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Agricultural sciences

ORGANIZATION OF ECOLOGICAL MONITORING IN RECLAMATED LANDS

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Abstract

The article is devoted to the issues of organization of reclamation measures and monitoring in the territories during the ecological restoration of saline and differently saline soils in the territory of the Republic of Azerbaijan.

The article provides extensive information on the main indicators of monitoring of reclaimed lands. It is indicated in which directions observations are carried out. Information is provided on the appropriate criteria for assessing the melioration of lands in the territories intended for improvement.

Keywords. *Reclamation, salinization, salinity, granulometric composition, ecological restoration, washing.*

Introduction.

The amount of irrigated lands considered suitable for agriculture in the territory of the republic is about 1.426 million hectares. Approximately 664.6 thousand hectares or 33.0% of these areas are saline lands to one degree or another.

One of such measures is the organization and implementation of monitoring in the appropriated areas.

Conducting monitoring helps to obtain complete information about the area, its current land reclamation status. Based on this information, a plan of measures for improvement in the appropriated areas is prepared.

Purpose of the study. Timely identification of changes in the territories, their assessment, forecasting, elimination and timely prevention of negative manifestations and consequences of processes arising from the impact of the implemented land reclamation measures, efficient use of lands, control over the effectiveness and activity of land reclamation measures.

The object of the study is irrigated lands suitable for cultivation and winter pastures in the territory of the republic.

Analysis and discussion.

The land reclamation condition is a system of indicators that affect the productivity of agriculturally designated arable lands and characterize the soil hydrogeological conditions of the territory. It is determined, determined in the process of monitoring the land reclamation condition of the ameliorated or meliorated lands, and this control is carried out in accordance with special normative and methodological materials.

The main indicators of the land reclamation condition of irrigated or meliorated lands are: the degree of drainage of the territory, the depth of groundwater, the mineral content and chemical composition of groundwater, the degree of salinization and salinization of soils in the 0-100 cm layer [1].

In accordance with the values of the indicators, it is determined whether the lands are in good, satisfactory and unsatisfactory condition based on the appropriate classifications.

With the exception of large land reclamation systems that require monitoring of reclaimed or reclaimed lands to be organized at the regional level, in most cases land reclamation monitoring is at the local level.

One of the main directions of land reclamation monitoring is ground observations. In land reclamation monitoring, a thorough land reclamation system (irrigation, thorough washing, chemical reclamation, etc.) is a priority [2].

In the land monitoring system, observations based on regime and operational observation systems are divided into: base observations characterizing the state of the lands before reclamation (allowing to distinguish natural negative processes from possible anthropogenic processes); periodic observations

(periods: month, day, year and more); operational observations determining changes in the state of the object; emergency (accident) observations characterizing the consequences of emergency situations.

The main criteria for the standard hydro-ameliorative systems included in the monitoring of reclaimed lands are: regional characteristics of the soil cover and its melioration status; the performance of hydro-ameliorative systems, the quality of water used for irrigation, the quality of drainage waters; the type and type of melioration measures [3; 4].

In the monitoring of reclaimed lands, it is important to distinguish natural processes from those caused by anthropogenic influences.

The main indicators of the properties characterizing the state of the soil and determining its classification suitability are: granulometric composition, density, structure, skeleton density, aggregate composition, humus content, humus layer thickness, hydrolytic acidity, pH, carbonation, porosity, moisture capacity, water permeability, mineralogical composition, soil-groundwater health, their chemical composition, etc.

Finally, summing up the above, it can be said that conducting ecological monitoring in the territories in accordance with the correct methodologies and in a timely manner creates conditions for determining the current state of reclamation of the territories under cultivation and thereby preparing a scientifically substantiated plan of measures required to increase soil fertility. This, in turn, has a positive effect on increasing soil fertility and increasing the productivity of agricultural crops.

The following observations are made on the basis of the main indicators in monitoring reclaimed lands:

1) The level of humus depletion (dehumusification), erosion (deflation); 2) the water-salt regime of groundwater (depth of occurrence and chemical composition), soil salinization (general, soda, repeated), the quality of surface waters, waterlogging or repeated waterlogging, increased soil moisture, flooding; 3) the possibility of soil salinization; 4) the structure of the soil cover; 5) physical condition of the soil (in simple agro-measuring and major land reclamation measures - irrigation, drying, major washing, chemical reclamation, etc.); 6) the level of accumulation of pesticides and their metabolites, heavy metals, chemical and radioactive elements, mineral fertilizers, waste water sediments.

Taking into account the degree of drainage of soils, the depth of groundwater and their mineralization, water supply and the amount of total evaporation, the degree of salinization and salinization of soils, alkalinity, productivity of cultivated plants and other indicators, the ecological and reclamation conditions of soils are classified by the AzHveM EIB into good, satisfactory, stable satisfactory and unsuitable soils [13].

Based on these criteria, it is possible to evaluate reclaimed lands, zone them, and develop a system of appropriate measures for their reclamation improvement (Table 1).

Table 1

Criteria for the ecological and reclamation conditions of reclaimed lands

Indicators	Land reclamation status				
	Purely unsatisfactory	Unsatisfactory	Unsatisfactory Unstable	Favorable Satisfactory	Good
Drainage rate, m ³ /day/ha	< 5	5-8	8-15	15-20	> 20
Depth of groundwater from the ground surface, m					
- at the beginning of vegetation	0,5-0,9 kimi	0,5-1,0	1,0-1,3	1,3-1,5	1,5-2,0
- during vegetation	1,0-0,9 kimi	1,0-1,5	1,3-1,8	1,8-2,5	2,5-3,0
- at the end of vegetation	1,5-0,9 kimi	1,5-2,0	2,0-2,5	2,5-3,0	2,5-3,0
Mineral content of groundwater	> 20	15-20	10-15	3-10	< 3
Total evaporation to water input ratio	> 1,0	1,0	0,8-1,0	0,6-0,8	< 0,6
Drainage flow to water input ratio	< 0,15	0,15-0,20	0,20-0,25	0,25-0,35	> 0,35
Salinity of the upper meter layer by chlorine, %	> 0,1	0,1-0,05	0,02-0,05	0,015-0,02	< 0,015
Soil salinity limits and salinity by dry matter, %	Saline S ₀ + 2,95	Highly saline S ₀ + (1,15-2,95)	Moderately Salinized S ₀ + (0,45-1,15)	Weakly Saline S ₀ + (0,15-0,45)	Saline < S ₀
Salinity limits, relative amount of absorbed sodium, %	Salinity, > 0,35	High salinity 25-35	Medium saline 15-22,5	Weakly saline 5-15	Salinity-free < 5
Alkalinity limits, amount of HCO ₃ associated with sodium and magnesium, %	Alkaline, < 0,180	High alkaline 0,14-0,18	High alkaline 0,095-0,140	Weakly alkaline 0,060-0,095	Alkaline-free < 0,060

Soil reaction, pH value in water suspension	Very high > 9,7	High alkaline 9,2-9,7	Medium alkaline 8,5-9,2	Weak alkaline 7,0-8,5	Criteria 7,0
Main crop cotton: -yield, s/ha -relative yield, %	0 0	3-10 10-40	10-18 40-70	18-25 70-100	25 və > 100

Analysis of soil, water, plants is carried out in certified analytical laboratories based on approved methodologies.

The results of reclamation monitoring are presented in the form of an ecological passport, map materials and a final report in accordance with the standards of technical documents.

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Arts

THE HISTORICAL DEVELOPMENT OF THE EDUCATION SYSTEM IN TURKEY AND AZERBAIJAN AND CONTEMPORARY EDUCATION

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TÜRKİYE VE AZERBAJCANT'DA EĞİTİM SİSTEMİNİN TARİHSEL GELİŞİMİ VE GÜNÜMÜZ EĞİTİMLERİ (1990-2020 Yılları)

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Abstract

Music education plays a significant role in shaping the artistic and aesthetic tastes of young people. Music, which brings joy to humans, also serves to purify the soul and cultivate refined sensibilities. Aristotle writes about the necessity of music in human life: "Since the Middle Ages, people have recognized the importance of music and incorporated it into educational curricula." According to Aristotle, "Just as physical exercise develops the body, music shapes one's character and taste. Undoubtedly, harmonious music fosters the development of a sound mind and the ability to make good judgments." Abu Nasr Al-Farabi also emphasizes the importance of music in human life: "Music is divided into theoretical and practical aspects. Practical music, which involves performance and practice, is essential for the development of human consciousness. Performing musical modes on instruments has a profound and positive impact on human psychology." This article focuses on examining the historical trajectory of the education systems in Turkey and Azerbaijan, as well as the development of music education in the modern era. The researcher identifies historical reforms in the education systems of both fraternal countries, highlighting similarities and differences in their music curricula across various periods. The ideological similarities and differences between Turkey and Azerbaijan manifest in science and education, as in all other fields. Until the modern period, the science and education policies of these two nations—sharing common roots, language, religion, and moral-spiritual values—have not been thoroughly studied in terms of parallels and distinctions in their curriculum content. This article aims to address that gap. It is particularly important to note that Azerbaijani music is an inseparable part of the broader Turkic cultural and musical heritage. "Recent studies in musicology on the mutual influences between Azerbaijani and Turkish musical cultures prove the existence of a multilayered, shared archive between these two traditions"

Özet

Müzik eğitimi, özellikle gençlerin sanatsal-estetik zevkinin oluşmasında önemli bir rol oynar. İnsana zevk veren müzik, aynı zamanda insan ruhunun arınmasına ve ince bir zevk sahibi olmasına hizmet eder.¹Aristoteles, müziğin insan hayatındaki gerekliliği hakkında şöyle yazar: "Orta Çağlardan beri insanlar müziğin önemini dikkate alarak onu eğitim programına dahil etmişlerdir." ¹ Aristoteles'e göre, "beden hareketlerine uygun olarak beden yapısı geliyorsa, aynı şekilde müzik de insanın karakter yapısı ve beğenileri üzerinde de belirleyici bir rol oynar. Şüphesiz ki, müzik,

insanda doğru zihin ve iyi değerlendirme yeteneğinin gelişmesine zemin hazırlar. "Müziğin insan hayatındaki önemini Ebu Nasr El Farabi de şöyle belirtir: "Müzik teorik ve pratik olarak iki kısma ayrılır. Pratik müzik, okumak ve icra etmek olup, insanın bilincinin gelişmesi için çok gereklidir. Müzik aletlerinde makamları icra etmek, insan psikolojisine oldukça büyük ve olumlu etki gösterir."¹ Müzik icrasının en önemli kısmı eğitimidir. Müzik eğitimi, planlanmış eğitim yöntemlerinin, müzik eğitimcisi tarafından belirli yöntemlerle uygulanması ile gerçekleşir. Bu yöntemler genel-mesleki ve özengen müzik eğitimi programları dahilinde gerçekleştirilmektedir. Sunulan makalede, Türkiye ve Azerbaycan'da eğitim sisteminin tarihsel süreç ve modern dönemde müzik eğitiminin gelişiminin araştırılmasına odaklanılmıştır. Araştırmacı, Türkiye ve Azerbaycan'ın eğitim sisteminde, müzik müfredatında benzer ve farklı yönleri yansıtmak için her iki kardeş ülkenin eğitim sisteminin tarihsel sürecini oluşumunu belirleyerek, tüm dönemlerde eğitim sisteminde yaşanan reformların neler olduğuna odaklanmıştır. Türkiye ve Azerbaycan devletlerinin ideolojik bakış açılarındaki benzerlik ve farklılık, tüm alanlarda olduğu gibi bilim ve eğitimde de kendini göstermektedir. Modern döneme kadar kökü bir, dili bir, dini ve ahlaki-manevi değerleri bir olan Türkiye ve Azerbaycan halklarının bilim ve eğitim politikası, müfredat sistemindeki içerik çizgilerinin benzer ve farklı özellikleri araştırılmamış olduğu gözlemlenmektedir. Sunulan makale, bu boşluğun giderilmesi bakımından önem taşımaktadır. Burada özellikle belirtilmelidir ki, Azerbaycan müziği, genel Türk kültürünün, müzik kültürünün ayrılmaz bir parçasıdır. "Son yıllarda müzik biliminde Azerbaycan ve Türk müzik kültürlerinin karşılıklı ilişkilerinin incelenmesine dair araştırmalar, bu iki kültür arasında çok katmanlı ortak bir arşiv olduğunu kanıtlamaktadır."¹

Keywords: Education system in Turkey, Education system in Azerbaijan, History of education, Music education.

