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BOTANY

PRODUCTIVITY OF SOYA VARIETIES IN THE FOREST-STEPPE OF UKRAINE

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Abstract

The article investigates the productivity of soybean varieties in the forest-steppe of Ukraine, in particular, the biological yield, chemical composition of grain and adaptive properties of different varieties. The research has shown that the Sigalia variety demonstrated the highest yield, which indicates its potential for production, as well as high protein and fat content, which makes it attractive for the food industry. Other varieties such as Diona, Diamond and Medea also performed well, but at slightly lower levels. The study highlights the importance of selecting varieties that can provide high productivity and quality, which will contribute to improved food security and economic sustainability of the agricultural sector. The results may be useful for agronomists and agricultural professionals.

Keywords: soybeans, varieties, yields, grain quality.

Introduction. Under the conditions of modern agricultural production in Ukraine, there is a growing demand for high-yielding soybean varieties, especially for cultivation in the Forest-Steppe zone, which is one of the main regions of soybean cultivation. Soybeans (*Glycine max* (L.) Merr.) are important as a source of protein and oil, which ensures their key role in food security and livestock production. The high protein content of soybeans makes them a promising crop for increasing feed supply, which is especially important given the environmental and economic challenges [1].

Breeding new soybean varieties adapted to the specific climatic conditions of the Forest-Steppe is an urgent task for agricultural science, as soybean productivity is highly dependent on weather conditions and agronomic practices. Climate change and temperature fluctuations pose additional challenges for agronomists, necessitating the search for stress-resistant soybean varieties. The forest-steppe of Ukraine has its own agro-climatic features that affect the vegetation of plants, including the length of the growing season, moisture availability and the level of stress [2, 3].

An important aspect of research into the productivity of varieties is their resistance to drought, pests and diseases, as well as their ability to achieve stable yields under changing climatic conditions. Today, Ukraine has a wide range of soybean varieties that differ in both biological characteristics and adaptive potential. However, the issue of selecting the best varieties for specific zones remains open.

The research is aimed at identifying soybean varieties that have the highest productivity and the best adaptability to the conditions of the Forest-Steppe of Ukraine. Agronomic evaluation of varieties is important to identify their optimal yield and resistance to external factors. The study includes an analysis of the response of different varieties to variable agro-climatic conditions, the level of technological support and the impact of biological products and fertilisers [4, 5].

The results of this research can serve as a basis for further improvement of soybean cultivation technologies and selection of varieties that ensure maximum productivity in the Ukrainian Forest-Steppe. This is especially important for the development of organic farming, as it allows to improve the quality and quantity of products without the use of synthetic inputs.

Material and Methods. Experiments to study soybean yields began in 2023 in the conditions of Zlagoda Farm, Bila Tserkva district, Kyiv region, and Stas Farm, Kozyatyn district, Vinnytsia region, through a comprehensive study. Laboratory studies were carried out at the Department of Plant Production Technologies and the certified laboratory of Polissia University.

From May to August 2023–2024, the Khmelnytskyi region experienced various weather conditions that affected agronomic indicators. In May 2023, the average temperature was around +16 °C, with precipitation of 60–70 mm, which was in line with seasonal norms. June was warm, with an average temperature of

+19 °C and higher precipitation of 85 mm, which created favourable conditions for crop growth. In July, the temperature rose to +22 °C, and although it reached +30 °C in some places, precipitation was 70 mm, which was slightly below normal. August 2023 ended the season with an average temperature of +21 °C and 65 mm of precipitation, accompanied by short-term showers, while maintaining sufficient soil moisture.

In 2024, May saw slightly warmer weather, with average temperatures around +17 °C, but precipitation dropping to 55 mm, causing a moderate moisture deficit. June remained warm, with an average temperature of +20 °C and precipitation of 90 mm, which provided the necessary moisture for active plant growth. July 2024 was one of the warmest on record, with an average temperature of +23 °C, at times exceeding +30 °C, and precipitation of 75 mm, which was in line with the norm. August 2024 had an average temperature of +22 °C and 60 mm of precipitation, creating optimal conditions for crop ripening.

In general, in these two years, weather conditions were favourable for agriculture, although 2024 was characterised by slightly higher temperatures and uneven precipitation, which could affect the moisture supply of crops at different stages of their development.

We studied varieties: Diamond, Dione, Medea, Sigalia. The arrangement of the experimental plots was systematic, replicated four times. The accounting area was 50 m².

The predecessor was hybrid winter rye. Ploughing was carried out after 3 weeks on the winter rye, with a

depth of 22–24 cm. Before sowing – cultivation by 4–5 cm. The sowing method was line sowing (15 cm). The norm is 450 thousand germinating seeds per hectare. Rolling after sowing to preserve moisture. In the phase of 1–3 trifoliate leaves of soybeans, the crop was treated with a tank mixture of Bazagran herbicide, 0.7 l/ha, and Karate Zeon insecticide, 0.6 l/ha.

The grain harvest on the plots was harvested after removing it from the protective strips. The accounting part of each plot was harvested by a combine harvester, placed in bags and weighed.

Statistical data processing was carried out using Microsoft Office Excel 2015 and Statistica software.

Results. Research results show that soybean yields are influenced by complex factors, including agronomic practices, varietal characteristics, climatic conditions and nutrition. An important factor is the choice of a variety that must be adapted to local conditions to realise its genetic potential. Among agronomic practices, special attention is paid to seeding rates and row spacing, which ensure optimal plant density. The use of biological and chemical plant protection products also plays a significant role in controlling weeds and pests. Research shows a significant dependence of yields on weather conditions, such as rainfall and temperature during critical phases of soybean growth.

One of the main features that characterises the economic value of soybean varieties is grain yield, which depends on the elements of productivity. Thus, the elements of the yield structure to a certain extent reflect the value of soybean yield (Table 1).

Table 1.

Formation of the yield structure of the studied soybean varieties, 2023–2024

Varieties	The height of the plant, cm	Lower bean attachment height, cm	Number of plants per 1m ²
Medea	70–94	15	40,8
Diona	80–102	15	41,7
Diamond	70–92	16	42,5
Sigalia	70–82	16	43,4

Table 1 presents the characteristics of four soybean varieties – Medea, Diona, Diamond and Sigalia – with the main parameters that affect their productivity and adaptive properties. Plant height: among the varieties, Diona has the highest height (80–102 cm), which may indicate a greater potential for yield formation under optimal conditions. Plant height of other varieties varies from 70 to 94 cm. Lower bean attachment height: This is important for mechanised harvesting as lower beans may be left unharvested. Medea and Diona have a lower bean attachment height of 15 cm, and Diamond

and Sigalia have a lower bean attachment height of 16 cm, which is sufficient for more efficient harvesting.

Number of plants per m²: plant density also affects yields. The Sigalia variety has the highest number of plants per m² (43.4), which can provide higher productivity under favourable conditions. The other varieties have between 40.8 and 42.5 plants per m², which is also optimal for achieving high yields.

In general, these indicators help to determine the potential of each variety for use in different agro-climatic conditions and cultivation technologies (Table 2).

Table 2

Quantitative indicators of the harvest, 2023–2024

Varieties	Number of beans per plant, pcs.	Number of seeds per bean, pcs.	Number of seeds per plant, pcs.	Weight of 1000 seeds, g
Medea	20,5	2,2	44,6	126
Diona	22,3	2,1	55,3	134
Diamond	23,6	2,7	61,2	171
Sigalia	21,0	2,6	57,0	158

Table 2 shows the productivity data of four soybean varieties – Medea, Dion, Sigalia and Diamond. They include the number of beans per plant, the number of seeds per bean, the total number of seeds per plant, and the weight of 1000 seeds.

Among the four varieties, Sigalia demonstrates the highest productivity indicators, in particular, the number of beans per plant is 23.6 and the average number of seeds per bean is 2.7, which is the highest among the varieties presented. This ensures the maximum total number of seeds per plant – 61.2 pcs, and the weight of 1000 seeds is 171 g, which indicates good filling and weight of seeds.

The Diamond variety also has high productive characteristics, including 21 beans per plant and an average number of seeds per bean of 2.6. The total number of seeds per plant reaches 57.0, and the weight of 1000 seeds is 158 g, which is slightly lower than Sigalia, but still quite high.

The Diona variety is distinguished by its average performance: about 22.3 beans are formed per plant, with an average of 2.1 seeds per bean, which ensures a total number of seeds of 55.3 pcs. At the same time, the

weight of 1000 seeds is 134 g, which is slightly less compared to Sigalia and Diamond.

Finally, the Medea variety has the lowest performance: the number of beans per plant is 20.5, the number of seeds per bean is 2.2, and the total number of seeds per plant is 44.6. The weight of 1000 seeds is 126 g, which indicates a lower productivity of this variety compared to others.

Thus, analysing the indicators, we can conclude that Sigalia and Diamond are the most productive varieties due to the higher number of seeds and higher weight of 1000 seeds, which gives them an advantage in potential yield.

To evaluate the performance of different soybean varieties, we conducted a yield analysis that reflects the differences between varieties in terms of quantitative indicators. The table below shows the results for each variety, allowing us to compare their yield potential. The data includes the average yield depending on the varietal characteristics, which takes into account the adaptive properties of each variety to the growing conditions. This allows us to draw conclusions about the most productive varieties for further introduction into agricultural production (Figure 3).

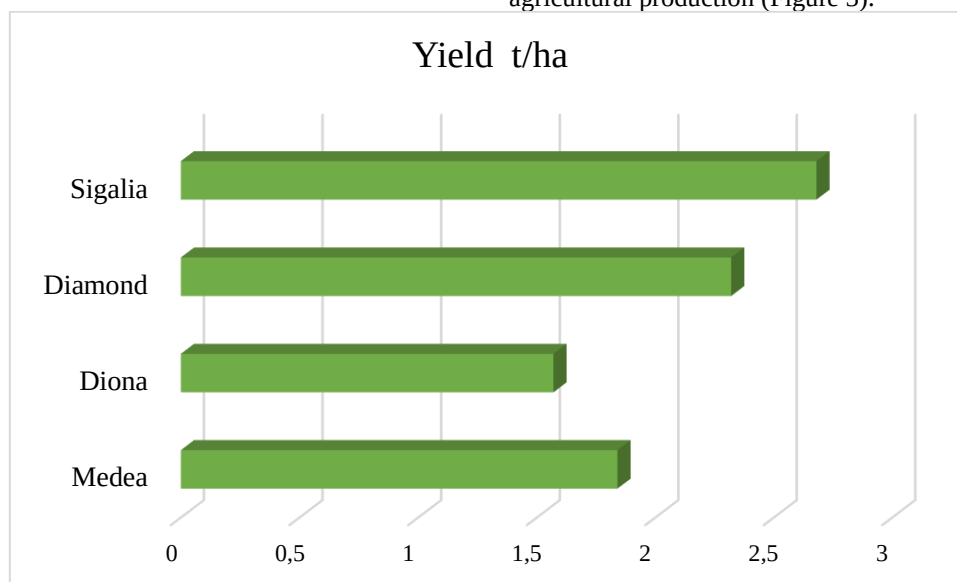


Figure 3. Grain yield of soybean varieties under study, 2023-2024

Figure 3 shows the yields of four soybean varieties: Dione, Medea, Diamond and Sigalia. Among them, Sigalia showed the highest yield of 2.68 t/ha, which indicates the high potential of this variety to produce a significant yield under favourable conditions. The second highest yielding variety was Diamond, with 2.32 t/ha, which also makes it a productive choice.

The Diona and Medea varieties demonstrated lower biological yields of 1.84 and 1.57 t/ha, respectively. This indicates their relatively lower potential, which may be due to their varietal characteristics or

adaptability to growing conditions. Thus, in order to achieve maximum productivity among the studied varieties, it is recommended to grow Sigalia and Diamond varieties, which show higher yield results.

In 2023–2024, studies of the chemical composition of soybean varieties revealed important characteristics that affect their food and technological use. The analysis showed a variety of protein, fat and carbohydrate content, which makes these varieties valuable for feed and food production (Table 4).

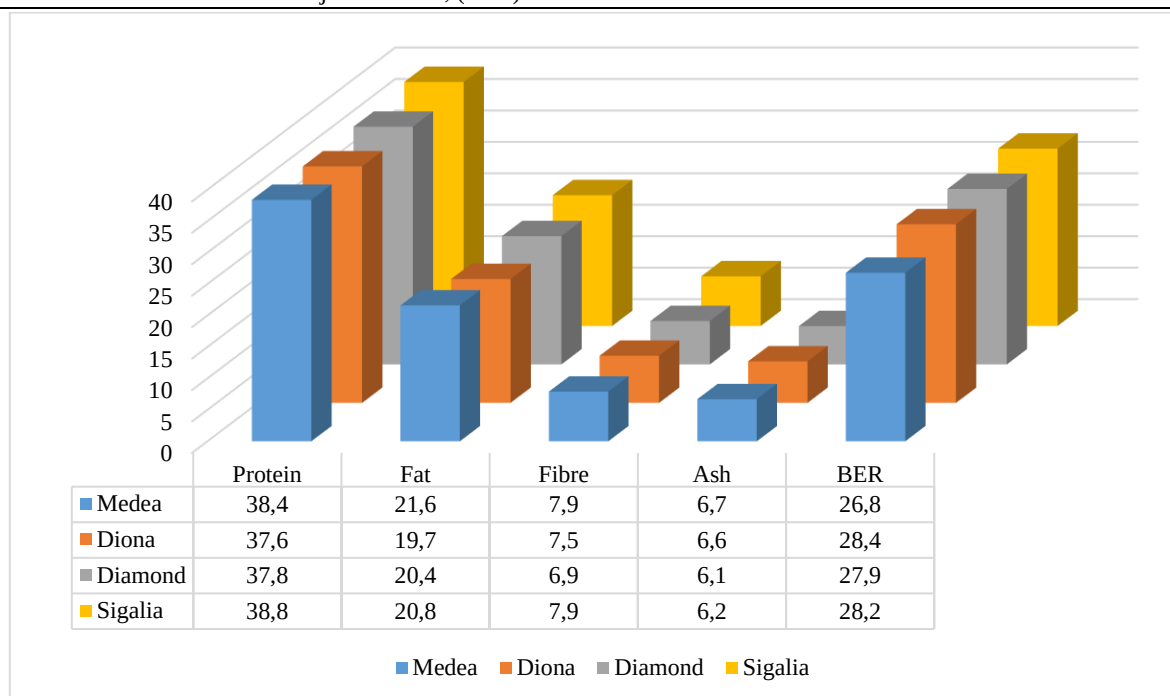


Figure 4. Chemical composition of grain of soybean varieties, 2023-20234

The figure 4 shows the chemical composition of the grain of four soybean varieties - Dione, Medea, Diamond and Sigalia – with a focus on protein, fat, fibre, ash and energy balance (EB).

Sigaliya has the highest protein content of 38.8 %, which indicates its potential as a nutritious component in animal and human diets. Compared to other varieties, Diona also has a high protein content (38.4 %), which makes it attractive to agronomists and processors.

Medea shows a protein content of 37.6 %, and Diamond – 37.8 %, which indicates sufficient nutritional value, but lower compared to Sigila.

Fat content ranges from 19.7 % for Medea to 21.6 % for Diona, with Sigila and Diamond averaging 20.8 % and 20.4 % respectively. Fibre, which is important for digestion, is highest in Diona and Sigalia (7.9 %), while Diamond has a 6.9 % content.

The varieties also differ in terms of ash content: Diamond has the lowest content (6.1 %), while the other variants range from 6.2 % to 6.7 %.

In general, the analysis of the chemical composition of the grain shows that Sigalia and Diona have the highest protein and fibre values, making them the most nutritious varieties, while the others, although having good characteristics, show slightly lower values. These results are important for the selection of soybean varieties that can meet the requirements of modern agromonic production.

Conclusion. As a result of the research, it was found that the productivity of soybean varieties varies significantly depending on their biological characteristics and chemical composition. The Sigalia variety was the most productive, demonstrating the highest yield (2.68 t/ha), which indicates its prospects for cultivation in the forest-steppe of Ukraine. The high protein and fat content in the grain of this variety makes it particularly valuable for the feed industry and nutrition.

Thus, the results of this study can be useful for agronomists seeking to optimise soybean production, ensuring a high-quality harvest and increasing the efficiency of agricultural production in Ukraine. It is recommended to introduce the most productive varieties into practice, which will improve food security and economic sustainability of the agricultural sector.

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CHEMISTRY

АКТИВНОСТЬ $\text{Al}\cdot\text{Ca} / \text{MnO}_x\cdot\text{CoO}_y\cdot\text{Pd}$ МАРГАНЕЦ-КОБАЛЬТ-ПАЛЛАДИЕВОГО КАТАЛИЗАТОРА В РЕАКЦИИ ОКИСЛЕНИЯ СО

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ACTIVITY OF $\text{Al}\cdot\text{Ca} / \text{MnO}_x\cdot\text{CoO}_y\cdot\text{Pd}$ MANGANESE-COBALT-PALLADIUM CATALYST IN CO OXIDATION REACTION

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Аннотация

Изучена активность марганец-палладиевого, кобальт-палладиевого и марганец-кобальт-палладиевого катализаторов, нанесенных на модифицированный алюмокальциевый носитель, в реакции окисления СО. Показано, что смешанный $\text{Mn}\cdot\text{Co}\cdot\text{Pd}$ катализатор более активен, чем образцы $\text{Mn}\cdot\text{Pd}$ и $\text{Co}\cdot\text{Pd}$.

Abstract

The activity of manganese-palladium, cobalt-palladium and manganese-cobalt-palladium catalysts supported on a modified alumina-calcium carrier was studied in the reaction of CO oxidation. It was shown that the mixed $\text{Mn}\cdot\text{Co}\cdot\text{Pd}$ catalyst is more active than $\text{Mn}\cdot\text{Pd}$ and $\text{Co}\cdot\text{Pd}$ samples

Ключевые слова: Алюмокальциевый носитель; окисление СО; $\text{Mn}\cdot\text{Co}\cdot\text{Pd}$ катализаторы.

Keywords: Alumina-calcium carrier; CO oxidation; $\text{Mn}\cdot\text{Co}\cdot\text{Pd}$ catalysts.

В реакции окисления СО изучены активности и основные физико-химические свойства как оксидных, так и смешанных $\text{Mn}\cdot\text{Pd}$ катализаторов [1]. Для применения в системах очистки отработанных газов как бензиновых, так и дизельных двигателей пригоден марганец-палладиевые катализаторы (марки МПК-1), нанесенные на алюмокальциевом носителе содержащие до 0,05 мас.% Pd [2, 3]. Применение оксидов марганца в виде вторичного носителя и активного компонента в комбинации с оксидами металлов с переменной валентностью, можно получить высокоактивные композиции для окисления СО [4]. В этом отношении интерес представляет изучение влияния добавок оксидов кобальта на активность марганец-палладиевого катализатора

МПК-1. В реакции окисления СО кобальтовые катализаторы $\text{Al}\cdot\text{Si} - \text{CoO}_y$ оказались более активны в зоне низких температур 140-170 °С, а катализатор $\text{Al}\cdot\text{Si} - \text{MnO}_x$ в зоне более высоких температур - 220–300 °С [5]. Катализатор $4\text{Co}\cdot\text{Mn}$ проявляет высокую активность и стабильность в процессе углекислотной конверсии метана [6].

Ниже приведены результаты изучения активности и термостабильности марганец-палладиевого, кобальт-палладиевого и марганец-кобальт-палладиевого катализаторов в реакции окисления СО. Катализаторы готовились путем одноразового диффузионного насыщения модифицированного алюмокальциевого носителя ШН-2М [7], водными

растворами азотнокислого марганца и кобальта. Технологические стадии приготовления кобальт-палладиевого и марганец-кобальт—палладиевого катализаторов такие же, как для катализатора МКПК-1. Формирование фазового состава оксидно-марганцевого катализаторов на алюмокальциевом носителе ШН-2М изучено и описано [3]. Разложение нитратов марганца и кобальта при температуре 400-450 °С протекает с образованием диоксида марганца и оксида кобальта. В смешанном марганец-

кобальтовом катализаторе - $\text{Al}\cdot\text{Ca} / \text{MnOx}\cdot\text{CoOy}\cdot\text{Pd}$ также зафиксированы эффекты, характерные для индивидуальных оксидов [8].

Испытания активности приготовленных образцов в реакции окисления CO, полученные на лабораторной проточной установке показали, что смешанные марганец-кобальт-палладиевые катализаторы по активности превосходят кобальт-палладиевый и марганец- палладиевый катализаторы (табл. 1).

Табл. 1.

Активность марганец-палладиевого и марганец-кобальт-палладиевого катализаторов в реакции окисления CO

Катализатор	Степень конверсии CO, % при температурах				
	100 °С	150 °С	200 °С	250 °С	300 °С
$\text{Al}\cdot\text{Ca} / \text{MnOx}\cdot\text{Pd}$ (МКПК-1)	5	63	81	86	86
$\text{Al}\cdot\text{Ca} / \text{CoOy}\cdot\text{Pd}$	5	70	75	85	85
$\text{Al}\cdot\text{Ca} / 2 \text{MnOx}\cdot\text{CoOy}\cdot\text{Pd}$	33	79	84	92	93
$\text{Al}\cdot\text{Ca} / \text{MnOx}\cdot\text{CoOy}\cdot\text{Pd}$	10	60	79	90	92
$\text{Al}\cdot\text{Ca} / \text{MnOx}\cdot 2\text{CoOy}\cdot\text{Pd}$	10	67	83	86	86

Рентгеноспектральный микроанализ проведенный на электронном зонде MS-46 французской фирмы “Сатеса” показал, что в катализаторе МКПК оксиды марганца и кобальта распределены по разному. Оксиды кобальта сконцентрированы в поверхностном слое носителя ШН-2М, проникая в глубину до 500 мкм, а оксиды марганца - на глубину 1000-1200 мкм. Соответственно, марганец и кобальт находятся на поверхности в изменённом количественном соотношении по сравнению с их общим содержанием в катализаторе (рис. 1). Анализ поверхностного слоя толщиной 500 мкм показал, что на данной глубине слоя сосредоточено до

90 мас. % палладия от общего наносимого количества. Следовательно, промотирующий эффект палладия проявляется на той глубине слоя, где находится основная часть оксидов кобальта и сравнительно незначительная часть оксидов марганца. Модифицирование оксида алюминия оксидом кальция стабилизирует оксиды кобальта в виде отдельной фазы [9]. Полагают [10], в присутствии палладия в поверхностном слое кобальт-палладиевого катализатора ионы Co^{3+} и Co^{2+} сохраняются в окта- и тетраэдрической координации. Палладий препятствует переходу кобальта в тетраэдрическую вакансию с образованием фазовой шпинели CoAl_2O_4 .

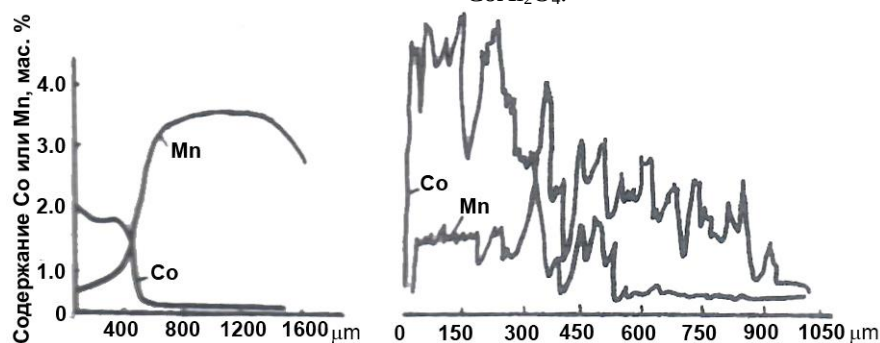


Рис. 1. Концентрационные кривые распределения Mn и Co в катализаторе МКПК

Активность катализатора МКПК после прокалики при температуре 600-900 °С в течение 10 часов близка, что можно объяснить сохранением ис-

ходного химического состава оксидов кобальта, которые сосредоточены у поверхности и в большей степени отвечают за его активность и стабильность

Табл. 2.

Влияние термообработки на активность опытных образцов Марганец-палладиевого (МПК-1) и марганец-кобальт-палладиевого (МКПК) катализаторов в реакции окисления СО ($W = 30$ тыс. ч^{-1} , $G_{\text{кат.}} = 5\text{г}$, реакционная смесь – 0,5 об. % СО + воздух).

Катализатор	Условия обработки		Температуры заданных степеней конверсии СО, %			
	Т, °С	τ, час	25 %	50%	70%	90%
МПК-1	--	--	130	138	174	230
	900	10	190	195	210	> 300
МКПК	--	--	128	140	155	210
	600	10	166	178	190	225
	900	10	183	189	194	235

Испытания на стенде в процессе дожигания отработанных газов бензиновых двигателей показали [11], что активность МКПК сопоставима с активностью палладиевых катализаторов (ШПК-0,5 и ШПАК – 0,3) и имеет близкие к ним температуры 50 %-ного превращения: по СО – 155 °С и по углеводороду – 155 °С. По этим показателям катализатор МКПК превосходит катализатор МПК-1.

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COMPUTER SCIENCES

SECURING MILITARY CYBERSPACE: A DETAILED ANALYSIS OF THREAT VECTORS AND STRATEGIC SOLUTIONS FOR BATTLEFIELD NETWORKS

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Abstract

While networked information systems are becoming the backbone of military operations, the problems of network system security increase accordingly. Battlefield networks dependent on wireless communication due to mobility have opened up a vast potential for cybersecurity attacks. This paper provides a broad overview of the key cybersecurity threats facing the military battlefield network, with an emphasis on the risks contributed by wireless communication. It further covers advanced protection mechanisms, including encryption, access control, and continuous monitoring of networks. It assesses the security impacts of some emerging technologies: SDR and CR technologies. The security recommendations are made at the end in the form of strong encryption, real-time monitoring, and adaptive architectures for cyberspace security. These recommendations would surely help in preserving the integrity of operations in the modern military environment.

Keywords: cybersecurity, military networks, battlefield networks, wireless communication, cyber threats, defense mechanisms, software-defined radio, cognitive radio.

INTRODUCTION

It also follows that military operations are becoming increasingly digital communications network-based, extending from tactical operations to higher echelons of command and control, and down to logistics. The shift towards modern globally interconnected cyberspace systems up from traditional tactical communication networks presents an unparalleled opportunity, bringing significant security challenges simultaneously. Specific to that, radio communications over the battlefield present critical vulnerabilities that adversaries could well leverage. This paper examines those cybersecurity challenges and puts forward some strategic solutions for improving the security of military cyberspace. The increasing intricacy of modern warfare, propelled by the integration of Network Centric Warfare, or simply NCW, has rendered operations evermore reliant upon real-time information sharing. Indeed, though NCW will yield substantial gains in military operations, military networks are also exposed to a range of cybersecurity threats. [1]

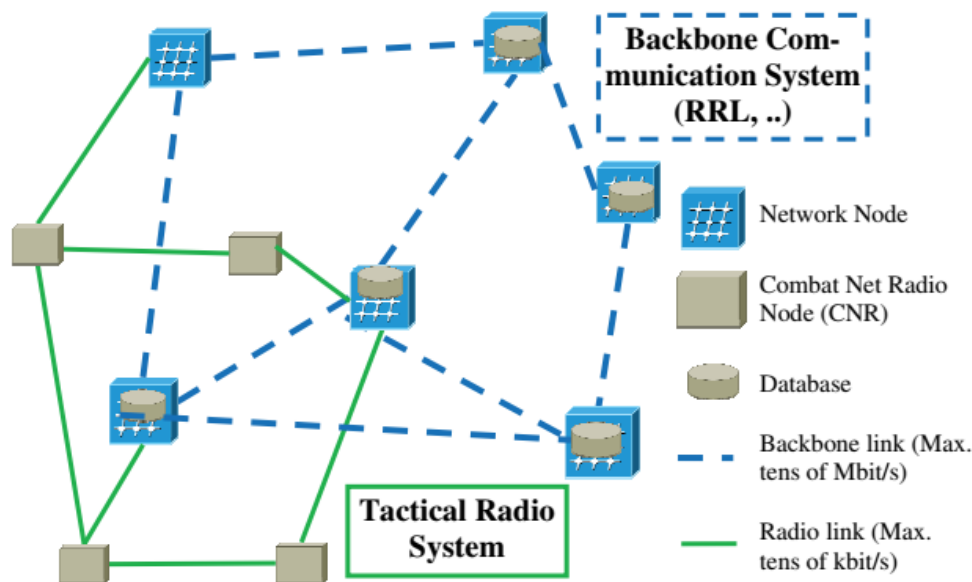
Modern military communication networks have transformed drastically from loosely interconnected tactical systems to highly integrated global networks—a cyberspace enabled by ever-advancing technologies, driven by the demand for near real-time data sharing, enhanced situation awareness, and expanded mission

flexibility. Conversely, however, increased connectivity results in a commensurate increase in vulnerabilities.

