However, there are barriers for country specific adoption and implementation. These pose unique challenges such as organizing prevention and screening services delivery through the current health infrastructure, access to screening facilities, follow-up management and adequate linkages for confirmatory diagnosis and subsequent treatment. Overall rates of CC screening and cancer screening among women remain suboptimal in many low- and middle-income countries.

Brisson M. et al. [8] demonstrate in their work that in May, 2018, WHO issued a global call to eliminate CC as a public health problem. To inform its global strategy to accelerate CC elimination, WHO created the CC Elimination Modelling Consortium (CCEMC) to examine the following key questions: what elimination threshold should be used; what prevention strategies can lead to elimination; when could elimination be reached for different countries; and how many cancers could be averted. The current working definition of elimination is an age-standardised CC incidence of four or fewer cases per 100 000 women-years. Alternative definitions, such as an incidence of ten or fewer cases per 100 000 women-years and an 80-90% reduction in incidence, have also been suggested. The only previous multicountry modelling study of CC elimination suggests that global elimination is possible through girls-only human papillomavirus (HPV) vaccination at 80-100% coverage with a perfectly effective 9-valent vaccine and twice-lifetime HPV-based screening. Herewith less than 30% of low- and middle-income countries have introduced HPV vaccination compared with more than 85% of high-income countries. Additionally, only about 20% of women in low- and middle-income countries have ever been screened for CC compared with more than 60% in high-income countries. Given that models necessarily include simplifying assumptions, the goal of the consortium is to use multiple models, taking into account their respective strengths and limitations, to illustrate the robustness of predictions. A systematic comparative modelling approach was used. To form the CCEMC, WHO selected three models that met the predefined eligibility criteria: HPV-ADVISE, Harvard, and Policy1-Cervix. The models projected reductions in CC incidence over time based on standardised HPV vaccination and cervical screening scenarios determined after consultations at various WHO technical expert, advisory group, and global stakeholder meetings. Three elimination thresholds were examined (CC incidence of four or fewer cases per 100 000 women-years, ten or fewer cases per 100 000 women-years, and $\geq 85\%$ reduction in incidence). The three CCEMC models (HPV-ADVISE, Harvard, and Policy1-Cervix) have been used extensively to inform recommendations on cervical screening and HPV vaccination in Australia, Canada, the UK, the USA, and at a global level [8]. Although developed independently, the models have common features. First, they are transmission-dynamic models of HPV infection and the natural history of CC. Second, they include the following components: sexual behaviour and HPV transmission, natural history of CC, vaccination, and screening, diagnosis, management, and treatment of cervical lesions and cancer. HPV transmission and cervical carcinogenesis are modelled for the HPV types in the 9-valent vaccine (HPV types 16, 18, 31, 33, 45, 52, 58) and other high-risk types. The models simulate type-specific HPV transmission through sexual activity, based on different risk groups and sexual mixing. The models reproduce the type-specific natural history of CC, from persistent HPV infection to CC via precancerous cervical lesions (cervical intraepithelial neoplasia grade 1 to 3). All models assume that HPV vaccines are prophylactic and capture post-vaccination herd effects. They can also simulate complex cervical screening and treatment algorithms at the individual level, by tracking and simulating each woman's screening history. Finally, all models were calibrated to highly stratified sexual behaviour and epidemiological data, validated to clinical trials or post-vaccination data, or both, and reproduce the age-specific CC incidence estimates from the Global Cancer Observatory (GLOBOCAN) 2018 for all 78 low- and middle-income countries.

A comparative modelling analysis by Brisson M. et al. [8], which includes projections from three independent transmission-dynamic models, provides consistent results predicting that CC can be eliminated as a public health problem by the end of the century, based on WHO's proposed elimination

threshold (i.e., CC incidence of four or fewer cases per 100 000 women-years). This modelling study shows that girls-only HPV vaccination would lead to CC elimination in most low- and middle-income countries, if high coverage is reached (>90% coverage) and the vaccine provides long-term protection. However, countries with the highest CC incidence at present (>25 cases per 100 000 women-years), more than 90% of which are in sub-Saharan Africa, would not reach elimination by vaccination alone. To achieve CC elimination in all 78 low- and middle-income countries, these models predict that scale-up of both girls-only HPV vaccination and twice-lifetime screening is necessary, with 90% HPV vaccination coverage, 90% screening uptake, and long-term protection against HPV types 16, 18, 31, 33, 45, 52, and 58. If this global elimination strategy, which includes a combination of intensive scaling up of HPV vaccination and cervical screening, is implemented, the results suggest that CC elimination can be achieved in all countries by 2100. In doing so, CC incidence would be reduced by 97% and more than 74 million cases would be averted over the next century.

An interesting and important study was conducted by Simms K.T. et al. [9], who in their work modeled the global situation with CC for future decades depending on the coverage of the population with HPV vaccination and screening. In this study, the authors aimed to quantify the potential cumulative effect of scaled up global vaccination and screening coverage on the number of CC cases averted over the 50 years from 2020 to 2069, and to predict outcomes beyond 2070 to identify the earliest years by which CC rates could drop below two absolute levels that could be considered as possible elimination thresholds-the rare cancer threshold (six new cases per 100 000 women per year, which has been observed in only a few countries), and a lower threshold of four new cases per 100 000 women per year. In this statistical trend study and modeling, our colleagues conducted did a statistical analysis of existing trends in CC worldwide using high-quality cancer registry data included in the Cancer Incidence in Five Continents series published by the International Agency for Research on Cancer. Next, the authors used the comprehensive and extensively validated simulation platform, Policy1-Cervix, to do a dynamic multicohort modelled analysis of the impact of potential scale-up scenarios for CC prevention, in order to predict the future incidence rates and burden of CC. Data are presented globally, by Human Development Index (HDI) category, and at the individual country level. As a result of the study, the following conclusions were drawn. In the absence of further intervention, there would be 44.4 million CC cases diagnosed globally over the period 2020-2069, with almost two-thirds of cases occurring in low-HDI or medium-HDI countries. Rapid vaccination scale-up to 80-100% coverage globally by 2020 with a broad-spectrum HPV vaccine could avert 6.7-7.7 million cases in this period, but more than half of these cases will be averted after 2060. Implementation of HPV-based screening twice per lifetime at age 35 years and 45 years in all low- or middle-income countries with 70% coverage globally will bring forward the effects of prevention and avert a total of 12.5-13.4 million cases in the next 50 years. Rapid scale-up of combined high-coverage screening and vaccination from 2020 onwards would result in average annual CC incidence declining to less than six new cases per 100 000 individuals by 2045-2049 for very-high-HDI countries, 2055-2059 for high-HDI countries, 2065-2069 for medium-HDI countries, and 2085-2089 for low-HDI countries, and to less than four cases per 100.000 by 2055-2059 for very-high-HDI countries, 2065-2069 for high-HDI countries, 2070-2079 for medium-HDI countries, and 2090-2100 or beyond for low-HDI countries. However, rates of less than four new cases per 100 000 would not be achieved in all individual low-HDI countries by the end of the century. If delivery of vaccination and screening is more gradually scaled up over the period 2020-2050 (eg, 20-45% vaccination coverage and 25-70% once-per-lifetime screening coverage by 2030, increasing to 40-90% vaccination coverage and 90% once-per-lifetime screening coverage by 2050, when considered as average coverage rates across HDI categories), end of the century incidence rates will be reduced by a lesser amount. In this scenario, average CC incidence rates will decline to 0.8 cases per 100 000 for very-high-HDI countries, 1.3 per 100 000 for high-HDI countries, 4.4 per 100 000 for medium-HDI countries, and 14 per 100 000 for low-HDI countries, by the end of the century. At the same time, the researchers emphasize that more than 44 million women will be diagnosed with CC in the next 50 years if primary and secondary prevention programmes are not implemented in low- or middle-income countries. If high coverage vaccination can be implemented quickly, a substantial effect on the burden of disease will be seen after three to four decades, but nearer-term impact will require delivery of cervical screening to older cohorts who will not benefit from HPV vaccination. Widespread coverage of both HPV vaccination and cervical screening from 2020 onwards has the potential to avert up to 12.5-13.4 million CC cases by 2069, and could achieve average CC incidence of around four per 100 000 women per year or less, for all country HDI categories, by the end of the century.