Anahtar Kelimeler: Türk eğitim sistemi ,Azerbaycan eğitim sistemi, Eğitim, Müzik eğitimi,

Giriş

Türkiye ve Azerbaycan kültürleri arasındaki birlik, karşılıklı etkileşim ve sıkı ilişki, ortak tarihi geçmişe, dilin, dinin, kültür ve eğitimin yakınlığına dayanır. Azerbaycan ve Türk halkları bir soydan olup, etnik yakınlığın yanı sıra bu halkların gelişiminde tarihi-kültürel bağ ve eğitimde yapılan reformlar önemli rol oynar. Türkiye-Azerbaycan kültürel ilişkilerinin en önemli ve sonuçları daha net görülen yönlerinden biri ve belki de birincisi eğitimidir. Bu alanda Türkiye-Azerbaycan ilişkileri büyük bir gelişim dinamizmi sergileyerek bu olumlu dinamizmin sonuçlarını eğitimin tüm alanlarında görmek mümkündür⁵.

XX. yüzyılın sonu-XXI. yüzyılın başlarında dünyada yaşanan sosyo-politik olaylar, eğitimin içeriğinin ve ders kitaplarının değiştirilmesini zorunlu kılmaktadır. Türkiye ve Azerbaycan'da eğitim sisteminin oluşumu uzun bir tarihi sürecin sonucudur ve çeşitli dönemlerde bu alanda bir dizi reform gerçekleştirilmiştir. Türkiye ve Azerbaycan'ın eğitim sisteminin gelişiminde ve ders kitabı politikasında ortak yönler bulmak mümkün olsa da, her ülkenin kendi eğitim ve ders kitabı politikasında benzer ve farklı yönler mevcuttur. (Hüseynova F., 2007, 158) Türkiye, Doğu ülkeleri arasında laik eğitim sistemini benimseyen ilk ülkelerden biri olduğu için bu ülkenin eğitim modeli diğer ülkeler için bir örnek teşkil edebilmektedir. Milli müzik ve kültür tarihinin, sanat alanında köklü geleneklerinin incelenmesi, büyüyen nesilde estetik, duygusal-emosyonel eğitimin güçlendirilmesi, genel entelektüel seviyenin gelişimi, yetenekli öğrencilerin keşfedilmesi gibi temel taleplerin yerine getirilmesinde müzik eğitimi büyük önem taşır. Manevi-estetik etkisine, didaktik özelliğine, vatanseverlik, hümanizm, dostluk ruhunda eğitici etki gücüne göre bu ders büyük geliştirici imkanlara sahiptir. Müzik eğitimi sürecinde başvurulacak çeşitli türlerle ait örnekler, öğrencinin kişiliğinin idraki, psikomotor açıdan gelişimine, manevi-emosyonel zenginleşmesine zemin hazırlar. Müzik eğitimi, "sistematik bir şekilde kaydedilen bir veya daha fazla sanat alanını öğreten estetik temelli bir eğitim süreci olup, sanatsal davranış ve kişilikte değişiklik yapar" (Bozkaya İ., 2001) Genel müzik eğitimi veren okullarında müzik dersinin temel amacı, milli ve insani sanat örnekleri temelinde öğrencilerde müzik kültürünün oluşturulması ve gelişimini sağlamaktır. Müzik eğitimi, "çocukluk döneminden başlayarak bireylere belirli müzik davranışları kazandırarak bu davranış ve becerileri geliştirme sürecidir."¹ İlköğretim düzeyinde öğrencilerin müzik türlerinin form, tür, üslup ve ifade araçları, yaratıcı-estetik faaliyetlerle ilgili (şarkı söylemek, dans etmek vb.) en basit ve ilk becerilere sahip olmaları sağlanır, onlarda sanatsal zevk, estetik kültür, milli müzik, ayrıca evrensel müzik örneklerine ilgi,

¹ Uçan, 1994, s. 23

yaratıcılığa eğilim, soyut ve imgesel düşünce, çalışkanlık ve diğer nitelikler oluşturulur.² Eğitim, insanın davranışlarında olumlu bir süreç olup, bu süreç bilim, teknoloji ve sanat alanlarını kapsayan bireyler ve toplumları şekillendirme ve yönetme amacı taşır. Bu süreç, gelişim ve becerilerin artırılmasına yönelik bir süreçtir.³

Türkiye'de Eğitim Sisteminin Oluşum Süreci

XIX. yüzyıla kadar Osmanlı Devleti'nde meydana gelen siyasi ve kültürel değişikliklerle birlikte edebiyat, bilim-egitim alanında da adımlar atılmıştır. XIX. Yüzyılda dünyada yaşanan siyasi ve sosyal gelişmeler, Osmanlı İmparatorluğun da modernleşme hareketinin başlamasına neden olur.(Kurt İ.,2010,6).Bu dönemde eğitim sistemi genellikle dini kurumların kontrolünde olup, cami ve medreselerde, sıbyan mektepleri, rüştiyeler ve idadiler aracılığıyla gerçekleştiriliyordu. Osmanlı döneminde resmi, tek bir eğitim sistemi yoktu ve devlette müzik alanında da modernleşme yönünde önemli adımlar atıldı.⁴ Coşkunsoy'un (2019), "Osmanlı Dönemi İstanbul'da Opera Mekanları" adlı makalesine dayanarak söyleyebiliriz ki, Osmanlı döneminde Türkiye'de müziğe ve opera sanatına ilginin yoğun olduğu gözlemlenmektedir.

1826 yılında Mızıka-i Hümayun adlı Avrupa müzik sistemine dayanan askeri müzik okulu kurularak, burada ilk kez Batı müziği öğretilmeye başlandı. Türkiye'de ilk ders kitaplarının yayınlanması da Osmanlı döneminde gerçekleştirilmiş ve "Türk Musikisi ve Usûlü" eserini ilk bilimsel eser olarak değerlendirmek mümkündür. (Faddeyev İ.L. 1993, 73) 1914 yılında Türkiye'de "Darülbey" adlı konservatuvar açılmış ve ünlü besteci Vezir Ziya Paşa bu okula liderlik etmiştir. Avrupa ve Türk klasik müziğinin ayrı ayrı öğretildiği bu kurumda Rauf Yekta Bey gibi bu dönemin ünlü müzik adamı da ders vermiştir.⁵ "Türkiye'de müzik eğitime verilen önem ve müzik eğitiminin geliştirilmesi, 'Cumhuriyet Dönemi Kültürel Gelişim Hareketi' ile daha da ağırlık kazanmakla birlikte, bu alandaki girişimler Osmanlı İmparatorluğu'nun son dönemlerine ve özellikle 1839 yılı Tanzimat Fermanı ile başlayan yenileşme hareketlerine dayanır.⁶"

Daha sonra Atatürk ve kahraman Türk milleti Kurtuluş Savaşı'nı zaferle sonuçlandırarak, Türkiye Cumhuriyeti Devletini kurdu ve bununla ülkenin tüm alanlarında gelişime doğru yeni reformlar yapıldı (Kurt İ.,2010,6).1923-1940 yıllarında Atatürk'ün fikirleri tüm alanlarda olduğu gibi eğitim alanında da kendini gösterir ve eğitim onun politikasında her zaman dikkat merkezinde durur. O, Maarif Kongresi'ni ve Heyet-i İlmiye adı altında bilim kurumlarını toplayarak, ilköğretim programları, ilk, orta ve lise eğitim aşamaları, ders kitaplarının kalitesinin artırılması, öğretim ve eğitimin kurulması gibi güncel konulara dikkat çekerek, bu alanların oluşumu ve gelişimi için gerekli kararlar alınmıştır (Kurt İ.,2010,7).

Türkiye Cumhuriyeti'nin politikasının önemli hedeflerinden biri de "Avrupa kültürüne uyumlu bir yaşam tarzı yaratmak" olmuştur. Bunun için bir dizi yasa maddesi kabul edilmiş ve bu yasa tasarılarında müzik kültürü ve müzik eğitiminin gelişim yönünü de belirleyen maddeler yer almıştır.⁷ Dönemin en önemli olaylarından biri, Arap alfabesinin kaldırılarak Latin harfli yeni Türk alfabesinin kabul edilmesiyle okuma yazma bilmeyenlerin sayısı azaltıldı ve milli, modern eğitim taleplerine uygun ders kitapları yayınlandı. Batı sistemi temelinde hazırlanan "Müzik Öğretimi" adlı ilk ders kitabı, müzik eğitimi alanında önemli bir bilimsel kaynak rolü oynadı. (Faddeyev İ.L. 1993, 58).

1990 Yılından İtibaren Günümüze Kadar Türkiye'de Eğitim Sisteminin Gelişim Aşamaları

1990 yılından itibaren Türkiye'nin eğitim sisteminde bir dizi köklü reform gerçekleştirilerek teknolojinin entegrasyonu ve uluslararası standartlara uyum temel faktör olarak alınmıştır. Sürekli gelişen yeni teknolojiler döneminde toplumun yeniliklere uyum sağlayabilmesi değişiklikleri kaçınılmaz kılar ve eğitim alanının sürekli şekillenmesi toplumun düşünce tarzının gelişimi yönünde gerçekleştirilir¹².