Legacy Tactical Networks: The military communication systems, like Combat Net Radios, have traditionally operated in the early times in segregated environments that do not support much in terms of connectivity. Due to their physical isolation, these systems are fairly secure and deploy closed-loop channels of communication. Still, they lack the flexibility and efficiency of modern communication networks. [3]

Network Centric Warfare and Global Military Networks: The integration of Network Centric Warfare and Global Military Networks initiated a new era. NCW is based on the integration of various sub-networks wherein information is shared among operational domains in real time. This transition has also resulted in the establishment of global cyberspace related to military activities, where information is exchanged among various wireless and wired communication channels. While NCW enhances battlefield efficiency, it also creates new threats and vectors of attack, especially within wireless environments. [2]

Modern military networks, especially those based on wireless communications, are susceptible to a lot of cyber threats. These can violate confidentiality, integrity, or availability of critical information and hence can pose a severe threat to mission success.



Pic. 1. Architecture of military tactical networks

Communication experience reveals that tactical environment is the most challenging based on the following reasons. As shown by Figure 1, outdated military tactical networks are organized around nodes and the interconnecting communication links. What it is essential to understand is that it demonstrates a much worst performance than commercial or fixed network nodes and links. The main medium of communication at tactical level is known as combat network radios, mobile nodes normally operating on TCP/IP and Long Range Radio Relay (LRR). The bandwidth capacity is relatively less than that of the commercial wireless technologies. Besides that, there are some specific demands which are most important for military equipment and are less essential in case of commercial systems. As it has emerged, this paper covers only a segment of total military systems that function in actual combat mission environments.

Wireless Communication Vulnerabilities: Wireless communication is indispensable for mobile military units, but it relates to a number of types of cyber threats by nature. Unlike wired communication, the information may intercept, jam, or even manipulate the wireless signals, especially in hostile areas. The inherent risks include:

- **Eavesdropping:** The opponent may eavesdrop on wireless communications to gather sensitive information.
- **Jamming:** Wireless signals can be disrupted, preventing military units from communicating effectively.
- **Physical Attack against the Nodes:** Most of the military nodes are physically highly vulnerable to attack, which often results in communications breakdowns.

Advanced Cyber Threats: With increasing complexity in military networks, advanced cyberattacks are posing serious threats. The key ones are:

- **Wormhole Attacks:** Through the exploitation of weak spots in wireless protocols, attackers create a

tunnel between two faraway nodes and thus reroute communication.

- **Blackhole Attacks:** Malicious nodes discard packets instead of forwarding them, causing a loss of information and interrupting processes.
- **Denial-of-Service (DoS) Attacks:** An attacker overloads network resources, making them unavailable for legitimate use.

The solution for the challenges in the battlefield wireless network can be multifold, and many methods can contribute to reducing the vulnerability not only of wireless communication but also of other weaknesses in the network. Encryption and secure protocols provide confidentiality and integrity to general communications and military communications in particular.

Advanced encryption using AES-256 and IPsec reinforcements provides a robust guard for data. In addition, secure communication protocols such as WPA3 must be implemented to keep wireless communications safe. Frequency hopping and spread-spectrum modulation techniques also can help to make the possibility of interception and jamming smaller by affecting the adversary's capability to disrupt communications. [4]

Continuous network monitoring is considered the backbone of any detection and response mechanism against cyberattacks. The use of automated IDS and anomaly detection methods would also help identify such threats before they cause serious harm. Moreover, incident response planning is the prior necessary action in order to reduce or minimize the impact of cyberattacks in real time.

These radios replace traditional military communication technologies and are known as SDR and CR. With the support of SDR and CR, these radios automatically adapt to the environment in terms of frequency and waveform settings, providing more flexibility and robustness. At the same time, it opens up a new attack surface because hackers may manipulate the software-based settings. Strict security controls should be put in place and updated regularly in case vulnerabilities in SDR or CR systems are found.

The adaptation of SDR technology means that radios can support up to different waveforms and are capable of performing a vast range of tasks depending on factors such as frequency, waveform and bandwidth. This flexibility enables the development of more elastic wireless networks in all platforms; each possess strengths and limitations contingent on certain operational characteristics.

While the use of CIPRs in militarized structures extends considerable benefits, there are some important security issues where the application of IPsec and key management is concerned. Furthermore, the new IP frame structure employs significant overhead and poses a challenge in networks especially bandwidth realize in tactical military communication in areas that utilize High Frequency (HF) radio band.

In recent military exercises, adversaries exploited vulnerabilities in wireless battlefield communication systems. These attacks demonstrated the importance of strong encryption and network segmentation to prevent eavesdropping and jamming. The use of advanced security protocols, such as WPA3, significantly reduced the risk of successful cyberattacks. [5]

CONCLUSION

The increasing use of wireless communication in the military networks on the battlefield exposes these networks to a number of cybersecurity issues. These vulnerabilities are due to the nature of wireless communication which is easier to intercept, jam, or access without permission. In so doing the amount of risk appetite already built in the system has to be well contained and planned out. This includes the use of superior means of protecting data confidentiality using encryption, controlling access to limited or no access at all to unauthorized users and taking network segmentation approaches to contain potential breaches and their effects. As well, the utilization of direct network connections and the employment of special security measures such as the monitoring of network activities is also indispensable.

The above presents that new technologies such as SDR and CR have great potentials and problems for military communications. These technologies offer more efficiency and operational effectiveness in unfavorable and variable circumstances like those of a battlefield. By means of SDR, military units can change the frequency of communications during missions to

overcome jamming while in the case of CR, communications can be conducted whereby the selection of the channel is made on-the-spot. But with these new systems, there emerges the challenge that since it is software oriented, the guidelines goes that an enemy can fight back by using the bugs or configurations to cause attacks. Hence, full cybersecurity measures including updates, scout measures, and defense forces compliance etc. should be embedded in these systems against any future occurrences. If the military battlefield network is fortified with technology especially the cybersecurity component, it makes it possible for armed forces to protect sensitive information and enhances vulnerability in the communications systems. This is very important to operational efficiencies because the absence of communication or disruption of data and vice versa in those important mission tasks may result to grievous consequences.

A comprehensive cyber defense system capable of adapting to new technologies and their corresponding threats is going to help military organizations outsmart their enemies and perform safe and effective activities in the ever growing and interconnected world.

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ECONOMY

METHODOLOGICAL FRAMEWORK FOR ASSESSING ENTERPRISE COMPETITIVENESS

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Abstract

This study synthesizes various theoretical perspectives on competition, highlighting it as an intrinsic economic phenomenon related to market exchange mechanisms for goods and services. It identifies vital aspects for evaluating the formation prerequisites of competitiveness – specifically competitive, product-based, and outcome-oriented factors. The characteristics of the methodological framework for assessing enterprise competitiveness are substantiated, and essential criteria for creating a comprehensive and reliable competitiveness assessment set are established.

Keywords: competition, enterprise, competitiveness, competitive advantage, market mechanism.

Introduction. Competitive rivalry is an integral element of the market mechanism, serving as a crucial factor for continuously enhancing business efficiency and improving commercial and economic relations within the market context. Competition is the primary mechanism that ensures a market economy's effectiveness, balance, and dynamism, playing a pivotal role in shaping global economic relations amid the contemporary globalization of all aspects of societal development.

Competition (derived from the Latin «concur», «concurentia» - collision or confrontation) is one of the essential conditions and significant drivers of societal, economic development. It serves as the principal force behind the expanded reproduction of production and the effective self-regulation of economic relations. Free competition, in particular, amplifies the role and importance of the individual within the broader context of social development, offering extensive opportunities for personal expression and establishing equal conditions for realizing individual ambitions and needs. The growth of market competition, which fosters genuine partnerships between consumers and leading enterprises, invariably leads to quality improvements and price reductions for goods. Ultimately, this progression benefits society, transcending geographical, political, and national boundaries.

Literature Review. The theoretical and methodological foundations for determining enterprise competitiveness have been explored in the works of distinguished economists, including Arefyeva O. [1], Horbal N. [4], Dashko I. [2], Dykany V. [3], Kuzmin O. [4], Lutska T. [1], Ponomaryova T. [3], Tarnavska N. [5], Camp R. [6], Kotler P. [8], Lane K. [8], Lenskold J. [7], Warren K. [9], among others. However, certain facets of competitiveness assessment (particularly those addressing the nuances of competitive development within specific market conditions) remain insufficiently studied. This underscores the urgent need for further investigation in these areas.

This study aims to synthesize theoretical perspectives and advance the methodological framework for assessing enterprise competitiveness.

Research Findings. Competition is an inseparable element of market relations, acting as an external force that compels producers to continually enhance the

efficiency of their economic activities, expand production scales, accelerate scientific and technological progress, and pursue the adoption of cutting-edge technologies and organizational forms in production. It represents the rivalry among market participants over optimal conditions for producing, selling, and purchasing goods and services and, consequently, maximizing profits.

For competitive rivalry to effectively foster market development, certain conditions must be met: a substantial number of sellers, comprehensive information about products and their sale conditions, the mobility of production resources.

When these conditions are fulfilled, market competition, which leads to the equalization of profit margins among producers, will facilitate the optimal allocation of labor and capital across production sectors. Thus, competitive market relations become the primary domain for the manifestation of the law of value, a principle in economics that states that the value of a commodity is determined by the amount of socially necessary labor time required to produce it. This law ensures both material (production of consumer value aligning with demand structure) and financial (alignment of aggregate product values, i.e., the sum of goods prices with the volume of effective demand) equilibrium in economic development.

Thus, two primary aspects of competition emerge as an economic phenomenon intrinsic to the functioning of the market mechanism for the exchange of goods and services:

1. Reflexive Nature of Competitive Interaction – This approach emphasizes the reflexive-behavioral dynamics among market participants (sellers and buyers), manifesting in varied forms of rivalry for advantageous access to specific resources, goods, and services that are objects of market exchange. This reflexive-behavioral perspective highlights participants' diverse strategies in securing optimal market interaction conditions.

2. Optimization-Based Selection of Market Participants – Here, competition functions as a process of "natural" selection (grounded in self-regulating mechanisms), favoring entities capable of offering the most beneficial conditions for society in producing and consuming goods and services essential to meeting human needs. This socially selective perspective sees market

competition as privileging participants who best meet efficient production and consumer satisfaction criteria.

It is essential to underscore that, for individual market participants, the critical elements of competition are often directly tied to the specific conditions and circumstances of their involvement in competitive (reflexive) interactions. Conversely, for society as a whole, competition acts as an automated mechanism for economic development, selecting the most efficient means (especially in terms of the ratio of results to costs) to meet a broad range of human needs and demands.

However, it is also necessary to recognize the significant adverse outcomes of market competition, which include the monopolization of the economy as small producers are displaced by larger enterprises, exacerbation of social inequality, increasing wealth disparity, heightened unemployment, and the onset of inflationary pressures, among others.

Implementing these competitive functions relies on market participants' adoption and use of specific competitive methods. The diversity of possible competitive conditions and circumstances (reflecting the complex structure and operational mechanism of the market as an economic relations system) along with the divergent goals and priorities of competitive actors, which may include profit maximization, market share expansion, or cost minimization, gives rise to a wide array of strategies and methods for achieving success in competitive rivalry. Consequently, competitive rivalry in market conditions acts as a spontaneous self-regulator, maintaining the balance of social production. This self-regulation leads to continuous improvements in economic efficiency, driven by the ongoing intensification of economic relationships and emerging conflicts between the interests of market participants in the exchange of goods and services.

In a balanced market, where prices reflect the socially necessary costs of production, competition imposes stringent requirements on producers. These requirements encompass cost reduction, resource conservation, and labor productivity enhancement. However, market equilibrium, a state where supply equals demand and prices remain stable, cannot be sustained solely through isolated measures, such as price adjustments, innovation implementation, or demand stimulation. Instead, market equilibrium emerges from achieving temporary balance across various levels of economic relations: between productivity growth and household income, across industries, and between consumption and accumulation funds, among others. Achieving this balance hinges primarily on the conditions under which market competition among economic agents arises and evolves, as competition becomes the primary driver of their innovative development.

Market competitiveness reflects the capability and potential of any individual market participant (or group of participants) to influence the terms of trade, particularly the price levels of goods and services. Thus, market competitiveness is defined by the extent to which individual enterprises can exert influence over the market, effectively setting the terms for the sale of goods and services unilaterally.

The level of market competition and overall market competitiveness compel enterprises to seek new forms and methods of competitive strategy, significantly enhancing the efficiency of their production and sales activities. Together, these efforts determine the origin and magnitude of an enterprise's competitive advantages and overall competitiveness.

The synthesis of approaches to defining the nature of competitive advantage and securing sustained competitive positions is a crucial step. It allows for the identification of three core aspects that are paramount in evaluating the prerequisites of competitiveness formation. Understanding these aspects is key to gaining a comprehensive view of enterprise competitiveness.

1. **Competitive Aspect** – Here, an enterprise's competitiveness is determined by the strength of its market position and the effectiveness of its actions within reflexive rivalry against other market participants.

2. **Product-Based Aspect** – This perspective links an enterprise's competitiveness directly to the competitiveness of the goods and services it produces to meet market needs. In this context, competitiveness is viewed as a direct outcome of the product's performance in the market.

3. **Result-Oriented Aspect** – Competitiveness is seen as a comparative indicator, reflecting the difference in resource utilization efficiency between the enterprise and similar entities within a homogeneous group.

Thus, a defining characteristic of enterprise competitiveness (EC) is the degree to which its activities meet a complex set of societal, national, and business-related goals. The need to harmonize various developmental priorities with this complex goal structure necessitates a sophisticated strategic approach to planning competitive advantages at the enterprise level. This strategic planning empowers businesses to identify optimal ways to ensure EC, thereby taking control of their competitive position.

The variety of sources and types of competitive advantages, which serve as the foundation for achieving stable competitive positions, coupled with the complexity and ambiguity of requirements for ensuring competitiveness, leads to a wide array of methodological approaches for evaluating EC (see Table 1).

Table 1

Characterization of the Methodological Framework for Enterprise Competitiveness Assessment

Method	Description of Methodological Approach	Method Characteristics	
		Advantages	Disadvantages
Multiplicative Method	This method assesses enterprise competitiveness (EC) by comparing the baseline and actual multiplicative effects of the relationship (chain) between profit (or effect) and investments in developing strategic potential, product assortment, and ensuring high-quality customer satisfaction.	The method offers relative simplicity in assessment procedures, provides forward-looking analytical insights, and emphasizes a balanced consideration of external and internal factors influencing competitiveness	It faces challenges in objectively defining the baseline multiplier and in differentiating the impact of various factors that influence the relationship between effect and investment.
Integral Indicator Method	The calculation of an integral indicator for the level of enterprise competitiveness (EC) combines assessments of consumer demand satisfaction (product competitiveness) and production efficiency (comparison of the enterprise's performance metrics with those of its competitors).	Clear and visually interpretable evaluation results. Enables the identification of strategic gaps and substantiates effective strategies for enhancing EC.	Challenges in obtaining detailed information on competitors' activities. Requires a substantial volume of calculations and ensuring metric comparability.
Taxonomic Method	This method involves synthesizing assessments of the company's competitive advantages across each product segment in the target market, considering the attractiveness of these segments, including market capacity, growth potential, and other factors.	A comprehensive approach to evaluation, taking into account the significance of both market and production factors in forming EC. Provides forward-looking assessments	Potential difficulties in obtaining reliable information about competitors' activities.
Matrix Method	The assessment of enterprise competitiveness (EC) is based on positioning within a matrix framework that compares evaluations of various aspects of its production-sales activities, production-technology base, competitive rivalry, product life cycle stage, and related factors.	Forward-looking and dynamic evaluation approach. Allows for EC assessments at different stages of the product and technology life cycle.	Inability to obtain precise quantitative assessments. Potential inaccuracy in expert evaluations. Lacks consideration for the relative importance of individual indicators.
Comparative Advantage Analysis Method	Enterprise competitiveness (EC) is assessed by synthesizing comparisons between the company's performance indicators (economic, financial, marketing-sales, production-technology, etc.) and the equivalent (best) parameters of competitors' business activities	Enables the analysis of the interrelated effects of various business activity aspects. Considers the impact of economies of scale. Simplifies the evaluation process and provides clear presentation of results	Static nature of the assessment. Inability to definitively interpret the factors driving the obtained EC ratings. Lacks attention to the influence of external factors.
Method Based on the Theory of Effective Competition	The assessment of enterprise competitiveness (EC) is conducted by comparing indicators of production-sales efficiency, operational efficiency, and financial stability of competing enterprises, as well as with industry averages and benchmarks within the economic sector	Focuses on understanding industry-specific operational characteristics and enterprise development, providing an evaluation of operational efficiency. Offers a comprehensive and detailed assessment approach.	Static in nature. Requires extensive calculations. Lacks emphasis on evaluating product competitiveness. Challenges in synthesizing evaluation results
Benchmarking	A comparative analysis of key success factors (business parameters) of the enterprise and its main competitors to assess the likelihood of the enterprise's success	Dynamic, comparative assessment approach with broad coverage of various business aspects	Ambiguity in selecting comparison enterprises and in defining performance indicators.

	under a specific strategic implementation		
Production Capability Analysis Method	A comprehensive evaluation of the enterprise's strategic potential, based on synthesized index assessments of product quality, cost-efficiency, and production flexibility. This method establishes quantitative relationships among key factors influencing enterprise competitiveness (EC) and models the potential impact of changes in conditions, ratios, or other interdependencies among production factors.	Broad coverage of EC formation factors. Offers a comprehensive evaluation at both the production level and for specific product types. Enables the identification of hidden dependencies and the evaluation of inter-factor influences in production, with an optimization-oriented assessment process	Possible challenges in obtaining reliable information on competitors. Insufficient attention to market factors and characteristics of marketing and sales activities. Inability to account for motivational factors
Product Quality Analysis Method	The assessment of enterprise competitiveness (EC) is based on comparing the parameters of the company's products with similar products made by competitors, while considering a broad range of market and marketing-sales factors	Emphasis on consumer value of produced goods. Hierarchical approach to assessment. Establishes the relationship between product competitiveness and overall EC	Limited applicability in multi-product production environments. Inability to compare assessments of production efficiency
Equilibrium Theory-Based Method	This method assesses enterprise competitiveness (EC) by evaluating the relative cost of production factors (such as loan interest rates, equipment procurement costs, labor wages, and material costs) which, according to market equilibrium theory, should be lower for enterprises with high EC.	Cost-oriented assessment. Broad scope, covering multiple areas of enterprise activity. Forward-looking in its evaluative approach	Lacks consideration of market competition influence. Results may lack precision and clarity. Unable to account for cyclical market factors

Thus, establishing a set of criteria for assessing competitiveness first requires the identification, from the broader pool of market participants (actual or potential), of those entities that meet the following requirements:

Homogeneity of Strategic Goals and Objectives: Enterprises included in the competitiveness assessment set should share similar strategic goals and orientations that guide their economic activities.

Ability to Influence Competitive Conditions: The entities must possess the capacity to impact competitive conditions in the market. Competitive conditions refer to the factors that influence a company's ability to compete, including price parameters, market demand fluctuations, product life cycles (both overall and at various stages), and similar factors.

Uniformity in Consumer Requirements: The enterprises within the assessment set should focus on satisfying consistent consumer demands aligning their operations toward similar market expectations.

Stability of the Competitiveness Assessment Set Across Levels: The composition of the competitiveness assessment set should remain consistent across product, resource-production, and market levels.

Similarity of Geographic Markets and Market Segments: The enterprises should operate within similar geographic markets and market segments, ensuring comparability regarding location and targeted customer bases.

Comparable Market Regulation Conditions: Regulatory conditions should be similar across enterprises, with no participant enjoying artificial advantages stemming

from temporary non-economic factors.

Uniformity of Resource Efficiency Evaluation Criteria: The criteria for evaluating resource efficiency among enterprises (such as the nature of outcomes, effects, costs, and their relative balance) should be consistent. Resource efficiency refers to the ability of a business to use its resources effectively to achieve its objectives. This forms the basis for determining competitiveness levels and identifying competitive advantages for each business entity.

Conclusions. The process of assessing an enterprise's competitiveness is significantly enhanced by the strategic tool of market segmentation. This approach, which involves dividing the target market into distinct groups, serves as a powerful risk mitigation strategy in the face of uncertain consumer behavior. By enabling the enterprise to concentrate its marketing and production efforts on meeting the needs of a specific target group, market segmentation directly contributes to the enhancement of effectiveness. Moreover, it plays a crucial role in managing market risks, such as the potential entry of new competitors and the resulting intensification of competition on the international market. The likelihood of these events occurring can be assessed, with this probability being inversely related to the height of market entry barriers. Higher entry barriers reduce the number of potential competitors, thereby lowering the risk of new entrants posing threats to established market players.

A comprehensive assessment of a tourism enterprise's competitiveness can be achieved by adhering to

these requirements. The precision and adequacy of this assessment are determined by employing a set of local indicators, whose values are subsequently aggregated using methods designed to minimize the influence of subjective factors.

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CURRENT CHALLENGES IN IMPORT SUBSTITUTION IN THE NATIONAL ECONOMY OF AZERBAIJAN

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Abstract

This paper explores the challenges and strategies of import substitution in Azerbaijan's economy, highlighting its role in promoting domestic production and reducing dependence on imports. The analysis covers government policies, technological needs, inflation control, and global trade dynamics. It finds that while Azerbaijan has made progress in diversifying its economy and fostering local industries, significant efforts in R&D, regional development, and policy adaptation are essential for sustained success. The study concludes that a well-executed import substitution strategy can enhance economic resilience, but it requires comprehensive planning, continuous evaluation, and investment in innovation and infrastructure.

Keywords: Import substitution, economic resilience, domestic production, non-oil sector development, technology transfer and innovation.

Introduction:

Import substitution has long been regarded as a strategic pillar in the development policies of nations aiming to build a resilient and self-sufficient economy. This approach focuses on fostering local production capabilities to meet domestic demand, thereby diminishing reliance on imports and enhancing the country's economic resilience. For Azerbaijan, which possesses a rich array of natural and economic resources, import substitution has emerged as an essential component of its economic policy framework aimed at reducing vulnerability to global market fluctuations and promoting sustainable growth.

Expanded Analysis on Import Substitution in Azerbaijan:

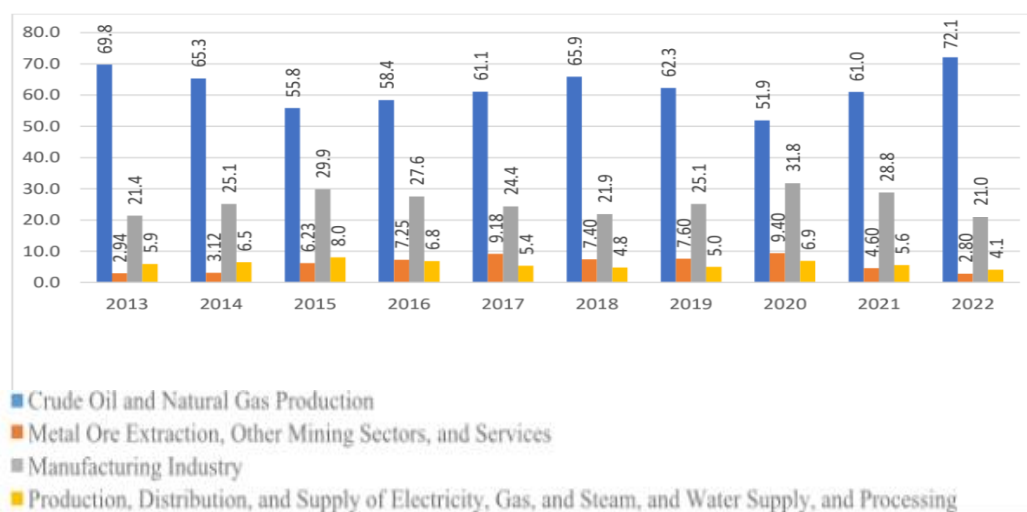
Economic Context and Strategic Importance:

Import substitution in Azerbaijan is not just an economic policy but an integrated part of the national development agenda. The strategy aims to shift from a reliance on imports, particularly in the non-oil sector, to fostering a diversified economic base that can sustain growth and create employment. The "Azerbaijan 2030: National Priorities for Socio-Economic Development," approved by presidential decree in 2021, underscores

the importance of developing local production capabilities to achieve a resilient, competitive economy. The document outlines a multi-faceted approach that includes enhancing industrial infrastructure, advancing technological capabilities, and building human capital.

Challenges and Strategic Goals: A critical challenge facing Azerbaijan's import substitution strategy is the modernization of its industrial sector to enable it to compete effectively with foreign imports. While the country has significant resource potential, leveraging it efficiently requires substantial investments in R&D, technology transfer, and innovation adoption. Ensuring that local industries have access to cutting-edge technologies and fostering an ecosystem that supports innovation are essential steps to producing high-quality, competitively priced goods.

Azerbaijan's manufacturing sector has shown mixed performance over the past decade. From 2013 to 2022, the share of production in the manufacturing sector decreased from 21.4% to 21%. However, this period also saw peaks, notably in 2015 and 2020, indicating that targeted measures for promoting local production and import substitution during economic downturns yielded positive results.



Graph 1. Sectoral Structure of Industrial Production, as a Percentage of the Total, Based on Actual Prices of Respective Years

**Source: Compiled by the author based on data obtained from the State Statistics Committee website https://www.stat.gov.az/source/food_balances/ (as of 19.02.2023) **

Government Policies and Legislative Support:

The government's support for import substitution has been multifaceted, encompassing legislative initiatives, financial incentives, and strategic partnerships. Key policies have included tax incentives for local manufacturers, subsidies for R&D initiatives, and strategic investments in critical sectors such as agriculture, pharmaceuticals, and light manufacturing. The State Program for Industry Development and various regional development plans also emphasize the need to strengthen local production capabilities and promote diversification.