In our country, according to Decree of the Government of the Republic of Kazakhstan dated

February 20, 2024 No. 102 [10], the list of diseases against which mandatory preventive vaccinations are carried out as part of the guaranteed volume of medical care at the expense of the republican budget includes routine preventive vaccinations against diseases caused by HPV (Annex 1). According to Annex 2 of this Resolution, girls aged 11 and 11.5 years will be vaccinated.

Now, as for this pathology in our republic. CC in the structure of all malignant tumors of both sexes of the population in 2022 took 6th place with a share of 5.51% (2021 - 4th place, 5.54%), in women - stable 2nd place - 9.7% (9.7%) [11].

The incidence rate per 100 thousand population increased from 9.4 to 9.92. In 10 regions of the republic, the incidence rate is higher than the national average: Pavlodar - 17.2 per 100 thousand people (2021 - 16.7) - the highest level, East Kazakhstan - 14.3 (10.8), North Kazakhstan - 14.3 (10.2), Atyrau - 13.2 (13.8), Zhetysu - 11.7, Karaganda - 11.7 (12.0), Abay - 11.1, Akmola - 11.1 (11.9), Mangistau - 11.1 (9.7), Kostanay - 10.8 (10.6) regions.

Low incidence rates in Zhambyl region - 5.8 per 100 thousand population (5.7), Turkestan region - 6.1 (5.2), Aktobe region - 8.3 (11.6), Kyzylorda region - 8.5 (8.2) areas.

CC in the structure of causes of death from malignant tumors of the population of both sexes in 2022 rose from 9th to 8th position, with a share of 4.6% (2021 - 4.3%), mortality from CC is stable at 3.1 per 100 thousand population (3.1).

The mortality rate from CC in 10 regions is higher than the national average: Akmola - 4.2 per 100 thousand population (2021 - 3.1) - maximum level, West Kazakhstan - 4.1 (4.8), Pavlodar - 3.8 (5.6), Almaty - 3.7 (2.5), Zhetysu - 3.7, Atyrau - 3.4 (4.0), East Kazakhstan - 3.3 (3.8), Karaganda - 3.2 (4.7), Kostanay - 3.2 (2.4) regions and Almaty city - 3.4 (2.9).

Below the national average mortality rate was registered in the Kyzylorda region - 1.7 (3.5) - the best result; North Kazakhstan - 2.0 (2.6), Aktobe - 2.2 (3.0), Turkestan - 2.3 (2.2), Mangystau - 2.8 (3.0), cities of Astana, Shymkent - and Abay region - 2.9 per 100 thousand population [11].

In 12 regions, a 100% level of morphological verification of the diagnosis is ensured. The lowest or worst indicator for the third year in a row was recorded in the Kyzylorda region - 94.3%. Below the national average, this figure was noted in Akmola - 98.8%, Atyrau - 98.9%, Kostanay - 98.9%, Mangistau - 97.6%, Pavlodar - 96.6% regions and Almaty city - 98.5 %.

In a number of regions, the frequency of diagnosis of stage I-II CC was lower than the national average (88.1%) - in Akmola - 76.2% - the worst result in the country, in Karaganda - 77.2%, Pavlodar - 81.3%, Zhetysu - 82.9%, Abay - 83.8%, Kostanay - 84.3%, Aktobe - 85.5%, West Kazakhstan - 85.7% regions. In the Atyrau region there is a 100% result.

The proportion of stage IV CC is higher than the republican average (2.7%) in the following regions: the worst result is in the Zhetysu region - 6.1%; next come: Karaganda - 5.1% (2021 - 5.6%), Akmola - 4.8% (2.3%), Kostanay - 4.5% (4.4%), North Kazakhstan - 3.9% (7.4%), Shymkent city - 3.8% (5.9%), Almaty - 3.7% (5.1%), Almaty city - 3.6% (1.8%), Zhambyl - 2.9% (0.0) regions. No advanced forms were registered in 3 regions. The lowest neglect is in the East Kazakhstan region - 1.0% (0.7%).

Indicators of late diagnosis of this pathology, as visually accessible localization (III-IV stages) are higher than the national average - 11.9% (15.4% in 2021) were noted in the Akmola region - 23.8% (2021 - 26.4 %) - worst result; Karaganda - 22.8% (35.2%), Pavlodar - 18.8% (20.8%), Zhetysu - 17.1% (24.2%), Abay - 16.2% (12.8%), Kostanay - 14.6% (15.6%), Aktobe - 14.5% (9.6%), West Kazakhstan - 14.3% (32.4%) regions. The least neglect is in the Mangistau region - 6.0% (20.8%).

Across the country, the five-year survival rate of patients with CC registered in 2018 was 59.9% in 2022, with a decrease from the level of 2021 (67.5% for those registered in 2017), and with a significant range in by region, from the maximum - 72.9% (2021 - 70.7%) in the North Kazakhstan region, to the minimum - 34.9% (64.4%) in the Atyrau region [11].

Next, regarding CC screening. CC screening is a periodic, comprehensive examination of women of a certain age group as part of a special medical program to prevent and reduce incidence and mortality from CC.

Type of screening - population. The purpose of screening is to identify pre-invasive diseases of the cervix with subsequent recovery. The screening method is a cytological examination of a smear for oncocytology from the cervix (traditional and liquid cytology) - Pap test. Interval - 1 time in 4 years. Target group: women aged 30-70 years who are not registered in the dispensary for CC. The expected results are a decrease in incidence and mortality from CC.

Screening steps:

1) Preparatory - formation of target groups, information support and invitation to screening. The preparatory stage is carried out by the nurses of the primary health care organization responsible for

preventive measures and includes: annual compilation of a list of women subject to screening in the coming year by November 15 of the current year, followed by monthly correction; informing target groups of the female population about the need for screening; screening invitation; ensure timely screening.

2) Screening - filling out a statistical card of a preventive medical examination (screening) of an outpatient (form 025-08/y), a register of patients subject to cytological screening and taking material for cytological examination from the cervix. The screening examination of the target groups of the female population is carried out by a specially trained midwife of the primary health care organization.

3) The final one is obtaining the results of cytology, informing the woman and developing further management tactics, fill out accounting and reporting statistical documentation. Responsible for the final stage of screening is the obstetrician-gynecologist of primary health care [12].