Genel eğitim okullarının müzik derslerinde programlara Osmanlı kültürü, Türk halk müziği ve milli müzik aletlerinin öğretimi ile ilgili konular eklenmiştir. Müzik yeteneği olan yetenekli öğrencilerin keşfedilmesi için müzik yarışmaları, müsabakalar, koro konserleri ve ansambl festivalleri düzenlenmiştir. 23 Nisan Çocuk Bayramı, 19 Mayıs Gençlik ve Spor Bayramı gibi resmi etkinliklerde okul korusu ve orkestra gruplarının katılımı öğrencilerin müzik sanatına ilgisini daha da artırdığı gibi onların estetik zevkini şekillendirmiştir. Aynı zamanda, öğretmenlerin daha da bilgilenebilmesi eğitimin kalitesini ve verimliliğini artırarak, MEB tarafından düzenlenen eğitim programlarında müzik öğretmenlerine dijital kaynaklardan yararlanma metodolojisi teknolojik yeniliklere uyum sağlamada önemli rol oynamıştır. Türkiye'nin

² Özturhan, 2022, s. 45

³ Asgarov, 2017, s. 16

⁴ Фадеев, 1993, s. 73

⁵ Asgarov, 2017, s. 24

⁶ Özer & Onuray Eğilmez, 2017

⁷ Asgarov, 2017, s. 24

birçok eğitim kurumu Türk cumhuriyetlerinin ilgili kurumları ile karşılıklı iş birliği protokolleri imzalayarak, eğitimin gelişimi için önemli ortak projeler gerçekleştirmiştir. (Məmmədli N. 2005, 125)

Genel eğitim okullarında öğrencilerin nota bilgisini artırmak için onlara teorik bilgiler vermek, Türkiye ve dünya müzik kültürünü tanıtmak için yeni dersler öğretim programına dahil edilir. Pratik çalışmalar aracılığıyla ses ve ritim duygusunun gelişimi sağlanarak, müzik bestelemek ve icra etmek gibi alışkanlıklar kazandırılmıştır. Geleneksel müziğin resmi genel müzik eğitimindeki yeri ve önemi hakkında daha fazla bilgi sahibi, dengeli ve empatik olarak, temel yaşama, özü itibarıyla millileştirme, formla anlama, hacimle özgürlük, öğretim yöntemlerinde modernlik yöntemleri uygulandı. (Uçan A., 1992, s.53-83)

Genel müzik eğitiminde yetenek göz önünde bulundurulmadan herkesin eğitim alması hedeflenirken, profesyonel müzik eğitiminde eğitim alacak kişilerin belirli bir düzeyde müzik yeteneğine sahip olmaları bir şart olarak talep edilir¹². 2000'li yılların ortalarından itibaren genel eğitim okullarında müzik derslerinde bilgisayar programları dijital müzik platformları ve interaktif tahtalardan yararlanmaya geniş yer verilerek, bu araçlarla dersler daha ilginç ve kapsamlı bir şekilde düzenlenir. (Müzik dersi, Öğretim programı, 2018). Aynı yıllarda eğitimde teknoloji ve kalitenin artırılması, müfredat sisteminin oluşturulması ve onun modern eğitim yöntemlerine uyum sağlaması yönünde önemli adımlar atılarak, müzik eğitimi müfredatı çeşitli yenilikler ve reformlarla geliştirilir. Müzik derslerinin içeriği yenilenerek, modern öğretim yöntemleri uygulanır ve teknolojilerden yararlanmaya öncelik verilir. Müzik alanında yapılandırmacı pedagoji temelinde yeni öğretim programı hazırlanarak, öğrencilerin aktif katılımına, yaratıcılık yeteneklerinin gelişimine öncelik verilir. Yüksek kaliteli eğitimin kazanılması için okullarda bilgisayar laboratuvarları ve dijital ekipmanlar kurulur. (Müzik dersi, Öğretim programı, 2018).

2003 yılında genel eğitim okullarında birçok derste, müzik derslerinde modern eğitim teknolojileri uygulanarak, dersin daha verimli ve kaliteli öğretimi sağlanır. Eğitim, bireylerin doğumundan başlayarak yaşam boyu devam eden bir kavramdır (Çeçen, 2019: 5). İnsanların eğitimi yaşam boyu devam ettiği için, eğitimi tanımlarken ayrıntılı bir şekilde tanımlamak gerekir. Eğitim kavramının formal ve informal eğitim olarak tanımlanması ile, 2005 yılında Türkiye'nin eğitim politikasında yeni müfredat sistemi uygulanarak, yapılandırmacı eğitim sistemi temel ilkelerine dayanır ve öğrencilerin aktif katılımını teşvik eder. Yeni müfredatın kurallarına göre önceki geleneksel ezberlemeye dayalı eğitim modelinden vazgeçilerek, yapılandırmacılığa dayalı yeni müfredat uygulanmıştır. Diğer derslerde olduğu gibi Müzik derslerinde de öğrencilerin aktif öğrenme sürecine katılımı artırılmıştır. Dersler arası ilişkiler güçlendirilerek, uygulamalı bilgilere öncelik verilmiş, Modern dil öğretim yöntemleri uygulanarak, dinleme, konuşma ve yazma becerileri geliştirilmiştir. Ayrıca, müzik ve sanat alanlarında ek kurslar ve ders dışı etkinlikler genişletilerek, öğrencilerin psikolojik sağlığını korumak için okul psikologları ve sosyal hizmetler bölümleri güçlendirildi².

Türkiye'nin Müzik müfredatına uygun olarak oluşturulmuş müzik eğitimi sisteminde öğrencilere temel değil, müzik sanatının genel yasaları hakkında bilgilerin verilmesi hedeflenir. (Müzik dersi Öğretim programı, 2018, 7). 2010 yılından itibaren genel eğitim okullarında "4+4+4" sistemi uygulanması, sınıf odalarının akıllı tahtalar ve tabletlerle donatılması öğrencilerin entelektüel seviyesini daha da artırmıştır. Tüm bu girişimler sonucunda eğitim alanlar internet teknolojilerini daha hızlı kavramaya başladılar ki, bu da onlara ders konularında yaratıcı olma imkanı sağladı. (Türkiye Cumhuriyeti'nin Eğitim Sistemleri, 2018).

Türkiye'de ders kitaplarının hazırlanması ve yayınlanması Milli Eğitim Bakanlığı tarafından gerçekleştirilir. Ders kitapları, modern eğitim standartlarına uygun olarak hazırlanmakla öğrencilerin bilgi ve becerilerini geliştirmeye yönelmiştir. Yeni ders kitaplarında bilimin gelişimi, ayrıca milli ve evrensel değerlerin korunması hedef alınarak, ders kitaplarının içerik kalitesi, eğitimin gelişiminde önemli bir faktör olarak kabul edilmiştir. (Müzik dersi Öğretim programı, 2018) Türkiye'de ders kitabı politikası, eğitim sisteminin temel bileşenlerinden biri olup, eğitim kalitesinin artırılması hedefini güder. Türkiye mevcut gelenekleri sürdürmekle birlikte ders kitabı politikasında yeni reformlar da gerçekleştirir. Örneğin, "Müzik" ders kitaplarının hazırlanması için 1 yıl önceden duyuru yapılır ve ders kitapları Şura'nın görüşüne sunulur, Şura üyelerinin kararı bakanın onayından sonra yürürlüğe girer. (Yıldırım A., 2010, 110) Türkiye'nin genel eğitim okullarında Müzik ders kitapları öğrencilerin bir birey olarak yetişmesi, onların vatan-sever ruhla büyümesi ve müzik becerilerinin oluşması için tüm bilgileri kapsar. V.P.Bespalko'nun sözlerine göre "Kompleks modeli gibi ders kitabı kendinde 4 elementi yansıtır: eğitimin amacı, eğitimin içerik ifadesi, didaktik ilkelerin seçimi ve hazırlanması, eğitimin belirli organizasyonel formlara yönelmesi ve onların pratikte yansması". (Bespalko V. 2007, 150)

Azerbaycan'da Eğitim Sisteminin Oluşumu ve Gelişim Süreci

Azerbaycan'da eğitim sistemi zengin tarihi ve gelişim aşamalarına sahip olup, ilk okulların ortaya çıkışı yeni çağın başlarına denk gelir.⁸ Milattan sonra III. yüzyıldan itibaren Azerbaycan'da ders kitabı politikası mevcut olmuş, VII-VIII. yüzyıllarda ise mükemmel olmasa da belirli bir sistem haline gelmiştir. Uzun süre okul ve medreselerimizde ders kitabı olarak kullanılan "Gülüstan", "Cameyi-Abbas", "Tarixi-Nadir" ders kitapları bizim düşündüğümüz anlamda ders kitabı olmamıştır. (Hüseynova A., 2015, 22) Azerbaycan'ın tarihi destanları olan "Dede Korkut" ve "Koroğlu" destanlarından halkın müzik sanatına büyük ilgisini görmek mümkündür.⁹ XVI-XVIII. yüzyıllarda Azerbaycan eğitiminde millileşmeye doğru eğilimler ortaya çıkmıştır. XIX. yüzyılın sonu, XX. yüzyılın başlarında Avrupa tipi eğitim sistemine uygun yeni okulların ortaya çıkışı ilk ders kitaplarının oluşumuna yol açmıştır. İçerik ve anlam bakımından çocukların yaş ve bilgi seviyesine uygun olmayan bu ders kitaplarında daha çok ezberciliğe öncelik verildi. (Hüseynova A., 2015, 83)

Sovyetler Döneminde Azerbaycan'da Eğitim Alanındaki Yenilikler

Sovyet döneminde eğitim sistemi merkezleştirilmiş ve ideolojik yönlü olup, bu dönemde yayınlanan eğitim programları önceki yılların programları ile aynılık gösterir. Bu dönemde Rusya işgaline maruz kalan Azerbaycan'da da birçok alanda olduğu gibi bilim ve eğitimde de yenilikler gerçekleştirildi.¹⁰

1941 yılında besteci İ.K. Abdullayev tarafından hazırlanan programda müzik teorisi, nota bilgisi ve müzik edebiyatı gibi bölümler yer almıştır. Bu programın temelinde besteci Adil Geray tarafından hazırlanan "Müzik ve Şarkı" programında, öğrencinin bilgi, beceri ve müzik yeteneğini daha da geliştirmek için bir dizi yöntem önerilerek, öğrencilerin estetik bakışlarını müzik faaliyeti sürecinde şekillendirmesi tavsiye edilmiştir. (Hüseynova A., 2015, 72)

Sürekli yenilenen ve geliştirilen programlar, eğitimin gelişim sütunlarını mükemmelleştirerek, müzik adamlarını düşündürür ve onları gelecek nesillerimizi daha bilgili, daha zevkli görmek arzusu çeşitli girişimlerin ortaya çıkmasına yol açar.

1962 yılında ünlü müzisyen ve eğitimci N.S. Melikmamedov tarafından hazırlanan "Şarkı" programı, daha yeni ve uygun yöntemlerle kapsanarak, "Müzik" dersinin öğretim sürecinde şarkı öğrenme ve müzik eserleriyle tanışma gibi aşamalara ayrılmıştır. (Hüseynova A., 2015, 93) Sonraki yıllarda "Maarif" yayınevi tarafından N.S. Melikmamedov, S.Ə. Quliyev, S.M. Ələsgərov tarafından 2, 3, 4. sınıflar için "Müzik" ders kitapları basılarak, bu ders kitapları öğrencilerin müzik eğitimi alanında önemli bir rol oynadı. (Hüseynova A., 2015, 7) N. Melikmamedov, 1969 yılında yayınladığı "Genel Eğitim Okullarında Müzik Öğretiminin Metodolojisi" adlı metodik kitabında, müziğin hem askeri hem de vatanseverlik eğitimi sürecindeki önemini şu şekilde ifade eder: "*Antik Yunanistan'da köleci toplumun ilk eğitim kurumları olan Sparta ve Atina okullarında kölelerin çocuklarına müzik ve dans da öğretilir, askeri eğitim müzikle destekleniyordu*" (Melikmamedov N.S., 1969, 28).

Bağımsızlık Yıllarında Azerbaycan Eğitiminde Yaşanan Gelişmeler

1991 yılında bağımsızlık kazanıldıktan sonra, Azerbaycan'da eğitim alanında köklü reformlar gerçekleştirilmeye başlandı ve kabul edilen Eğitim Kanunu ile eğitim alanında hukuki bir temel oluşturuldu. Sovyet eğitim sisteminden milli eğitim sistemine geçişle birlikte okullarda milli-manevi değerlerin ve Azerbaycan ideolojisinin yaygınlaştırılması güçlendirildi ve Latin alfabesinin kullanılmaya başlanmasıyla ders kitapları kademeli olarak yenilendi. (Melikmamedov N.S., 1969, 28).