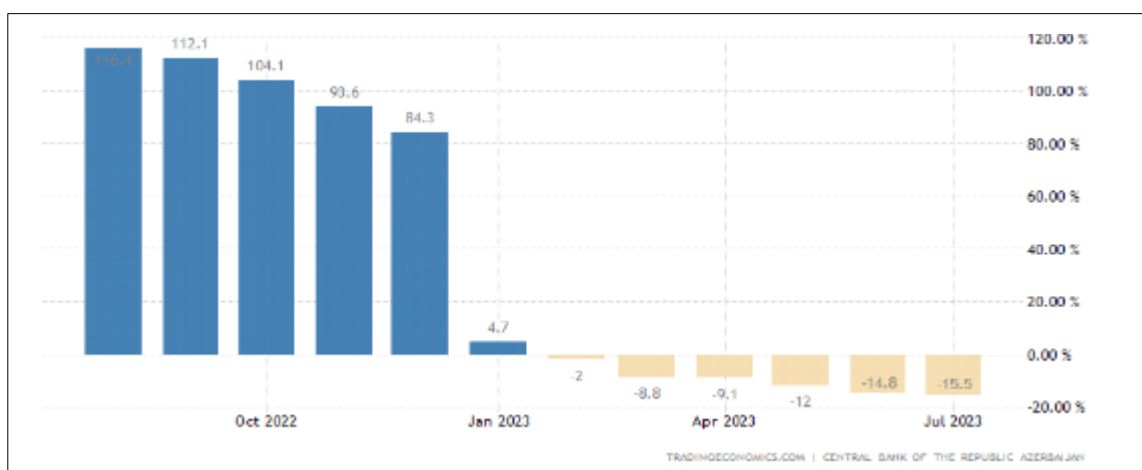
Impact of Global Trade Dynamics: The global economic environment and international trade agreements play a significant role in shaping Azerbaijan's import substitution strategies. Balancing these strategies with the country's international trade obligations is crucial to avoid trade conflicts and maintain a competitive position in global markets. The shift in Azerbaijan's main import partners over the years reflects its adaptive

approach to global trade dynamics. For example, while Russia, the United Kingdom, and Singapore were key import sources in 2005, by 2022, the focus had shifted towards Russia, Turkey, China, Germany, and other regional players. This shift indicates an effort to diversify partnerships and secure trade routes that support the country's import substitution goals.

Detailed Economic Analysis:

Inflation Trends and Price Competitiveness:

Managing inflation and ensuring price competitiveness are vital for a successful import substitution policy. In July 2022, inflation in Azerbaijan stood at 12.7%, which slightly reduced to 12.2% by July 2023. Food inflation also declined from 15.1% to 14.3% during the same period. A significant decrease was observed in producer prices, which fell by 15.5%. Meanwhile, import price indices were measured at 123.4 and 127.9 points, indicating that domestic production is becoming more cost-effective compared to imported goods.



Graph 2. Dynamics of Prices for Products of Azerbaijani Producers

Source: <https://tradingeconomics.com/azerbaijan> and data from the Central Bank of the Republic of Azerbaijan.

Lower domestic production costs can enhance local producers' ability to meet domestic demand, reduce reliance on foreign suppliers, and encourage consumer preference for local products. This shift not only strengthens the economic stability of the nation but also stimulates job creation and technological advancement within the local economy.

Amid measures aimed at curbing inflation and reducing prices, Trading Economics' global macro models and analysts' expectations predict that by the end of the third quarter of 2023, producer prices in Azerbaijan are expected to change by -4.00% (<https://tradingeconomics.com/azerbaijan/forecast>).

Regional Implications and Future Outlook: Implementing an effective import substitution policy also requires regional development. Azerbaijan's varied regions have different resource bases, industrial capacities, and levels of technological advancement. A targeted approach that leverages these regional differences by fostering specialized industrial zones and innovation hubs is essential for maximizing the potential of import substitution strategies. For instance, the establishment of industrial parks and free economic

zones in areas like Sumgayit and Ganja has played a role in boosting local production.

The future success of Azerbaijan's import substitution efforts will hinge on continuous adaptation to new economic realities, investments in human capital to develop skilled labor, and maintaining a balance between local and global market demands. The medium-term focus (3-5 years) should prioritize strengthening research institutions, enhancing industry-academia collaboration, and developing sustainable practices that can support long-term economic growth.

Conclusion:

Import substitution in Azerbaijan is an evolving strategy that integrates national policy objectives with broader socio-economic goals. While the country has made strides in creating a more self-sufficient economy, challenges such as technological modernization, infrastructure development, and the need for continuous policy adaptation remain. The effectiveness of these policies will depend on their implementation and the country's ability to respond to global economic changes. With a strategic approach and concerted efforts across all sectors, Azerbaijan can build a resilient,

competitive economy that supports long-term sustainable growth.

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MODELLING THE IMPACT OF EXTERNAL DEBT ON THE MACROECONOMIC DEVELOPMENT OF UKRAINE

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Abstract

The factors that determine the amount of external public debt are considered. The factors of influence of the external debt on the macroeconomic development of Ukraine are estimated. The stages of building a VAR model are considered. A comparison of the data generated by the model with the actual historical data is carried out. The forecasted values of individual macroeconomic indicators according to the VAR model (2) are presented. The dynamic of the macroeconomic indicators of Ukraine, which have interdependent relations with the public debt, is presented. The existence of cause-and-effect relationships between the ratio of general government sector debt to GDP of Ukraine and a number of macroeconomic indicators, mainly with time lags of 1 and 2, is revealed. The obtained results indicate an expected downward trend in the indicator in the next 5 quarters. It is determined that an increase in the share of external debt in GDP should be expected.

Keywords: debt, external public debt, macroeconomic development, model, impact.

Introduction. Public debt management involves the process of creating and implementing strategic mechanisms for influencing the public debt, which ensure the possibility of attracting the necessary amount of financing, achieving target spending indicators at an acceptable level of risk, as well as achieving any other goals that the government sets for itself, for example, development and maintaining an efficient market of government securities. From the point of view of the macroeconomic context of public policy, the government must ensure the stability of the level and rate of growth of the public debt, which can be serviced under various circumstances, adhering to the target indicators of costs and risks.

Literature Review. Considering aspects of the impact of external debt on the macroeconomic development of countries of the world, it can be argued that there are many models that describe this impact. Representatives of the scientific community [1–10] and others study the impact of external debt on the macroeconomic development of countries of the world. However, certain aspects of these issues have not yet been studied in detail.

The article is aimed at developing a model and validating the results of the impact of external debt on the macroeconomic development of Ukraine.

Research Finding. The amount of external public debt depends on many factors, including key economic indicators, namely: gross domestic product (GDP), volume and dynamic of exports, volume and dynamic of imports, value and dynamic of the exchange rate, the state of the balance of payments, the inflation rate, the Central Bank's discount rate and its derivatives, state budget deficit, political stability (instability), etc. It should be borne in mind that the external debt indicator is not static; its amount may vary depending on many factors, including changes in the taxation regime, changes in regulatory policies, changes in foreign economic conditions (for example, changes in the volume of foreign demand for export goods), changes in the

economic environment, etc. All these changes may affect the amount of other macroeconomic indicators and, in turn, the amount of external public debt.

Based on the above, the article assesses the factors of influence of external debt on the macroeconomic development of Ukraine on the basis of the following indicators: the ratio of general government sector debt to GDP; debt service as a percentage of total state budget expenditures; consumer price index; real effective exchange rate index; foreign direct investments; the volume of imports; and the political stability index. The existence of statistical significance of causal relationships is proved using the Granger test and a forecast model of the public debt to GDP ratio is built on the basis of the ARIMA (Autoregressive Integrated Moving Average) model.

The procedure for building a VAR model includes the following steps: analysis of time series characteristics; causality test (existence of relationships between variables); test for stationarity of time series; transformation of time series into stationary ones (if necessary); search for the optimal model order; data preparation; model development and estimation; forecasting data for future periods based on the model and carrying out the transformation of the results (if necessary).

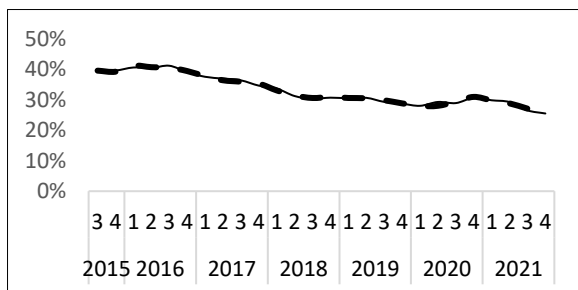
Modern economic research is based on the use of econometric models of various types. In our case, the indicators under study change over time. That is why the basis of modelling is the choice among those models that are designed to model time series. The purpose of the modelling is to forecast future values of the indicator under study. In addition, based on the obtained results, it is possible to draw conclusions and recommendations for managerial decisions in the field of macroeconomic development of the country. Two broad approaches have been developed for modelling time series data: the time domain approach and the frequency domain approach.

Among the list of models, the VAR (Vector Autoregression) model was selected, which is used to study the dynamic of macroeconomic indicators and their relationship with external public debt. The chosen model

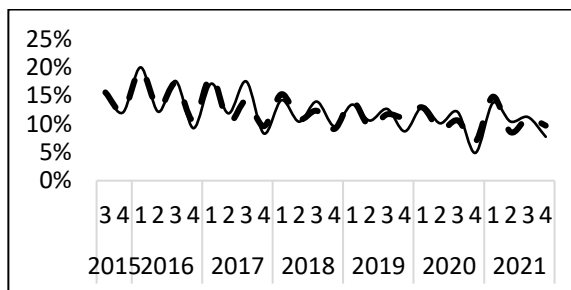
allows to calculate the impact of changes in one indicator on other indicators, which can be useful for forecasting future external debt, as well as to draw conclusions about the impact on macroeconomic development.

Models are developed and the results of the impact of external debt on Ukraine's macroeconomic development are validated. A comparison of the data generated

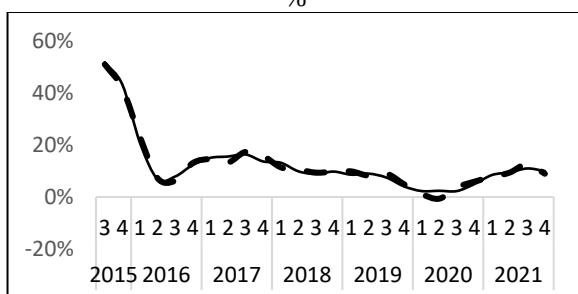
by the model with actual historical data is presented below (Figure 1). The forecasted values of individual macroeconomic indicators according to the VAR (2) model for the period 2021–2023 are shown in Figure 2. The dynamic of Ukraine's macroeconomic indicators that have interdependent connections with public debt (for the period 2015–2021) is shown in Figure 3.



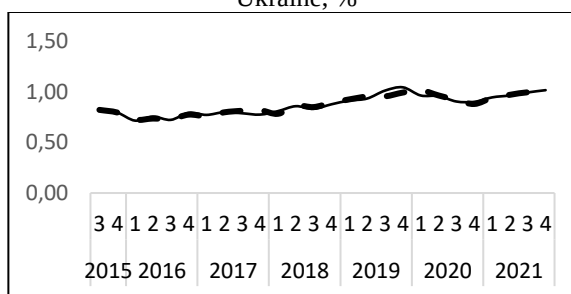
General government sector debt to GDP of Ukraine, %



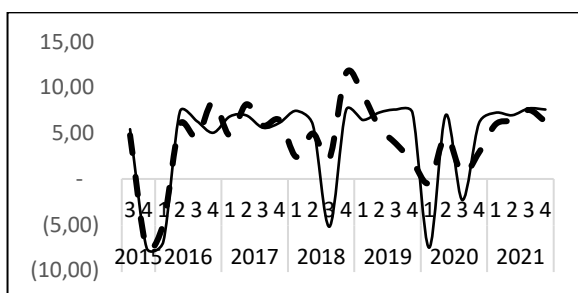
Debt servicing to total state budget expenditures of Ukraine, %



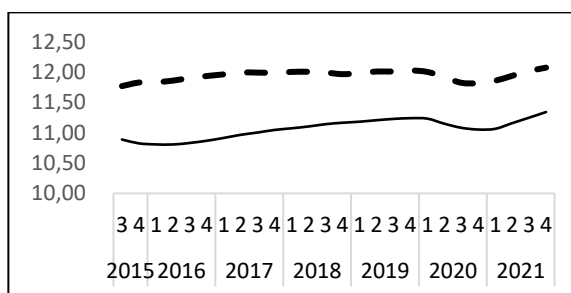
Consumer price index



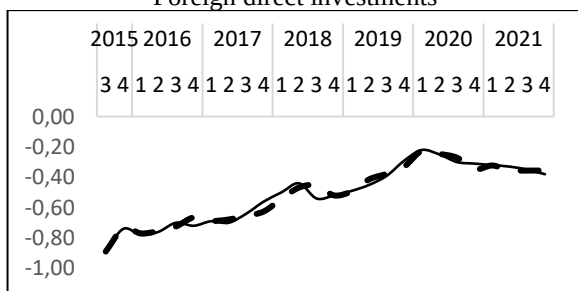
Index of the real effective exchange rate of the hryvnia to the US dollar



Foreign direct investments



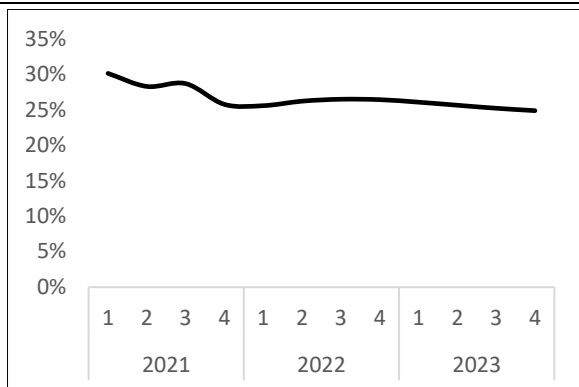
Imports



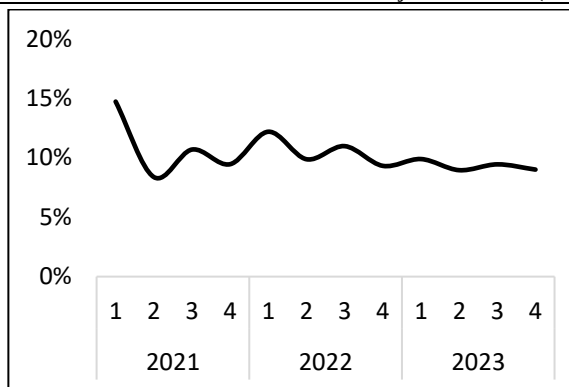
Political stability index

— Actual data
- - - Model data

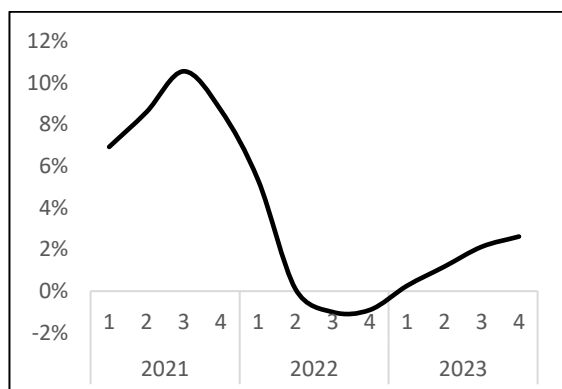
Fig. 1. Comparison of actual data with the model values of the VAR model (2)



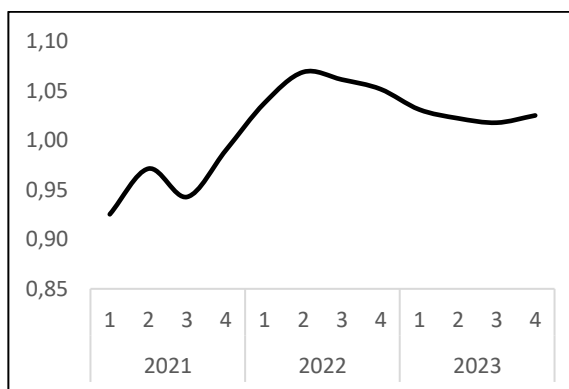
General government sector debt to GDP of Ukraine, %



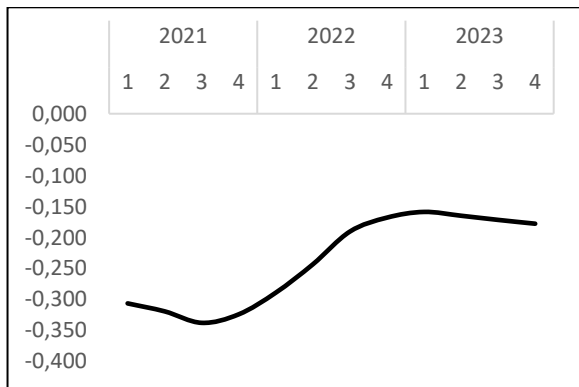
Debt servicing to total state budget expenditures of Ukraine, %



Consumer price index

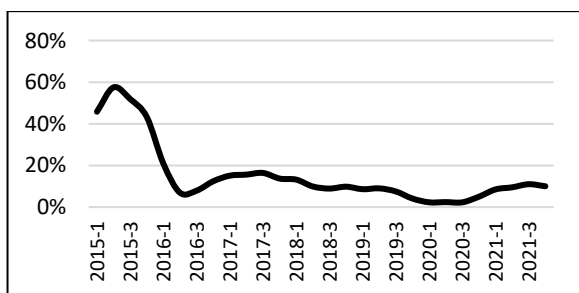


Index of the real effective exchange rate of the hryvnia to the US dollar

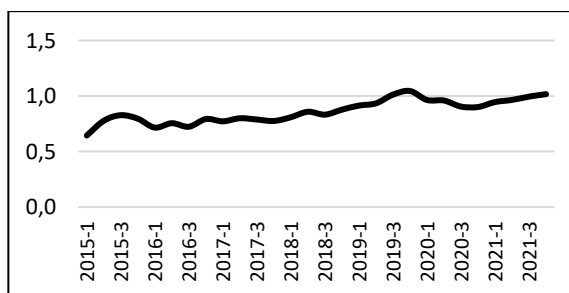


Political stability index

Fig. 2. Forecasted values of individual macroeconomic indicators according to the VAR model (2) for the period 2021–2023.



Consumer price index



Index of the real effective exchange rate of the hryvnia to the US dollar

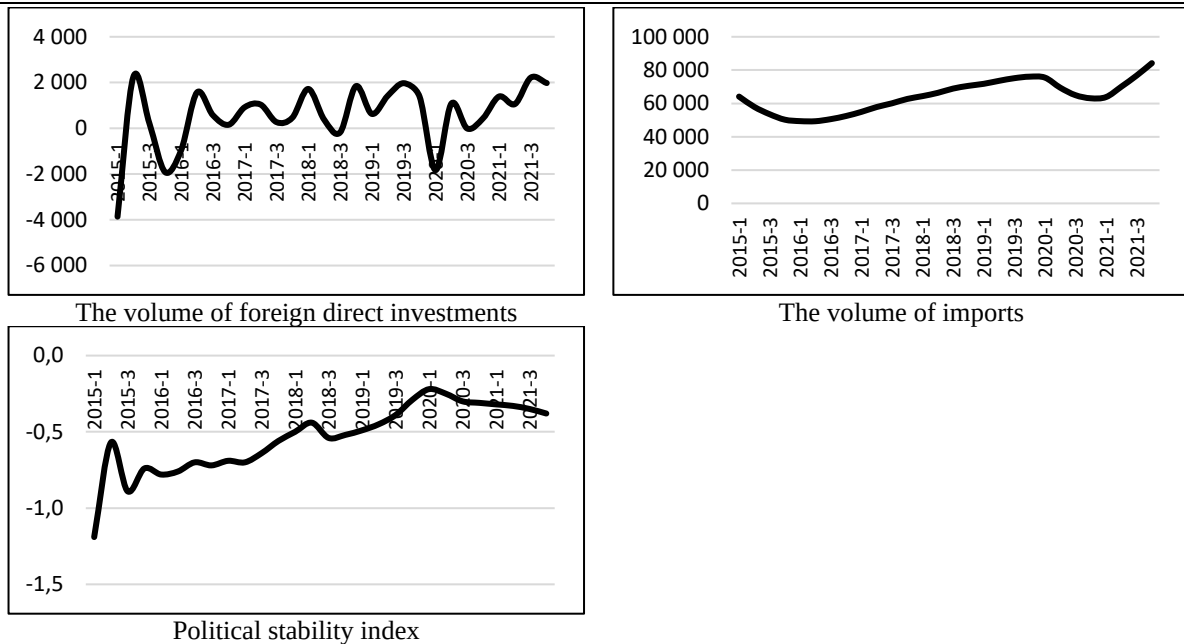


Fig. 3. The dynamic of Ukraine's macroeconomic indicators that have interdependent relations with public debt (for the period 2015–2021)

The existence of cause-and-effect relationships between the ratio of general government sector debt to GDP of Ukraine and a number of macroeconomic indicators, mainly with time lags 1 and 2, was revealed which allows to proceed to building an econometric model. The obtained results show an expected downward trend in the indicator over the next 5 quarters. However, actual verification of the model in modern conditions of military operations is impossible. This is due to a catastrophic drop in GDP and a rapid increase in foreign aid to Ukraine from allies, some of which comes under extended funding programmes. Under these conditions, the share of external debt in GDP is expected to grow.

Conclusions. A model of the influence of external debt on the macroeconomic development of Ukraine was developed using the VAR model methodology. The obtained system of 5 equations allows to form qualitative forecast estimates that confirm their reliability in retrospect, and the model itself can be used to develop practical measures of public debt management policy, forecasting related macroeconomic indicators and implementing measures for public administration of economic development of Ukraine.

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LANDSCAPE ECOLOGY

ORDUBAD İNZİBATİ RAYONUNDA TORPAQLARIN FORMALAŞMASINA TƏSİR GÖSTƏRƏN FAKTORLAR

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FACTORS AFFECTING SOIL FORMATION IN ORDUBAD ADMINISTRATIVE DISTRICT

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Özet

Məqalədə mövzunun aktuallığı, məqsədi, vəzifələri və material metodikası haqqında məlumat verilir. Mövzunun əsas hissəsində Ordubad inzibati rayonunda torpaq mühitinin qorunması üçün ərazinin fiziki-coğrafi şəraiti (relyef, iqlim, hidroloji və hidrogeoloji, bitki və heyvanlar ailəmi, antropogen təsir, və s.), degradasiya prosesləri (şorlaşma, eroziya, bataqlıqlaşma, daşlılıq, kol-kos basmış sahələr və s.), morfoloji, fiziki və kimyəvi xüsusiyyətləri öyrənilir.

Nəticədə Ordubad inzibati rayonunda torpaq mühitinin qorunması üçün ərazinin fiziki-coğrafi şəraiti öyrənilib təhlil olunmaqla, mədəni-təbii bitkilər altında torpaqların qiymətləndirilməsi, aqroistehsalat qruplaşdırılması və ərazidə aqromeliorativ tədbirlərə ehtiyacı olan torpaq qruplarını da müəyyənləşdirilməsi üçün istiqamətlər göstərilmişdir. Eyni zamanda bu tədqiqat Ordubad inzibati rayonunda yayılmış bütün torpaq tiplərindən, yarım tiplərindən və növmüxtəlifliklərindən səmərəli istifadə etmək üçün bir neçə təklif və tövsiyələr verilmişdir.

Abstract

The article provides information about the topic's relevance, purpose, tasks and material methodology. In the main part of the topic, the physical and geographical conditions of the territory (relief, climate, hydrological and hydrogeological, plant and animal family, anthropogenic influence, etc.), degradation processes (salinization, erosion, swamping, stony, bush- mowed areas, etc.), morphological, physical and chemical properties are studied.

As a result, by studying and analyzing the physical-geographical conditions of the area in order to protect the soil environment in the Ordubad administrative region, directions were indicated for the assessment of land under cultural and natural plants, grouping of agro-production and determining the land groups that need agro-ameliorative measures in the area. At the same time, this study has given several suggestions and recommendations for effective use of all soil types, subtypes and species diversity spread in Ordubad administrative region.

Açar sözlər: Coğrafi amillər, eko-coğrafiya, torpaq, bonitet, torpağın bonitirovkası, torpağın ekoloji qiymətləndirilməsi.

Keywords: Geographical factors, eco-geography, soil, bonitet, bonitet of soil, ecological assessment of soil.

Giriş. Tədqiqat obyekti coğrafi mövqeyinə görə şimal-şərqdən Ermənistan Respublikası, cənubdan İran İslam Respublikası, qərbdən isə Culfa inzibati rayonu ilə sərhədlənir.

Ərazidə çay şəbəkəsinin normal olmasına baxmayaraq muxtar respublikanın digər inzibati rayonlarına nisbətən məhsuldar torpaqlar azlıq təşkil edir. Bu da ərazinin əksər hissəsinin hündür və sıldırımli dağlardan ibarət olması ilə əlaqədar olmaqla, ərazidə torpaqların yüksək dərəcədə eroziya proseslərinə məruz qalmasına səbəb olur.

Məlumdur ki, dünyada baş verən səhrələşmə-torpaq degradasiyası prosesləri Naxçıvan Muxtar Respublikasında da yayılan torpaqların mühitinin pozulmasına da təsirini göstərir. Ərazidə müxtəlif təbii və antropogen təsirlər nəticəsində torpaqlarda baş verən degradasiya prosesləri münbitliyin azalmasına, məhsuldarlığın aşağı düşməsinə və əhalinin ərzaq ehtiyatlarının ödənilməsində iqtisadi-sosial çətinliklər yadır.

Naxçıvan Muxtar Respublikasında da yayılan torpaqların mühitinin pozulmasına da təsirini göstərən və ərazidə müxtəlif təbii və antropogen təsirlər

nəticəsində torpaqlarda baş verən deqradasiya prosesləri münbitliyin azalmasına, məhsuldarlığın aşağı düşməsinə və əhalinin ərzaq ehtiyatlarının ödənilməsində iqtisadi-sosial çətinliklər yaranan regionlardan biri də Ordubad inzibati rayonudur.

Regionda güclü sellər nəticəsində Ordubad maili düzənliyi torpaqlarının əksər hissəsi kiçik və iri həcmli daşlarla örtülmüşdür. Muxtar respublikada torpaq fondunun 17,8 faizini, məhsuldar torpaqların isə 6,4 faizini təşkil edir. Məhz, bu baxımdan Ordubad inzibati rayonunda yayılan torpaqlarda tədqiqatların aparılması aktualdır (1, s. 15; 2, s. 7).

Tədqiqatın məqsədi: Ordubad inzibati rayonunda torpaqların formalaşmasına təsir göstərən təbii və antropogen faktorların öyrənilməsi və mühitin itirilməsinə təsir göstərən mənfi proseslərdən şorlaşmanın, şorakətləşmənin, bataqlıqlaşmanın və digər faktorların mənşəyini (genezisini), yaranma səbəblərini, forma və yayılma coğrafiyasını bilmək, onu düzgün qiymətləndirmək, təsnifatını hazırlamaqla, lazımı tədbirlər həyata keçirməkdən ibarətdir.

Materiallar və Metodlar: Mövzuya aid ədəbiyyat, çöl materialları toplanmış və işin metodikası hazırlanmışdır. Mövzu işlənməkdə olan tarixin ayrı-ayrı inkişaf mərhələlərində xarici ölkələrdə, o cümlədən Azərbaycan və Naxçıvan MR-də və o cümlədən Ordubad inzibati rayonunda torpaq-bitki tədqiqatları aparan alimlərin monoqrafiya, metodik vəsait, xəritə materialları və müasir tələblərə cavab verən iş təcrübələrindən istifadə olunmuşdur [3, s. 9-25; 4, s. 307-310; 5, s. 5-38; 6, s. 17-25]. Tədqiqat obyekti kimi Ordubad inzibati rayonunda yayılan torpaq sahələri seçilmişdir.

Ərazinin relyef şəraiti. Ordubad Muxtar respublika ərazisinin çox hissəsini Kiçik Qafqazın Zəngəzur və Dərələyəz silsilələri və onların Araz çayının dərəsinə doğru uzanan və müasir relyefdə orta və alçaq dağlıq yarıdan qolları əhatə edir. *Zəngəzur silsiləsi* Kiçik Qafqazın ən yüksək silsilələrindəndir; ən hündür zirvəsi Qapıcıq dağı (3906 m), *ən aşağı nöqtəsi Kotam dərəsi 600 metrdir.* Eyni zamanda Kiçik Qafqazın Azərbaycan Respublikası ərazisində ən yüksək zirvəsidir və daimi qar xəttindən 41 m yuxarıda yerləşir.