Cytological screening of CC is a complex of organizational and medical measures aimed at early detection of precancerous and neoplastic diseases of this localization and at reducing the mortality of this cohort of patients. For traditional cytology, a smear containing 8-12 thousand cells of stratified squamous epithelium (including cells of metaplastic epithelium) is considered adequate; for liquid cytology - 5 thousand cells. For both methods, the number of cells of endocervical epithelium and/or metaplastic epithelium (from the transformation zone) must be at least 10 (single or in clusters). If more than 75% of the cells of the stratified squamous epithelium are covered with erythrocytes, leukocytes, etc., then the quality of the smear is considered unsatisfactory.

Interpretation of the results of a cytological study is carried out according to the Bethesda-terminology cytological system:

Intraepithelial changes and malignant processes are absent (NILM). This group includes cytological conclusions about the normal state of the epithelium, as well as the presence of various non-neoplastic diseases. Normally, squamous epithelial cells, groups of cells of columnar epithelium and metaplastic epithelium, a small number of leukocytes, and rod/mixed microflora are found in preparations. In the presence of non-neoplastic processes, their nature and, if possible, the cause are specified: atrophic changes, reactive changes associated with inflammation, including typical regeneration. In addition, the presence of microorganisms is indicated: *Trichomonas vaginalis*, fungi, morphologically corresponding to *Candida* spp., bacterial vaginosis, cellular changes corresponding to the defeat of Herpes simplex virus, squamous epithelial cells with atypia of unknown significance (ASC-US), squamous epithelial cells with atypia of unclear significance, not excluding the presence of a high degree of intraepithelial changes (ASC-H). Low-grade squamous intraepithelial changes (LSIL) include lesions associated with HPV and CIN I, high-grade squamous intraepithelial changes (HSIL) include CIN II, CIN III, carcinoma in situ and cases suspected of invasion, squamous cell carcinoma, cervical (glandular) epithelium with atypia of unknown significance, cells of the cervical (glandular) epithelium, possibly neoplasia, endocervical adenocarcinoma in situ, endocervical adenocarcinoma, endometrial adenocarcinoma, secondary adenocarcinoma, unclassified carcinoma, other malignant tumors.

There are certain features when taking material for oncocytopathology: firstly, the examined woman should be informed about the exclusion of sexual intercourse, vaginal manipulations, including douching, baths, tampons, etc. 2 days prior to sampling. Taking material for cytological examination is carried out by the midwife of the examination room of the department of medical examinations of the primary health care organization: the traditional method (2 glasses - with obligatory fixation in 96% alcohol, it is preferable to use glass slides with a polished edge, which are easily marked) or the liquid cytology method (one container with stabilizing liquid); the code or surname of the patient, identical to the code and surname in the form for sending material for cytological examination, should be clearly marked on the glasses or container [12].

At the same time, when using the traditional method, the biomaterial is delivered to the cytological laboratory as soon as possible after its collection in specialized containers for glass slides with 96% alcohol. If there are visible visual changes in the cervix, then the material is taken from the woman and, without waiting for the results, she is referred for an examination by an obstetrician-gynecologist.

A cytological study is carried out in centralized cytological laboratories at oncological institutions, where an archive of cytological preparations of patients involved in the screening examination is formed, regardless of the result, for a period of at least 10 years with the formation of a computer database.

What material and technical equipment is required to take material for a Pap test? It is as follows: soap and water for washing hands, a light source for cervical examination, a gynecological chair, a disinfected speculum and gloves, an Eyre spatula, a glass slide and a marking pen, a container with a stabilizing solution for liquid cytology, a fixative solution (96% alcohol), a container with warm water for

lubricating and warming the vaginal mirrors, a 0.5% chlorine solution for disinfecting gloves and instruments, or another approved for this purpose. And, of course, the registration form itself.

For carrying out liquid cytology, you additionally need: a disposable cervix brush, a container with a stabilizing solution for liquid cytology, and a fixing solution.

At the same time, a smear for oncocytology cannot be taken: during menstruation, earlier than 48 hours after sexual contact or after using lubricants, vinegar or Lugol solution, tampons or spermicides, after vaginal examination or douching, and also during the treatment of genital infection.

The results of CC screening are as follows. In 2022, 771,282 women of the target group aged 30 to 70 years were examined during cytological screening (in 2021 - 757,454).

During cytological screening in 2022, 392 cases of CC were identified (319 in 2021). The detection rate increased from 0.42 to 0.51 per 1000 women examined [11].

High detection of CC during screening is ensured in Aktobe, Almaty, Atyrau (1.59 is the best result), East Kazakhstan, Kyzylorda, Pavlodar, North Kazakhstan, Turkestan regions and Shymkent city.

The detection rate in these regions ranges from 0.55 to 1.59 per 1000 women examined. Compared to 2021, there is an increase in detection in 10 regions, with the exception of Akmola, Aktobe, Zhambyl, Kostanay, Mangistau, North Kazakhstan regions and Shymkent city. The worst result in Astana city is 0.15 per 1000 women examined.

Cytologically, cervical precancer was detected in 1.16% of those examined (2021 – 0.99%). The detection rate of precancer below 0.6% (the planned indicator for 2022, according to the Comprehensive Plan) was noted in Aktobe, Karaganda and Kostanay regions.

A high proportion of stage I CC (70% or more) was detected in 6 regions of the country (in 8 in 2021): Kostanay, Mangistau (94.7% - best result), North Kazakhstan, Turkestan regions, cities of Almaty and Astana. Low levels of early detection of CC (below 50%) were not observed in any region.

Localized processes (stages I-II) were identified in 99.2% of all cases of detected cancer (96.5% in 2021). In the Akmola and Karaganda regions, cases of SS were identified not only in the localized, but also in the widespread stages of the process. A total of 3 cases of SS were identified in stage III and not a single case in stage IV (in 2021 - 11 and 0, respectively) [11].

In conclusion, it can be stated that CC occupies one of the leading places among all existing nosological forms of malignant tumors. At the same time, despite the small percentage of patients detected at stages III and IV of the disease, as a visually accessible localization, taking into account a number of factors, early diagnostic indicators do not allow oncologists and gynecologists to "sleep peacefully." Variability, nonspecificity and veiledness of symptoms, its similarity with various non-tumor processes, leads to neglect of the tumor process. All this requires both oncologists and, first of all, primary health care workers and, of course, gynecologists to increase the level of oncological alertness, inform the population about early symptoms that may indicate this pathology or the onset of proliferative changes and carrying out high-tech diagnostic measures and, as a result, timely treatment. Patients at risk with precancerous diseases should undergo routine examination within the prescribed time frame. The development of screening technologies and methods of primary prevention in the form of vaccination of adolescent girls against HPV allows us to hope for a reduction in the incidence of this disease in the female population.

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Pedagogical sciences

CRITICAL THINKING SKILLS AND ITS ROLE IN THE SCIENCE OF METHODOLOGY

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Abstract

Over the past decade, the world has changed incredibly and is changing at a very fast pace. The integration of educational content can become one of the effective tools for solving this problem. Critical thinking is currently the most important principle of the development of the modern education system, closely related to the principle of differentiation. Big changes are currently taking place in Kazakhstan. A developing society needs educated, moral, initiative people in modern conditions who can make decisions of their choice, anticipate their possible consequences, are capable of cooperation, are mobile, dynamic, constructive and feel responsible for the fate of the country. Education is becoming a powerful driving force for economic growth. The integration of sciences, the desire to accurately reflect the overall picture of the world is a characteristic feature of modernity.