Azerbaycan Cumhuriyeti bağımsızlığını kazandıktan sonra, onun egemenliğini ilk tanıyan kardeş Türkiye Cumhuriyeti olmuştur. Bağımsızlığın güçlendirilmesi, Azerbaycan'ın ekonomik gücünün artırılması ve uluslararası arenada siyasi ilişkilerin kurulması için güvenilir ortakların desteğine büyük ihtiyaç duyulduğu bir dönemde Azerbaycan, bu desteği Türkiye Cumhuriyeti'nden almış ve iki kardeş ülke arasındaki ilişkiler daha hızlı bir şekilde gelişmeye başlamıştır. Bir millet, iki devlet olan Azerbaycan ve Türkiye arasındaki iş birliği tüm alanları kapsıyordu. Kendi sırasında, iki kardeş ülke arasındaki iş birliğinin sadece siyasi ve ekonomik değil, aynı zamanda kültür, bilim ve eğitim alanlarında da yeni dönemin gerekliliklerine uygun olarak daha da geliştirilmesi için gerekli adımlar atılmaya başlandı. (Hüseynova F., 2007, 80)

1992 yılında Türkiye ile Azerbaycan arasında bir anlaşma imzalanarak, Azerbaycan eğitiminin gelişiminde yeni imkanlar açıldı, aynı zamanda Müzik ders kitaplarının daha kapsamlı ve zengin bir şekilde sunulmasına zemin hazırlandı (Hüseynova F., 2007, 83). Anlaşmanın sonucu olarak, 1997, 1998, 2003 yıllarında basılan "Müzik" ders kitaplarında bilgilerin özümsemesi ve beceri-alışkanlıkların kazandırılması müzik materyalleri temelinde gerçekleştirildi, eğitim aşamalarında reformlar yapıldı, okulların maddi-teknik altyapısı güçlendirilerek, yeni öğretim programları ve müfredatlar uygulandı.

2000-2020 Yıllarında Azerbaycan Eğitim Sistemindeki Reformlar

⁸ Asgarov, 2017, s. 10

⁹ Asgarov, 2017, s. 11

¹⁰ Özturhan, 2022, s. 45

XXI. yüzyılda "Müzik" müfredatına uygun olarak oluşturulan müzik eğitiminde, öğrencilere müzik sanatı hakkında daha kapsamlı bilgilerin verilmesi hedeflenmiştir. Müfredat reformları ve yeni eğitim standartlarının uygulanmasıyla genel eğitim konsepti onayını bulmuş, öğrenci merkezli eğitim modeline geçiş yapılarak, ders müfredatları yenilenmiştir. (Emre İlhan, 2025, 5) Modern dönemde Azerbaycan genel eğitim okullarında müzik öğretimi, milli müfredatın bir parçası olarak, öğrencilerin müzik bilgilerini artırmak, estetik zevklerini şekillendirmek ve milli müzik mirasımızı onlara aşlamakla gelecek nesillerimizi vatansever bir ruhla yetiştirmeyi amaçlamaktadır. Milli müzik ve kültür tarihimizin, sanat alanında köklü geleneklerimizin incelenmesi, büyüyen nesilde estetik, duygusal-emosyonel eğitimin güçlendirilmesi, genel entelektüel seviyenin gelişimi, yetenekli öğrencilerin keşfedilmesi gibi temel taleplerin yerine getirilmesinde müzik eğitimi büyük önem taşır. Manevi-estetik etkisine, didaktik özelliğine, vatanseverlik, hümanizm, dostluk ruhunda eğitici etki gücüne göre bu ders büyük geliştirici imkanlara sahiptir. Müzik eğitimi sürecinde başvuru çeşitli türlere ait örnekler, öğrencinin kişiliğinin idraki, psiko-motor açıdan gelişimine, manevi-emosyonel açıdan zenginleşmesine zemin hazırlar. Genel eğitim okullarında müzik dersinin temel amacı, milli ve insani sanat örnekleri temelinde öğrencilerde müzik kültürünün oluşturulması ve gelişimini sağlamaktır.

Alman besteci Carl Orff, "öğrencilerin yaratıcılığının gelişimi için müzik eğitimi" sistemini geliştirmiştir. Carl Orff, kendi müzik pedagojik konseptini oluşturarak bunu öncelikle müzik eğitimi alanında çocuklarla çalışan öğretmenlere yönelik hazırlamıştır (Jilin V.A., 2008, 65). Müzik dersi müfredatı, Azerbaycan Cumhuriyeti'nin Milli Müfredatı temelinde hazırlanmış ve modern eğitim yöntemlerine uyarlanmıştır. Öğrenci merkezlik, sonuç odaklılık, sistemlilik ve entegratiflik gibi ilkelere dayanan bu müfredat, öğrencilerin öğrenme başarılarını düzenli olarak değerlendirmeyi, onların gelişiminin izlenmesini öngörür, öğrencilere müzik eğitimi alanında günlük hayatta gerekli olan becerilerin kazandırılmasının gerekliliğini şart koşar.¹¹ **Azerbaycan Cumhuriyeti'nde Genel Eğitim Milli Müfredatı. Bakü, Eğitim, 2006, s.5.**

Modern Dönem Azerbaycan Eğitim Sisteminde Yapılan Reformlar

Modern dönemde Azerbaycan'da eğitim sistemi, modern gerekliliklere uygun olarak gelişmekte, uluslararası standartlara uyum sağlamakta ve öğrencilerin bireysel gelişimine odaklanmaktadır. Azerbaycan genel eğitim okullarının "Müzik" ders kitapları, öğretim araçlarının hazırlanmasına yönelik gereklilikler, öğretim materyalinin planlanması, öğretim yöntemlerinin belirlenmesi ve öğretmenin hazırlığının gerçekleştirilmesi için uygun talimatlar şeklinde hazırlanmış kurallar temelinde yazılmıştır.

Öğrencilerin müzik alanında temel bilgi, beceri ve alışkanlıklara sahip olmaları amacıyla ders kitaplarında çeşitli karakterde konular resimler aracılığıyla sunulmuştur. Estonyalı bilim adamı J. Mikk şöyle demiştir: "Ders kitabının temel işlevi, öğrencileri bilgi edinmeye teşvik etmektir" (Mikk J. 2000).

Ders kitaplarında şarkıların, dansların ve enstrümantal parçaların içeriği "şartlı resimler"de kendini göstermiştir. Bunun yanı sıra, şarkıların kıta ve nakaratlarının içeriği öğrenciler tarafından daha kolay anlaşılın ve özüm sensin diye onların içeriği ayrı ayrı resimlerde verilmiştir. Ders kitaplarında müzik bilgileri, dersin içeriğinin bir unsuru olarak yer alır. Genel olarak, eğitimin içeriğinin belirlenmesinde hangi müzik bilgilerinin temel, hangilerinin özel olduğunu söylemek o kadar da kolay değildir. Ders kitaplarında şarkı söyleme, müzik eseri dinleme, imaj tasviri, müzik aletlerinde çalma, dans elementleri, orkestra şefliği hareketleri ve ritmik çalışmalar gibi faaliyet türleri, öğrencilerin yaş seviyesi, algılama yeteneği, ilgi ve ihtiyaçlarını dikkate alarak onların yaratıcı düşüncesinin gelişimine hizmet eder. Sunulan eserlerin bes-tecilerinin portreleri ve şarkılarının metinleri yerleştirilmiştir. Müzik repertuarına kolay özüm-senen ve öğrencilerin yaş seviyesine uygun törensel, hüzünlü, neşeli karakterde müzik örnekleri dahil edilmiştir.¹²

Türkiye ve Azerbaycan Eğitim Sisteminde Benzer ve Farklı Yönler

Kültürlerimiz arasındaki tarihi ve kültürel-manevi bağların yeni düşünce zemininde incelenmesi ve araştırılması, halkımızın bütünlüklü olarak Türk dünyası edebiyatı ve kültürüyle buluşması için en gerekli şarttır. Bu anlamda Büyük Atatürk'ün söylediği sözler bizim için bir öğüttür: "Azerbaycan'ın kederi bizim kederimiz, sevinci bizim sevincimizdir" (Ergün A., 1997)

Türkiye'nin Azerbaycan ile eğitim alanında uluslararası işbirliğini güçlendirmesi, küresel eğitim standartlarına uyum sağlama ve kültürlerarası diyalogun güçlendirilmesi açısından önemlidir. Bu reformlar, Türkiye'nin eğitim sisteminin modern gerekliliklere cevap vermesini ve küresel rekabet gücünün artırılmasını hedeflemektedir.¹³

¹¹ Eğitim Bakanlığı, 2006, s. 5

¹² Rəcəbov, Zamanlı & Quliyeva, 2010

¹³ Öztürk, 2023, s. 27

Türkiye ve Azerbaycan genel eğitim okullarında müzik öğretmenlerinin mesleki becerilerinin artırılması için çeşitli eğitim programları ve seminerler düzenlenir. Öğretmenlerin sertifikasyon sürecine dahil edilmesi, onların daha bilgili bir uzman olarak yetişmesinde önemli rol oynar. Bu faaliyetler, öğretimin kalitesini yükseltmeyi ve öğretmenlerin modern öğretim yöntemlerine uyum sağlamasını hedefler.¹⁴ Her iki ülkenin öğretim sisteminde benzer yönlerden biri de genel eğitim okullarında müzik derslerinde modern teknolojilerin daha geniş kullanılmasıdır. Bu çerçevede dijital öğretim materyalleri, online platformlar ve interaktif eğitim araçları öğretim sürecine entegre edilmiştir.

Sonuç

-Sonuç olarak belirtmek gerekir ki, Türkiye'de eğitim sistemi Osmanlı döneminden modern döneme kadar evrim geçirerek, laik ve modern bir eğitim modeline dönüşmüştür. Türkiye'de müzik eğitimi sistemi zamanla Osmanlı döneminden Batı modeline dayalı bir sisteme geçiş yapmıştır. Bu geçiş, Cumhuriyet döneminde Atatürk'ün reformlarıyla hızlanmış ve Türkiye, dünya standartlarında müzik eğitimi veren ülkelerden biri haline gelmiştir.

-Günümüzde hem klasik Batı müziği hem de geleneksel Türk müziği öğretilmekte ve müzisyenler uluslararası arenada tanınmaktadır. Bugün Türkiye'de eğitim sistemi, öğrencilerin çeşitli alanlarda gelişimini sağlayan, teknolojik ve akademik yenilikleri bünyesinde birleştiren bir model üzerine kurulmuştur. Türkiye'de 1990 yılından sonra eğitim alanında önemli reformlar gerçekleştirilmiştir. Zorunlu eğitimin artırılması, teknolojilerin eğitime entegrasyonu ve müfredat sisteminin uygulanarak yenilenmesi sayesinde eğitimin kalitesi yükseltilmiştir.

-Modern dönemde Türkiye, dijital ve yenilikçi eğitim modellerine daha fazla önem vermekte ve eğitim uluslararası standartlara uygun şekilde geliştirilmektedir. 2000'li yıllarda Türkiye eğitim sisteminde önemli reformlar hayata geçirilerek, eğitimin daha modern ve etkili olması sağlanmıştır.

-Teknolojinin uygulanması, yeni müfredat modeli, yabancı dil öğretiminin güçlendirilmesi bu yıllarda temel gelişim yönleri olarak kaydedildi. Bu reformlar sonucunda Türkiye eğitim sistemi uluslararası standartlara daha da yaklaştı.

-1990-2020 yılları arasında hem Türkiye hem de Azerbaycan'ın genel eğitim okullarında müzik müfredatı daha interaktif, yaratıcı ve teknoloji temelli bir hale getirildi. Öğrencilerin müzik bilgi ve becerilerini geliştirmek için hem milli hem de uluslararası müzik unsurları öğretime dahil edildi. Pratik yaklaşımın güçlendirilmesi ve modern teknolojilerin uygulanmasıyla müzik eğitimi daha kapsamlı ve etkili bir şekil aldı.