İnzibati rayonunun əsas sahəsini təşkil edən Ordubad maili düzənlikləri torpaqəmələgəlmə prosesində müsbət rol oynayaraq, digər relyef formalarına nisbətən torpaq qatının qalınlığı ilə seçilir. Relyef torpaqəmələgətirən amil kimi torpaq örtüyünün yaranmasında bilavasitə iştirak edir və onun rolu əsas ehtibarilə iqlim şəraitinin torpaqda təsirinin dəyişməsindən asılıdır. (Babayev 1999).

Geoloji quruluşu. Geoloji quruluşuna görə Ordubad inzibati rayonun ərazisi geoloji cəhətdən Kiçik Qafqazın Naxçıvan qırışıqlıq tektonik zonasında yerləşir. Digər tektonik zonalarından fərqli olaraq, geoloji quruluşu ümumi qalınlığı 14 km-ə qədər Kaynozoy (Yerin geoloji tarixinin son 65 mln. ili), Mezozoy (65-248 mln. ili), Paleozoy (248-540 mln. ili) dövrlərinin çökmə, vulkanogen-çökmə, yerüstü vulkanların püskürmə qatlarından və yer qatının daxilində kristallaşmış süxurlardan təşkil olunmuşdur. Alt Pliosen yaşlı kiçik intruzivlər (kütlələr) və

ekstruzivlər silsilənin cənub-qərb yamacında konusvarı, günbəzvarı çıxıntılar yaradaraq təkrarolunmaz relyef əmələ gətirirlər.

Ordubad maili düzənliklərini təşkil edən dördüncü dövr çöküntüləri hidrogeoloji baxımdan xüsusi maraq doğurur. Bu dövrün çöküntüləri əsasən allüvial, prollüvial, dellüvial mənşəli olub müxtəlif tərkibə və qalınlığa malikdir.

Düzənliyin dağətəyi şimal-qərb və şimal-şərq hissəsində həmin çöküntülər Gilançay, Düylünçay, Vənəndçay, Ordubadçay və digər çaylarının gətirmə çöküntüləri olub, tərkib ehtibarilə arası qum gillicələrlə doldurulmuş çaqıl və çinqillili iri çay daşlarından ibarətdir. Bu hissədə çöküntülərin qalınlığı 70 metrə çatır.

Dağətəyi zonada cənub-qərbə Arazkənarı terrasə doğru çaydaşları tədricən kiçik fraksiyalı çöküntülərlə xırda ölçülü çinqillərlə, qumlarla, qumçalar və gillicələrlə əvəz olunur. Çöküntülərin ümumi qalınlığı Arazkənarı zonada 197 metrə çatır.

Geomorfoloji quruluşu. Geomorfoloji cəhətdən düzənlik və maili düzənliklər zəif və orta dərəcədə parçalanmışdır. Aparığımız araşdırmalar nəticəsində müəyyən olunmuşdur ki, ərazi geomorfoloji cəhətdən 2 hissəyə, cənub-qərb Arazkənarı terrasə və şimal-şərq Gilançayın kətirdiyi konusuna ayrılır. Düzənliyin şimal-şərq və cənub kənarları Orta və Üst devon, Rerm və Karbon yaşlı kvarsli əhəngdaşları ilə təşkil olunmuş, dağətəyi zona isə qum daşları və gilli şirstlərlə əhatə olunmuşdur. Həmin süxurlar düzənliyin mərkəzi, Arazkənarı hissəsinə doğru dərinləşərək, üzəri Miosen və Dördüncü dövrün çöküntüləri ilə örtülmüşdür (Babayev 1999).

Ərazinin iqlim şəraiti. Torpaqəmələgəlmə prosesində iqlim amillərinin rolunu yaddan çıxarmaq olmaz. Burada yağıntılar (N^2 , CO^2 , O^2), su buxarı, günəş enerjisi və digərləri torpağın üzvü maddələrinin əmələgəlməsində yaxından iştirak edir. Ordubad inzibati rayonun qışı soyuq, yayı quraq, isti yarımsəhra iqlimi hakimdir. Muxtar respublikanın ərazisində ayrılmış bu düzənliklər bitkilərin həyatında həlledici rol oynayan termik ehtiyatlarla zəngindir.

Bu iqlim tipi Araz çayı boyu ərazinin mütləq yüksəkliyi 600-1000 metr, nisbi yüksəkliyi isə 0-400 metr təşkil edir. Ərazinin coğrafi mövqeyi, səmanın açıqlıq dərəcəsindən asılı olaraq iqlim parametrləri aşağıdakı kimi xarakterizə olunur. Müsbət temperaturların cəmi $4600-4400^{\circ}C$, $5^{\circ}C$ -dən yuxarı müsbət temperaturların cəmi $3800-4000^{\circ}C$ -ə, $10^{\circ}C$ -dən yuxarı müsbət temperaturların cəmi $3600-3400^{\circ}C$, orta illik temperatur $10^{\circ}C$, orta mütləq maksimum $36^{\circ}C$, orta mütləq minimum $20^{\circ}C$ təşkil edir. İllik yağıntıların miqdarı 210-220 mm təşkil edir. Bitkilərin vegetasiyaya başladığı mart-aprel aylarında nisbi nəmliyə 40-45 faiz təşkil edir. Lakin, əsas bitkilərin inkişafı müşahidə olunduğu iyul-avqust aylarında 2-5 faizdən yuxarı qalxa bilmir. Ona görə də bu sahələrdə intensiv suvarma əkinçiliyini tətbiq etmək lazımdır.

Düzənlikdə əsasən allüvial-subasar, bataqlıq-çəmən, çəmən-boz, boz-çəmən, boz, tünd-boz, boz-qonur torpaqları yayılmışdır.

Hidroloji və hidrogeoloji şəraiti. Torpaqəmələgətmə proseslərinə təsir göstərən

amillərdən biri də ərazinin hidroloji və hidrogeoloji quruluşudur. Ona görə də torpaq tədqiqatları apararkən ərazidə süxurların tərkibi, çöküntülərin əmələgəlmə şəraiti və qrunut sularının hidrogeoloji cəhətdən öyrənilməsi də vacib məsələlərdən biridir.

Tədqiqat obyektində ərazinin geoloji quruluşu, ilə bərabər süxurların tərkibi, hidroloji və hidrogeoloji şəraitinin öyrənilməsi də maraq doğurur. Aparığımız araşdırmalar nəticəsində müəyyən olmuşdur ki, ərazidə dördüncü dövr çöküntüləri sulu olub, əsasən təzyiqsiz qrunut sular, Arazkənarı çöküntülərin alt təbəqəsində isə təzyiqli suların mövcudluğu ilə səciyyələnir.

İlk növbədə inzibati rayonda hidroloji şəraitə diqqət yetirdikdə çay şəbəkəsi normal inkişaf etmişdir. İnzibati rayonun təsərrüfatlarında Gilançay, Düylünçay, Vənəndçay, Ordubadçay və digər çaylarının və qismən Araz çayından nasoslar vasitəsilə çəkilən suların istifadə olunur.

Bitki və heyvanlar ailəmi. İnzibati rayonunda əsasən qəhvəyi, dağ-qəhvəyi, dağ boz-qəhvəyi, bozqır və bozqırlaşmış dağ-qəhvəyi, bozqır dağ-çəmən və s. torpaqlar yayılmışdır.

Torpaqəmələgəlmə prosesində üzvü maddənin yaranması bitki və heyvanlar ailəminin xüsusi rolu vardır. Torpaqların münbitliyi üçün böyük əhəmiyyəti olan çöküntülərin toplanması bitki və heyvanlarla əlaqədardır. Bitkilər hər şeydən əvvəl torpaqların üst qatında qida elementlərini toplayır. Bitki qalıqları bitki mikroorqanizmlərinin həyat fəaliyyəti üçün enerji mənbəyidir. Bitkilər bir sıra üzvü turşular ifraz edərək, torpaqda çətin həll olan birləşmələri bitki tərəfindən mənimsənilmiş hala salır.

Tədqiqat obyektində torpaqəmələgəlmə prosesində əvvəldə göstərilən faktorlarla bərabər təbii deqradasiya proseslərini və insan amilini də xüsusi qeyd etmək lazımdır. Antropogen relyef insan fəaliyyəti ilə dəyişdirilmiş və yaradılmış relyefdir. Qədim zamanlardan insan yaranandan sonra uzun əsrlər boyu ətraf mühitə çox yönlü fəaliyyəti nəticəsində torpaq və bitki örtüyündə dərin izlər buraxmışdır. İlk mərhələdə təbii landşaftlar bir çox hallarda mədəni bitki landşaftına, yəni aqrolandşaftlara çevirilmişdir.

I. Təbii amillər 1. Eroziya prosesləri-su eroziyası, -külək eroziyası, iqlimin dəyişməsi-İstiləşmə, quraqlıq, şoranlaşma və şorakətləşmə 4. Bataqlıq və bataqlıq-çəmənləşmə, daşlıqlar və kol-kos basmış sahələr

II. Antropogen təsir. Səhrələşmə torpaq deqradasiyasını yaranan səbəblər arasında təbii amillərlə yanaşı, antropogen təsirlər də əsas diqqət çəkən məsələlərdən biridir (M.Babayev). Antropogen təsir ətraf mühitə, o cümlədən torpağa təsir göstərən insan fəaliyyətinin müxtəlif formalarını birləşdirir. Müxtəlif formalarda insanların torpaqlara kortəbii münasibəti bir çox hallarda ərazidə eroziya proseslərinin inkişafını sürətləndirir və bataqlıq sahələri yaradır. Məsələn, sahələrdə heyvanların sistemsiz otarılması, ağac və kolların qırılması eroziya proseslərini sürətləndirən əsas amillərdəndir. İnzibati rayonda səhrələşmə və torpaq deqradasiyasını yaranan antropogen amillərin müxtəlif formalarından biri olan əhalinin ərazidə məskunlaşmasına diqqət yetirək.

Əhalinin ərazidə məskunlaşmasının torpaqlara təsirinə nəzər saldıqda, burada əhalinin sıxlığı torpaq münbitliyinə təsir göstərən əsas faktorlardan biridir. İnzibat rayonda əhalinin sıx məskunlaşdığı Gilançayın və Ordubadçayın orta axarı kəndi ətrafı torpaqlardan mədəni və təbii bitkilər altında olduqca səmərəli istifadə olunur. Lakin, bəzi təsərrüfatlarda və əhali seyrək və yaxud olmayan ərazilərdə isə torpaqlardan səmərəli istifadə olunmur. Ona görə bu ərazilərin torpaqları öz münbitliyini get-gedə itirərək deqradasiya proseslərinə uğrayaraq əkin dövrüyyəsindən çıxır. Belə torpaq sahələri Düylünçay, Vənəndçay, Ordubadçay və digər çaylarının aşağı axarlarında və inzibati rayonun dağlıq hissələrində müşahidə olunur. Ərazidə torpaq münbitliyinin azalmasına təsir göstərən əhali sıxlığı ilə bərabər, qış və yay otlaqlarında heyvanların sistemsiz otarılması, ağac və kolluqların qırılması hallarına rast gəlinir

Nəticələr:

Ordubad inzibati rayonunda kənd təsərrüfatı təyinatlı torpaqların mühitinin qorunması və münbitliyinin artırılması istiqamətində aparılmış tədqiqatların təhlili əsasında aşağıdakı nəticələr əldə olunmuşdur.

- İnzibati rayonun torpaq mühitinin formalaşmasına, inkişafına təsir göstərən əsas fiziki-coğrafi amillər (ərazinin coğrafi mövqeyini, relyef, geoloji, geomorfoloji quruluşunu, iqlim şəraitini, bitki və heyvanlar aləmini, antropogen təsiri və b.), əkinçiliyin inkişaf tarixi, aparılan torpaq, aqroekoloji tədqiqatlar və deqradasiya prosesləri (şorlaşma, eroziya, bataqlıqlaşma, daşlıq, kol-kos basmış, antropogen təsiri və s.) öyrənilmişdir. Göstərilən tədqiqatların nəticələri təhlil olunaraq ərazidə torpaq mühitinin qorunmasında istifadə olunmuşdur.

- Tədqiqat obyektində eyni zamanda mədəni və təbii bitkilər altında torpaqlar qiymətləndirilmiş və aqroistehsalat qruplaşdırılması əsasında aqromeliativ tədbirlərə ehtiyacı olan torpaq qrupları da üzə çıxarılmış və bütövlükdə inzibati rayonlarında yayılmış bütün torpaq tip, yarım tip və növmüxtəliflikləri öyrənilmişdir.

Təkliflər

- Ordubad inzibati rayonda xüsusilə Ordubad maili düzənliyinin şərq hissəsində torpaqların iri həcmli daşlardan təmizlənməsi, Arazboyunun çökəklik olan sahələrdə şoran torpaqların duzlardan yuyulması və bataqlıqların qurudulması ilə mədəni bitkilər altında istifadə olunması məsləhət görülür.

- Ordubad inzibati rayonunun orta və yüksək dağlıq ərazilərində güclü sellər nəticəsində yarğanlar və bir neçə kənddə (Biləv, Behrud,) torpaqların sürüşmə proseslərinə rast gəlinir. Qeyd olunanlarla bərabər xüsusilə, Gilançayın orta axarında Biləv kəndindən yeni Su elektrik stansiyasına çəkilən su kanalının ətrafında olan torpaq sahələrinə iri həcmli daşlar tökülərək ərazi başdan-başa korlanmışdır. Göstərilən neqativ halların aradan qaldırılması üçün aid qurumlar tərəfindən həmin ərazilərə tökülən iri həcmli daşlar təmizlənməli, güclü sellərin və sürüşmə proseslərinin qarşısını almaq üçün lazımi tədbirlərin həyata keçirilməsi məsləhət görülür.

Göstərilən tədbirlər Ordubad inzibati rayonunda qeyd etdiyimiz ərazilərdə elmi əsaslarla planlı surətdə həyata keçirilərsə ərazidə torpaqlardan maksimum dərəcədə səmərəli istifadə etmək olar.

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NORMAL AND PATHOLOGICAL PHYSIOLOGY

ПОКАЗАТЕЛИ БИОХИМИЧЕСКИХ МАРКЕРОВ ФОСФОРНО-КАЛЬЦИЕВОГО ОБМЕНА И МЕТАБОЛИЗМА КОСТНОЙ ТКАНИ У ПАЦИЕНТОВ С ОСТЕОАРТРОЗОМ

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INDICATORS OF BIOCHEMICAL MARKERS OF PHOSPHORUS-CALCIUM EXCHANGE AND BONE TISSUE METABOLISM IN PATIENTS WITH OSTEOARTHRITIS

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Аннотация

Остеoarthritis (OA) - это дегенеративное заболевание, поражающее суставы и предсуставные ткани, что приводит к снижению качества жизни. В данном исследовании изучается минеральный обмен у пациентов с ОА, выявлено значительное снижение уровня кальция, фосфора и магния, особенно у пациентов с реактивным синовитом. Повышенная активность щелочной фосфатазы способствует резорбции костной ткани и остеопеническим состояниям. Полученные данные подчеркивают необходимость разработки стратегий лечения, направленных не только на устранение симптомов ОА, но и на устранение основных метаболических и биохимических дисбалансов, влияющих на здоровье костей.

Abstract

Osteoarthritis (OA) is a degenerative disease affecting joints and pre-articular tissues, leading to reduced quality of life. This study examines mineral metabolism in OA patients, showing significant decreases in calcium, phosphorus, and magnesium levels, particularly in those with reactive synovitis. Elevated alkaline phosphatase activity contributes to bone resorption and osteopenic conditions. The findings highlight the need for treatment strategies that address not only OA symptoms but also underlying metabolic and biochemical imbalances affecting bone health.

Ключевые слова: Остеoarthritis (OA), минеральный обмен, дефицит кальция, резорбция костной ткани, щелочная фосфатаза.

Keywords: Osteoarthritis (OA), mineral metabolism, calcium deficiency, bone resorption, alkaline phosphatase.

Osteoarthritis (OA) is a systemic disease of joints and pre-articular tissues, traditionally defined as a degenerative process with symptoms of inflammatory disease according to X-ray signs. Osteoarthritis (Osteoarthrosis) is a progressive disease of the musculoskeletal system that leads to a deterioration in the quality of life and disability. The wide spread of osteoarthritis and the social consequences associated with it have raised the issues of improving the diagnosis, treatment and rehabilitation of patients with this pathology to the level of medical, social and economic problems(6,7,8). More than 20% of the world's population suffers from OA, 80% of these people have mobility problems, and 30% of people with disabilities are OA sufferers [1,9,10]. OA is a polyetiological disease.

There is no specific reason for the development of this disease. According to L.I.Alekseeva and others (2004), the basis of pathogenesis lies in the imbalance between anabolic and catabolic processes, primarily in the hyaline cartilage and subchondral bone, which are induced (supported) by various factors. It should be

emphasized that OA involves the pathological process, including the synovial membrane, joint capsule, intra-articular ligaments and pre-articular muscles [1].

The aim of the study is to study the status of some indicators of mineral metabolism in patients with OA.

Materials and methods: OA diagnosis was determined based on the nomenclature and classification of the Institute of Rheumatology of the Russian Academy of Medical Sciences (1989) and osteoarthrosis classification criteria. 64 (87.8%) of the patients with OA under our control were women and 9 (12.3%) were men. the average age was 48.9. The table showing the clinical characteristics of the examined patients shows that the patients with OA were divided into two subgroups according to their initial status: a) 32 patients (44%) with OA complicated by secondary reactive synovitis and b) 41 patients (56%) with OA not complicated by secondary synovitis). The age of the patients was from 31 to 72 years. The duration of the disease was from 1 to 20 years. In order to determine the stage of OA, the affected joints were examined radiographically. Stage I

was detected in 10 (13.6%), stage II in 32 (43.9%), stage III in 31 (42.5%) patients. According to the clinical form, 90.4% of the patients had gonarthrosis, 9.6% had hip joint arthrosis. It should be noted that the amount of calcium in the plasma is controlled by the skeletal system, which is sensitive to hormonal signals. By reabsorbing phosphate and magnesium, the kidneys

exert the main control over the exchange of these ions, thereby providing a constant calcium level without involving bone tissue. The effect of parathyroid hormone and vitamin D in this process is unquestionable. Vitamin D in its active form supports the bone mass and ensures the delivery of adequate amounts of calcium and phosphorus for the mineralization of new bone.

Table 1

Indicators of mineral metabolism in blood in patients with osteoarthritis

Indicator	Healthy individuals n-20	OA control n-34
Calcium content mmol/l	2.36±0.02	2.07±0.13*
Phosphorus content mMol/l	1.18±0.04	0.89±0.05*
Magnesium content in mmol/	1.095±0.07	0.87±0.03
Alkaline phosphatase ED/l	117.5±4.2	215.8±9.71

Note: * - Note: * - $R < 0.05$ is the reliability of differences

Results and discussion: In OA, we observe a decrease in the level of calcium in the blood, which is more pronounced in the combined form of the disease.

Our tests provide information on the total concentration of calcium in ionized and non-ionized forms, although the intracellular concentration of Ca^{2+} ions is much lower and is associated with soluble ligands, cell membranes.

Inorganic phosphorus plays an important role in the metabolism of bone tissue. In the blood serum, inorganic phosphorus is given as NRO_4^{2-} and $\text{N}_2\text{RO}_4^{3-}$ ions.

It is known from the results of the examination (Table 1) that the examined patients tend to decrease the amount of phosphorus in their blood, which is more apparent in osteoarthritis.

For example, in patients with OA, the amount of phosphorus in the blood decreases to values of 0.89 ± 0.05 mmol/l, which is 25% lower than the initial values. In the combined form of the disease, the amount

of phosphorus decreases even more and was 0.76 ± 0.02 mmol/l (normally 1.18 ± 0.04 mmol/l), ($R < 0.05$).

It is known that hypophosphatemia develops in vitamin D3 deficiency [5]. Phosphorus absorption disorders are probably associated with chronic liver disease, and may also be a condition of overproduction of parathyroid hormone by the parathyroid glands. Also. With the development of OP, it is possible that its excretion by the kidneys increases in conditions of resorption in bone tissue.

Balanced with vitamin D, magnesium ion is another vital element. The analysis of the obtained results showed a decrease in its amount in the blood, especially in the combined form of the disease, compared to the average of 12-14% in healthy individuals. A less pronounced state of hypomagnesemia can activate parathyroid hormone secretion. It should be pointed out that the ineffectiveness of treatment of hypocalcemia with vitamin D in many cases is due to this same hypomagnesemia [9.12].

Table 2

Indicators of STMZ markers in patients with OA

Indication	Healthy	OA
Osteocalcin (ng/ml)	18.2±2.8	13.9±0.33
B- Cross Labs (ng/ml)	0.22±0.03	0.42±0.02*
P-TH (pg/ml)	34.1±2.3	26.3±2.24*

Note: * - $R < 0.05$ is the reliability of differences with the healthy group

It is known that alkaline phosphatase hydrolyzes pyrophosphate, which has a negative effect on the mineralization process, that is, under these conditions, the enzyme is considered a controller of the calcification process and participates in the formation and mineralization of bone matrix osteoid.

The results of the presented investigation show that in the investigated subjects with OA, the activity of alkaline phosphatase increases reliably and is 270.8 ± 13.0 Ed/l and 272.6 ± 11.2 Ed/l, respectively, which is 2.3 times higher than the initial values, times higher ($R < 0.05$). In recent years, a theory appeared that the changes occurring in the subchondral bone are probably primary and lead to cartilage degradation [5.9].

One of the hypotheses explaining this process is the fact that the subchondral bone produces a large amount of pro-inflammatory cytokines and growth factors, which can enter the overlying tendon (as a result

of the formation of tendon microcracks and vascular invasion of the calcified tendon zone) and degrade the tendon tissue [2.11]. A number of osteotropic hormones (parathyroid hormone, calcitonin, somatotrophic hormone, thyroid and sex hormones) have a systemic effect, their secretion is associated with various directed changes in the concentration of calcium in the blood.

It is known that calcium and phosphorus participate in a number of the most important biochemical functions of the body. Support in the form of an exoskeleton or endoskeleton is required for the body to perform support and movement functions. The body's needs were met in two ways, on the one hand, in the calcium-phosphorus mineral fund (reserve), and on the other hand, due to the development of the endoskeleton, the main function of which is oxyapatite.

Therefore, bone diseases often occur in conditions where calcium and phosphorus homeostasis disorders are covered by bone.

It is known that cellular product - extracellular matrix vesicles are involved in the calcification process. Vesicles store high concentrations of alkaline phosphatase. When the vesicles enter the extracellular space, they begin to accumulate calcium and phosphorus. Calcium absorption probably involves binding to proteoglycans, while phosphorus accumulates due to the action of alkaline phosphatase on pyrophosphates. After that, amorphous calcium phosphate, which turns into oxyapatite in sequence modification, begins to form inside the vesicles. Complex formation plays a central role, which is considered a specific source for oxyapatite proliferation.

It is of particular importance to study the status of markers indicating STMZ disorders in the detection of osteopenic conditions in OA.

Bone tissue metabolism is characterized by two opposite processes: formation of new bone tissue and resorption (degradation) of old tissue. Normally, the amount of newly formed tissue is equal to that which is resorbed. One of the indicators determining bone tissue resorption is blood plasma alkaline phosphatase, collagen degradation product of type I - type I collagen S-telopeptide (CrossLaps), markers of bone tissue formation and bone matrix formation marker - total amino-terminal propeptide of type I procollagen (PINP). is considered

Osteocalcin (glc-protein) is a non-collagenous protein, specific for bone mass and dentin. Osteocalcin is synthesized from osteoblasts and is responsible for the formation of the extracellular matrix of bone. Serum osteocalcin levels are associated with skeletal growth and increase rapidly during bone formation [1.12].

In our research, the study of the status of special markers of osteopenia showed that these indicators have special dynamics. We can see that osteocalcin, the index of bone tissue synthesis, is 1.42 times lower in OA than in the healthy group.

The index of bone tissue resorption increased by 1.9 times in B-Cross Labs OA and was equal to 0.42 ± 0.02 ng/ml on average, which is 2.14 times higher than the values of healthy people ($R < 0.05$). The same dynamic of changes is also reflected in RNA parameters, in which its amount in patients with OA was on average 26.3 ± 2.24 pg/ml and compared to the parameters of the control group.

It means 22.9% lower ($R < 0.05$) in a relatively statistically reliable way.

Bone mineralization marker with densitometric measurements (Z-criterion) in OA patients was found to be negatively correlated with osteocalcin ($r = -0.39$), and osteocalcin was positively correlated with IF ($r = +0.62$).

When the daily amount of oxyproline in urine, which is an indicator of bone resorption, was checked in patients with OA, its amount was on average 22.4 ± 0.28 , which is 1.45 times higher than that of the control group ($R < 0.05$).

Thus, determination of indicators of STMZ markers has gained important diagnostic value in rheumatic

diseases. Violation of STMZ indicators was reflected in the case of all markers. Based on these data, varying degrees of STMZ marker indicators in OA lead to bone resorption, accelerating osteodystrophic processes.

The above-mentioned data indicate that the dynamics of changes in the amount of blood mineral content and enzyme activity in osteoarthritis have a similar nature and depend not only on hormonal status, vitamin D metabolism disorders, but also on many metabolic processes that affect the process of bone formation and decay (resorption).

In OA, we observed a decrease in blood calcium, which was more pronounced when the disease was accompanied by impaired liver function. Similar dynamics were observed in the study of the amount of phosphorus and magnesium in the blood of the subjects. This was not only due to lack of vitamin D, but also due to chronic liver disease.

Alkaline phosphatase activity in subjects with OA was convincingly increased 2.3-fold when co-occurring with chronic liver disease.

Vesicles fall out of the cell and begin to accumulate calcium and phosphorus. Calcium absorption probably involves its binding to acidic phospholipids and proteoglycans, where IF accumulates due to the action of alkaline phosphatase on pyrophosphate. After that, the formation of amorphous calcium phosphate, which is gradually modified into oxyapatite, begins to form inside the vesicles.

Thus, in patients with OA, changes in blood mineral composition, determined dynamics of enzyme activity are of the same nature and are not only related to calcium-phosphorus changes in blood content, hormonal status disorders, vitamin D metabolism, but also affect the process of bone formation and resorption in osteopenic disorders. It is also related to the functional state of the liver, where many metabolic processes take place.

Based on the knowledge about the pathogenesis of OA, the treatment of this chronic progressive joint disease can be limited to: reducing pain and inflammation, reducing the number of sprains and new joint damage, improving the quality of life, slowing the progression of OA and preventing disability, pathogenetic treatment of OA as well as restores the normal structure of the hyaline cartilage, stops catabolic processes and improves the mineral composition of bone tissue by activating the synthesis of valuable glycosaminoglycans and type II chondrocyte collagen.

Conclusion: the detected disturbances in the parameters of mineral metabolism in OA patients indicate the potential risk of polyorgan disorders, which is undoubtedly one of the pathogenetic mechanisms that allow the disease to worsen. This situation requires constant monitoring of metabolic disorders in patients with OA.

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PEDAGOGY

ARTIFICIAL INTELLIGENCE IN TEACHING ENGLISH PROSPECTS AND LIMITATIONS

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Abstract

This article explores the role of artificial intelligence (AI) in teaching English as a foreign language in the context of Kazakhstan. The paper examines both the prospects and limitations of using AI tools in educational settings based on global and Kazakhstani research. AI applications such as virtual tutors, grammar-checking programs, and language-learning apps are increasingly being integrated into English language teaching to improve personalized learning and student engagement.

The practical part of the study includes the experience of using AI tools with 7th-grade students at Zhuban Moldagaliyev Secondary School № 2 in the city of Uralsk. Tools such as ChatGPT for conversational practice, Grammarly for writing improvement, and Duolingo for vocabulary expansion were used in the classroom. Despite the high potential of AI in improving students' language skills and engagement, its effectiveness was sometimes limited by a lack of resources and students' reliance on AI feedback. Overall, the article demonstrates how AI can support the process of teaching English in Kazakhstan, while acknowledging the current limitations for its widespread use.