Keywords: critical thinking, integration, biology, technology, creative thinking s, general skills, secondary school, innovation.

Modern life requires replacing the formula "education for life" with the formula "critical thinking skills for life". The main object is to determine the effectiveness of interdisciplinary connections in the process of teaching interdisciplinary integration in biology lessons. Comprehensive teaching methods the purpose of helping students: to teach them to learn; to teach them to do; to learn to live together; to learn to live in harmony with themselves. Such learning goals lead to the formation of children's not critical, but in the sense of choosing the optimal solution from a set of solutions. Now, when time demands from us and our children more interesting and non-standard solutions in order not to get lost in this world, to find our place in life, critical thinking is unlike any other[1].

Any teacher, using any technology, method, is looking for the most beneficial one for the child. The student studies theory to improve his knowledge in the lessons of natural science, physics, geography, etc.

Integrated learning implies not only the interconnection of knowledge in different subjects in one lesson, but also the unification of various technologies, methods and forms of one subject and even within one lesson. Integrated classes can be conducted throughout the school day using a variety of methods [2]. A number of classes can be held within the framework of a single topic. Classes are conducted by 2-3 teachers. 60-80% of the study time is devoted to the creativity of students, various methods of influencing the student, multimedia support are used. Integrated lessons have many advantages because they not only solve common educational problems, allowing students to form a more holistic view of the world. A great opportunity to use various technologies, methods, and forms in integrated lessons — in the conditions of our school — allows us to solve another important task - this is a health-saving approach to learning. The use of integration methods in the organization of the educational process contributes to the creation of conditions of psychological comfort, assuming the presence of an atmosphere. creativity, cooperation and mutual assistance, opportunities for self-expression and self-realization, successful personal development and preservation of children's health.

The effectiveness of integrated education depends on the correct, pedagogically sound choice of forms of educational organization, provided by a deep and comprehensive analysis of the educational, developmental, and educational capabilities of each of them. Integration between subjects is possible only with a healthy and healthy climate in the teaching staff, their fruitful cooperation based on mutual understanding and respect promotes the formation of consistency and integrity of knowledge, skills and abilities of students, their views on the world, culture and its values[3]. In turn, to conduct an integrated

lesson, the following conditions must be taken into account: first of all, the teacher must choose the object of study in the lesson and carefully analyze the content of the lesson.

During the implementation of the lesson, it is necessary to think over the technology of independent educational activities of students. The teacher should use problem-based teaching methods, as this activates the mental activity of students at all stages of the lesson. A thoughtful combination of individual and group forms of work is also an integral part of the integrated lesson. Of course, one should not forget to take into account the age-related psychological characteristics of students and their orientation towards a healthy lifestyle. An integrated lesson also cannot be implemented without knowledge of its types and forms. Such classes give the best results, teachers find different tasks, sort them according to their connections with different subjects. The number of embedded stems should not be large. On average, 2 classes per month will be optimal, so the method will not interfere with the assimilation of new material. The most successful in my practice are the following forms of integrated classes: research, excursions, travel. And methods are a lesson in learning skills and a lesson in repetition [4]. Integration as a means of learning contributes to the formation of consistency and integrity of knowledge, skills, skills of students, their attitude to the world, culture and its values. The greatest happiness of a teacher is to look at the joy of children from the small discoveries they have made in our built-in lessons.

The importance of biological education based on the improvement of the educational system space is currently possible with the use of technology. Based on the research problem, methods of theoretical literature analysis, research, survey, comparison, analysis, induction, synthesis, observation were used [5].

The survey questions were mainly intended to determine which technology could be used to develop a higher quality of knowledge. The vast majority of teachers, i.e. 75%, are integration technologies.

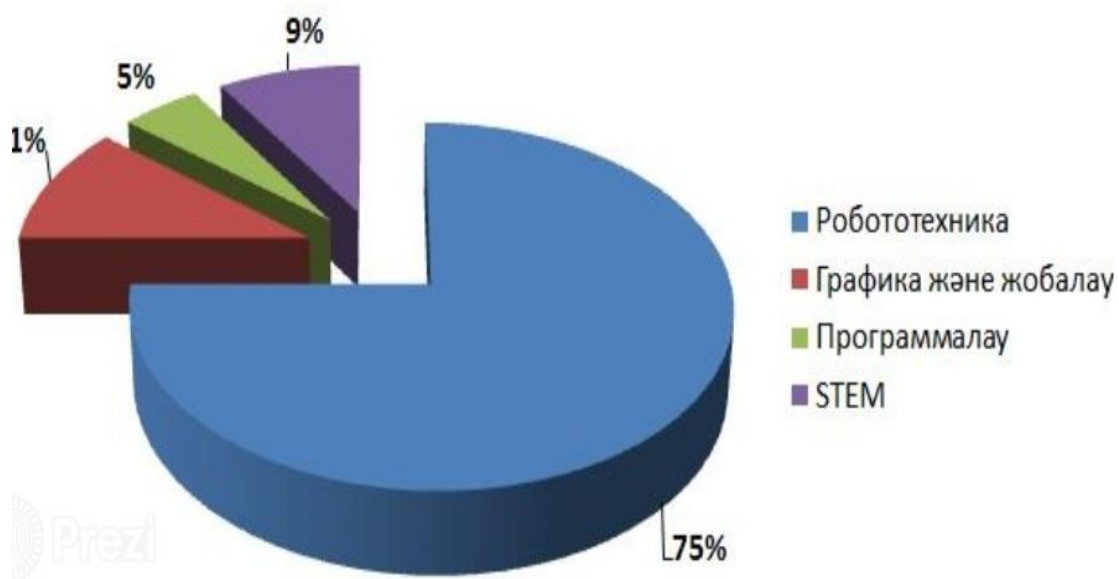


Figure 1: Ways to integrate biological critical thinking skills in general education schools

Critical thinking technology is an integrated approach to learning, i.e. it develops the student's skills of applying knowledge gained in theory in practice. We can say that STEM is a laboratory of modern innovative projects. After all, STEM is rapidly developing in modern foreign countries. As these countries develop, a competitive generation is also developing. In Kazakhstan, the education of a competitive generation is the task of every teacher. Thus, it is aimed at increasing interest in science.

1. American bacteriologist R.Colwell at a biology lesson, interdisciplinary communication, in turn, stimulates the student, develops a systemic need for an object of knowledge, forms skills for comparison, analysis of complex processes and phenomena of objective reality.

2. Kazakh encyclopedia in an integrated lesson, a skill is formed, thinking, memory, imagination are developed

The main objectives of the "integration technology" are:

1) Familiarization with the integrated system "integration technology duties

2) to consider global trends and experience of integration technologies in the countries of the world;

3) study and evaluation of the advantages of integration technologies in the modern education system;

The main forms of improvement and development of education in biology are the ability to apply and demonstrate effective teaching methods and techniques in biology lessons in the process of developing cognitive, biological literacy of adolescents, defining its tasks and goals.