-Her iki ülkenin Müzik ders kitaplarında nota yazısı, ritim, melodi ve armoni gibi müzik teorisi konuları kapsamaktadır. Ders kitaplarında klasik müzik ve modern müzik türlerine daha geniş yer verilmiştir. Eğer Türkiye'nin ders kitaplarında halk müziği örnekleri ön plandaysa, Azerbaycan ders kitaplarında halk müziği, milli dansların yanı sıra bestekâr şarkılarına daha geniş yer verilmiştir. Böylece, hem Türkiye hem de Azerbaycan'da yapılan çeşitli araştırmalarda karşılıklı ilişkiler daha çok sosyo-politik yönlü olsa da, bu ilişkilerin kültürel yönlerine de değinilmiştir. Ancak, modern dönemimize kadar bilim ve eğitim alanında Türkiye-Azerbaycan eğitim sistemi karşılaştırılarak, yan yana konulmamıştır.¹⁵

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¹⁴ Öztürk, 2023, s. 29

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Chemical sciences

SYNTHESIS OF Co COMPLEXES AND BIOLOGICAL ACTIVITY

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Abstract

We have been investigated the synthesis hydrogenated salicylidene-aniline and cobalt complex. We have improved structure of synthesized compounds structure in different spectral methods. We have also been explored biological activity of synthesized compounds. We have revealed that ligands and metal complexes have shown high antimicrobial properties.

Keywords: Schiff base, metal complexes, antimicrobial properties

Schiff bases and their metal complexes have shown wide range of applications. Schiff bases are studied widely due to their synthetic flexibility, selectivity and sensitivity towards the central metal atom, structural similarities with natural biological compounds and also due to presence of azomethine group ($-N=CH-$) which imports in elucidating the mechanism of transformation and racemization reaction biologically[1-3].

Schiff bases having chelation with oxygen, nitrogen, etc donors and their complexes have been used as drugs and reported to possess a wide variety of biological activities against bacteria, fungi and certain type of tumors and also, they have many biochemical, clinical and pharmacological properties[4-5].

We have described the synthesis and antimicrobial properties of Co complex. The structure of ligands and metal complex were proved IR spectra. First ligand were synthesized by the condensation of salicylic aldehyde and aniline. Second ligand was synthesized N-salicylideneaniline with sodium borohydride reaction. Cobalt complex was synthesized reaction of hydrogenated Schiff bases and cobalt-acetate.

Antimicrobial properties of synthesized compounds were evaluated by the diffusion method. Antimicrobial activity of the compounds of tested against using *Pseudomonas Aeruginosa*, *Mycobacterium lacticolum*, *Aspergillus niger*, *Cladasporium resinale*, *Penicillium Chrosegenum*, *Chastomium gloloodium* *Trichoderma viride*. The sterilized (autoclaved 121°C for 15 min) medium ($40-50^{\circ}$) was poured into the Petri dishes to give a depth of 3-4 mm and allowed to solidify. The suspension of the microorganism the steaked on plates. The paper discs impregnated with the test compounds was placed on the solidified medium. The plates were pre-incubated forth at room temperature and incubated at 37°C for 24 hour[6-7].

Both ligands and their metal complexes have shown high antimicrobial properties. Schiff base and hydrogenated Schiff base have shown moderate antimicrobial properties (death zone approximately 2,4-2.6) . Metal complexes of Schiff base and hydrogenated Schiff base have shown highest antimicrobial properties comparing with ligands. But hydrogenated Schiff base metal complex have shown both bactericidal and fungicidal propeties(death zone bactericidal 3,3-3,4 fungicidal 3,3,3,3)

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Economic sciences

THE IMPACT OF PROGRESSIVE INCENTIVE MECHANISMS ON ECONOMIC DEVELOPMENT IN AZERBAIJAN'S SERVICE SECTOR

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Abstract

The implementation of progressive incentive mechanisms aimed at stimulating the development of Azerbaijan's service sector holds significant importance in terms of sustainable economic growth and enhancing competitiveness. Tax incentives, the adoption of innovation-driven initiatives, and the development of human capital are mechanisms that can foster the expansion and improvement of service sector quality. The role of public-private sector partnerships in this context is also crucial, as they facilitate the efficient utilization of resources and accelerate the implementation of innovations. The effective application of these mechanisms can positively impact the country's economic development and contribute to the improvement of societal well-being.

Keywords: *The service sector in Azerbaijan, tax incentives, economic development, competitiveness, sustainable development, service quality.*

The foundation of modern life lies in the need to ensure a high standard of living for individuals. To achieve this, construction and creative activities must be carried out across all sectors. These initiatives should be implemented within the framework of developing public-private sector partnerships [3]. In this regard, the extensive construction and creative activities carried out in the country are not limited to the industrial and infrastructure sectors; they also encompass the development of the service sector, one of the promising areas of the economy.

In recent years, Azerbaijan's national economy has been rapidly diversifying, with a focus on the development of the non-oil sector. One of the key areas of this non-oil sector is the service sector. The share of the service sector in the gross domestic product has significantly increased and has emerged as a vital component of the economy. The government's economic reforms, improvements in the business environment, and the implementation of innovations have created a solid foundation for the formation of a highly competitive environment within the service sector.

The service sector constitutes a vital component of society's production activities, alongside material production industries. In recent years, the development of the service sector has reflected the specific characteristics of Azerbaijan's economy. This economic dynamism arises, on the one hand, from structural changes within the business sector and, on the other hand, from the increase in the real incomes of the population [2, p.384]. The economic indicators obtained demonstrate that the expansion of the service sector is closely linked not only to domestic socio-economic factors but also to global trends. In this context, the development trajectory of the national economy necessitates the modernization of the service sector in alignment with international trends, as well as the implementation of reforms that address contemporary challenges.

In an increasingly globalized world, the role of the service sector in economic development continues to grow. The demand for services in this sector necessitates the implementation of innovative approaches [1, p.19]. Given the growing importance of the service sector, the scientific evaluation of the promotional mechanisms applied in this field has become particularly relevant. In this regard, existing research offers an opportunity to gain a deeper understanding of the factors that influence the development of service industries from both theoretical and practical perspectives. This allows for a more comprehensive exploration of the forces shaping the growth of the sector.

The overall conclusions suggest that in order to ensure the sustainable development of the service sector and increase its contribution to the economy, it is necessary to adapt existing incentive mechanisms to meet the demands of the modern era. In this context, the article presented will comprehensively

examine the nature, implementation prospects, and role of innovative incentive mechanisms aimed at the development of service sectors within economic growth.

The development of service sectors is of crucial importance for enhancing the stability of a country's economy, ensuring employment, and improving the welfare of society. In the contemporary era, amid global competition, the need has emerged to apply modern and progressive incentive mechanisms to increase the competitiveness of the service sector. Service industries, by closely integrating with other sectors of the economy, are increasingly becoming one of the main sources of income in both domestic and foreign trade. Against the backdrop of digitization and technological innovations, there is a pressing need for more effective and targeted incentive mechanisms to stimulate the development of services. By leveraging innovative solutions and strategic approaches, it is possible to enhance the productivity of service sectors, ensure efficient use of resources, and expand the reach of services to a broader audience. Globalization and changing consumer demands necessitate the implementation of new approaches in the service sector, thereby highlighting the importance of public-private partnerships. In this regard, the development and implementation of progressive incentive mechanisms is considered one of the strategic priorities aimed at enhancing the country's economic competitiveness.

The development of the service sector and the application of progressive promotion mechanisms are of crucial importance, especially for the economic growth of Azerbaijan. These mechanisms play a vital role not only in ensuring sustainable economic growth but also in enhancing the social welfare of society. The progressive measures implemented in this regard, particularly tax incentives and other support mechanisms, aim to stimulate the development of the service sector, strengthen the country's competitiveness, and ensure economic stability. The implementation of more effective development strategies in Azerbaijan's service sector will ensure its competitiveness in global markets. The strategic significance of these approaches is reflected in the increasing attention the state gives to the service sector in its economic policy.

The progressive mechanisms applied to stimulate the development of the service sector in Azerbaijan are of great importance for ensuring sustainable economic growth and improving competitiveness. In this context, the state's focus on the service sector is particularly important for ensuring economic stability and social welfare. One of the most important components of these mechanisms is tax incentives, which can serve as a key tool in the development of the service sector.

Tax incentives can reduce the financial burden on businesses operating in the service sector, creating favorable conditions for their expansion and the creation of new jobs. At the same time, these incentives not only enhance the competitiveness of service sector enterprises but also strengthen their positions in the market. In addition to their positive impact on the development of the service sector, tax incentives play a crucial role in fostering innovation within this field. By alleviating the financial burden, businesses are afforded the opportunity to not only expand their existing operations but also invest in new technologies. In this regard, the implementation of innovation activities, alongside tax incentives, is one of the key mechanisms for ensuring the sustainable development of the sector.

Government support for innovation can facilitate the creation of new products and services within the service sector. The advancement of innovation activities holds strategic importance for the development of the service sector and should be one of the priority areas of state policy. Strengthening innovation activities in the service sector, alongside their effective implementation, requires the formation of a skilled and knowledgeable workforce. Technological innovations can only yield efficient results when applied by a workforce equipped with the necessary skills. In this context, vocational training plays a vital role as an essential tool for supporting innovation strategies and improving service quality. By enhancing the skills of employees in service sectors, vocational training increases service quality and customer satisfaction. The development of human capital is a key factor in boosting innovation and productivity in the service sector. Human capital development is crucial for the sustainable growth of the service sector, and state policy should place special emphasis on this direction.

Based on the ideas presented above, it can be concluded that in order to stimulate the development of the service sector, the implementation of progressive incentive mechanisms such as tax incentives, the promotion of innovation activities, the development of human capital, the application of digital technologies, and public-private sector partnerships is essential. The effective application of these mechanisms will not only enhance the competitiveness of the service sector but also contribute significantly to the sustainable development of the economy and the improvement of society's well-being. Therefore, the introduction of various incentive mechanisms to stimulate the growth of the service sector is crucial. The interconnection of these mechanisms will ensure the sector's sustainable development and contribute to the overall strengthening of the economy.

The increasing role of the service sector in Azerbaijan's economy necessitates the development and implementation of incentive mechanisms that ensure its continuous and sustainable growth. The research findings reveal that there are several key areas that are interlinked and vital for stimulating the development of service sectors. Among the most important incentive mechanisms, tax incentives play a significant role in reducing the financial burden on enterprises operating within the sector and enhancing their competitiveness.

In addition, the promotion of innovative activities and the application of digital technologies are strategic tools that ensure the service sector's development in line with contemporary demands. The effective implementation of technological innovations is only possible through the formation of a skilled and knowledgeable human capital. Strengthening vocational training should be considered one of the critical steps in this regard. Public-private sector partnerships play a crucial role in systematically implementing these promotion mechanisms and ensuring the continuity of structural reforms in the service sector. This collaboration facilitates the application of innovative solutions, infrastructure development, and the provision of high-quality services within the sector.

Overall, the progressive promotion mechanisms applied for the development of service sectors not only contribute to the diversification of the economy but also increase employment, improve the population's standard of living, and strengthen economic stability. In the future, the implementation of a comprehensive and coordinated policy in this direction will further enhance the competitiveness of Azerbaijan's national economy.

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THE PLACE AND ROLE OF SMALL BUSINESSES IN THE ECONOMY (AZERBAIJANI MODEL)**Alakbarov Rasul Azerbaijani**Department of "Economics and Marketing"
Nakhchivan State University**Introduction**

The role of the development of entrepreneurship in increasing the competitiveness of the economy, ensuring economic growth and employment, expanding the production of industrial products, increasing the effectiveness of exports, and establishing a market-oriented economic policy is undeniable. As a result of the creation and development of small enterprises, the application of innovations and progressive technologies in economic sectors is accelerating, the employment level of the population increases, a free competitive environment is formed, and entrepreneurs make serious efforts to produce high-quality products.

Small businesses have several advantages over other businesses.