Keywords: artificial intelligence (AI), English language teaching (ELT), education in Kazakhstan, AI in education, language learning tools, ChatGPT, Grammarly, Duolingo, English as a foreign language (EFL), AI possibilities and limitations.

Introduction. Artificial intelligence (AI) is playing a transformative role in education worldwide, particularly in enhancing language learning. In Kazakhstan, AI technologies are gradually being integrated into English as a Foreign Language (EFL) instruction to overcome the limitations of traditional teaching methods and cater to the diverse needs of learners. Global studies have demonstrated that AI-driven tools, such as chatbots, intelligent tutoring systems, and automated feedback mechanisms, offer personalized learning experiences and real-time feedback, making language acquisition more efficient and engaging (Kemelbekova et al., 2024).

Despite the increasing interest in AI's potential in education, its implementation in Kazakhstan, particularly in primary and higher education, faces several challenges. One of the main hurdles is the lack of localized AI tools that consider Kazakh and Russian languages, which are essential for multilingual learners. Research conducted at Abai Kazakh National Pedagogical University highlights the effectiveness of AI tools in improving students' English speaking abilities. AI systems such as chatbots, combined with speech recognition tools, have proven useful in enhancing pronunciation and fluency (Kemelbekova et al., 2024).

Kazakhstani researchers have also explored the use of gamification and AI in motivating younger learners. For example, Duisenova and Zhorabekova (2024) investigated the integration of AI and gamified learning platforms in primary schools and found that these methods significantly increased motivation and language proficiency among young learners. The combination of game-based learning and AI provided interactive experiences that kept students engaged, fostering intrinsic motivation and improving their language skills.

However, challenges such as unequal access to technology across regions and insufficient teacher training on AI tools remain critical barriers to widespread adoption. Teachers play a crucial role in facilitating the integration of AI into classrooms, and their readiness and perceptions significantly influence the success of these initiatives (Barakina et al., 2021). Thus, to fully realize the benefits of AI in English language teaching in Kazakhstan, further research is needed on both localized AI tools and teacher training programs.

In Kazakhstan, AI is slowly being incorporated into education, particularly in the realm of English language learning. Several Kazakhstani scholars have contributed to the understanding of how AI can enhance ELT in local contexts. Bibigul Dilzhan (2024), in her study titled *Teaching English and Artificial Intelligence: EFL Teachers' Perceptions and Use of ChatGPT*, explores the use of ChatGPT in classrooms. The study reveals that while the AI-driven chatbot is useful for providing students with real-time feedback on conversational English, there are concerns among teachers regarding the tool's inability to fully replace human instructors. ChatGPT is effective in simulating real-world dialogues, but limitations such as its lack of cultural and contextual awareness hinder its complete effectiveness in the classroom.

Similarly, Kairat Darkhan (2021), in his dissertation examines the use of Automatic Speech Recognition (ASR) systems to enhance English teaching. ASR systems, which convert spoken language into written text, are proving useful for pronunciation practice and improving listening comprehension. However, the lack of localized ASR tools that support Kazakh or Russian languages limits their applicability in local schools.

Darkhan emphasizes the need for AI systems to cater to the multilingual needs of Kazakhstan's students, particularly in rural areas where English proficiency levels are lower.

Turar Tangirbergen's study (2022) *Teachers' Experiences of Using Mobile Applications for Teaching English as a Foreign Language in Kazakhstan*, investigates the challenges teachers face when incorporating AI-powered mobile apps such as Duolingo into their curriculum. While these apps are beneficial for gamified and engaging learning, many teachers in Kazakhstan feel that such apps cannot replace face-to-face interaction in language learning. Tangirbergen also points out the digital divide between urban and rural schools, where access to AI tools is limited due to infrastructure challenges.

Finally, Saken Yeslyamov (2024), in his study *Application of Software Robots Using AI Technologies in Education*, investigates the use of AI-based robots in Kazakhstani schools. The study highlights how these robots assist in managing large classrooms by offering personalized learning exercises to students. While promising, this technology is still in its early stages, and there is a need for more research on its long-term effectiveness and scalability across the country's education system.

The prospects of AI in English language teaching are considerable, both globally and in Kazakhstan. AI tools offer the potential for personalized learning experiences, allowing students to work at their own pace and receive instant feedback on their progress. For example, platforms like ChatGPT can engage students in real-time conversations, helping them practice their speaking skills in a low-pressure environment. Similarly, grammar-checking tools such as Grammarly provide immediate corrections, helping students improve their writing accuracy.

In Kazakhstan, the integration of AI into ELT has the potential to bridge gaps in language learning resources, especially in rural areas. AI tools can supplement traditional teaching methods and help overcome the shortage of qualified English teachers. Furthermore, AI technologies like Duolingo and other mobile learning apps allow students to access high-quality language lessons outside the classroom, democratizing education and making it more accessible to students across the country.

Despite these positive prospects, there are notable limitations to the use of AI in English language teaching, particularly in Kazakhstan. One major challenge is the lack of localized AI tools that cater to the Kazakh and Russian languages. Most AI-based language learning platforms are designed for English speakers, which limits their usability for non-native English learners in Kazakhstan. Darkhan (2021) and Tangirbergen (2022) emphasize that this lack of localization creates a barrier for widespread AI adoption, particularly in regions where students are not proficient in English.

Another significant limitation is the digital divide in Kazakhstan. While AI tools are increasingly being used in urban schools, rural areas often lack the technological infrastructure necessary to support AI-based learning. Schools in these areas may not have access to the internet or devices required for AI tools like Duolingo or Grammarly, which limits students' opportunities to benefit from these technologies. Furthermore,

many teachers may lack the training needed to effectively integrate AI into their teaching, as noted by Yang and Plass (2021).

Finally, there is a broader concern about the over-reliance on AI in education. While AI can provide valuable support in language learning, it cannot replace the human element of teaching. Teachers play a critical role in fostering creativity, critical thinking, and emotional intelligence—skills that AI has not yet been able to replicate. As Dilzhan (2024) points out, AI tools like ChatGPT may offer helpful feedback, but they lack the ability to truly understand cultural nuances and student emotions, which are crucial for effective language learning.

The literature on AI in education reveals both significant opportunities and challenges. Global trends demonstrate AI's potential to personalize learning and engage students in new ways, while Kazakhstani research highlights the need for localized AI tools and better infrastructure to fully integrate these technologies into the education system. AI tools offer promising prospects for English language learning in Kazakhstan, but limitations related to language barriers, access to technology, and the need for human interaction must be addressed for AI to reach its full potential in education.

Methodology and practical implementation.

This section outlines the methodology used in incorporating AI-based tools into the teaching of English as a foreign language (EFL) to 7th grade students in secondary school №2 named after Zh. Moldagalieva, as well as the practical implementation of these tools in classroom settings. The focus is on three AI-powered tools: ChatGPT, Grammarly, and Duolingo. The methodology is based on a blended learning approach that integrates both traditional teaching techniques and AI-driven tools to enhance language learning experiences. This approach aims to engage students, offer personalized feedback, and provide real-world applications of English.

The choice of AI tools was based on their relevance to different aspects of English language learning. ChatGPT was selected for conversational practice due to its ability to simulate natural dialogues and offer real-time feedback. Grammarly was chosen for its advanced grammar-checking capabilities, allowing students to improve their writing by receiving instant corrections and suggestions. Duolingo was integrated into the vocabulary and grammar lessons because of its gamified and adaptive learning features, which could motivate students through rewards and continuous feedback.

A mixed-methods approach was employed to evaluate the integration of AI tools, combining qualitative feedback from students and quantitative data based on their performance before and after using the tools. AI was integrated into daily lesson plans through structured activities, where students alternated between traditional teacher-led lessons and AI-assisted learning.

ChatGPT was used to simulate real-life scenarios, such as ordering food or asking for directions. Students were divided into pairs to interact with the AI, and afterward, they discussed their conversations and received feedback on grammar and fluency.

Grammarly was implemented during essay assignments. Students drafted essays on topics such as "My Favorite Place in Kazakhstan" and used Gram-

marly to revise their work before submission. A comparative analysis was done between their initial drafts and the AI-revised versions.

Duolingo was assigned as a homework activity for vocabulary building. Lessons from Duolingo were tied to classroom content, and students were asked to track their progress using the app's metrics.

Results and feedback. To measure the effectiveness of AI tools, a pre-assessment of students' English

proficiency levels was conducted at the beginning of the implementation.

Guiding questions:

1. What time do you wake up?
2. What do you do first thing in the morning?
3. What are your main activities during the school day?
4. How do you spend your free time after school?
5. What do you usually do before going to bed?

Criteria	4 – Excellent	3 - Good	2 - Satisfactory	1 - Needs Improvement
Fluency	Speaks smoothly with no noticeable pauses.	Speaks with few pauses, overall smooth.	Frequent pauses or hesitations but still understandable.	Many pauses, making communication difficult to follow.
Sentence Structure	Uses a variety of simple and complex sentences accurately.	Mostly uses correct sentence structures, with occasional minor errors.	Limited variety in sentence structures, several noticeable errors.	Significant sentence structure errors, mostly simple sentences.
Use of Vocabulary	Uses a wide range of appropriate vocabulary with no repetition.	Uses varied vocabulary, with minimal repetition.	Vocabulary is somewhat repetitive, with basic word choices.	Limited vocabulary and frequent repetition.
Pronunciation	Pronounces key vocabulary clearly and correctly with no issues.	Mostly clear pronunciation, with minor issues that don't hinder understanding.	Some mispronunciations that occasionally affect understanding.	Pronunciation errors make it difficult to understand the speaker.

Picture 1. Speaking Task Rubric: Describe Your Daily Routine

To assess the effectiveness of AI tools in enhancing English proficiency among Kazakhstani students, a pre-assessment was conducted to establish baseline levels. The assessment involved a speaking task based on guiding questions related to students' daily routines, along with a writing task on "My Favorite Hobby." Notably, insights from Kazakhstani scholars provide context to this evaluation, emphasizing the need for innovative educational practices in the region.

The results from the speaking task demonstrated varied proficiency levels among the 24 students. Approximately 50% exhibited good fluency, characterized by smooth speech with minimal pauses, while 30% had occasional hesitations and needed support in vocabulary variety. Most students relied on simple sentence structures, with only a few attempting more complex forms. Vocabulary usage was largely basic, but around 40% successfully incorporated a broader range of language. Pronunciation was generally clear, though some students struggled with specific words, which occasionally impacted comprehension.

The writing assessment revealed positive trends in students' writing abilities. About 70% of students scored in the "Excellent" and "Good" categories, demonstrating effective grammar usage, spelling accuracy, and a good variety of vocabulary. Most structured their essays well, presenting clear introductions and conclusions. However, approximately 30% fell into the "Satisfactory" or "Needs Improvement" categories, indicating challenges with sentence variety and grammatical issues, particularly with verb tenses and subject-

verb agreement. Despite these difficulties, many students expressed enthusiasm for their hobbies, enhancing their engagement in the writing process.

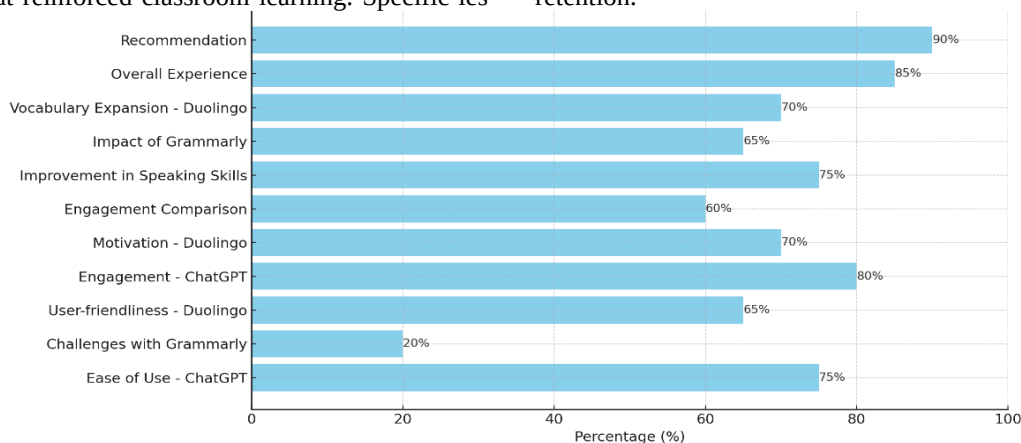
Kazakhstani scholars have emphasized the importance of integrating technology into education to improve language acquisition. For example, A.S. Tazhibayeva, a prominent researcher in educational technology, notes that AI tools can facilitate personalized learning experiences, catering to the diverse needs of students in Kazakhstan. Additionally, G.K. Sadvakassova highlights that using innovative tools like AI can bridge the gap between traditional teaching methods and modern pedagogical approaches, fostering greater student engagement and motivation.

The implementation of AI tools was a crucial step in this educational initiative. ChatGPT was introduced as a virtual tutor for conversational practice, allowing students to simulate real-world dialogues in a supportive environment. Through various scenarios, such as booking hotels or asking for directions, students gained confidence in English communication. The AI provided instant feedback on grammar and sentence structure, leading to improvements in fluency and sentence complexity during subsequent interactions.

Grammarly was integrated during essay-writing exercises and served as a critical tool for enhancing writing skills. Students composed essays on topics like "My Favorite Place in Kazakhstan" and used Grammarly to identify and correct errors in real time. This facilitated critical engagement with their writing, leading to noticeable improvements in clarity and grammatical accuracy from initial drafts to final versions.

Duolingo was employed as a supplementary tool offering vocabulary and grammar practice. Its gamified approach motivated students to engage with language tasks that reinforced classroom learning. Specific les-

sons were assigned based on curriculum focus, and progress was monitored through a competitive leaderboard, fostering enthusiasm and improving vocabulary retention.



Picture 2. Survey results on AI tools in English learning

After several weeks of using these AI tools, a post-assessment was conducted to evaluate improvements in speaking, writing, and vocabulary retention. Qualitative data were collected through surveys, highlighting students' experiences with the AI tools, including ease of use, engagement, and perceived benefits in language skill improvement (picture 2). A bar chart illustrated the survey results on the effectiveness of the AI tools in English language learning, indicating significant contributions from all three platforms. ChatGPT excelled in fostering engagement and motivation for conversational practice. Grammarly proved vital for writing enhancement and self-revision skills, while Duolingo received slightly lower ratings in ease of use and overall experience, suggesting potential areas for improvement in user interface or lesson design.

Conclusion

The integration of AI tools in English language teaching in Kazakhstan presents significant opportunities and challenges. This study has demonstrated that tools such as ChatGPT, Grammarly, and Duolingo can enhance the learning experience for seventh and eighth graders by providing personalized, interactive, and engaging methods of language acquisition. The results from both qualitative and quantitative assessments indicate improvements in students' speaking and writing skills, as well as increased vocabulary retention.

ChatGPT emerged as a particularly effective tool for fostering engagement in conversational practice, allowing students to simulate real-life interactions and receive immediate feedback. Grammarly's role in refining students' writing highlighted its value in promoting self-awareness and critical thinking regarding their language use. Duolingo's gamified approach encouraged consistent vocabulary practice, although feedback indicated that improvements could enhance its user experience further.

Despite the positive outcomes, challenges such as the lack of localized AI tools and the digital divide in Kazakhstan present barriers to fully harnessing the potential of AI in education. The need for teacher training and infrastructure development cannot be overlooked if

AI is to be successfully integrated into language learning environments.

Moving forward, further research is required to explore the long-term effectiveness of AI tools, their scalability across diverse educational contexts, and strategies for overcoming existing limitations. As educators and policymakers strive to enhance English language teaching in Kazakhstan, leveraging the strengths of AI can contribute to more inclusive and effective learning experiences for all students.

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ПОЧАТОК ЄВРОІНТЕГРАЦІЇ У ПІДГОТОВЦІ ФАХІВЦІВ ДОШКІЛЬНОГО ПРОФІЛЮ: ІНКЛЮЗІЯ

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THE BEGINNING OF EUROPEAN INTEGRATION IN THE TRAINING OF PRESCHOOL SPECIALISTS: INCLUSION

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Анотація

У статті відображається євроінтеграція як важливий етап розвитку сучасної освіти в Україні. Отримані результати у підготовці майбутніх вихователів до роботи в інклюзивних групах закладу дошкільної освіти. *Наукові методи дослідження* які використовувались: теоретичний аналіз, синтез та порівняння. Також застосовувалися емпіричні методи. *Перспектива подальших досліджень* та розробки в цьому напрямку полягає у необхідності розширення міждисциплінарного підходу до підготовки фахівців дошкільної освіти. Зокрема, важливим є залучення фахівців з медицини, психології та соціальної роботи для створення комплексної системи підтримки інклюзивного навчання.

Abstract

The article reflects European integration as an important stage in the development of modern education in Ukraine. Obtained results in the preparation of future educators to work in inclusive groups of the preschool education institution. Scientific research methods used: theoretical analysis, synthesis and comparison. Empirical methods were also used. The prospect of further research and development in this direction lies in the need to expand the interdisciplinary approach to the training of preschool education specialists. In particular, it is important to involve specialists in medicine, psychology and social work to create a comprehensive support system for inclusive education.

Ключові слова: інклюзія, дошкільна освіта, вихователь, євроінтеграція, підготовка студента.

Keywords: inclusion, preschool education, teacher, European integration, student training.

В Європі було проведено багато досліджень на тему підготовки фахівців дошкільної освіти для роботи в інклюзивних умовах. Основними організаціями та дослідниками, які працюють у цій галузі, є: Європейська Агенція з розвитку спеціальної та інклюзивної освіти (European Agency for Special Needs and Inclusive Education) — ця агенція займається розвитком інклюзії в системі освіти, в тому числі у дошкільному віці [4]. Проект DECET (Diversity in Early Childhood Education and Training) — впровадженням інклюзивної практики в дошкільних закладах [2]. Університети Європи, такі як Університет Осло (Норвегія), Університет Гренобля (Франція) проводять важливі дослідження з підготовки педагогів до роботи в інклюзивних класах. **Університети Скандинавських країн** (Швеція, Данія) — вони відомі своїми передовими програмами в галузі інклюзивної освіти. Наприклад, Університет Гетеборга в Швеції пропонує магістерські програми з інклюзивної освіти, включаючи підготовку дошкільних фахівців. **Університети Великобританії** — такі заклади, як Лондонський інститут освіти (UCL Institute of Education) [7] та Університет Единбурга, також пропонують спеціалізовані програми для підготовки вчителів до роботи в інклюзивних умовах. **Італія** — італійська система

освіти відома своїм підходом до інклюзивності, а багато італійських університетів, таких як Університет Болоньї, активно займаються підготовкою фахівців для роботи з дітьми з особливими потребами в інклюзивному середовищі. Крім того, низка європейських проектів, таких як Erasmus+ та різні програми співробітництва, фінансують обміни та підготовку спеціалістів з інклюзивної освіти на міжнародному рівні.

Наукові дослідження щодо інклюзивної підготовки фахівців дошкільного профілю в Європі а також у США [1] підкреслюють важливість створення рівних можливостей для всіх дітей незалежно від їхніх індивідуальних особливостей. Одним з результатів досліджень стало створення інструментів для самооцінки навчальних закладів, що сприяють розвитку інклюзивних практик. Так, наприклад, у США Національна асоціація освіти дітей раннього віку (NAEYC) [5] розробляє стратегії, які включають підготовку педагогів для роботи з різними соціальними групами, дітьми з особливими потребами та тими, хто вивчає дві мови. Це включає розвиток компетенцій у сфері співпраці з родинами та використання інклюзивних педагогічних підходів. Таким чином, підготовка дошкільних педагогів як у Європі, так і в США базується на дослідженнях,

що підкреслюють важливість постійної освіти, використання гнучких навчальних програм.

В Європі та США є численні дослідження на тему інклюзії, особливо у сфері освіти, науки та технологій. Основними аспектами таких досліджень є рівність можливостей для жінок, етнічних меншин, людей з інвалідністю та інших груп, які стикаються з дискримінацією або недостатньою представленістю. У Європі одним з ключових документів є «Science Europe» [6], що фокусується на сприянні рівності та інклюзії в дослідницькому середовищі. Організація розробляє рекомендації для покращення умов для жінок і меншин у науці та освіті, а також сприяє інтеграції вразливих груп на різних етапах кар'єри.

Платформи, такі як PLOS Computational Biology, пропонують рекомендації щодо організації академічних дискусій на теми інклюзії та справедливості, де особлива увага приділяється ролі мікроагресій та неусвідомлених упереджень у наукових колективах.

Національні інститути охорони здоров'я (NIH) запустили стратегічний план, спрямований на покращення різноманітності та інклюзивності як у дослідженнях, так і серед науковців. Цей план передбачає підтримку досліджень, які сприяють культурним і структурним змінам в академічних установах та впроваджують політики щодо гендерної рівності, соціального статусу, а також расової інклюзії. Окрім того, в Європі реалізуються різноманітні наукові дослідження щодо інклюзивної освіти, особливо у школах. Наприклад, European Agency for Special Needs and Inclusive Education [4] проводить детальні огляди на цю тему, аналізуючи кращі практики та наукові проекти, спрямовані на підвищення досягнень усіх учнів незалежно від їхніх потреб.

Підготовка фахівців дошкільної освіти до роботи в умовах інклюзивних груп закладу дошкільної освіти є важливою складовою цього процесу. Інклюзивна освіта в Європі базується на принципах рівних прав для всіх дітей, включно з тими, хто має особливі освітні потреби. В Україні це питання є актуальним, зважаючи на міжнародні зобов'язання та прагнення забезпечити дотримання прав дітей з інвалідністю. Фахівці дошкільної освіти мають бути готові до роботи з різними категоріями дітей, зокрема з дітьми, які мають особливі освітні потреби. Це включає володіння спеціальними методиками, розуміння психологічних та педагогічних аспектів роботи в інклюзивному середовищі. Зі зростанням суспільного усвідомлення важливості інклюзії виникає потреба в підготовці педагогів, які зможуть впроваджувати інклюзивні практики у дитячих садках та інших навчальних закладах. Це також відображає зміни в громадському сприйнятті освіти і прав дитини.

Дошкільна освіта активно опановує євроінтеграційну підготовку фахівців дошкільного профілю. Актуалізується завдання створення освітньої моделі сучасного фахівця – педагога дошкільної освіти із сформованими компетентностями до роботи в умовах інклюзії.

Інтенсивні перетворення, що відбуваються на сучасному етапі розвитку суспільства в соціокультурній і економічній галузях, обумовлені сучасними тенденціями розвитку у всіх сферах соціальної життєдіяльності суспільства, зокрема, у галузі освіти. В зв'язку з цим основна мета дошкільної освіти – це підготовка фахівців, що мають високий рівень кваліфікації в інклюзії. Фахівці, які здатні освоювати інклюзивну сферу в цілях ефективного виконання професійної діяльності, в контексті її відповідності європейським стандартам мають професійну перспективу. Освітня політика України в цьому сприяє. Наводимо основні організаційні дії по ландшафту освітньої української політики. Наприклад, «Про організацію психологічного і соціального супроводу в умовах інклюзивного навчання» (Лист МОНмолодьспорту України від 26.07.2012 № 1/9-529). «Про визначення завдань працівників психологічної служби системи освіти в умовах інклюзивного навчання» (МОНмолодьспорту України від 02.01.2013 № 1/9-1) «Про організаційно-методичні засади забезпечення права на освіту дітям з особливими освітніми потребами» (Лист МОН України від 08.08.2013 № 1/9-539). «Щодо організації діяльності інклюзивних груп у дошкільних навчальних закладах» (Лист МОН України від 12.10.2015 № 1/9-487). «Щодо Порядку та умов надання субвенції з державного бюджету місцевим бюджетам на надання державної підтримки особам з особливими освітніми потребами» (Лист Міністерства освіти і науки України від 29.11.2017 № 1/9-639). «Щодо організації діяльності інклюзивних груп у закладах дошкільної освіти» (Лист МОН України від 13.11.18 року № 1/9-691). «Методичні рекомендації щодо організації навчання осіб з особливими освітніми потребами в закладах освіти в 2019/2020 н.р.» (Лист МОН України від 05.08.2019 №1/9-498) і т.д.

Все вищезазначене підкреслює важливість питання підготовки педагогічних кадрів до роботи в інклюзивному середовищі сучасного дошкільного закладу.

Спеціалісти вищої освіти засвідчують низку перешкод у впровадженні інклюзивної освіти, а саме: недостатня кількість освітніх інституцій спеціальних дошкільних закладів (розвивально-ресурсних центрів, груп з інклюзивної освіти дітей в ЗДО) на місцевому і регіональному; недосконалість механізмів створення інклюзивних груп у системі загальної дошкільної освіти для дітей з особливими освітніми потребами; відсутність системної підготовки педагогів у галузі інклюзивної освіти; недостатня матеріально-технічна база закладів вищої освіти для забезпечення якісної підготовки фахівців з інклюзивної освіти (асистентів вихователя інклюзивної групи ЗДО); низький рівень готовності соціуму (педагогів, батьків) до сприйняття таких дітей та роботи з ними в умовах інклюзії; недосконалість програмно-методичного, матеріально-технічного забезпечення інклюзивної освіти дошкільників; відсутність координації в роботі професійних спеціалістів-практиків, батьків, науковців у сфері

організації комплексного супроводу дітей з особливими освітніми потребами.

Актуальність упровадження інклюзії в освіті посилює потреба професійної підготовки майбутніх педагогів дошкільної освіти до роботи в інклюзивному середовищі дошкільного закладу, а також невизначеність функціонування вищої школи України, пов'язана із переходом від традиційної знанневої моделі засвоєння знань до розвивальної моделі компетентнісного професійного розвитку, що зумовлює необхідність розроблення та реалізації техніки і практики її формування.

Актуальність розробки моделі формування готовності педагогів до роботи в інклюзивному середовищі ЗДО підтверджує й аналіз практичного досвіду закладів вищої і дошкільної освіти, який виявив вагомі прогалини у підготовці спеціалістів.

Кафедра дошкільної освіти Маріупольського державного університету протягом декілька років працювала на науковою темою «Інноваційно-технологічні засади підготовки фахівця до роботи в інклюзивному середовищі закладу дошкільної освіти» (Державний реєстраційний номер № 0120U102548). За період 2020-2024 досліджено специфіку підготовки фахівців до роботи в інклюзивному середовищі закладу дошкільної освіти. Визначені педагогічні умови такі як: психолого-педагогічний супровід, методичне забезпечення підготовки і захисту кваліфікаційних робіт, організація педагогічних практик в закладах дошкільної освіти, організація самостійної роботи з проблематики інклюзії.

Використані теоретичні (аналіз літератури і нормативних документів, порівняльний метод, моделювання структури готовності фахівця, історичний метод, класифікація і типологізація, систематичний метод, синтез, узагальнення, метод збору та обробки інформації з інклюзії, метод виділення інклюзивних категорій) і емпіричні методи дослідження (опитування, тестування, спостереження, аналіз кваліфікаційних робіт, звітів педагогічних практик, самостійних робіт студентів). У навчальних дисциплінах кафедри дошкільної освіти враховано формування професійно-інклюзивної компетентності фахівців до роботи в просторово-предметному, інформаційно-технічному, змістовно-методичному, комунікативному та організаційно-управлінському інклюзивному середовищі. Були такі початкові дисципліни як: «Основи спеціалізації», «Педагогіка і психологія інклюзивної освіти», «Асистент вихователя в системі інклюзивної освіти», «Практикум з фізичної культури в інклюзивному середовищі», «Юридичне і правове забезпечення дошкільної освіти», «Основи дефектології та логопедії», «Актуальні проблеми організації освітнього процесу у ЗДО», «Логопеди-

чний практикум», «Логопсихологія», «Нормативно-правові засади організації дошкільної освіти в Україні», «Психолого-педагогічний супровід сім'ї дитини з особливими освітніми потребами», «Актуальні проблеми дошкільної педагогіки», «Основи логопедії та дефектології з практикумом», «Теорія і спеціальна методика з виховання дітей з вадами мовлення».