To present examples of educational projects implementing technologies in biological education as an integrated system. That is, when creating this object, for example, whether it is a small constructor, a small single hydraulic crane, he does it by combining the knowledge that he was able to calculate using chemistry, physics, mathematics, geometry. Thus, the student thinks that I am applying knowledge. That's how, working on techniques in biology class, the ability to apply it in life is very important for a children.

Elements of technologies used in biology lessons:



Figure 3.4: Elements of critical thinking technologies used in biology lessons

Conclusion

60-80% of the study time is devoted to the creativity of students, various methods of influencing the student, multimedia support are used. Critical thinking skills have many advantages because they not only solve common educational problems, allowing students to form a more holistic view of the world. A great opportunity to use various technologies, methods, and forms in integrated lessons — in the conditions of our school — allows us to solve another important task - this is a health-saving approach to learning. The use of integration methods in the organization of the educational process contributes to the creation of conditions of psychological comfort, assuming the presence of an atmosphere.

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A COMPREHENSIVE EXPLORATION OF EFFECTIVE TEACHING METHODS IN ENGLISH LANGUAGE TEACHING AT SECONDARY SCHOOL TO FOSTER LANGUAGE ACQUISITION, FLUENCY, AND PROFICIENCY

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Abstract

This comprehensive article explores a range of effective teaching methodologies tailored specifically for secondary school children in English Language Teaching (ELT). It focuses on enhancing language acquisition, fostering fluency, and achieving proficiency in English, crucial for academic and professional success in today's globalized world. The methodologies under scrutiny include Communicative Language Teaching (CLT), which prioritizes authentic communication and interactive learning experiences to develop practical language skills. Additionally, Task-Based Language Teaching (TBLT) is examined for its emphasis on real-world tasks that require students to use English in meaningful contexts, promoting both language proficiency and critical thinking skills. Through a comprehensive examination of these methodologies and strategies, this article provides educators with insights and practical approaches to create inclusive and engaging learning environments that cater to the diverse needs of secondary school learners. By implementing these effective teaching methods, educators can better support students in mastering English as a vital tool for academic achievement, career advancement, and global citizenship.

Introduction

Education is the nation's main tool in improving quality society advances and develops towards advancing science and technology. Education is one of the very important factors to support as well guarantee students have skills and innovation (Utami, A. R., Aminatun, D., & Fatriana, N. (2020). English proficiency is crucial in today's interconnected world, influencing educational and career opportunities. Secondary school marks a critical phase in language development, where students build upon foundational skills and strive towards communicative competence in English. Effective teaching methods play a pivotal role in guiding students through this journey, fostering not only linguistic skills but also confidence and cultural understanding. The sheer number of concepts, theoretical underpinnings, road maps, classroom practices, pedagogical approaches, methods, styles, strategies, techniques, and many other terminologies that have flourished in ELT in the last 70 years, is overwhelming (Saeedy Robat, E., Khodabakhshzadeh, H., Ashraf, H., & Elahi Shirvan, M. (2021). This article explores key methodologies and strategies that educators can employ to create engaging and effective learning environments for secondary school children studying English as a second language.

Communicative Language Teaching (CLT)

Communicative Language Teaching (CLT) is a learner-centered approach that prioritizes real-life communication over mere memorization of grammar rules and vocabulary. CLT emphasizes authentic communication and interaction in the language learning process. Since the late 1970s to early 1980s, the CLT approach has been advocated as an effective teaching and learning strategy (Dos Santos, L. M. (2020). For secondary school children, CLT encourages interactive activities such as role-plays, debates, and problem-solving tasks where language use is contextual and meaningful. By engaging in communicative tasks, students develop fluency, improve their ability to express themselves in English, and gain confidence in using the language authentically.

According to Richards, J. C., & Rodgers, T. S. (2014), CLT focuses on communicative competence, which includes not only linguistic competence but also sociolinguistic and strategic competence. This holistic approach ensures that students not only learn language structures but also understand how to use them appropriately in various social and cultural contexts. In other words, the purpose of the CLT approach is to help students handle the communication skills of the target language (Dos Santos, L. M. (2020).

Task-Based Language Teaching (TBLT)

Task-based language teaching (TBLT) is a high-profile approach which has developed out of the communicative approach to language teaching, established during the 1980s (Hasnain, S., & Halder, S. (2023). Task-Based Language Teaching (TBLT) revolves around the completion of meaningful tasks that require the use of English to achieve specific objectives. In secondary school settings, TBLT can be implemented through project-based learning, simulations, and collaborative activities. These tasks comprise 'real world' or 'target' tasks and 'pedagogic' tasks as distinguished by Nunan, D. (2004). Nunan, D. (2004): 1) says real world tasks involve 'use of language beyond the classroom' and pedagogic tasks 'occur in the classroom'. These tasks simulate real-world language use scenarios, encouraging students to apply their language skills in practical contexts. By engaging in tasks that are relevant and challenging, students develop problem-solving abilities and enhance their communicative proficiency in English.

Ellis, R. (2014) emphasizes that TBLT not only promotes language acquisition but also fosters autonomy and motivation among learners. By focusing on tasks that are meaningful and achievable, educators can create dynamic learning experiences that cater to the diverse needs and interests of secondary school students.

Integration of Technology

Technology plays a transformative role in English language teaching by providing interactive tools, multimedia resources, and virtual communication platforms (Hampel, R., & Stickler, U. (2005). The integration of technology in ELT provides secondary school students with access to a wide range of resources and interactive learning opportunities. Educational apps, online platforms, and multimedia materials offer engaging ways to practice language skills, access authentic language content, and receive immediate feedback. Digital tools enhance learning experiences by offering immediate feedback, personalized learning paths, and authentic language materials from diverse cultural contexts. Today, the use of technology has become a necessity, not a privilege. Because technology is included in every area of our life, mobile phones, cars, apps, computers, smart homes, and many things we cannot here count constitute the abundance of examples (Yilmaz, A. (2021). Virtual classrooms and communication tools enable students to participate in discussions, collaborate with peers globally, and develop digital literacy skills alongside their language proficiency. Technology makes many direct and indirect contributions to the education system. Online learning, simulation environments, virtual laboratories, access to scientific information, instant access to technological developments, online learning applications and many other situations are solely some of these (Brito, R., Dias, P., & Oliveira, G. (2018).

Hampel and Stickler (2005) suggest that technology-enhanced language learning environments can enhance motivation and engagement among students, particularly in secondary school settings where digital literacy is increasingly important for academic and professional success.

Developing Cultural Competence

Cultural competence is integral to effective language learning as it enables students to understand and navigate diverse cultural norms, values, and communication styles. Educators can promote cultural competence by integrating cultural content into lessons, exposing students to diverse perspectives, traditions, and customs associated with English-speaking cultures. By fostering respect for cultural diversity and empathy towards others, students develop the skills needed to communicate effectively and respectfully in multicultural environments.

Cultural competence is essential for effective communication and understanding in a multicultural world (Kramsch, 1993). In ELT, cultural competence involves developing awareness of cultural norms, values, and communication styles associated with English-speaking cultures. Educators can promote cultural competence by integrating cultural content into language lessons, exposing students to diverse perspectives, traditions, and customs. By exploring cultural topics, literature, and media from English-speaking countries, students gain insights into cultural diversity and develop empathy and respect for different cultural identities.