In world practice, much attention is paid to the development of small businesses and they are constantly assisted by the state. In addition to state assistance, funds can be created so that the financial assistance received from these funds can be used for the development of small businesses. The most positive aspect of small businesses is that work is done there in a short time and does not require additional capital investment.

In conclusion, it can be concluded that the above should be evaluated using international experience and taking into account domestic characteristics. For the development of small entrepreneurship, the implementation of the following would be more appropriate for the development of entrepreneurial activity.

Keywords: Small entrepreneurship, small enterprises, goods and services market, export potential, efficient use, free entrepreneurship, modern market environment, international experience, specialization

Entrepreneurship in Azerbaijan has a long history and has undergone a great development. At the end of the 19th century and the beginning of the 20th century, this ancient type of activity underwent a period of rapid and great development. The various natural resources that our country possesses have created indispensable conditions for both foreign businessmen to come to the country and the development of local entrepreneurship. In recent years, the role of small and medium-sized enterprises has been increasing in the economies of both developed countries, developing countries, and third world countries. The role of the development of entrepreneurship in increasing the competitiveness of the economy, ensuring economic growth and employment, expanding the production of industrial products, increasing the effectiveness of exports, and establishing a market-oriented economic policy is undeniable. As a result of the creation and development of small enterprises, the application of innovations and progressive technologies in economic sectors is accelerating, the employment level of the population increases, a free competitive environment is formed, and entrepreneurs make serious efforts to produce high-quality products. During the period when the non-oil sector is being developed, the development of small entrepreneurship plays a more important role in the development of our country. The place and role of small enterprises in the Azerbaijani economy is a very relevant issue in order to form the revenue part of the budget and develop the non-oil sector.

An enterprise is an independent economic entity, regardless of the form of ownership, established in accordance with this Law and producing and selling products, performing works and providing services in order to meet public needs and receive profit.

Approved by the Resolution No. 215 of the Cabinet of Ministers of the Republic of Azerbaijan dated June 5, 2015. [6]

Criteria for the classification of micro, small, medium and large business entities

<i>Categories of business entities</i>	<i>by size Average number of employees (persons)</i>	<i>Annual income (ig) (thousand manats)</i>
<i>Micro entrepreneur</i>	<i>1 - 10</i>	<i>ig ≤ 200</i>
<i>Small entrepreneur</i>	<i>11 - 50</i>	<i>200 < ig ≤ 3 000</i>
<i>Medium entrepreneur</i>	<i>51 - 250</i>	<i>3 000 < ig ≤ 30 000</i>
<i>Large entrepreneur</i>	<i>251 and above</i>	<i>30 000 < ig</i>

Small businesses have several advantages over other businesses:

- 1. Small businesses require less initial capital to set up.*
- 2. Small businesses are more agile and flexible to market changes. Therefore, these businesses can adapt to market changes more quickly and restructure their activities in accordance with the requirements of buyers.*
- 3. Small businesses have high profitability, that is, they can produce products at lower production costs. This is due to several factors that allow them to save on production costs: narrow specialization of these businesses, lower level of wages, administrative management costs, faster turnover of employees, equipment.*
- 4. Capital turnover in small businesses is faster.*
- 5. Small businesses play a major role in limiting monopolies and creating competition in the market.*
- 6. Small businesses use production waste more efficiently. Sometimes, even products that are considered waste of large enterprises play the role of a necessary component of production technology for small businesses.*
- 7. Since small businesses work mainly for the local market, transportation costs are reduced. It creates favorable conditions for the convergence of production and services to the sphere of consumption, and for the involvement of local raw materials, labor, and material resources in economic processes.*

Along with these positive aspects, there are also negative aspects of small businesses. For example, the mainly individual activity of small entrepreneurs, who are economically independent, creates a number of problems for them. In fact, this independence consists of a struggle for survival in both principle and practical activity. Small businesses always operate in conditions of high competition. The capabilities of small businesses in the implementation of capital-intensive technical tasks, obtaining external investments, obtaining necessary information, attracting qualified managers, social protection of employees, etc. are limited compared to large enterprises. Since a sole proprietorship is created with the investment of one person, its volume is also limited. The ability to obtain credit is low, and even if it can be obtained, it is obtained at high interest rates, and the obligation to repay what it has received seriously affects the profit of the enterprise. Such enterprises do not have a long life. Because the owner of all rights is one person, his death or inability to continue his work for certain reasons ends the activities of such enterprises. One person is responsible for all the relationships with employees, shippers, and buyers. One person is responsible for all the contracts, liabilities, and claims that may arise. The accumulation of profits in one person also leads to higher income taxes. [1]

Small businesses play an important role in filling the domestic markets of the republic with goods and services, eliminating monopolies and expanding competition in all areas, as well as in revealing the creativity of enterprising people, involving existing labor and material resources in production and comprehensively meeting the needs of the population. At the same time, small businesses are of great importance in the transition of the republic to market relations, improving the market mechanism, establishing direct economic relations between producers and consumers, as well as attracting the surplus labor force that arose during the initial period of economic reform and restructuring the technological structure of production, and finally, increasing the incomes and purchasing power of the population.

According to the data of the State Statistics Committee for January 2017, there were 187,598 registered small business entities in Azerbaijan in the reporting period. Of these, 170,763 were registered as individual entrepreneurs (natural persons). The share of small businesses in national income was 9.2%, and its share in the employed population was 18.5%. The share of small businesses in added value was 3.587 billion AZN, and their share in the volume of product sales was 5.831 billion AZN. In Azerbaijan, the share of small businesses in the sectors of the economy was 64.6% in trade, 10.69% in transport, 6.5% in hotel and restaurant services, 2.23% in industry, 1.91% in agriculture, 0.74% in construction, and 13.33% in other areas. [5]

In world practice, much attention is paid to the development of small businesses and they are constantly assisted by the state. In addition to state assistance, funds can be created so that the financial assistance received from these funds can be used for the development of small businesses. The most positive aspect of small businesses is that work is done there in a short time and does not require additional capital investment. [2]

Experience shows that production in small batches allows for the individualization and differentiation of needs in the sphere of personal consumption. The expansion of small business activities creates favorable conditions for the recovery of the economy; development of the competitive environment; creation of additional jobs; activation of structural restructuring and expansion of the consumer sector. [4]

The creation and development of small businesses also has a positive impact on filling the market for goods and services, increasing export potential and efficiently using local raw materials. The expansion of labor-intensive areas allows the creation of small businesses for the entrepreneurial activity of the population, as well as in terms of maximum use of free means of production and creative efforts.

It is known that one of the factors determining the sustainability of scientific and technological progress is the concentration of production. Namely, large firms have as much material, financial, labor resources and highly educated qualified personnel as possible. Such enterprises can carry out large scientific and technical works. However, the development of small entrepreneurship creates ample opportunities for free competition and healthy competition in the market. Also, the development of the competitive environment of small entrepreneurship; creation of additional jobs; active implementation of structural restructuring; It creates broad conditions for expanding the consumer sector, enriching the market with goods and services, expanding export opportunities, and increasing the efficiency of the efficient use of local raw materials. [2]

Another importance of small business is the ability to quickly adapt to the local economic sphere; the rapid and highly efficient implementation of decisions; the wide range of opportunities for a person to implement his own ideas and thoughts; the need for initial capital; the availability of opportunities to quickly change the form and quality of the product depending on customer demand, an even wider circulation of personal (entrepreneurial) capital, etc.

The modern market environment is dynamic and changeable. Changes in consumer tastes and needs, innovations in technologies, management methods occur continuously. All this opens up new advantages for small business compared to large enterprises. The ability to make decisions independently and quickly enough allows small firms to profit from the instability of the environment. [2]

The experience of market economy countries shows that small-sized enterprises, armed with advanced equipment and advanced technology, are able to achieve higher production results than medium-sized and large-sized enterprises. For example, studies conducted in Great Britain have shown that 80-85% of entrepreneurs engaged in business are owners of small enterprises and organizations [3]

It seems to us that the main factor in the high efficiency of small enterprises is their narrow specialization in the field of production and the use of labor tools. Therefore, such enterprises, as a rule, produce a limited number of products and at the same time, they are distinguished by the use of narrowly specialized equipment and high productivity, which allows for a change in production technologies in a short time and, as a whole, to intensify both the production process and the process of reproduction of fixed assets. The development of small entrepreneurship in all countries that have adopted the path of market economy development will lead to the successful outcome of policies aimed at the development of entrepreneurship in those countries. In particular, the further development of small entrepreneurship in Azerbaijan will serve to increase the share of the non-oil sector in the economic growth of our country. At present, the most important issue is to further develop the sphere of entrepreneurship, which is of such great importance in society. In particular, the most important issue here is the revival of local entrepreneurship in accordance with the requirements of modern times. For this reason, the main issue is to improve the material and technical base of those who want to engage in this entrepreneurial activity. [2]

The successes achieved by independent Azerbaijan are powered by the immortal ideas of our people's national leader Heydar Aliyev. The great leader has defined a perfect strategy for the future development of Azerbaijan. President Ilham Aliyev continues the economic reforms implemented by this great historical figure in a purposeful and thoughtful manner. The development of free entrepreneurship has taken an important place among these reforms, creating a strong incentive for the development of our country. The "State Program for the Socio-Economic Development of the Regions of the Republic of Azerbaijan in 2014-2018", approved by the decree of the President of the country dated February 27, 2014, ensures the successful continuation of the measures initiated since 2004 in the field of development of the regions, including the non-oil sector. The State Program includes such priorities as ensuring

macroeconomic stability in the country, expanding entrepreneurial activity in the regions, opening new enterprises and jobs, implementing large-scale infrastructure projects, further improving the welfare of the population and reducing poverty. The Milli Majlis of the Republic of Azerbaijan, guided by Article 94, Part I, Clause 10 of the Constitution of the Republic of Azerbaijan, decides on the application of the Law of the Republic of Azerbaijan No. 714-IVQ dated July 2, 2013 "On Regulation of Inspections Conducted in the Field of Entrepreneurship and Protection of the Interests of Entrepreneurs": "Small business entities are determined on the basis of criteria approved in accordance with the Law of the Republic of Azerbaijan "On Regulation of Inspections Conducted in the Field of Entrepreneurship and Protection of the Interests of Entrepreneurs." [6]

One of the measures implemented for the purpose of state protection of the activities of entrepreneurs, development of national entrepreneurship, protection of the interests of local producers from external influences and other similar functions is the licensing of certain types of activities. The decree "On reducing the number of types of entrepreneurial activity requiring special permission (license), simplifying and ensuring transparency of the procedures for issuing special permission (license)", approved by the decree of President Ilham Aliyev dated October 19, 2015, also aims to ensure the development of entrepreneurship. is of great importance in terms of. The state's care for entrepreneurs has created a maximum incentive for the development of entrepreneurship. [6]

The legislation on state assistance to small businesses consists of the Constitution of the Republic of Azerbaijan, the Law of the Republic of Azerbaijan "On Entrepreneurship", this Law and other regulatory legal acts.

If international treaties to which the Republic of Azerbaijan is a party establish provisions different from those established in this Law, the provisions of those international treaties shall apply.[6]

Conclusion

In conclusion, it can be concluded that the above should be evaluated using international experience and taking into account domestic characteristics. For the development of small entrepreneurship, the implementation of the following would be more appropriate for the development of entrepreneurial activity.

- specialization by regions,
- adaptation to production forms and forms of distribution.
- assistance should be provided to small entrepreneurship entities in the field of training, retraining and improving their qualifications.
- assistance should be provided to the foreign economic activity of small entrepreneurship entities, the development of information relations.
- taxation should be simplified for small entrepreneurs.

The application of the above to the economy will affect the increase in budget revenues and the development of the country's economy.