Зроблено висновок про інноваційно-технологічні засади підготовки фахівців. Надані рекомендації для викладачів педагогічних закладів щодо підвищення ефективності підготовки фахівців до роботи в умовах інклюзії. Обговорені виклики та перспективи у сфері інклюзивної освіти на рівні дошкільних закладів. Сформульовані пропозиції щодо їх подолання.

Таким чином, початок євроінтеграції у підготовці фахівців дошкільного профілю, зокрема в контексті інклюзії, відкриває нові можливості для забезпечення рівного доступу до освіти всіх дітей, а також сприяє підвищенню якості професійної підготовки педагогів. Однак для успішного впровадження інклюзивної освіти необхідно продовжувати роботу в напрямку адаптації освітніх програм та підвищення компетенцій педагогічного персоналу.

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ПРАГМАТИЧЕСКИЙ ПОДХОД К АНАЛИЗУ ГРАММАТИЧЕСКОЙ КАУЗАТИВИЗАЦИИ В УЗБЕКСКОМ И АНГЛИЙСКОМ ЯЗЫКАХ

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PRAGMATIC APPROACH TO THE ANALYSIS OF GRAMMATICAL CAUSATIVIZATION IN THE UZBEK AND ENGLISH LANGUAGES

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Аннотация

В данной статье в результате прагматического подхода к анализу грамматико-лингвистического явления каузативизации авторы демонстрируют различные каузальные значения, выражаемые одной и той же формой, в зависимости от контекста и ситуации, в которой происходит общение между собеседниками. Кроме того, авторы проводят различие между истинным и псевдопричинным употреблением одного и того же грамматического шаблона в зависимости от определения, данного грамматической причинности в этой статье.

Abstract

In this article at the result of the pragmatic approach to the analysis of the grammatical linguistic phenomenon causativization the authors demonstrate different causal meanings expressed by one and the same form depended on the context and the situation in which the communication takes place among interlocutors. Besides, the authors distinguish between true causative and pseudo-causative usage of the same grammatical pattern depended on the definition given to the grammatical causation in this article.

Ключевые слова: переходность/непереходимость, каузативизация/некаузативизация, агглютинативные, флективные, относительные аффиксы, производные аффиксы, корневые морфемы, аффиксальные морфемы, нулевые морфемы, аналитическая, синтетическая, синтагматическая и парадигматическая оппозиция, бинарная оппозиция, фактивная причинность, пермиссивная причинность.

Keywords: transitivity/intransitivity, causativization/non-causativization, agglutinative, inflected, relative affixes, derivative affixes, root morphemes, affixal morphemes, zero morphemes, analytically, synthetically, syntagmatic and paradigmatic opposition, binary opposition, factitive causation, permissive causation.

In linguistics discourse “pragmatics” refers to the strategies by the help of which language users relate the lexical or grammar meaning of utterances to their communicative value in context. Pragmatic approach includes semantic meanings of words and structures found in dictionaries and grammars, and the “pragmatic” values which these linguistic elements receive when they are used in communication. Communicative

competence involves not only dictionary or grammar meaning, but also the meanings expressed in the course of communication. Grammatical structures have not only grammatical forms, but they also have different meanings in context, proceeding from the position they are used. The term meaning subsumes lexical, semantic and pragmatic meaning. Here we take into consideration form, meaning and function. Focusing on form we

take into account the level of integration of the speaker's attitude to all three aspects: form, meaning and function. Although the term "pragmatics" relates to the study of "how we do things with language" it is reasonable to identify **when, where, how and why** the analyzed linguistic phenomenon is used, proceeding from the situation and the context it is used. So the aim of the article is the pragmatic approach to the analysis of the grammatical linguistic phenomenon causativization in the languages of different genealogical families: English (Germanic) and Uzbek (Turkic).

In linguistics causative meaning is the operation where the subject causes someone or something to do something or causes a change in state of a non-volitional event, sometimes the subject lets the caused object do something the latter is inclined to do. As the aim of the article is to demonstrate the pragmatic approach to the analysis of grammatical phenomenon, we describe the expression of one and the same grammatical form expressing different causal meanings in different contexts proceeding from the position they are used (**when, where, who, how, why**) in the course of communication between interlocutors.

The verbs with the zero morpheme **uxlaØ** "sleep" (in Uzbek imperative form of the verb is expressed by the zero morpheme), **o'qi** "read" become non-causative forms only when they are opposed to the causative forms **uxlat** and **o'qit**.

Mentioned above verbs 1) **uxla** "sleep" and **o'qi** "read" being opposed to **uxladi** "slept" – **uxlayapti** "is sleeping" – **uxlaydi** "will sleep"; 2) **o'qi** "read" being

Active Voice	Reflexive Voice	Reciprocal Voice	Passive Voice
yuv-di "he washed (something)"	yuvin-di "he washed (himself)"	yuvish-di "they washed (something)"	yuvil-di "(something) was washed"

Analysis of the given above examples shows that the definite grammatical meaning expressed by zero morpheme in the structure of the Uzbek language is depended on the position of its usage, that is what form of the word of the same class it is opposed to. F.F. Fortunatov, A.I. Smirnitky, M.V. Panov and other followers of Moscow linguistic school proceeded from the interpretation that the word is always grammatically formulated and its meaning is not the simple sum of meanings of its morphemes, but a phraseological unit taken together. English word structure also is divided into main and formal parts, for example, in the words **tables**, **benches** we find two parts: 1) **table** -, **bench**-, 2) - **s**, - **es**. Most of the English words such as **a book**, **a pen**, **a chair** coincides with the Uzbek words **bola**, **kitob**, **qalam** where the root and formulated independent word coincide formally. Linguistic analysis of these words shows that these words which are similar to their roots are divided into the main and formal parts. The formal part is expressed implicitly that is by the zero morpheme. The zero morpheme's grammatical meaning is defined on the basis of the binary opposition with the other form of this word, for example:

1) writeØ (Present Simple)→wrote (Past Simple);

writeØ (Active Voice)→is written (Passive Voice);

opposed to **o'qidi** "read [red]" – **o'qiyapti** "is reading" – **o'qiydi** "will read" are considered to be not non-causative forms, but imperative forms of the verbs. Without mentioned oppositions we cannot speak of one or the other form either.

In the pair of verbs **bezamoq/bezatmoq** – "to decorate/to decorate" we find expression of causal meaning with the absence of non-causal meaning. Pair of verbs **bezamoq/bezatmoq** cannot be included in the system of causativization, because only sound distinctions do not make up the form of the word. In the given above pair of verbs **bezamoq/bezatmoq** the same meaning is expressed, that is "to decorate", as we see there is no opposition non-causative/causative concerning form and meaning followed with function.

As we have marked above, imperative form of the mood in Uzbek is expressed by the zero morpheme and it correlates with the causative and indicative forms of the verb depended on the position of its usage.

Analyzing the nature of zero morphemes S. Yakhontov says that, as a rule, agglutinated affixal morpheme is opposed not only to other affixal morphemes, but it is opposed to the zero morpheme as well [32, p. 95]. For example, oblique case forms are opposed to the nominative case form which is expressed implicitly, that is by the zero morpheme; the noun in plural with the affixal morpheme **-lar**: **bolalar** is opposed to the noun in singular which is expressed by the zero morpheme: **bolaØ/bolalar**. The form of the Active Voice of the verb with the zero morpheme is opposed to all other forms of the voice of the same verb.

writeØ (Indicative Mood)→(You) write (Imperative Mood).

2) boyØ (singular)→boys (plural);

boyØ (common case)→boy's (genitive case).

In the Uzbek language we find the same characteristic feature of the word structure:

kitobØ (singular)→**kitoblar** (plural);

kitobØ (common case)→**kitobning** (genitive case).

As we see the grammatical meaning expressed by the zero morpheme in the English and Uzbek word structure is depended on the position it is used, that is, it depends on the binary opposition of at least two or more forms of this word with the same lexical meaning and the same class of words it is included.

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INNOVATION IN TERMINOLOGY WITHIN MILITARY EDUCATION

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The influence of the military-political factor on the process of developing military terminology is closely connected with global conflicts, military cooperation, and technological changes. All this draws special attention to the importance of in-depth research into military terminology, which has already gone beyond the frames of application in special fields of communication and entered everyday communication as a result of information from mass media. While describing the emphatic character of their development, military terms should be classified according to the usage criteria, ways of formation, structural features, and features of stylistic functioning. Different linguistic means to form the military terms are affixation, compounding, abbreviation, and conversion. The findings have brought into focus what effect technological and scientific advancement has had on the increase of military lexicon.

Keywords: military terminology, English language, military education, term classification, word formation, globalization.

Description: (INTRODUCTION)

Military-political issues are perhaps the most popular topic in news releases and analytical articles: states and governments of leading countries, in order to expand their influence, are constantly developing and updating projects related to the creation of weapons and military technologies. In many regions of the world, ethnic, religious, and armed conflicts exist or are emerging. However, the trend of globalization and internationalization leads to the fact that most states of the world are trying to maintain international security and strategic stability by intensifying military cooperation in various forms and at different levels. All these factors influence the development of military terminology, which requires in-depth and comprehensive research at the present stage of its development.

The beginning of the 21st century is marked by global world events: we are witnessing important migration processes, creating precedents in politics and legislation, the collapse and emergence of states. Many of these events are military in nature, and the capabilities of the media make it possible to convey the details of what happened to every home and family. Special television channels talk about modern types of weapons and demonstrated by the military films. Anyone can find descriptions of various unclassified types of weapons on the Internet. In other words, military vocabulary has long gone beyond the limits of highly specialized use and entered the vocabulary of the common man. Recognizing military terminology as the most the moving part of the military sublanguage, domestic and foreign linguists are exploring various aspects of the military terminological arsenal: from the structure of the term and its translation [5], systematization and unification to its cognitive aspects [3]. Permanent and consistent development of military-defense sphere gives a powerful impetus to the development of the linguistic component, which undoubtedly entails the formation of new areas of study, to which already existing scientific paradigms are successfully applied and developed new. The theoretical significance of such research lies in the expansion and streamlining of general linguistic knowledge, while practical application refers to both

the military sphere, as well as the social and journalistic sphere.

The presence of an army is a mandatory characteristic of any modern sovereign state. A distinctive feature of an army is its size and the degree of its combat effectiveness. The composition of the army, traditions and the attitude of society towards the army are the most important reasons that influence the formation and further development of military terminology. It should be noted that military terminology is replenished not only in times of various kinds of conflicts, but also during military reforms and transformations. The secrecy and closeness of the army form the prerequisites for the emergence and development of military language. The concept term comes from the Latin 'terminus' and is translated as 'limit, end'.

The main difference between the terminological vocabulary from non-terminological is its maximum abstractness, unambiguity, internationality, logic and semantics. Thus, the term means a word or phrase fixed behind a specific concept in the system of concepts of a given field of science or technology. Classifying terms British maritime law from the point of view of structure, A.E. Fedotova shares them into the following types: 1) root terms, the basis of which coincides with the root; 2) derived terms consisting of a stem and affixes; 3) compound terms formed by adding two or more stems; 4) terminological combinations [2].

Military terms can be classified as follows:

I. By sphere of use (various types of troops, i.e., staff, general tactical, organizational, military topographical, command formation).

Terms of various branches of the military - terms that are used to describe concepts in armed forces formations: units, formations, associations, institutions, establishments, organizations and governing bodies. For example, '*artillery*', '*infantry*', '*radio technical troops*', '*air force*', '*airborne troops*'.

Staff terms are terms that are widely used in military personnel management bodies. For example, '*headquarters*', '*staff car*', '*personnel*'.

General tactical terms - terms that are used when solving general tactical problems, conducting combined arms combat and its preparation. For example,

'defense', provost corps 'field gendarmerie', 'offensive'.

Organizational terms are terms that are used in various units of military forces. For example, 'unit', 'battalion', 'division', 'company'.

Military topographical terms are terms that are used in terrain study, orientation, target designation, and taking measurements on the ground. For example, *topographic map*, *cartography*, *land survey*, *'aerial photography'*.

Command and drill terms are terms that are used in drill training and command speech of military personnel. For example, *Arms, port!* *'Weapons to the chest!'*; *Eyes, right!* *'Turn to the right!'*.

II. By method of formation (morphological word formation, abbreviations);

Methods of morphological word formation of commonly used vocabulary in English are characteristic and in the formation of terminological vocabulary from any field of scientific knowledge, including for the formation of military terms [4]

Morphological word formation is the main way word formation and includes the following methods: affixation, compounding, abbreviation and conversion.

- affixation is a method of word formation that allows you to create new terms by attaching word-forming affixes to the stems of various parts of speech. For example, *maintainability*, *surveillance*, *deterrence*, *reunion*.

- compounding is a method of word formation that allows you to form new words by combining the stems of two or more words. For example, *aircraft*, *breakthrough*, *battlewise*.

- an abbreviation is the omission of individual letters and syllables in a word, and sometimes the removal of a significant part of the word except for individual letters. For example, *Svc Pit* (*service platoon*) *'service platoon'*, *sub* is derived from *'submarine'*, *radome* from *radar dome* *'antenna radome Radar'*.

- conversion is a very common type of word formation in military terminology of the English language, in which belonging to a certain part of speech, a word, without changing its original form, acquires the meaning of another part of speech. For example,

shell > *to shell*; *blockade* > *to blockade*;

rocket > *to rocket*; *mortar* > *to mortar*.

III. By structure (one-part, two-part, multi-part);

T.I.Arbekova defines vocabulary, formed in this way, as 'complex formations' consisting of a few words [1]. Examples in the following terminological units can serve in the military sphere: the concept of *'aircraft carrier'* - an aircraft carrier, formed from two words *'aircraft'* and *'carrier'*; *'combat management system'* - a combat management system consisting of three words: *'combat'* - battle, *'management'* - man-

agement, *'system'* - system; term *'man-portable surface-to-air missile'* - portable anti-aircraft missile system.

The basis of the military terminology of the English language is made up of single-component and multi-component nominative units, which are mainly represented by substantive compounds. For example, *battle* - battle field - battlefield interdiction - battlefield interdiction line - battlefield air interdiction.

IV. By stylistic characteristics (neutral and emotionally charged lexical units).

It should be noted that military terms are usually presented lexical units that are neutral in emotional connotation. However, this classification should be given according to stylistic characteristics, since emotionally charged lexical units in the military sphere denote the same concepts as neutral lexical units.

Emotional coloring means an emotional attitude to the concept named by the word associated with the meaning of the word. Examples of emotionally charged military vocabulary in the English language are the following words: *push-button war*, *trigger-happy* *'shooting indiscriminately'*, *slick ship* *'unarmed helicopter'*.

CONCLUSION

In conclusion, it should be noted that the development of science and technology, conducting new developments in the military sphere, improving existing models' equipment and weapons is reflected in lexical composition of the language. Pursuit to accurate and concise transmission of information, characteristic of both oral and for written speech, allows you to identify most common methods information of complex terms, as well as certain trends in the use of military terms in texts.

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THE IMPACT OF DIGITALIZATION ON THE TEACHING AND LEARNING OF ESP (ENGLISH FOR SPECIFIC PURPOSES)

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Abstract

Digitalization has transformed the teaching and learning of English for Specific Purposes (ESP), significantly enhancing accessibility, flexibility, and engagement. The integration of digital tools such as multimedia, online courses, and virtual classrooms allows for more personalized and interactive learning experiences. Instructors can utilize simulations and interactive tasks, while learners benefit from the flexibility of digital platforms. These advancements enable collaboration that is more effective and adaptable, aligning ESP education with the technological demands of modern professions. Overall, digitalization has made ESP education more efficient and accessible to a global audience.

Keywords: Digitalization, ESP (English for Specific Purposes), virtual classrooms, multimedia, flexibility, personalization.

Introduction

In recent years, digitalization has reshaped educational practices across a wide range of disciplines, including the teaching and learning of English for Specific Purposes (ESP). As technology continues to evolve, it has introduced new opportunities and challenges for educators and learners alike. ESP, which focuses on the specific language needs of professionals in various fields, such as medicine, business, or engineering, has particularly benefited from these advancements. Digital tools and platforms have made specialized language instruction more accessible, flexible, and tailored to individual needs, significantly enhancing the efficiency and effectiveness of both teaching and learning processes. This introduction aims to explore how digitalization has revolutionized ESP education, highlighting the key changes it has brought to modern pedagogy.

Materials and types of research

When examining the impact of digitalization on the teaching and learning of English for Specific Purposes (ESP), several key objectives can be considered. Here are some objectives that can guide your exploration of this topic: enhancing accessibility and flexibility, investigate how digital tools can provide access to ESP resources for diverse learners, regardless of location or time. Analyze the impact of online platforms on the availability of specialized content in various fields (e.g., business, medicine, and engineering). Improving engagement and motivation through exploring the role of interactive digital tools (e.g., gamification, multimedia content) in increasing learner engagement in ESP courses. Facilitating collaborative learning through examine how digital communication tools (e.g., forums, video conferencing) support collaboration among ESP learners and between learners and instructors. These objectives can guide research, curriculum design, and the development of teaching strategies to maximize the benefits of digitalization in ESP education.

Research questions

These materials and research methods allow for a thorough examination of how digitalization is transforming the teaching and learning of ESP, providing a foundation for continuous improvement in this field.

1. How has digitalization affected the accessibility and availability of ESP learning materials?
2. What are the most effective digital tools and platforms for teaching ESP?
3. How does digitalization influence the motivation and engagement of ESP learners?

These research questions aim to provide a comprehensive understanding of the ways digitalization is influencing the teaching and learning processes within ESP.

Participants

These research questions are designed to gain a thorough understanding of the opportunities and challenges that digital technologies offer in the area of English for Specific Purposes (ESP). To achieve this, approximately 20 foreign language teachers and 30 students from our school participated in completing questionnaires about the use of digital tools for ESP and their effects on student learning. Students provided insights into their experiences with technology in language education, particularly highlighting how these tools aided in enhancing their communication skills in the foreign language, while also addressing the specific needs of learners in specialized professional settings.

Tools

In this study, various research tools were utilized to collect data on the development of using digital tools for ESP learners learning a foreign language. These tools consisted of questionnaires and interviews aimed at evaluating the experiences of both teachers and students regarding the incorporation of technology into language instruction.

First, a questionnaire was distributed to students. The primary purpose of this questionnaire is to gather insights from students regarding their experiences with

digital tools in the context of English for Specific Purposes (ESP) learning. Specifically, it aims to determine the frequency and types of digital tools students utilize for their ESP studies. Understand how digital tools have influenced students' engagement, motivation, and communication skills in the foreign language. Highlight any difficulties or barriers students face while using technology for learning ESP.

Second, semi-structured interviews were conducted with students; the purpose of conducting interviews in this context is to obtain in-depth insights into students' experiences with digitalization in English for Specific Purposes (ESP) learning. Specifically, the objectives include exploring personal experiences gaining a deeper understanding of how individual students perceive the role of digital tools in their ESP learning journey. Investigate particular advantages that students have experienced from using digital technologies, such as improved communication skills, engagement, or access to resources. Delve into the challenges and barriers students encounter when utilizing digital tools, providing richer detail than quantitative surveys can offer.

Procedure

Conducting research on the impact of digitalization on the teaching and learning of English for Specific Purposes (ESP) involves a systematic approach to identify specific aspects of ESP you want to investigate (e.g., teaching methodologies, student engagement, assessment), determine the impact of digital tools (e.g., e-learning platforms, social media, digital resources) on these aspects. Formulate clear research questions or hypotheses based on your objectives and literature review.

Enter the questionnaire

Teachers and students from diverse backgrounds were selected to participate in the study. Questionnaires were distributed to foreign language teachers to gather data on their experiences with technological tools and their impact in teaching English language. Additionally, short interviews were conducted with selected teachers to gain deeper insights and feedback regarding their use of technology. The study also included a survey of students to understand their perceptions of how these tools facilitated their engagement in ESP classes.

Conducting an interview

To gain deeper insights into the impact of digitalization on the teaching and learning of English for Specific Purposes (ESP), a series of interviews were conducted with both teachers and students involved in ESP programs. The purpose of these interviews was to explore their experiences, perceptions, and the challenges they face when integrating digital tools into their teaching and learning practices. The study involved some participants, including ESP teachers and students. Semi-structured interviews were conducted, lasting between 30 to 45 minutes each. Questions focused on the use of digital tools, perceived benefits, challenges encountered, and suggestions for improvement. Both teachers and students noted that digital tools increased student engagement. For instance, one teacher stated, "Using interactive platforms like Kahoot has transformed the way my students participate in class. They are more involved and enthusiastic." Digital tools provided access to a wider range of resources. A student

commented, "Having access to online databases and multimedia content has helped me understand complex topics much better."

Data analysis

Many participants highlighted technical difficulties, such as unreliable internet connections and software glitches, as major challenges. One teacher remarked, "Sometimes, the technology fails us during class, which disrupts the flow of the lesson and frustrates both me and the students." Some teachers expressed a need for more training on how to effectively integrate technology into their lessons. A teacher noted, "I feel like I could do so much more if I had proper training on how to use these digital tools effectively." Students expressed mixed feelings about the impact of digital tools on their learning experience. While some found them beneficial, others felt overwhelmed. One student shared, "While I appreciate the resources available, sometimes it feels like there's too much information, and it can be hard to keep up." Teachers suggested regular training workshops to improve their technological skills. Increased technical support from institutions was emphasized to address issues as they arise. Students recommended organizing digital resources more effectively to avoid information overload.

The interviews revealed that digitalization has significantly affected the teaching and learning of ESP, enhancing engagement and access to resources while also presenting challenges related to technology and training. The findings suggest that while digital tools offer numerous benefits, there is a need for ongoing professional development and better technical support to maximize their effectiveness in ESP classrooms.

Research results

The study aimed to explore how digitalization affects the teaching and learning of English for Specific Purposes (ESP) by analyzing the experiences of teachers and students. Data was collected through questionnaires and interviews, focusing on the use of digital tools, their effectiveness, challenges faced, and overall perceptions. 50 respondents (20 teachers and 30 students) from № 42 "Ak niet" school-gymnasium. Participants included both experienced and novice teachers across various fields, and students enrolled in ESP courses at different educational levels. 80% of teachers reported using digital tools regularly in their ESP lessons. 65% of students indicated they engage with digital tools in at least 75% of their classes. 70% of teachers utilized platforms like Moodle or Google Classroom. 60% used tools like Zoom or Microsoft Teams for lessons and discussions. 50% of teachers integrated applications like Kahoot and Quizlet for interactive learning. 85% of students reported feeling more motivated in lessons that incorporated digital tools. 75% of teachers and students appreciated the increased access to a variety of learning materials, such as online articles, videos, and simulations.

Students highlighted the importance of resources in improving their understanding of specialized vocabulary and concepts. 60% of teachers reported experiencing technical difficulties during lessons, including internet connectivity issues and software malfunctions. 55% of teachers expressed the need for additional train-

ing to effectively integrate digital tools into their teaching. A teacher stated, "I often feel underprepared to use technology in a way that benefits my students." 40% of students mentioned feeling overwhelmed by the amount of information available online, leading to difficulties in discerning relevant content. 70% of teachers believed that digital tools positively influenced students' understanding and retention of ESP content.

Students reported an improvement in their ability to apply language skills in real-world scenarios, with 65% feeling more confident in their language abilities. While many students found digital tools beneficial, 30% reported feelings of frustration when technology failed or when they encountered difficulties navigating digital platforms.

The research findings indicate that digitalization has a significant impact on the teaching and learning of ESP, offering numerous benefits while also presenting specific challenges. As educators and students adapt to new digital tools, it is essential to address the challenges identified to maximize the effectiveness of these resources in enhancing the ESP learning experience.

This structured presentation of research results clearly outlines the key findings and insights regarding the impact of digitalization on ESP education. You can adjust the details based on your specific research outcomes and participant responses.

Conclusion

This study investigated the impact of digitalization on the teaching and learning of English for Specific Purposes (ESP), highlighting both the benefits and challenges faced by educators and students. The findings suggest that digital tools significantly enhance the ESP learning experience, making it more interactive, engaging, and resource-rich.

Key Insights

1. Enhanced Engagement and Accessibility:

Digital tools have transformed ESP classrooms, fostering greater student engagement and motivation. The accessibility of diverse resources has empowered both teachers and students, enabling them to explore specialized content in innovative ways.

2. Positive Learning Outcomes: The integration of technology has led to improved learning outcomes, with many educators reporting enhanced comprehension and retention of subject-specific language skills among students. Participants noted that digitalization facilitates real-world application of language, preparing students for professional contexts.

3. Challenges and Concerns: Despite these advantages, the study revealed several challenges. Technical issues, such as connectivity problems and software malfunctions, can disrupt lessons and hinder learning. Additionally, the need for further training and support for teachers was identified as a significant barrier to effective implementation.

4. Mixed Student Experiences: While many students appreciate the benefits of digital tools, some reported feelings of overwhelm due to the abundance of online resources. This highlights the need for structured guidance in navigating digital content to optimize learning outcomes.

To maximize the positive impact of digitalization on ESP teaching and learning, several recommendations emerge from the study:

- **Professional Development:** Institutions should prioritize ongoing training programs to equip teachers with the necessary skills to integrate technology effectively into their curriculum.

- **Technical Support:** Providing robust technical support can help address issues promptly, ensuring that technology enhances rather than disrupts the learning process.

- **Structured Resources:** Developing curated resource lists and training students on how to effectively utilize digital tools can alleviate feelings of overwhelm and enhance their learning experience.

In conclusion, while digitalization presents challenges, its overall impact on the teaching and learning of ESP is largely positive. By addressing the identified barriers and embracing the opportunities that technology offers, educators can create a more effective and engaging learning environment that prepares students for the demands of the modern workforce. Continued research and adaptation will be essential as digital tools evolve, ensuring that ESP education remains relevant and impactful in an increasingly digital world.

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PHILOLOGY

INTERNET JOURNALISM AS AN IDEAL FREE AND OPERATIVE MEANS OF INFORMATION

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Abstract

Internet journalism, also called as digital journalism, cyber journalism or netizen Journalism, is defined as the reporting of facts when produced and distributed via the Internet. In other words, it's a contemporary form of journalism where editorial content is distributed via the internet compared to publishing it via print or broadcast. Digital Journalism made an entrance to the scene since 1990s and yes that's when the Internet made its entrance as well. Many large journalist media such as newspapers and television networks opened their own websites to feed the needs of their audience with additional material to that the exhibited either on paper or on TV.

What constitutes as online journalism has been debated by scholars; however, what they have agreed on is the fact that a product that is news and features the current scene, either presented solely or in combination with other tools including text, audio, video or other interactive forms like storytelling, and distributed through digital media technology is a form of digital journalism.

This leads us to the next step... The article analyzes the features that make online journalism special, its difference from traditional journalism, and summarizes the results.

Keywords: internet journalism, Wikipedia, worldwide, user content, social media, mass media, AI.

Through the Internet, which is considered the biggest phenomenon of the 21st century, a fundamental change is observed in the information environment and in the field of journalism. Professor Russell Newman, an expert on media technologies, characterizes these changes as follows:

- changed the essence of geographical distance;
- created a great progress in the development of communication;
- created conditions for increasing the speed of communication;
- increased the possibilities of interactive communication;
- played a role in combining previously separate and unrelated forms of communication.(1)

Although interactivity is considered one of the main factors in the functioning of new media, individual media samples have different degrees of interactivity. Tony Feldman in his book "Introduction to Electronic Media" notes that the number of digital satellite televisions, which are considered new media technologies, is increasing. But from the point of view of meeting the demand of the viewers, they cannot demonstrate interactivity. This means that interactivity, unlike digitality, is by no means characteristic of all new media technologies. (2)

The most used mobile applications in the messaging service are those with live streaming capabilities. Live communication - Wechat, Facebook, WhatsApp, Messenger, Twitter, Instagram, Snapchat and other such applications - is spreading more rapidly in recent times. Facebook currently has over three billion monthly active users. Meta Platforms owns four of the largest social media platforms with one billion monthly active users each: Facebook (main platform), WhatsApp, Facebook Messenger and Instagram. Countries with the highest profile social platforms USA and

China Most of the high-profile social networks with billions of users come from the USA, but services such as the Chinese social networks WeChat, QQ or the video sharing app Douyin also attract the main attention in their regions due to local context and content. does. Dow's popularity led to the launch of an international version of a small software platform called TikTok, which currently ranks 6th in the ranking of social networks with 1.5 billion users. (3)

Although traditional television, radio, newspapers still exist, interactivity, promptness, pluralism, etc. it is obvious that it will lose to online media. According to the experts' analysis, compared to Web 1.0, the Web 2.0, the Web 3.0 model allows users not only to comment on the created content, but also to create new content within the topic and upload photos.