Kramsch (1993) argues that language and culture are inseparable, and language learning should encompass intercultural competence to prepare students for global citizenship. By incorporating cultural content into language lessons, educators can help students develop a deeper understanding of the cultural contexts in which English is used worldwide.

Conclusion

In conclusion, effective teaching methods in English Language Teaching (ELT) for secondary school children play a pivotal role in facilitating language acquisition, fostering fluency, and promoting proficiency in English. By embracing methodologies such as Communicative Language Teaching (CLT) and Task-Based Language Teaching (TBLT), educators empower students to engage actively in the language learning process through authentic communication and meaningful tasks. These approaches

not only enhance linguistic competence but also nurture critical thinking, problem-solving skills, and confidence in using English in various contexts.

As ELT continues to evolve in response to technological advancements and cultural globalization, educators must adapt instructional strategies that prioritize communicative competence, cultural awareness, and digital literacy. By staying abreast of educational innovations and continuously refining teaching practices, educators can create dynamic and inclusive learning environments that meet the evolving needs of secondary school students.

Ultimately, through effective teaching methods that emphasize communication, critical thinking, cultural understanding, and technological proficiency, secondary school students can develop the language skills necessary to succeed academically, professionally, and personally in an interconnected and multicultural society.

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BURNOUT OF ENGLISH TEACHERS IN UKRAINE IN THE CONDITIONS OF WAR**Petliovana Liliia**Ph.D., Associate Professor
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In recent years, job burnout of English teachers in Ukraine has become prominent in the field of education and psychology. The emergence of the syndrome of professional (emotional) burnout among teachers became especially relevant after the full-scale Russian invasion when many teachers (especially English teachers) had to change their place of residence or even go abroad because of the war. The lack of live communication with students in the usual classroom, the inability to work online safely and systematically due to frequent blackouts, constant air raids, domestic discomfort, a wide range of responsibilities, and the need for continuous professional development – all this disrupted the established working regime and narrowed the possibilities for proper rest.

According to a GoGlobal study, 54% of Ukrainian teachers experience professional burnout. The survey of educators focuses on the problems of adaptation to IDP at higher schools, changes in the condition of students, professional burnout, and the need for psychological support.

82% of teaching staff are confident that they can work with students who have severe stress or psychological problems. Signs of stress include anxiety, frustration, lack of motivation to learn, apathy, indifference, confusion, and lack of attention. In addition, teachers need knowledge and skills on how to act in extreme situations, help students, identify signs of stress in learners, and resolve conflicts between students.

When teaching online, teachers feel the need for technical and practical assistance, such as help with holding lessons and implementing methodological recommendations. In addition, 71% of the teachers complain about the lack of Internet access [10].

Teaching has long been regarded as the most prestigious profession in the world, with various reputations and expectations from all sides. However, teaching is also considered to be one of the most stressful professions in the world.

Burnout is a serious psychological syndrome that can affect an individual's well-being and the functioning of whole organizations, such as universities. It consists of three basic stages: exhaustion, depersonalization, and reduced personal accomplishment. A sense of achievement concerning their careers. The first aspect is emotional exhaustion which alludes to a circumstance in which educators lack the emotive energy to keep up with a learner's education and manner because of prolonged encounters with different inconveniences. In addition, emotional exhaustion is a consequence of being overwhelmed and exhausted by being with others, specifically, learners. The second aspect is depersonalization, which is a circumstance in which the educator does not show emotions to the learners and regards them as objects as opposed to individuals. Depersonalization can be a consequence of the emotive requirements of the career as an educator, which could deny educators the ability to be reactive to learners' needs (Maslach). Weak personal efficacy is the feeling an individual has of being less beneficial and competent in their work. It refers to a negative assessment of their career performance and the overall value of their career.

Thus, it is quite natural that in order to fulfill their professional mission, English teachers should have, on the one hand, deep theoretical and practical knowledge, and, on the other hand, a psychological resource that will allow them to solve professional tasks in a quality manner. The depletion of this resource leads to the teacher's "professional burnout", the danger of which lies primarily in the decrease in the teacher's own performance, and deformation of his/her personality, which at the same time affects the psychological state of students, their attitude to learning, motivation, etc.

Not only personal variables but also work-setting characteristics influence burnout. The teaching profession is claimed to be extremely demanding, hence teachers seem to be prone to burnout. This may be the reason why the syndrome has already been investigated about teachers of various subjects or levels. Yet, there has been no research to date attempting to investigate burnout in English teachers. It may be speculated that as learning a new language is different from learning any other subject, also teaching it may require different skills on the part of the teacher, leading to different (most probably higher) levels of burnout. Consequently, a thorough investigation of foreign language teacher burnout in Ukraine should be proposed.

Research results show that it is not only a cross-cultural phenomenon but a very serious problem. The stress may not only lead to health problems but also affect the quality of teachers' work and their relationships with other participants in the educational process such as students, colleagues at work, and family members. Teachers who suffer from constant stress leading to burnout in a majority of cases escape from their duties, often take sick leave, and become less effective. Therefore, it seems crucial to focus on the roots of teachers' stress, try to understand the nature of burnout, and find effective ways to cope with its negative consequences.

As indicated by Kocór, teachers are at risk of burnout more than any other professionals. Because of the fact that in their work they are in close contact with students and their parents; it is teachers who educate, behave, and solve problems. An educator's job requires not only comprehensive knowledge but also engagement and commitment. As a result, teachers have their students' problems in mind even when they do not perform their professional activity but are at home getting prepared for the next lessons. It can lead to the situation that a teacher may transform school problems into family life. It causes conflicts, a tense domestic atmosphere, and blurs the border between work and family life, violating all the more importance of decent health balance [4, 2].

In a similar vein, Pokhrel and Chhetri emphasize that working from home as an additional job obligation to working in the classroom setting exacerbates the stress response. One of the greatest factors in chronic work stress is working consistently in the evenings in addition to a full-time day shift, spending the supposed relaxation time planning and grading. Work that penetrates teachers' personal and family time is perceived as an additional hardship that was not meant by the initial "work agreement" [8, p. 135]. Furthermore, working from home deletes the perception differentiation between home and comfort. The teacher's brain never feels "at home", the environment where it can relax and separate the educator from professional challenges and responsibilities [3, p.97].

It is maintained that multiple elements cause educator burnout. Personal elements involve demographic or character factors (age, gender, years of instructing experience, character, etc.). Outcomes regarding age as an indicator of educator burnout are rather inconsistent in the literature. For example, some research has no proof of age as an indicator of educator burnout. In research that discovered gender differences, consistent results involved female educators documenting greater degrees of emotive fatigue and male educators documenting greater degrees of depersonalization and ineffectiveness. As for marital status, single people (men in particular) are more likely to have burnout than married people. Unmarried individuals appear to have even greater degrees of burnout than divorced individuals. Concerning ethnicity, very little research has evaluated this demographic factor; thus, it is impossible to outline any experiential patterns. Also, the outcomes demonstrated that the most effective elements in the condition of burnout are the expressive dimensions of character and career inconveniences like career anxiety and societal help [5, p.108]. Among the career inconveniences, the discerned workload had the strongest effect on the aspect of emotive fatigue and affected this burnout element with the greatest regression coefficient. It is demonstrated by this outcome that workload is a deciding element for the growth of the condition. The discerned workload is linked to the degree of obligation a person intends to accept and the discerned function anxiety a person encounters. Therefore, function anxiety and obligation could be intermediary elements between burnout and discerned workload [2, 4, 9].