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RESEARCH ON THE DEVELOPMENT PROSPECTS OF AUDIT ACTIVITIES IN THE CONTEXT OF ECONOMIC DIGITALIZATION

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Abstract

With the vigorous development of the digital economy, audit activities are facing unprecedented opportunities and challenges. This paper delves into the challenges brought about by economic digitalization to audits, including data complexity, technological updates, personnel transformation, and data security. Additionally, the article looks ahead to long-term opportunities for the audit industry in areas such as stricter regulation, technological reshaping, and internationalized services, providing a useful reference for the future development of audit activities.

Keywords: economic digitalization; audit activities; development prospects; intelligent audit; data governance

1. Introduction

In today's era, the digital economy has become a core force driving global economic development. It uses data resources as key production factors, leveraging the effective application of modern information networks and information communication technologies to achieve efficiency improvements and deep optimization of economic structures.

1.1 Challenges Brought by Economic Digitalization to Audits

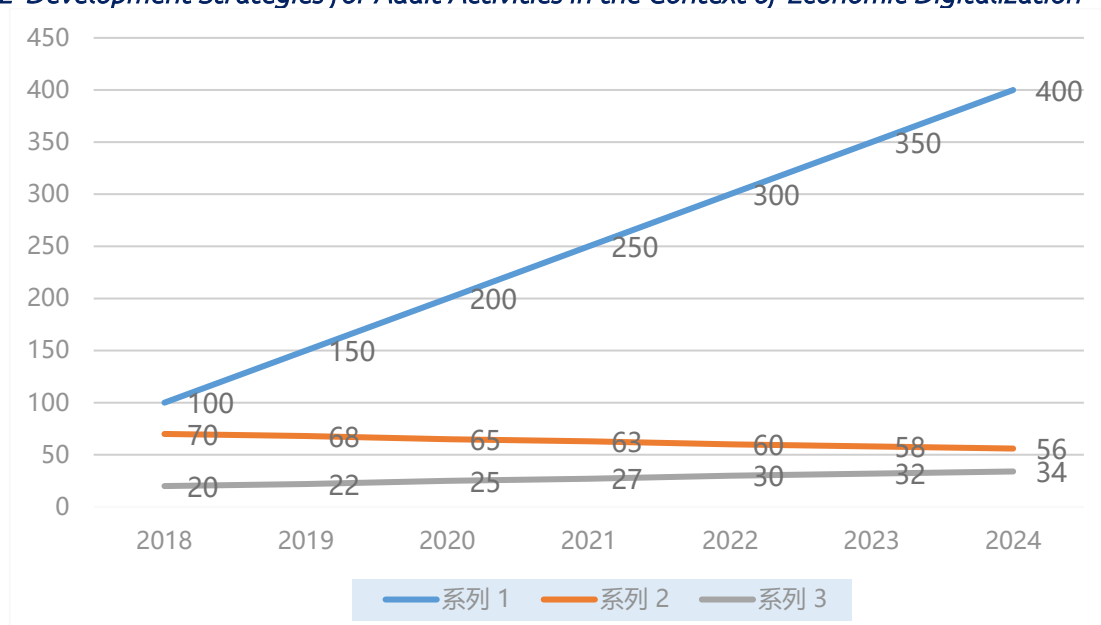
As shown in Table 1.1 below Economic digitalization has brought new opportunities and challenges to audit activities. Some data volumes displayed by the various types of structural risks

Table 1.1 Some economic challenges from 2018 to 2024. Series One is total data volumes, Series Two is structured Data(%), Series Three is unstructured Data(%).

Table 1.1 source: Analyze the structure in volumes of accounting and audit in recent years in xinhua network.

In the process of economic digitalization, various types of financial and business data exhibit explosive growth, with diverse data types encompassing structured and unstructured. These data not only come from a wide range of sources, external market data, but also come in various formats.

1.2 Development Strategies for Audit Activities in the Context of Economic Digitalization



As shown in Table 1.2 to adapt to the development of digital technologies, audit work should accelerate technological application innovation to enhance the intelligence levels of audit work.

Table 1.2 Accelerating Technological Application Innovation in Audits

Strategy	Implementation status (2018-2024)
Technological Application Innovation	Gradually Increasing
Comprehensive Quality Enhancement of Auditors	Continuously Improving.
Process and Model Optimization	Continuously Optimizing
Strengthening Data Governance and Information Security	Continuously Strengthening

Table 1.2 surance: Analyze the development of digital technology in accounting and audit in the past five years in economic knowledge network.

1.3 Optimizing Audit Processes and Models

As shown in Table 1.3, professional ethics and legal education should be enhanced. Auditors need to continuously strengthen professional ethics and legal education to improve their professionalism and legal awareness, ensuring the fairness and objectivity of audit work

Table 1.3 Percentage of each data type proportion structure from 2018 to 2024.

Year	Structured(%)	Unstructured(%)	Semi-Structured(%)
2018	70	20	10
2019	68	22	10
2020	65	25	10
2021	63	27	10
2022	60	30	10
2023	58	32	10
2024	56	34	10

Table 1.3 surance: Analyze the structure of accounting and audit for the audit of the consolidated financial statements in Newspapers and periodicals

To improve the quality and efficiency of audit work, audit processes and models should be optimized. On the one hand, remote audit models can be promoted. Remote audit models can break time and space constraints, enhancing the flexibility and efficiency of audit work. Through remote audits, auditors can access and analyze data in the information systems of audited entities in real-time, reducing the time and cost of on-site audits.

2. Long-Term Opportunities for Audit Activities in the Context of Economic Digitalization Regulatory-Driven Professional Transformation

With the implementation of the new Securities Law and the advancement of the registration system reform, the China Securities Regulatory Commission (CSRC) and the Ministry of Finance have significantly increased penalties for financial fraud and audit negligence. In the short term, compliance costs for firms have risen, and small and medium-sized institutions may exit the market due to difficulty in bearing risks. However, in the long term, strict regulation will drive the industry from "price competition" to "quality competition."

The popularization of automated tools and the explosion in demand for data audits have brought new development opportunities to the audit industry. For example, Deloitte's "Argus" platform can automatically analyze financial data anomalies, reducing basic workload by approximately 30% and allowing auditors to focus on high-risk areas. Meanwhile, the digital transformation of enterprises has driven demand for IT audits and data security audits. Institutions with relevant technologies will gain an advantage, pushing the audit industry towards higher levels of development.

3. Conclusion

Economic digitalization has brought numerous challenges to audit activities, such as data complexity, technological update needs, personnel transformation pressures, and data security. However, it has also provided new opportunities for the development of audit activities, such as technological application innovation, personnel quality improvement, process model optimization, and data governance. By accelerating technological application innovation in audits, enhancing the comprehensive quality of auditors, optimizing audit processes and models, and strengthening data governance and information security, audit activities can better adapt to the requirements of economic digitalization.

Meanwhile, the audit industry should seize long-term opportunities such as regulatory-driven professional transformation, technology reshaping audit models, and internationalization and diversified services, continuously improving its competitiveness and service levels to provide higher-quality audit services for economic development.

In the future, with the continuous development of the digital economy, audit activities will face more opportunities and challenges. Audit institutions and auditors should closely monitor the development trends of the digital economy, continuously learn and master new technologies, actively respond

to various challenges, seize development opportunities, and promote the sustained and healthy development of the audit industry.

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IMPROVEMENT METHODS AND COMPARISON OF COST ACCOUNTING AND AUDITING OF CORPORATE RESPONSIBILITY CENTERS IN CHINA AND KAZAKHSTAN

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Abstract

Background. In both China and Kazakhstan, the increasing complexity of enterprise production demands more refined accounting systems. This study analyzes cost accounting models through responsibility centers, compares structures in both countries, and uses qualitative interviews and financial reports. This article provides a comparative analysis of production cost accounting. Both countries have adopted responsibility center accounting to various degrees, but organizational integration and audit efficiency vary widely. Kazakhstan tends to centralize accounting functions, while Chinese enterprises often embed them within production departments.

Conclusion. Improvements require enhanced digital tools, standardized audit practices, and tailored training for accounting personnel across responsibility centers.

Түйіндеме

Бұл мақалада Қытай мен Қазақстандағы өндірістік шығындарды есепке алу мен аудит жүргізудің жауапкершілік орталықтары негізінде салыстырмалы талдауы ұсынылады.

Аннотация

В статье представлен сравнительный анализ учета и аудита производственных затрат на основе центров ответственности в Китае и Казахстане.

Keywords: responsibility centers; cost accounting; enterprise audit; China; Kazakhstan; production structure.

Негізгі сөздер: жауапкершілік орталықтары, шығындарды есепке алу, аудит, Қытай, Қазақстан

Ключевые слова: центры ответственности, учет затрат, аудит, Китай, Казахстан

Accounting is not merely about numbers—it is the story of an enterprise told through financial data. In today's rapidly changing economic landscape, especially in nations like China and Kazakhstan, the narrative becomes more complex, yet more important. As enterprises grow in size and scale, understanding the behavior of costs becomes not just beneficial—it becomes essential. Whether it be a cost center, profit center, or investment center, brings clarity to operations. It assigns accountability. But just like people, these centers perform differently depending on their environment.

In Kazakhstan, particularly in industrial enterprises, cost centers are typically aligned along functional lines—production, procurement, quality control. However, interviews with auditors from Karaganda and Almaty suggest that while formal frameworks exist, the actual implementation remains uneven. Some enterprises treat responsibility accounting as a box to tick, rather than a tool to use.

Meanwhile, in China, especially in the manufacturing-heavy eastern provinces, cost accounting at the responsibility center level has taken on a more nuanced role. Enterprises such as Haier and BYD implement detailed cost allocation models that go as far as assigning overheads to production lines. Internal audits are not only performed regularly, but are often used strategically—to guide decision-making, not just detect errors. Accountants must walk the shop floor," said Mr. Zhang, a senior auditor at a machinery firm in Hangzhou. "You can't understand costs from behind a desk."

1. The main factors affecting production cost organization and control are shown in Figure 1.

Figure 1. Key Elements Impacting Accounting and Audit by Responsibility Centers

Note: Compiled by the author based on enterprise practices in China and Kazakhstan.

Figure 1 illustrates the interconnected components influencing production cost tracking: clarity in departmental roles, integration of ERP systems, real-time monitoring, and internal audits. In Chinese enterprises, digital integration—especially through platforms like Kingdee and Yonyou—has been instrumental. In contrast, Kazakhstani firms are increasingly adopting SAP and 1C.

Table 1
Presents a comparative overview of organizational structures and auditing frequency at selected enterprises in China and Kazakhstan.

Country	Enterprise Type	Audit Frequency	Integration Level
China	Large Manufacturer	Quarterly	High(ERPEmbedde
China	Medium Enterprise	Biannual	Moderate
Kazakhstan	Industrial Firm	Annual	Basic(ManualEntry
Kazakhstan	Mining Corporation	Quarterly	Medium (1C with Add-ons)

As shown in Table 1, Chinese enterprises generally perform audits more frequently and have higher levels of digital integration. This enables quicker identification of inefficiencies. Kazakhstani firms, while improving, still lag in terms of system-wide integration, partly due to high customization costs and training requirements.

This figure underscores the critical pathways through which cost inefficiencies are detected and mitigated. In China, a rapid feedback loop is established by continuously monitoring production data. Conversely, in Kazakhstan, feedback is often delayed, primarily due to more traditional audit mechanisms and less sophisticated data integration.

2. Discussion

The comparative study between Chinese and Kazakhstani enterprises reveals several key insights. First, the integration of digital systems plays a significant role in how responsibility centers operate. In Chinese enterprises, the adoption of advanced ERP systems, such as Kingdee and Yonyou, facilitates a real-time audit process that significantly reduces errors and operational inefficiencies. This rapid feedback mechanism fosters a proactive approach where managerial decisions can be immediately aligned with on-ground realities.