The modern development of information technologies has also created a new model of traditional television and radio - Internet television and Internet radio. Internet television and radio is considered as an electronic information medium that is spread by hundreds of thousands and millions of people through the global network and the whole planet becomes its consumer. Today, newspapers, radio, television and modern mass media in the world play the role of a mirror of the people and act as a bridge between the government and society. For example, any important decision made by the government needs to be communicated to citizens in a way they can understand. The media should fulfill this mission.

New media also play an important role in shaping public opinion. It is clear that in the modern era, the mass media (mass media) act as an educational tool in understanding the nature of socio-political and socio-economic events, learning and defending rights and freedoms, getting acquainted with various problems and finding ways to solve them.

At a time when news stories can be written (or recorded), and distributed worldwide in a matter of minutes, saying the digital age has transformed journalism is an understatement. (4)

Technology has permanently changed the way news is created, presented, and consumed. While there's more easily accessible content than ever before, many would argue that the overall quality of journalism has declined. Others love the way it's led to the adoption of a variety of different news sources and platforms.

News reporting has always been deadline driven, but the speed of today's newsgathering leaves old-school journalism in the dust. However remarkable the tech tools, each story needs a critical and experienced eye before publication, and this step is often rushed or even skipped, leading to errors and inaccuracies. Funding for long-term, investigative pieces has also been slashed at TV news stations and newspapers, leading to a significant dearth of in-depth coverage. In the mad race to grab the attention of the world's eyeballs, some of the principles of journalism are brushed aside.

But the digital age has also democratized journalistic processes, leading to a new era where citizens with the desire and ability can report on stories themselves through a variety of tools and platforms. Now the power has shifted—we can all decide what's newsworthy or not.

Whether you see them as good or bad the changes are here, and we must adapt. Things are only getting more bizarre with the advent of sophisticated AI tools capable of writing complete articles—a topic we'll leave for another discussion.

There are several aspects that distinguish new media from traditional media. The emergence of new media creates a fundamental change in the activities of mass media representatives. The wide spread of social networks is observed with drastic changes in the media industry. Due to technological possibilities, the term "personal media" has appeared as an alternative to the concept of "mass media".

The main differences between traditional and new media are:

- new media are more flexible than traditional media;
- new media is open, traditional media is closed;
- new media addresses the users, while traditional media addresses the public;
- texts are short in new media and long in traditional media;
- new media conveys the picture, traditional media text;
- new media is active, traditional media is passive.

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PHYSICS

IT IS POSSIBLE TO PROVE THE EXISTENCE OF OTHER MUTUALLY INVISIBLE UNIVERSES ADJACENT TO OUR VISIBLE UNIVERSE BY ASTRONOMICAL OBSERVATIONS IN THE PORTALS OF CONSTELLATIONS THAT ARE INVISIBLE OUTSIDE THE PORTALS¹

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Abstract.

The article explains that the special theory of relativity (SRT), created in the early twentieth century, which is an outstanding scientific achievement, was ahead of its time, because in physics at that time lacked some knowledge necessary for its creation – physical reality of imaginary numbers was not proved and the its physical meaning was not explained, dark matter and dark energy were not discovered, discrete mathematics and hyper-complex numbers were not used, and WMAP and Planck space-crafts were not launched into space yet. Therefore absence of the mentioned knowledge was justifiably replaced by postulates. But not everything was guessed. And present now in the version of SRT studied in all physics textbooks, the postulate called the principle of non-exceeding the speed of light turned out to be incorrect. Therefore the corrected version of SRT in which this postulate is replaced by the experimentally proved principle of physical reality of imaginary numbers is offered. In this corrected version of SRT also offered a experimental proof of the existence of mutually invisible parallel universes astronomical observations in portals invisible outside the portals of constellations. And it is explained, why the principle of non-exceeding of speed of light not disproved so far by physical experiments is incorrect. And why the incorrect version of SRT, studied in all physics textbooks, is still in demand.

Keywords: special theory of relativity, principle of non-exceeding the speed of light, principle of physical reality of imaginary numbers, relativistic formulas, dark matter, dark energy, universes, anti-universes, Multiverse, portals, anomalous zones.

1. Introduction

In the 20th century, physics, having changed the thousand-year-old tradition of creating theories on the basis of reliable experiments, began to call hypotheses that were interesting but not experimentally confirmed theories, including the special theory of relativity (SRT).

But what's even worse is that as a result of the struggle for survival, SRT was canonized - in the community of relativistic physicists and in public opinion, a conviction was formed about its infallibility, about the inadmissibility of its criticism and any subsequent corrections. Therefore, for example, in the USSR it was forbidden to criticize the SRT even three times - in 1934 by the decree of the Central Committee of the All-Union Communist Party (Bolsheviks) on the discussion of relativism, in 1942 by the decree of the Presidium of the Academy of Sciences of the Soviet Union on the theory of relativity and in 1964 by a secret decree of the Presidium of the Academy of Sciences of the Soviet Union, which prohibited any criticism of Albert Einstein's theory. And reviewers of some good journals have now started writing in their reviews *"I will not allow criticism of Einstein"*.

Unfortunately, the ban on criticism of scientific theories is not a new phenomenon. For example, Nikolai Copernicus, who spent 40 years in the 16th century creating the heliocentric system of the world, wisely published his theory *"On the Revolutions of the Celestial Spheres"*, which refuted the geocentric system of

the world of Claudius Ptolemy after his own death, not wanting to end up in the Inquisition. And Giordano Bruno and Galileo Galilei, who carelessly supported Copernicus' theory, had to deal with the Inquisition. Giordano Bruno was even burned alive at the stake. Therefore, the corresponding to common sense process of creating scientific theories by identifying in them as a result of experimental studies of certain shortcomings and their subsequent correction was not always smooth.

And although created in the early XX century by Joseph Larmor [1], Nobel Prize winner Hendrik Antoon Lorentz [2], Jules Henri Poincaré [3], Nobel Prize winner Albert Einstein [4] and other outstanding scientists STR [5]-[7], rightly recognized as a great scientific achievement, due to the lack of the necessary experimental knowledge at that time, which was forced to be replaced by postulates, as it turned out in the 21st century, nevertheless turned out to be incorrect [8]-[48], because:

- its relativistic formulas were incorrect;
- the relativistic formulas obtained in it were incorrectly explained using the incorrect principle of non-exceeding the speed of light;
- from these incorrect relativistic formulas were made incorrect conclusions about physical unreality of imaginary numbers discovered 400 years before the creation of STO and about the existence in nature of our only visible universe, in which everything is measured only by real numbers.

¹ This is reprint of the article "Antonov A. A. Experimental Evidence for the Existence of Other Mutually Invisible Universes Neighboring Our Visible Universe. *European Journal of Applied Sciences. Services for Science and Education. United Kingdom. Vol. 12 No 5. DOI: 10.14738 /aivp.125.17785*"

However, it continues to be studied all over the world today uncorrected in all educational institutions, even the most prestigious ones.

2. Unsuccessful refutations of the version of the special theory of relativity presented in all physics textbooks

Why? Let's figure out why it happened this way. The relativistic formulas obtained by the creators of STR:

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

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

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

in which m_0 – rest mass of a moving body;

m – relativistic mass of a 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 – speed of motion of a body;

c – speed of light;

were explainable only in the range of subluminal speeds $v < c$, in which the quantities m , Δt and l took on values measured by real numbers. But in the range of superluminal speeds $v > c$ these quantities m , Δt and l already took on values measured by imaginary numbers discovered by Scipione Del Ferro, Niccolò Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli [49] 400 years before the creation of the STR, the physical meaning of which, however, was not explained by them. But, perhaps, even earlier than them, imaginary numbers were discovered by Paolo Valmes [50], who for this was burned alive at the stake by the sentence of the mercilessly cruel inquisitor Thomas de Torquemada. Even Isaac Newton², in order to avoid trouble, preferred not to use imaginary numbers at that time. The creators of the STR also did not know how to explain them. And the physical meaning of imaginary numbers in physics textbooks has not been explained to this day. Moreover, the graph of the function $m(v)$ in the range of velocities $v > c$ (see Fig. 1a) corresponds to a physically unstable process that cannot exist in nature at all.

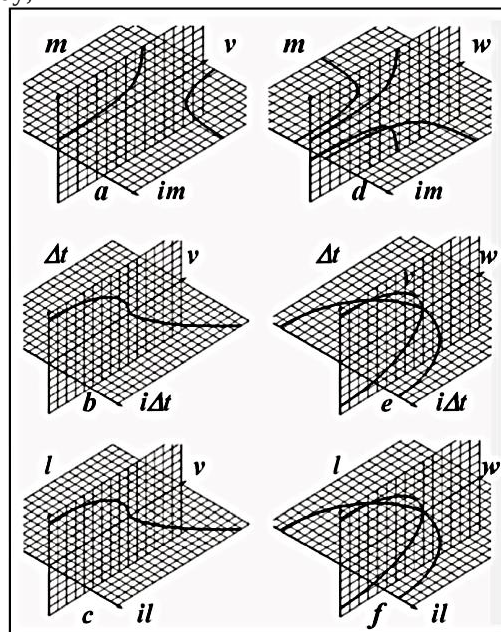


Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ and $l(v)$ corresponding to the existing and the corrected versions of the STR in the subluminal $V < C$ and superluminal $V > C$ ranges

But such a theory, which even its creators could not explain, was naturally of no use to anyone. And therefore, at that time, a postulate called the principle of not exceeding the speed of light was justifiably introduced into the STR, the essence of which is clear from its name. And according to this postulate, formulas (1)-(3) in the range of speeds $v > c$ no longer needed to be explained, since the functions $m(v)$, $\Delta t(v)$, $l(v)$ allegedly do not correspond to any existing processes in

nature in this range. And this was very close to the truth. In any case, at the time this postulate appeared in the STR, such processes were unknown on earth.

Therefore, from formulas (1)-(3) it was quite logical to conclude that imaginary numbers are physically unreal and that in nature there is only one visible universe. And in this form STR is still presented in all physics textbooks.

² And his friend William Whitson, in an atmosphere of the omnipotence of the Inquisition, was stripped of his professorship and expelled from Oxford University for some of his careless statements.

But in 1934, Pavel Alekseevich Cherenkov discovered a process called Cherenkov radiation [51], which refuted the version of STR presented in physics textbooks, since it was explained by the movement of electrically charged particles in a transparent medium with a refractive index $n > 1$ at a speed exceeding the phase velocity of light in this medium. For this discovery P. A. Cherenkov, I. E. Tamm and I. M. Frank even received the Nobel Prize in 1958. Nevertheless, STR withstood, specifying that the principle of not exceeding the speed of light refers to the speed of light only in a vacuum, i.e. in an optical medium with a refractive index $n = 1$.

The next attempt to refute the textbook version of STR was undertaken by the widely publicized OPERA experiment [52] at the Large Hadron Collider in 2011, in which approximately 200 physicists from 36 institutes in 13 countries took part. The goal of the experiment was to detect superluminal neutrinos, and thereby refute the principle of not exceeding the speed of light and the generally accepted version of STR. For which the performers of this experiment expected to receive

the Nobel Prize. And on September 23, 2011, an article by the OPERA collaboration appeared in the archive of electronic preprints, in which it was reported that such superluminal neutrinos had been detected by them. However, on March 15, 2012, a message was published about the ICARUS experiment [53] conducted at the same Large Hadron Collider, which refuted the OPERA experiment.

And that's it. No one other than the author³ of this article has offered any other physical refutations of the corrected principle of not exceeding the speed of light.

3. Successful refutation of the version of special theory of relativity presented in physics textbooks

So why then is it stated above that the version of the special theory of relativity presented in physics textbooks is incorrect?

Because there are other sciences besides physics. Including electrical engineering and radio engineering, which appeared before the STR, and whose very existence proves the physical reality of imaginary numbers and thereby refutes the version of the STR presented in physics textbooks.

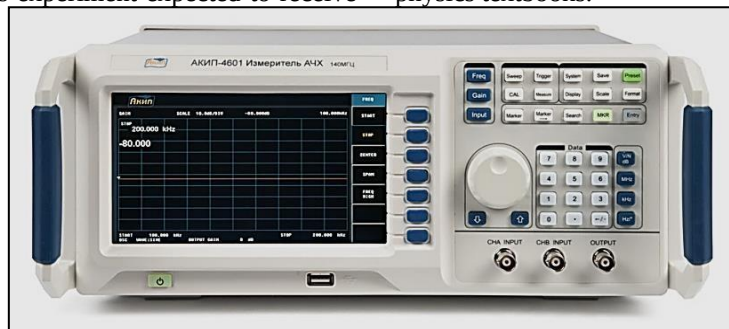


Fig. 2. In any radio-technical laboratory there are devices called frequency response meters, which prove the physical reality of imaginary and complex numbers by their mere existence

Indeed, in electrical engineering and radio engineering, the Ohm's law, as interpreted by Steinmetz [54], discovered in 1893, is fundamental. It is now used daily in practical work by millions of electrical and radio engineers all over the world. Thus, naturally, confirming that it is true. And according to this law, in linear electrical circuits of alternating current, the electrical resistances of capacitors and inductors (also called inductors) are measured by imaginary numbers of different polarities, and only the resistances of resistors are measured by real numbers. Note that the previous phrase states that the imaginary resistances of capacitors and inductors are measured. And indeed, in all electrical and radio engineering laboratories there are many devices (for example, see Fig. 1) that measure the imaginary parameters of electrical circuits. Even every radio amateur has such a simple device, called a tester.

And everything that is measured really physically exists. Physicists know this very well. And this is a fundamental position of any science. If people did not use devices in their activities, but relied on knowledge obtained only from their senses, then science would not exist. And since in electrical and radio engineering the resistances of capacitors and inductors, once called imaginary, are in fact measured by existing devices, then

they are not imaginary at all, but the most real physically existing. And the author of this article wrote about this back in 2008-2010 [55]-[59], i.e. before the publication of the results of the OPERA experiment, making it unnecessary. But the OPERA collaboration ignored these publications and carried out its own very expensive, but unsuccessful experiment. Relativistic physicists still ignore subsequent, including other, proofs of the principle of physical reality of imaginary numbers [60]-[66]. According to which the SRT is refuted by the existence of bell ringing, tsunamis and even suspended swings on playgrounds. Since it follows from the generally accepted version of the SRT that they should not be there. That is, the swing should not swing after a push from parents. But you know that they swing.

Nevertheless, these publications prove in the most indisputable way that the named imaginary numbers, contrary to the postulate of the STR about not exceeding the speed of light, are physically real not only in electrical and radio engineering, but always and everywhere in all sciences. And therefore it is time to realize that mathematics cannot be one for Einstein, another for Steinmetz, and a third for someone else. Therefore, imaginary numbers are physically real in all sciences. Including physics. And textbooks on different sciences

³ See below for more information on them.

(primarily physics textbooks and radio engineering textbooks) should not contradict each other.

And since the statement following from the postulate of not exceeding the speed of light of the STR about the physical unreality of imaginary numbers turned out to be incorrect, it is obvious that this postulate itself is also incorrect. And therefore the generally accepted version of the STR itself is also incorrect [8]-[48].

And no experiments are ever refuted by postulates.

But how then can we explain the existence in physics of the physically unrefuted principle of not exceeding the speed of light?

4. Correction of relativistic formulas of STR taking into account the experimentally proven principle of physical reality of imaginary numbers

So, we need to think some more.

Since, as has just been proven, imaginary numbers are physically real, the relativistic formulas of STR, taking this circumstance into account, must be explained. And for this, first of all, they must be corrected so that they correspond to physically realizable processes. For this, the relativistic formulas (1)-(3) in the ranges $-\infty \leq v < 0$ and $c \leq v < +\infty$ must be such that the graphs of the functions $m(v)$, $\Delta t(v)$, $l(v)$ (Fig. 1d,e,f) are similar to the graphs of the same functions $m(v)$, $\Delta t(v)$,

$l(v)$ (Fig. 1a,b,c) in the range $0 \leq v < c$, i.e. have the form

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

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

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

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).

Moreover, this function i^q in formulas (4)-(6), defining the essence of each universe, for successive values of $q(v)$ equal to $0, 1, 2, 3, 4, 5, \dots$, takes values $+1, +i, -1, -i, +1, +i, \dots$. And the value $q(v)=0$ in formulas (1)-(3) for the range of speeds $V < C$ corresponds to our visible universe, which for definiteness we will call the tardion universe. To the value $q(v)=1$ in the superluminal velocity range corresponds some other invisible universe, since it is beyond the event horizon. For

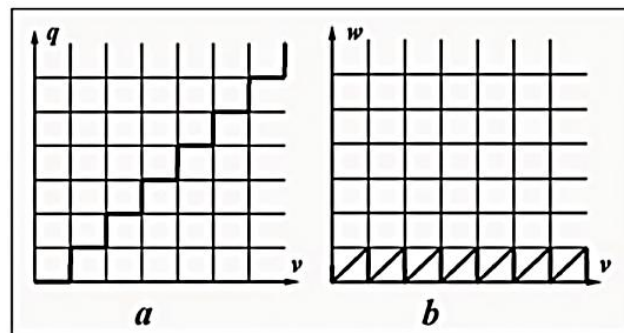


Fig. 3. Graphs of the functions $q(v)$ and $w(v)$, illustrating the meaning of the “floor” function of discrete mathematics

definiteness, therefore, we will call it the tachyon universe. The value $q(v)=2$ will then correspond to the invisible tardion antiuniverse, the value $q(v)=3$ will correspond to the invisible tachyon antiuniverse, the value

$q(v)=4$ will correspond to another (and therefore already invisible) tardion universe, the value $q(v)=5$ will correspond to another tachyon universe. And so on.

Such structure of the hidden Multiverse also allows, at last, to explain the problem that has been tormenting us for a long time - how to reconcile the experimentally proven principle of physical reality of imaginary numbers and the supposedly experimentally irrefutable principle of non-exceeding of the speed of light (because of which the wrong version of STO, presented in all physics textbooks, is still in demand)? And it turns out that everything is explained very simply and clearly. The statement about existence in the nature only our visible universe follows from the refined principle of non-excess of speed of light. And the refined principle of non-excess of speed of light of STO follows from the statement about existence in the nature only our visible universe. But that's self-deception that proves nothing! In fact, the refined principle of the unexceeded speed of light, irrefutable in the generally recognized version of STO, is refuted by the existence of other mutually invisible tardion and tachyon universes and antiverse within the hidden Multiverse, since for all of them $v > c$.

And in order to learn something else about the hidden Multiverse, additional experimental knowledge is already needed.

5. Correction of relativistic formulas using experimental data obtained by WMAP and Planck spacecrafts

And as such additional experimental data we will use the data obtained by the WMAP and Planck spacecrafts, although they were launched into space with a different purpose - to study dark matter and dark energy.

The WMAP spacecraft [83] was launched by the National Aeronautics and Space Administration (NASA) in 2001, and it operated until 2010. And Planck spacecraft [84], launched by European Space Agency (ESA) in 2009, operated until 2013. And according to the data obtained by the WMAP spacecraft, the entire Universe (in fact, of course, 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) is 4.9% baryonic matter, 26.8% dark matter and 68.3% dark energy. But what dark matter and dark energy are themselves, was not explained.

And since it was proved above in the most indisputable way that there is not a mono-universe but a hidden Multiverse in Nature, dark matter and dark energy should now be explained in the hidden Multiverse [85]-[89]. In this case it is quite logical to assume that these phenomena are somehow generated by the very structure of the hidden Multiverse and are caused by mutual influence of invisible parallel universes on each other. And then the main features of these phenomena - their invisibility and undetectability of their corpuscular contents - which have been unexplained so far, can be explained clearly and convincingly:

- dark matter and dark energy are in fact not any material physical entities, but only phenomena (pre-

sumably gravitational shadow) generated by the existence, besides our visible tardion universe, by other invisible parallel universes and antiverse of the hidden Multiverse;

- dark matter is a phenomenon generated by the existence of invisible parallel universes of the hidden Multiverse neighboring our visible universe;

- dark energy is a phenomenon generated by the existence of other invisible parallel universes of the hidden Multiverse besides our visible universe and its neighboring invisible universes;

- and precisely because dark matter and dark energy are merely phenomena, they have no material content⁴.

Therefore, attempts to detect some subatomic particles of dark matter and dark energy by the current research at the Large Hadron Collider are probably of little promise.

Such an explanation of these phenomena also allows us to clarify the structure of the hidden Multiverse. Indeed, assuming, in accordance with the law of communicating vessels, that the mass of different invisible parallel universes in the hidden Multiverse is almost identical with a high degree of accuracy due to the presence of a large number of portals between them that have existed for billions of years, it is possible to determine:

- how many parallel universes form the hidden Multiverse. And according to the above data obtained by the WMAP spacecraft, their number is $100\% / 4.6\% = 21.74$. And according to the data obtained by the Planck spacecraft, their number is $100\% / 4.9\% = 20.41$. Therefore, their real number is presumably 20 ... 22 parallel universes.

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

- how many parallel universes generate the phenomenon of dark energy. And according to the data obtained by the WMAP spacecraft, their number is $73.0\% / 4.6\% = 15.87$. And according to the data obtained by the Planck spacecraft, their number is $68.3\% / 4.9\% = 13.94$. Therefore, their real number is presumably 14...16 parallel universes.

And as can be seen, the experimental data obtained by the WMAP and Planck spacecrafts did not confirm the above conclusions about the structure of the hidden Multiverse, since our visible universe in this structure has not two neighboring invisible parallel universes - one tachyon universe and one tachyon antiuniverse - but five or six.

Therefore, it is obvious that there was some error in the previous reasoning. And it turns out that we were wrong in assuming that in the hidden Multiverse⁵ there is only one additional dimension q and, consequently, its correspondence to physically real complex numbers

⁴ Just as our shadow on a sunny day has no material content

⁵ Just like in the only visible universe in the generally accepted version of STR

containing only one imaginary unit. And in order for six⁶ other parallel universes to be neighbors with our visible universe in the really existing hidden Multiverse – three tachyon universes and three tachyon antiuniverses – it is necessary to have three additional dimensions q, r, s ,

where $q(v) = [v_q/c]$ – is the "floor" function of discrete math from the argument v_q/c , which is

the coordinate q of the fourth spatial dimension v ;

$r(v) = [v_r/c]$ – is the "floor" function of discrete math from the argument v_r/c , which is the r coordinate of the fourth spatial dimension;

$s(v) = [v_s/c]$ – is the "floor" function of discrete math from the argument v_s/c , which is the s coordinate of the fourth spatial dimension;

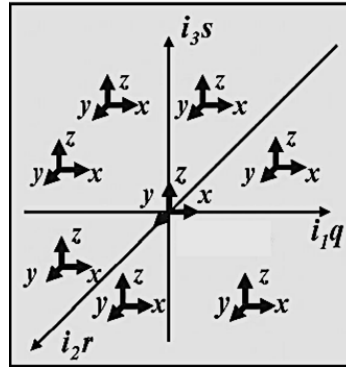


Fig. 5. Six-dimensional space of the hidden Multiverse, where q, r, s are the coordinates of invisible parallel universes, and x, y, z are the coordinates of the matter content in each parallel universe

In such a quaternion structure of the hidden Multiverse [91], [92], unlike the structure considered earlier (in Fig. 4), the distribution of the material content in each three-dimensional parallel universe will be determined by some function $f_{q,r,s}(x, y, z)$, and the quantities i_1q, i_2r and i_3s are the coordinates of these universes. That is, the hidden Multiverse will be 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 live in a three-dimensional pocket of higher dimensional space". And therefore, the relativistic formulas (7)-(9) should be corrected once again as follow

$$m(q, r, s) = \frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1 - [v/c - (q + r + s)]^2}} \quad (10)$$

$\overline{v}_q, \overline{v}_r, \overline{v}_s$ – projections of the velocity vector $\overline{v}$ on orthogonal coordinates q, r, s .

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 [90], containing three imaginary units i_1, i_2, i_3 , which are related to each other by the relations

$$i_1^2 = i_2^2 = i_3^2 = -1 \quad (7)$$

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

$$i_1 i_3 i_2 = i_2 i_1 i_3 = i_3 i_2 i_1 = 1 \quad (9)$$

$$\Delta t(q, r, s) = \Delta t_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (11)$$

$$l(q, r, s) = l_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (12)$$

And from formulas (10)-(12) it follows that such a hidden Multiverse still has a helical structure. In this case, it is possible to move to the tardion antiuniverse from the tardion universe and to the tardion universe from the tardion antiuniverse in different ways, but not in an arbitrary way, but only in such a way (see Fig. 6)

in which the quantity $i_1^q i_2^r i_3^s$ will successively take the

⁶ Or less. Then some parallel universes of our hidden Multiverse may be missing and replaced by universes of neighboring Multiverses.

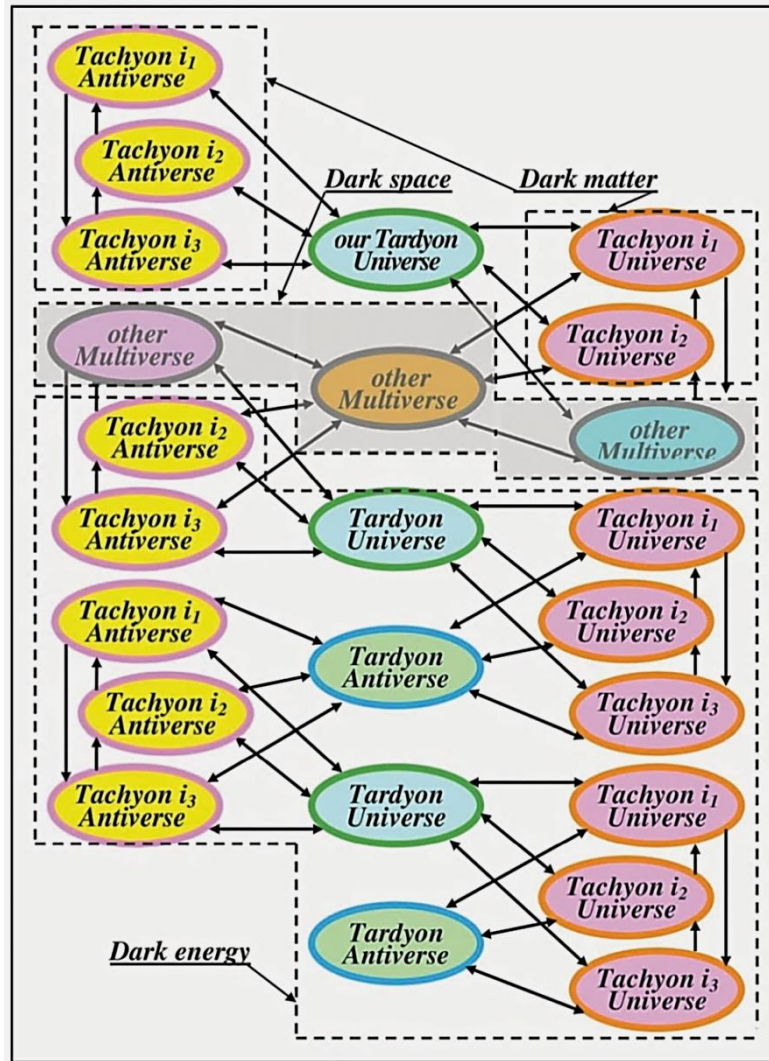


Fig. 6. Possible quaternion structure of the hidden Multiverse containing twenty-two parallel universes, including six invisible universes adjacent to our visible universe

values $+1$, $+i_1 \oplus i_2 \oplus i_3$, -1 , $-i_1 \oplus i_2 \oplus i_3$, $+1$, ... and so on, where $\oplus$ is the symbol of the logical operation of discrete mathematics 'exclusive OR'. In this case, different trajectories of movement from some universes (or antiuniverses) to others can differ only due to the replacement of some tachyon universes from i_1, i_2, i_3 with others and some tachyon antiuniverses from i_1, i_2, i_3 with others. Therefore, the tachyon universes i_1, i_2, i_3 in the hidden Multiverse are placed parallel to each other. The tachyon antiuniverses i_1, i_2, i_3 for the same reasons are also placed 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 antiuniverses must alternate in the following sequence – 'tardyon universe', 'one of the tachyon universes', 'tardyon antiuniverse', 'one of the tachyon antiuniverses', 'tardyon universe', 'one of the tachyon universes', etc.