Other reasons for personal burnout in educators determined in the literature are decreased independence and self-effectiveness, (decreased self-esteem is the capability of effectively coping with a particular circumstance); inflexibility regarding criteria, goals, and functions; low expectations of school administration and instructing institutions, specifically if the latter is linked to a school institution that is not open to alteration and innovation [1, p.183]. Institutional elements involve organizational and career features like unsuitable career requirements, socioeconomic status of the school, managerial help, etc. Maslach has determined six kinds of institutional inconveniences: career overload, absence of authority (dispute circumstances or function uncertainty), inadequate fulfillment, fall of the sense of civic and belonging (when teamwork is deficient, and so, respect is absent), unfair management within one institution, and so on [5, p.109].

Elements that may increase educator burnout involve an absence of societal help from peers and managers, lower socioeconomic school status, institutional inflexibility, career requirements overload, insufficient payments or assets, inadequate educator training or coaching in handling issues involving controlling learners, absence of educators' involvement in school decision making, and other physical factors like crammed classes, poor workplaces, and poor career circumstances. Overall, societal help offers chances for reassessments and adjustive reactions to career anxiety leading to alleviated burnout.

Furthermore, heavy workloads involve offering feedback on tasks and getting ready for exams and assessments. Career pressure leads to burnout in all dimensions. Moreover, the speed of the condition's growth is increased by career requirements. Studying educator burnout in the setting of EFL is an important topic as outcomes of studies demonstrate that educator burnout can harm learners' education and inspiration. For example, Meidani showed that an important environmental element is educators' burnout status, which is associated with the standard of learners' inspiration [6, p.5].

However, it is worth stating that excessive constant stress in most cases leads to burnout with devastating consequences for both the teacher's life and the whole social surroundings of a person. Emotional fatigue or exhaustion develops against the background of events and news about the war. The main signs of emotional exhaustion during the war are irritability from the news; unwillingness to read the news; war-related content fatigue; apathy; reducing the intensity of the impact. Many teachers and employees of educational institutions are not fully aware of the harmful effects of war on the well-being of teachers. As a result, this issue is often ignored or not addressed properly, leaving educators without the necessary support and resources to deal with the emotional challenges they face.

The profession of a teacher belongs to the professions of the "person-person" type, which is characterized by active interpersonal interaction and a high level of stress, which can lead to emotional burnout syndrome. It is important to note that the war left its mark on people's lives, in particular, it showed us how much such a profession as a teacher is in demand and important. Teachers were forced to adapt to new conditions in connection with the transition to a distance learning format. Thus, teachers have a double burden: conducting classes both online and on the university's Moodle educational portal. The distance format is characterized by the absence of "live" contact with students. Through the monitor screen, it is much more difficult to receive feedback, interest and attract attention, and maintain discipline and work atmosphere.

Emotional burnout is a characteristic phenomenon for those professionals who have constant emotional human contact. Educators are fully exposed to it, but, unfortunately, they often do not even correlate the symptoms that have appeared with this phenomenon. Without realizing that burnout is happening, they are exposed to a wide variety of risks: irreversible changes in character, deterioration or loss of health, destruction of personal relationships, sudden desire to leave the profession, and loss of accumulated experience, status, and interest.

Depression, apathy, a feeling of constant fatigue, sometimes rudeness, and intemperance are often the result of the increased intensity of pedagogical work.

So, the symptoms of emotional burnout are:

- fatigue, inability to recover overnight or on weekends;
- tension, constant anxiety, excitement, inability to switch from thoughts about work, difficulty falling asleep, shallow sleep;
- frequent irritation and difficulty in hiding negative attitudes towards students, colleagues, couples, and noise;
- the desire to perform even creative work monotonously, stereotypically;
- resistance to any changes and innovations;
- apathy, pessimism, cynicism, passivity, feeling of one's own incompetence, senselessness and hopelessness of work;
- the desire to compensate for the condition after the working day through overeating, alcohol consumption, frequent smoking, and mindless viewing of all TV programs.

Practical recommendations for a teacher with emotional burnout:

1. Regular rest, finding a balance between work and rest. Try not to take work home with you.
2. Constant physical exercises. Find the kind of physical activities that will bring pleasure (running, yoga, pilates, etc.).
3. Full sleep is the most important factor that reduces stress and emotional burnout.
4. Organization of your work (workplace, daily schedule, etc.).
5. Visiting a psychologist or psychological group in order to reduce symptoms of stress and emotional burnout.
6. Autogenic training or meditation for the purpose of reducing psycho-emotional tension and anxiety, as well as restoring strength.
7. Creation of circles at the university for psychological and pedagogical support of teachers with emotional burnout, which will include diagnosis (reveals changes in the expressiveness level of emotional burnout and personal characteristics of the teacher), determination of maladaptive strategies for overcoming the syndrome, development and implementing a program to overcome the syndrome.

8. Creation of an educational direction at the university, which will include holding lectures with the aim of informing teachers about the causes and signs of emotional burnout; and familiarization of teachers with self-help methods and techniques for maintaining work capacity and psychosomatic health [7, p 171].

Burnout is a crucial mental condition that can impact both human well-being and different institutions like schools. EFL educator programs must provide personal and group guidance services to educators who are prone to burnout and must manage educators regularly to monitor alterations in their way of living and standard of instruction. Such programs need to aim at enhancing educators' interpersonal relationship competencies and increase their coping tactics to allow them to deal with challenges at work and prevent educator burnout

In the conditions of war, everyone needs psychological support, especially teachers, because in order to teach and share new experiences with their students, it is important to have it has its own resources. It is important for a teacher to learn how to quell one's own destructive thoughts, regulate emotions, and prevent one's own burnout in time.

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Physical sciences

CURRENT STATE OF THE POLYCRYSTALLINE SILICON MARKET

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Abstract

The article analyzes the current state of the global polycrystalline silicon market. Despite efforts to reduce production costs, prices for polycrystalline silicon remain relatively high due to high demand. It is concluded that the polycrystalline silicon market has positive growth prospects due to global efforts to switch to renewable energy sources.

Keywords: polycrystalline silicon, solar panel, ecology, investment, market, driver.

Introduction

Polycrystalline silicon is one of the key materials in the production of solar panels and semiconductors. Today, the polycrystalline silicon market is characterized by high development dynamics, due to both the growth in demand for solar batteries and innovations in technological production processes. This article examines the main trends, challenges and prospects that determine the current state of the polycrystalline silicon market.

China is the world leader in polycrystalline silicon production, accounting for more than 80% of global output. This is due to significant investment in solar energy development, government support, and technological innovations that allow Chinese companies to maintain competitive prices for their products. The largest players in this segment are Tongwei Group, GCL-Poly Energy Holdings, Daqo New Energy Corp., Xinjiang East Hope New Energy Co., and Xinte Energy Co. These companies are constantly expanding their production capacity and introducing new technologies to improve production efficiency.