One of the simplest to explain such quaternion structures of the hidden Multiverse is shown in Fig. 6. It differs from the structure shown in Fig. 4 in that it contains several different tachyon universes and antiuniverses arranged in parallel, corresponding to three imaginary units i_1, i_2, i_3 . Another difference is that such a structure of the Multiverse contains not only bi-directional portals corresponding to formula (7) and designated by double-sided arrows, but also unidirectional portals⁷ corresponding to formulas (8), (9) and designated by single-sided arrows.

⁷ Why in such portals movement is possible only in one direction - from the entrance to the exit - is difficult for us, living in a space in which movement in nature is possible in any direction, to imagine. The processes that determine the possibility of such movement in nature are yet to be understood.

But for visitors who find themselves in such one-way portals, they are more dangerous than two-way portals, since it is impossible to return from them to your universe. Although in the metro with one-way movement on escalators we still encounter. But the metro is not nature.

Moreover, naturally, movement from our tardyon universe to a tardyon antiuniverse through some tachyon universe – for example $\mathbf{i}_1$ – does not necessarily have to proceed through a tachyon antiuniverse $\mathbf{i}_1$. It can proceed through tachyon antiuniverses and. The same reservation applies to the situation if the movement from the tardion universe to the tardion antiuniverse begins through tachyon universes $\mathbf{i}_2$ or $\mathbf{i}_3$.

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

6. How can we be sure that there are other mutually invisible universes neighboring our visible universe?

Thus, we have finally fully proven and explained that the version of STR studied in all physics textbooks is incorrect and have proposed a corrected version of this theory. But for this corrected version to have every right to be called a theory, it must be fully confirmed

experimentally. We have already proven the physical reality of imaginary numbers. Therefore, it remains to prove the real physical existence of other mutually invisible universes and anti-universes in addition to our visible universe.

And again, it turns out that this is possible and not even very difficult. It would seem that for this it is necessary to visit other universes. But this is not necessary. It is enough to at least look into them. As in order to be convinced that in addition to the room visible to us, in which we are now, there is a neighboring invisible room, it is enough to look into the neighboring room from the corridor connecting these rooms. The corridor connecting neighboring universes is the portals [93]-[95]. And the entrances to the portals are at least some of the so-called anomalous zones, of which there are many on Earth – more than one hundred thousand [96]-[99]. And in order to be sure, while in the portals, that you are no longer in our universe, but on the way to a neighboring universe, you need to look at the starry sky through a telescope and see other constellations in it [100]-[105]. This is a very reliable experiment, since you cannot draw constellations in the sky.



Fig. 7. Main Astronomical Observatory of the National Academy of Sciences of Ukraine

But people avoid visiting these anomalous zones, because people who get there usually do not return. And they are right to avoid them, because portals are labyrinths, and invisible ones at that. Therefore, getting out of them is really very difficult. But if you know this, then portals can still be used for scientific research, taking appropriate precautions. Well, at least in the form of Ariadne's thread, which helps to find the way back. And even better with the use of unmanned robotic vehicles, which are now very successfully used in military operations. It is also possible to create portal orientation tools (similar to a compass for sailors), using the phenomenon of weakening the level of terrestrial radio radiation when immersed in portals.

It is even possible to take advantage of the fact that since there are a great many anomalous zones, observatories are already located in some of them. For example, the Main Astronomical Observatory of the National Academy of Sciences of Ukraine, which is located in the Golosevsky Forest just 12 km from the center of the capital of Ukraine, Kiev (Fig. 7). Of course, in the anomalous zone at the very entrance to

the portal, the change in the configuration of the observed constellations is very small and is imperceptible to the human eye, but with the help of a computer, into which information from several observatories located close to each other in the anomalous zones and outside the anomalous zones will be entered, these changes can be detected (see Fig. 8). Otherwise, astronomers with a telescope will have to go deeper into the portal. After all, the English astrophysicist Sir Arthur Stanley Eddington [106] managed to confirm the deflection of light rays in the gravitational field of the Sun predicted by the general theory of relativity back in 1919 with his famous experiment, similar to the one we are proposing.

The proposal to conduct such a simple and low-cost experiment was published several years ago. And it is even strange that it has not been done yet, since in the case of a successful discovery of neighboring parallel universes, one could receive a Nobel Prize for their discovery, and in the case of their failure to discover them, one could very authoritatively prove the validity of the generally accepted version of STR studied in all

physics textbooks. So in any case, a very valuable scientific result would have been obtained.

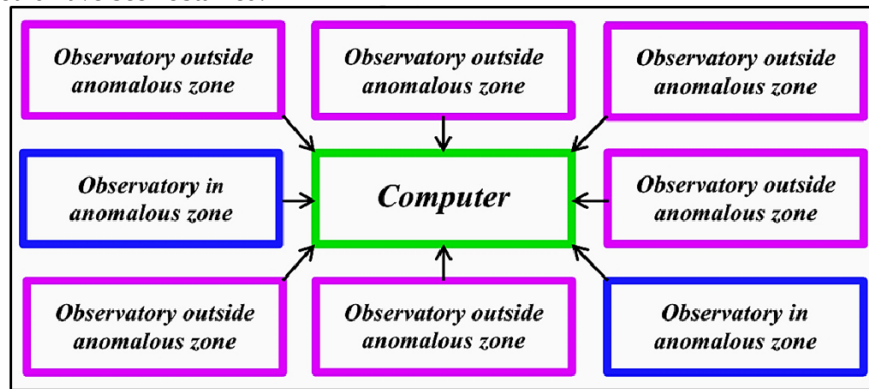


Fig. 8. Scheme of an astronomical experiment to detect invisible universes

But when such an experiment is done, then if the existence of neighboring invisible universes is proven, sooner or later there will be a desire to study them. And first of all, to find out how many there are. But it will be difficult to answer this question with the help of astronomical observations, since all the observatories are located in different places and their observations will therefore be difficult to compare. And in this situation it will therefore be useful to additionally use geophysical research of portals [107]-[116].

7. Conclusion.

Thus, the article has proven experimentally and explained theoretically that the version of STR presented in all physics textbooks is indeed incorrect, since:

- the relativistic formulas obtained in it are incorrect;
- the relativistic formulas obtained in it are incorrectly explained using the incorrect principle of not exceeding the speed of light;
- from these incorrect relativistic formulas, incorrect conclusions are made about the physical unreality of imaginary numbers and the existence in nature of our only visible universe, in which everything is measured only by real numbers.

But in the generally accepted version of STR, from the relativistic formulas obtained in it, it follows that speed is the fourth spatial dimension, in which, therefore, other parallel universes exist. And these parallel universes, in order to exist without plunging into each other, are mathematically described by alternating real and imaginary numbers, as a result of which they are all mutually invisible.

However, without understanding this, the creators of STR, without completing their derivation, left their relativistic formulas such that the incorrect mathematical description of the invisible universes adjacent to our visible universe made them physically unrealizable. And, unable to explain all this, they postulated the principle of not exceeding the speed of light, by which from the fourth spatial dimension realizing the principle of relativity they left only our visible universe, because only in this way could they explain anything. But in this article the author offers a description of an astronomical experiment in portals, by which the existence of mutually invisible parallel universes can be proven and

thereby also the existence of the fourth spatial change in full.

Therefore, the article once again presents the corrected version of the STR proposed by the author [117]-[125], from which incorrect principle of not exceeding the speed of light is excluded and replaced by an experimentally proven general scientific principle of the physical reality of imaginary numbers discovered 500 years ago, which finally explains their physical meaning.

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IN THE PLASMA MAGNETIC FIELD. PROPERTIES OF PLASMA

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Thermal conductivity of plasma does not depend on its density. The thermal conductivity coefficient of pure hydrogen plasma was calculated due to the proportionality of the thermal conductivity with the electron concentration and the length of the free path. In plasma, pressure is defined as the flow of momentum (momentum) across a cross-section of critical area. To describe the behavior of plasma in a magnetic field, let's consider the movement of a charged particle in such a field. When viewed along the line of magnetic force, a negatively charged particle moves in a clockwise direction, and a positively charged particle moves in a counterclockwise direction. The instantaneous center of the circular trajectory is called the center of rotation or the center of rotation. Since the Lorentz force is always perpendicular to the velocity vector, the magnetic field does no work on the particle.

Keywords: Plasma, magnetic field, magnetic flux, charged particle.

Any plasma in a large volume must be neutral with great accuracy, otherwise strong electrostatic forces will arise as a result of the interaction of charged particles of different signs. The properties of the plasma are determined by the sum of its components. The density of the plasma is equal to the sum of the densities of its components.

$$\rho = \rho_i + \rho_e + \rho_n = n_i m_i + n_e m_e + n_n m_n \quad (1.1)$$

where i, e, n subscripts correspond to ions, electrons, and neutral particles. If C_0 - the speed of the entire volume of the gas C_{es} - s is the speed of the electron, the individual (random) speed

$$v_{es} = C_{es} - C_0 \quad (1.2)$$

The average value of the individual velocities should probably be zero. The kinetic temperature of any component $\bar{v}e^2$ is determined by the root-mean-square velocity:

$$\frac{3}{2} \cdot kTe = \frac{1}{2} m_e \bar{v}e^2 \quad (1.3)$$

Here $\bar{v}e^2$ is the root mean square value of the random velocities of all particles from a given component. The average velocities of particles belonging to different components are different due to electromagnetic and similar forces, but collisions between particles reduce this difference to zero and create a state of equilibrium. In equilibrium, the average energy of thermal motion of any type of particle is the same.

Therefore, in the case of equilibrium, the indices indicating the type of particle are discarded. In the case of equilibrium, the distribution of particles according to their velocities $f(v)$ is described by Maxwell's distribution function. That is, $1sm^3$ the number of particles in the range of velocities $v, v + dv$

$$Nf(v)dv = 4\pi N \left(\frac{m}{2\pi kT} \right)^{3/2} v^2 \bar{e} \frac{mv^2}{2kT} dv, \quad (1.4)$$

where $N - 1sm^3$ is the number of particles in. Such distribution formulas are true for all types of particles. Any deviations in this distribution are eliminated by collisions. $f(v)$ the most probable speed corresponding to the maximum of the function

$$v = \sqrt{\frac{2kT}{m}} \quad (1.5)$$

Since there are few collisions in the case of very high plasma, it is necessary to look separately at the summations of the individual velocity vector along the directions. Such a situation occurs in interplanetary space. The particles, roughly speaking, either fly away from the Sun, or change directions as they move perpendicular to the lines of force in the magnetic field. [1, 2]

In plasma, pressure is defined as the flow of momentum (momentum) across a cross-section of critical area. Therefore, the pressure in any direction is equal to the average momentum moving along the three coordinate directions and transported through that section. In other words, we are looking at a P tensor such that each element represents the momentum carried by all types of particles.

$$P = \begin{pmatrix} nm\bar{v}x^2 & nm\bar{v}\bar{x}vy & nm\bar{v}\bar{x}vz \\ nm\bar{v}\bar{y}vx & nm\bar{v}\bar{y}^2 & nm\bar{v}\bar{y}vz \\ nm\bar{v}\bar{x}vz & nm\bar{v}\bar{z}vy & nm\bar{v}\bar{z}^2 \end{pmatrix} \quad (1.6)$$

The non-diagonal elements of this tensor are zero (since their average values are zero due to the same velocities of the particles in the positive and negative directions). So only the diagonal elements remain.

$$P = \begin{pmatrix} nm\bar{v}x^2 & 0 & 0 \\ 0 & nm\bar{v}y^2 & 0 \\ 0 & 0 & nm\bar{v}z^2 \end{pmatrix} \quad (1.6)$$

If collisions occur frequently enough, then these three diagonal elements are equal to each other and i for any direction

$$P_i = \frac{1}{3} nm \bar{v}^2 \quad (1.7)$$

is taken.

If the rarefied plasma is in a magnetic field, then the pressure in the direction of the field and in the direction perpendicular to it can be different. In this case the pressure tensor

$$P = \begin{pmatrix} P_{\parallel} & 0 & 0 \\ 0 & P_{\perp} & 0 \\ 0 & 0 & P_{\perp} \end{pmatrix} = \begin{pmatrix} nm \bar{v}_{\parallel}^2 & 0 & 0 \\ 0 & nm \bar{v}_{\perp}^2 & 0 \\ 0 & 0 & nm \bar{v}_{\perp}^2 \end{pmatrix} \quad (1.8)$$

is in the form of If the magnetic field is directed along the axis, $v_{\parallel}$ and $v_{\perp}$ show the longitudinal and forward components of the velocity vector, respectively. When studying interplanetary plasma, it is necessary to take into account the difference between $P_{\perp}$ and $P_{\parallel}$. [3, 4]

The settling time of equilibrium in plasma is called relaxation time. It is a quantity that characterizes this period t_D , during which any particle 90° changes its direction of motion. If we denote by an index any averaging property of the field (for example, concentration, average velocity, temperature), f

$$t_D = \frac{v^3}{A_D \left[\Phi \left(\frac{v}{v_f} \right) - G \left(\frac{v}{v_f} \right) \right]}, \quad (1.9)$$

$$\text{Here } A_D = \frac{8\pi e^4 n_f Z^2 Z_f^2 \ell n \Lambda}{m^2}$$

$$\Lambda = \frac{3}{2\sqrt{\pi}} \cdot \frac{1}{Z \cdot Z_f} \left(\frac{T}{157000^0} \right)^{3/2} \left(\frac{10^{24}}{0,147 n_f} \right)^{1/2} \quad (1.10)$$

Z - the total charge of the particle, $T/157000^0$ - the temperature in the atomic unit, $\alpha^3 n_f$ - the number of electrons in the cube with a Bohr orbit (a), G and Φ - the parameters calculated according to the Sipitser table. χ Suppose we want to know the relaxation rate of fast electrons in the solar corona due to elastic collisions (i.e. collisions in which the internal energy does not change). The speed of these electrons will slow down due to the collision between them, because, according to the laws of classical mechanics, energy is easily transferred between those of similar mass, and the difference in mass is extremely bad. If the energy of fast electrons $16000 eV$, $T_f = 2 \cdot 10^6$ If

$\frac{v}{v_f} \approx 10^0$ K is . Concentration $n_e = 10^9$, $\ell_n \Lambda = 40$, $v_1 \approx 40$. Meanwhile, electrons 25 sec.

they will "cool down" due to elastic collisions. Radiation and other effects reduce this time further.

The thermal conductivity of the plasma is proportional to the concentration of electrons and the length of the free path. Since the length of the free path is inversely proportional to the concentration, the heat conduction of the plasma does not depend on the density. Thermal conductivity of pure hydrogen plasma

$$K = 1,05 \cdot 10^{12} \frac{T^{3/2}}{Z \ell_n \Lambda} \frac{kal}{san} \cdot diameter \text{ cm} \quad (1.13)$$

In a strong magnetic field, the thermal conductivity of the plasma in the direction perpendicular to the lines of force decreases at a high rate; heat is carried only by ions and heat conduction

$$K_{\perp} = 3,54 \cdot 10^{25} \frac{Ai^{1/2} Z ni^2 \ell n \Lambda}{T^{1/2} B^2} \frac{kal}{san} diameter \text{ cm} \quad (1.14)$$

happens. To describe the behavior of plasma in a magnetic field, let's look at the movement of a charged particle in such a field:

Characterizing the magnetic field $\vec{B}$ - the induction vector can change in space both in value and direction. Therefore, it is convenient to show the area with lines of force. Lines of force are parallel to their vector at each point $\vec{B}$, their density is proportional to the modulus of this vector. If the magnetic field changes due to the movement of the plasma, the magnetic field lines are deformed (densified or rarefied). Before moving on to the overall motion of charged particles, let's look at the motion of an individual particle. The force acting on a particle with $\vec{B}$ charge e and mass in a magnetic field is the Lorentz force. m

$$\vec{F} = \frac{d\vec{p}}{dt} = \frac{e}{c} \vec{v} \times \vec{B}, \quad (1.15)$$

where $\vec{p}$ - is the particle's momentum (momentum) vector, $\vec{v}$ - is its velocity. The vector product on the right shows that the net force $\vec{v}$ is perpendicular to both and $\vec{B}$

When viewed along the line of magnetic force, a negatively charged particle moves in a clockwise direction, and a positively charged particle moves in a counterclockwise direction. The instantaneous center of the circular trajectory is called the center of rotation or the center of rotation. Since the Lorentz force is always perpendicular to the velocity vector, the magnetic field does no work on the particle.

$$\rho = \frac{|P_{\perp}|c}{|e|B}, \quad (1.16)$$

where $\rho_{\perp}$ - is the component of the momentum vector perpendicular to the magnetic field.

Circular frequency of rotation

$$\omega = \frac{|e|B}{\gamma mc}, \quad (1.17)$$

$$\text{here } \gamma = \frac{P}{mv} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \sqrt{1 + \frac{P^2}{m^2 c^2}} \quad (1.18)$$

or relativistic correction.

$$B \cdot \rho = \frac{P_{\perp} c}{|e|} \quad (1.19)$$

The result is called magnetic stiffness and plays an important role in studying the trajectory of cosmic rays. The leading hub concept was introduced by Alven. The particle rotates around this point and at the same time moves along the trajectory determined by the non-magnetic forces. For example, an electric field parallel to a magnetic field $e\vec{E}$ interacts with the electron - force, $-\frac{e\vec{E}}{m}$ giving it momentum towards the leading center.

When a particle r moves in a spiral over the surface of a cylinder with a radius, the leading center slides into the lines of force. [5]

An electric field perpendicular to the magnetic field creates a drift perpendicular to the leading center $\vec{E}$ and $\vec{B}$ its vectors. The speed of this drift

$$v_{ap} = \frac{E_{\perp}}{B} = \frac{10^8 E_{\perp}}{B} \text{ (V / sm)} \quad (1.20)$$

If the magnetic field is uneven, then the radius of curvature of the trajectory changes with the change of field intensity. Therefore, the trajectory alternately consists of half-loops of increasing and decreasing length (long where the field is weak, short where the field is strong). As a result, in the direction perpendicular to the particle $\vec{B}$ and grad vectors $|\vec{B}|$

$$vg = \frac{v_1 \rho \text{grad}_1 B}{2B} \quad (1.21)$$

moving at drift speed.

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PSYCHOLOGY

ROLE OF EMOTIONAL INTELLIGENCE IN THE DEVELOPMENT OF LEADERSHIP COMPETENCIES

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Abstract

The aim of this article is to study the relationship between emotional intelligence and leadership effectiveness in heads of educational institutions. Nowadays, emotional intelligence has become one of the key components of leadership competencies. It encompasses the ability to recognize, understand, and manage one's own emotions, as well as the emotions of others, which is crucial in educational settings where interpersonal relationships are paramount. This study highlights the pressing need for professional development programs focused on enhancing emotional intelligence among educational leaders. Such programs can equip leaders with essential skills to foster a positive school climate, improve communication, and promote collaboration among staff, students, and parents. By developing emotional intelligence, leaders can better navigate challenges, resolve conflicts, and inspire their teams.

Additionally, the research underscores the correlation between high emotional intelligence and improved leadership outcomes, including increased staff morale, enhanced student performance, and more effective decision-making. It suggests that educational institutions should prioritize emotional intelligence training as part of their leadership development initiatives to cultivate more resilient and adaptive leaders.

Keywords: emotional intelligence, leadership, leadership competence, education.

Main text of the article

In today's education system, the success of educational institutions directly depends on the skills of their leaders. They play a crucial role in creating a supportive environment for effective communication between teachers, students, and parents. Therefore, in addition to their professional knowledge and management skills, emotional intelligence is essential for a successful leader.

This study aims to examine the components of emotional intelligence and its importance for effective leadership. It also explores the relationship between emotional intelligence and various aspects of leadership, such as communication, conflict resolution, and decision-making.

Emotional intelligence is the ability to understand and manage one's own emotions, as well as the emotions of others. It is an important skill for everyone, but especially for managers, as it has a significant impact on their behavior, relationships with colleagues, and interactions with the team. A leader's emotional intelligence can greatly influence the overall atmosphere and success of the team.

Daniel Goleman, in his book "Emotional Intelligence" [1], noted that people with well-developed emotional intelligence are more likely to be successful in life. People with low emotional intelligence may experience internal struggles that undermine their ability to focus on work. Goleman's research has shown that the key to a leader's effectiveness and success in an organization lies in their emotional intelligence. His work challenges traditional thinking by emphasizing the importance of emotions in evaluating a person's performance.

Schools are an important institution that shapes the future of society. Children are our future and spend a

significant portion of their lives in school. Therefore, the actions of teachers and administrators have a significant impact on student behavior. The success of a school depends on the relationships between administrators, teachers, and students, as well as the community they serve. School principals are required to maintain good relations with various parties. Directors must have emotional intelligence in order to build positive relationships with different people.

Benjamin Palmer studied 43 managers to assess the connection between emotional intelligence and leadership style [2]. He found significant correlations with several aspects of the transformational leadership model. Together, the results suggest that emotional intelligence - the ability to control and manage emotions within oneself and others - may be a fundamental competence for a leader who can transform.

Julian Barling also conducted a preliminary study on the link between emotional intelligence and transformational leadership [3]. His findings show that people with higher emotional intelligence are seen by their subordinates as exhibiting leadership behavior.

In a study conducted by Dulewich and Higgs in 1999, the researchers investigated the relationship between emotional intelligence and professional competence, focusing on the effectiveness of leadership in career growth [4]. The authors analyzed data from 58 managers in the UK and Ireland, using an emotional intelligence self-assessment tool based on a professional competence survey. They found that emotional intelligence explained more of the variance in promotion than other factors, suggesting that it plays an important role in career success.

The main purpose of this experiment is to evaluate the impact of emotional intelligence on leadership based on three key results:

1. Team performance;
2. Effectiveness of conflict resolution;
3. Employee engagement and satisfaction.

The study will test the hypothesis that leaders with higher emotional intelligence will see better results in these areas compared to leaders with lower emotional intelligence.

We have selected 2 groups of managers. Group 1 consisted of 22 with a high level of emotional intelligence, identified using standardized EI assessments. Group B consisted of 28 managers with moderate or low levels of emotional intelligence based on similar assessments.

5 employees were selected for each manager, who report directly to them. This provides a representative sample of team dynamics under different leadership styles.

Before starting the study, the level of emotional intelligence of each manager was measured using a standardized assessment of EI by Daniel Goleman. This allowed us to obtain basic data on the emotional intelligence of each leader. In addition, a basic assessment survey was conducted with the participation of team members: Team performance, levels of conflict in the team, employee satisfaction and engagement. The key findings of our analysis are summarized below:

Team performance

Group A. Teams led by managers with high EI showed significant improvement in performance, both in terms of productivity and goal attainment. Average team performance increased by 18% compared to baseline. High EI managers demonstrated greater empathy, provided regular positive feedback, and managed stress effectively, creating a positive work environment that led to increased performance.

Group B. Teams led by low EI managers showed a 6% improvement in performance, significantly lower than Group A. While there were some increases in performance, they were less consistent and more dependent on external factors. Managers with medium/low EI were more focused on task performance and less on employee motivation and emotional needs, which resulted in lower collaboration and occasional alienation among team members. Also, they tend to rely on authoritarian management styles, which results in lower levels of creativity and initiative among employees.

The results shows that higher levels of emotional intelligence in leadership are strongly associated with improved team performance.

Effectiveness of conflict resolution

Group A. High EI managers excelled at empathy and active listening, which helped team members feel heard and understood. They also used emotional regulation techniques to stay calm and focus on finding a solution. The managers of this group were able to address the underlying emotional issues causing conflicts (e.g. miscommunication, stress, or different values), not just the surface-level issues.

Group B. Managers with moderate/low EI were more focused on resolving the practical or task-oriented aspects of the conflict (e.g., performance or resource allocation issues) but often missed the emotional dynamics underlying the disputes.

When conflicts escalated, these managers had difficulty containing their emotions, sometimes resulting in more impassioned or impersonal decisions.

Employee satisfaction and engagement

Group A. Employees in teams led by high EI managers reported significantly higher levels of satisfaction and engagement. On the satisfaction survey, employees rated their leaders 20% higher in terms of emotional support and leadership effectiveness. High EI managers were more likely to provide individualized support, recognize employee achievements, and create an emotionally safe work environment. This led to higher morale and a stronger sense of team cohesion. High EI leaders were also more successful in managing team stress, which contributed to a healthier work-life balance for employees and fewer reports of burnout.

Group B. Employees under moderate/low EI managers reported lower satisfaction and engagement. On average, these employees rated their leaders 10% lower for emotional support and leadership effectiveness. While task-focused leadership was often seen as efficient, it did not foster the same level of emotional connection with employees, leading to a higher turnover intention and lower enthusiasm for work. Employees in Group B were more likely to report feeling underappreciated or disconnected from their managers, which contributed to lower motivation and engagement.

Employee satisfaction and engagement scores for Group A were significantly higher than those for Group B ($p < 0.01$), further supporting the importance of emotional intelligence in fostering positive employee experiences.

Conclusion

After analyzing the results of this study, it became clear that emotional intelligence (EI) plays a crucial role in effective leadership. Data from both Group A (high EI leaders) and Group B (medium/low EI leaders) showed significant differences in results in several key areas — team performance, conflict resolution, and employee satisfaction.

Leaders with high levels of emotional intelligence consistently outperformed their peers in these areas. Their ability to understand and manage emotions — both their own and those of their team members — contributed to smoother work, increased productivity and employee engagement. Managers with a high level of EI were also better prepared to resolve conflicts quickly and constructively, which helped to strengthen the sense of trust and cohesion in their teams.

On the other hand, while managers with medium or low EI levels could achieve results in certain areas, they faced great difficulties in building strong relationships with their teams. Conflict resolution took longer, and employee engagement was lower. These leaders often paid more attention to the tasks than the emotional dynamics of their teams, which, as the results show, can undermine long-term productivity and morale.

According to a study by Robert Kerr, John Garvin, Norma Heaton, and Emily Boyle, the data analysis reveals that individual intelligence plays a crucial role in effective leadership [5]. Specifically, employees' perceptions of a manager's performance are strongly linked to the manager's emotional intelligence (EI).

What is particularly striking is how emotional intelligence shapes not only an individual leader, but also the entire team. High-level EI managers create an environment in which employees feel supported, valued, and motivated to achieve the best results. This has the opposite effect, increasing the overall morale and satisfaction of the team, which ultimately contributes to the success of the organization.

As we move forward, this research reinforces the idea that emotional intelligence is not just a "pleasant" trait, but a fundamental leadership skill. Organizations seeking to create highly effective teams and a positive workplace culture should prioritize emotional intelligence in their leadership development programs. It's not just about teaching leaders' technical skills, but also about helping them connect with and understand the people they lead. Emotional intelligence is the key to making such connections, and as this study shows, that's the difference between a good leader and an outstanding one.

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