Growing global demand for solar panels continues to drive polycrystalline silicon production. The shift to renewable energy sources, the desire to reduce carbon emissions, and the active development of solar power infrastructure in various countries are driving demand for polysilicon. Demand for polycrystalline silicon is expected to grow at 10-15% per year in the coming years, driven by global efforts to transition to green energy sources.

The polycrystalline silicon market is dominated by a few large producers, primarily from China. Table 1. shows the largest producers and their production capacities.

Table 1.

Company	Location	Production capacity (tons/year)
Tongwei Group	China	220,000
Daqo New Energy Corp.	Xinjiang, China	225,000
GCL-Poly Energy Holdings	China	250,000
Xinte Energy Co., Ltd.	China	200,000
Wacker Chemie AG	Germany	80,000
OCI Company Ltd.	South Korea	90,000
Xinjiang East Hope New Energy Co., Ltd.	Xinjiang, China	150,000
Hemlock Semiconductor	Michigan, USA	36,000
Jiangsu Zhongneng Polysilicon Technology Development Co., Ltd.	Jiangsu, China	70,000
JinKo Solar Holding Co. Ltd.	Jiangxi, China	60,000

The table shows that the largest volumes of polycrystalline silicon production are concentrated in Chinese companies, which account for a significant portion of global production. Market leaders such as Tongwei Group, GCL-Poly Energy Holdings and Daqo New Energy Corp. continue to increase their capacity to meet growing demand.

The growth of the global solar panel market is the main driver of demand for polycrystalline silicon. This is due to increased investment in solar energy and government initiatives to transition to renewable

energy sources. Fig. 1 shows a graph illustrating the annual growth of installed solar panel capacity worldwide.

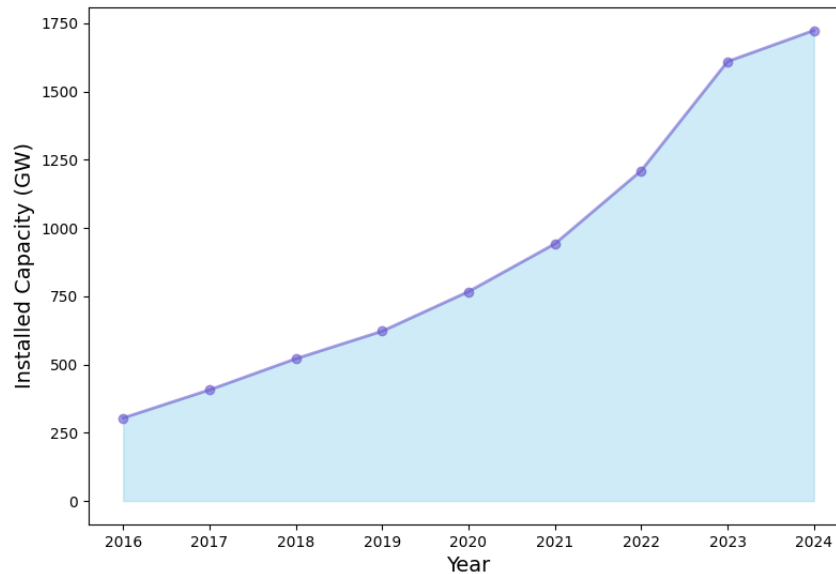


Fig. 1. Annual Growth of Installed Solar Power Capacity Worldwide (2016-2024)

A significant increase is projected in 2024, driven by continued declines in solar technology costs and support from governments around the world.

Polycrystalline silicon prices have been relatively volatile in recent years due to various factors including demand, production costs, and geopolitical risks. Table 2. shows the average polycrystalline silicon prices over the past five years.

Table 2.

Year	Average price (\$/kg)
2019	9.5
2020	10.2
2021	12.8
2022	11.5
2023	13.3

The table reflects fluctuations in average prices for polycrystalline silicon from 2019 to 2023. In 2023, there is an increase in the average price, which is due to increased demand and an increase in production costs due to inflation and raw material costs.

Polycrystalline silicon manufacturers continue to innovate to improve production efficiency and product quality. One promising area is the use of Fluidized Bed Reactor (FBR) technology, which reduces energy consumption and production costs.

The geography of polycrystalline silicon production and consumption is influenced by various factors, including raw material availability, infrastructure, and government policies. Table 3. shows the distribution of polysilicon production and consumption by region.

Table 3.

Region	Production (tons/year)	Consumption (tons/year)
Asia	800,000	650,000
Europe	50,000	120,000
North America	30,000	70,000
Rest of the World	35,000	40,000

The table shows that the main production and consumption of polycrystalline silicon is concentrated in Asia, due to China's dominance in this industry. Europe and North America are also significant consumers, but production in these regions lags behind Asian figures.

Despite the existing challenges such as price fluctuations and logistical issues, the outlook for the polycrystalline silicon market remains favorable. Demand for polysilicon is expected to grow in the coming years due to the increasing number of solar power plants and the development of energy storage technologies.

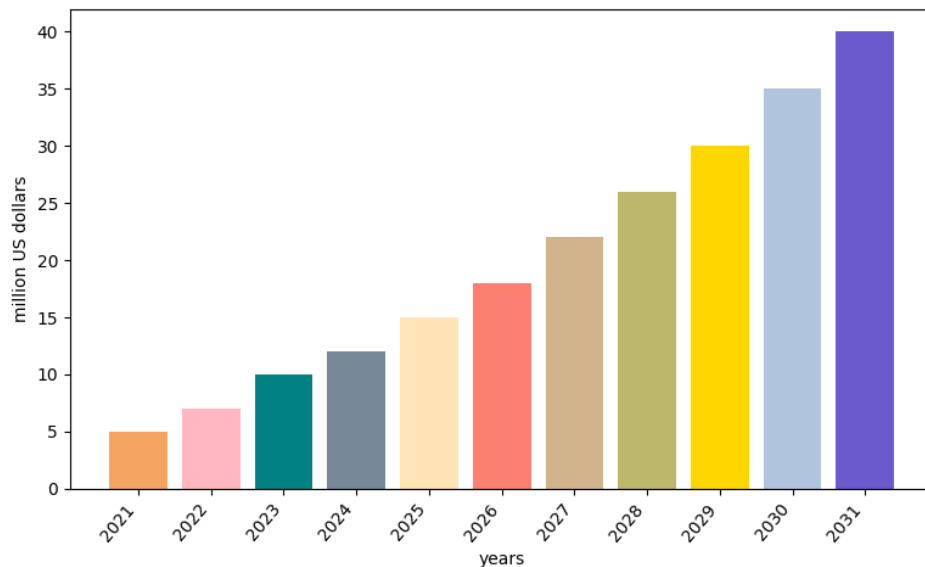


Fig.2. Polycrystalline silicon market growth forecast (2021-2031)

The graph (Fig. 2) illustrates the projected growth of the global polycrystalline silicon market from 2021 to 2031. During this period, the market is expected to grow at an average annual rate of 8-10%, driven by global efforts to transition to renewable energy sources.

Conclusion

The polycrystalline silicon market is in a stage of active development, characterized by high growth rates and significant investments in new technologies. Despite the existing challenges, the market outlook remains positive, which is due to global trends in the development of solar energy and sustainable development. Polycrystalline silicon manufacturers will continue to adapt to changing market conditions, introducing innovative solutions and increasing the efficiency of their production processes.

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