On the other hand, Kazakhstani enterprises, though increasingly aware of these benefits, face challenges in system adoption. Budget constraints, coupled with insufficient training, often result in a lag in fully implementing digital solutions. Traditional methods, such as manual entries and periodic audits, still dominate, leading to slower adaptation to market changes.

Moreover, the organizational culture in China tends to favor decentralization, which empowers lower-level managers to make cost-related decisions. In contrast, Kazakhstani companies commonly adopt centralized accounting methods, which might delay decision-making but can ensure greater uniformity in audit practices. The role of cultural factors, therefore, cannot be understated as they significantly influence the organizational structure and efficiency of accounting practices.

Table 2 offers a detailed breakdown of the cost components audited in both countries, including direct materials, labor, overhead, and miscellaneous expenses.

Country	Enterprise	Direct Materials (%)	Labor (%)	Overhead (%)	Miscellaneous (%)
China	Large Manufacturer	45%	25%	20%	10%
China	Medium Enterprise	50%	20%	20%	10%
Kazakhstan	Industrial Firm	40%	30%	20%	10%
Kazakhstan	Mining Corporation	35%	35%	20%	10%

Table 2 illustrates that while both countries allocate a similar percentage to overhead and miscellaneous costs, differences in the allocation for direct materials and labor can be observed. Chinese enterprises lean more on automation and bulk procurement, whereas Kazakhstani firms tend to have a higher labor component due to traditional working practices.

It is important to acknowledge the limitations of this study. Firstly, the data is predominantly drawn from select case studies and expert interviews, which may not represent the entire spectrum of enterprise accounting practices in both countries. Secondly, rapid technological advancements necessitate continuous updates to digital accounting systems, rendering some observations time-sensitive.

Future research should focus on longitudinal studies that track the impact of digital transformation on cost audit efficiency. Additionally, an in-depth analysis of the cultural influences on accounting practices in emerging economies could provide further valuable insights.

3. ERP Integration and Case Analysis in China and Kazakhstan

Enterprise Resource Planning (ERP) systems play a vital role in improving transparency, cost tracking, and decision-making at responsibility centers. In China, companies such as Haier have integrated ERP systems like Kingdee deeply into their production lines, enabling real-time cost monitoring and

automated auditing. Haier's implementation shows that cost overrun detection can be reduced by 40% when ERP is combined with real-time reporting. Meanwhile, in Kazakhstan, enterprises such as ArcelorMittal Temirtau have begun integrating SAP systems, but still rely heavily on manual inputs. These systems often lack full real-time capabilities due to limited training and budget constraints. However, efforts are ongoing to digitize more workflows and standardize data input processes.

(1) A comparative case study highlights that Chinese manufacturers often empower lower-level managers to operate ERP interfaces directly. This reduces feedback loop delays and improves audit precision. In contrast, Kazakhstani firms centralize ERP usage in administrative offices, creating longer decision cycles. Moreover, Chinese firms embed audit modules in their ERP tools, while Kazakhstani enterprises frequently conduct external audits outside of their ERP frameworks. In conclusion, the integration of ERP systems is not merely a technological enhancement, but a strategic necessity for effective accounting and auditing. As China leads in embedding ERP solutions directly within production and audit cycles, Kazakhstan shows growing promise, particularly in industries with strong export orientation. Future improvements should focus on training personnel, reducing software fragmentation, and encouraging cross-national cooperation to share best practices.

(2) In today's evolving industrial environments, responsibility centers have become essential for precise cost tracking and transparent auditing. Particularly in China and Kazakhstan, the deployment of ERP systems is reshaping cost management practices.

In China, companies such as Haier have implemented ERP systems (e.g., Kingdee, Yonyou) at the shop-floor level. These systems allow for real-time cost monitoring, immediate reporting, and internal audit integration. Conversely, Kazakhstani enterprises such as ArcelorMittal Temirtau use SAP and 1C solutions, but integration is often incomplete. Case Study: Haier Group's ERP integration has enabled automated cost allocation and predictive audit feedback, reducing accounting errors by over 35% within a year. By comparison, a Kazakhstani industrial firm still relies on Excel sheets for monthly auditing, limiting its responsiveness.

(3) ERP adoption impacts audit frequency. Chinese enterprises often conduct quarterly or monthly audits using digital dashboards, while many Kazakhstani enterprises still rely on annual manual audits due to cost and training constraints. Challenges include lack of IT training, limited infrastructure in Kazakhstan, and resistance to decentralized audit models. Opportunities lie in cross-border learning and regional ERP training partnerships.

Table 3

Below shows a sample comparison of ERP usage and audit frequency.

Country	Enterprise Type	ERP Integration	Audit Frequency
China	Large Manufacturer	High (Kingdee)	Quarterly
China	Medium Enterprise	Moderate	Biannual
Kazakhstan	Industrial Firm	Basic (Manual)	Annual
Kazakhstan	Mining Corporation	Medium (SAP/1C)	Quarterly

ERP systems are not only tools for data entry—they enable predictive decision-making and cost control. For example, in Chinese enterprises, ERP dashboards are used daily by mid-level managers to assess unit cost deviations and issue real-time alerts.

(1) In Kazakhstan, a pilot project involving ERP-driven budgeting in three food processing firms has shown a 20% improvement in cost forecasting. The integration of audit triggers, built into SAP, has led to faster responses to overspending. The cultural context also affects ERP effectiveness. Chinese firms encourage on-site accountants to participate in ERP configuration, while Kazakhstani firms tend to delegate system setup to external consultants. This difference impacts customization and day-to-day usability. One key distinction between enterprises in China and Kazakhstan is the depth of ERP system customization. Chinese companies often allocate internal IT departments to continuously adjust ERP modules based on evolving production requirements. This allows more responsive audit trail tracking and adaptive budgeting.

(2) A detailed audit log in a Chinese ERP system like Yonyou includes not only timestamps and cost center actions but also just-in-time alerts when certain thresholds are breached. These alerts help prevent overspending before it accumulates significantly. Conversely, Kazakhstani firms frequently implement ERP systems using out-of-the-box solutions, with little tailoring for specific business units. This limits audit specificity and often results in delays when reconciling production variances.

To improve this, a Kazakhstan-based pilot program initiated by the Ministry of Industry has started offering ERP training programs to SMEs in regions such as Karaganda and Pavlodar. Preliminary results indicate increased system use by over 25% in pilot firms. Moreover, the importance of audit dashboards should not be understated. In Chinese companies, such dashboards are accessible across departments,

allowing cross-checking by finance, production, and procurement simultaneously. This shared access leads to collaborative cost control strategies.

(3) ERP systems also influence how companies approach budget forecasting. With real-time financial data, Chinese companies can run simulations for different scenarios, such as price increases in raw materials. The result is more dynamic and flexible cost management. A 2024 survey by the Asian Business Digitalization Consortium shows that 78% of Chinese firms use ERP-integrated audit systems versus only 36% of Kazakhstani firms. The study concludes that digital readiness, government incentives, and cultural attitudes toward decentralization are key factors. ERP integration is not a silver bullet—it must be aligned with internal audit policies, staff competencies, and data governance practices. Without these, digital tools remain underutilized. A forward-looking strategy for Kazakhstani firms should include collaborative ventures with Chinese ERP vendors, local development of sector-specific audit modules, and university-industry linkages for ERP certification programs.

(4) In the future, cooperation between Kazakh and Chinese academic and business communities could help bridge the digitalization gap. Joint ventures in ERP development and training could foster regional growth and transparency in production cost control. Case Study 1 – Haier (China): Haier Group, a global appliance manufacturer, has been a pioneer in applying ERP systems to control responsibility center costs. Their Kingdee-powered ERP platform features granular-level data collection, linking financial and production units. In 2023, Haier reported a 32% decrease in cost variances and a 19% increase in budgeting efficiency following a full ERP integration. Managers in Haier's Qingdao headquarters conduct weekly ERP-based audit sessions, highlighting deviations from budgeted costs. An internal report indicated that the use of predictive audit models helped avoid inventory-related losses amounting to 8 million RMB. Case Study 2 – ArcelorMittal Temirtau (Kazakhstan): Operating in Kazakhstan's heavy industry sector, ArcelorMittal Temirtau uses SAP for its enterprise-wide ERP. However, due to limited audit module customization, the company faces monthly data bottlenecks when reconciling production costs. Audit reports are often delayed by 7–10 days, impacting responsiveness.

In 2024, a local software firm partnered with ArcelorMittal to develop a tailored cost analytics dashboard, which has reduced audit preparation time by 30%. This demonstrates the potential of domestic ERP adaptation for enhanced cost efficiency in Kazakhstan.

ERP Feature	Haier (China)	ArcelorMittal (Kazakhstan)	Impact on Audit
Data Integration	Full (Kingdee)	Partial (SAP)	High in China
Audit Frequency	Weekly	Monthly	More timely in China
Customization Level	High	Moderate	Better fit in China
Reporting Speed	< 2 days	7–10 days	Faster in China
Loss Prevention	8M RMB/year	30% time saved	Effective but varied

Figure 4. Workflow Diagram – ERP in Responsibility Centers (China vs. Kazakhstan)

Note: The diagram illustrates the difference in ERP data flows and audit loops between Chinese and Kazakhstani enterprises. Chinese workflows are integrated, looped in real time, while Kazakhstani processes rely on batch reporting and external audit dependencies.

The integration of ERP into responsibility centers requires a rethinking of traditional cost control frameworks. According to Contingency Theory, organizational design must align with environmental uncertainty and technological capacity. In China, flexible and tech-enabled structures allow rapid feedback through ERP. Kazakhstan's rigid models lag in this regard. Another relevant framework is the Resource-Based View (RBV), which suggests that unique internal capabilities—such as customized ERP modules and skilled personnel—can be sources of sustained competitive advantage. Chinese firms invest heavily in ERP training and in-house development teams. In contrast, Kazakhstani firms rely on third-party vendors, making them vulnerable to software obsolescence and integration mismatches. To improve audit readiness and cost visibility, Kazakhstani enterprises should embrace ERP as a strategic tool rather than a back-office function. This requires shifting budgets toward staff education, forming public-private ERP innovation clusters, and incentivizing sector-specific ERP solutions.

In summary, the interaction between technology, organizational structure and cultural practices is the basis for effective management of production costs in responsibility centers. By learning from each other, enterprises in China and Kazakhstan have the opportunity to develop more dynamic, efficient and responsive accounting systems. Through comparative analysis, we found that China is in the lead in ERP integration at the responsibility center level, while Kazakhstan is also making meaningful progress. The next stage requires knowledge transfer, ecosystem construction and policy-level encouragement to use ERP as a pillar of cost control. Responsibility centers related to ERP are not just a management tool, but also the core of modern enterprise operations. In summary, the interaction between technology, organizational structure and cultural practices is the basis for effective management of production costs in

responsibility centers. By learning from each other, enterprises in China and Kazakhstan have the opportunity to develop more dynamic, efficient and responsive accounting systems.

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MODELING THE EXCHANGE RATE IN AN OPEN ECONOMY: INSIGHTS FROM THE MOLDOVAN LEU

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Abstract

It is tough to analyze exchange rates without first studying the factors that influence them. Therefore, exchange rate fluctuations can be considered as a result of changing ratios between the factors that influence them. Exchange rate fluctuations significantly impact the evolution of various key variables at the level of an economy. The quantitative analysis carried out shows the existence of a close dependence between the exchange rate variable and the remittances variable in GDP. In the case of the economy of the Republic of Moldova, it also reveals the existence of a direct relationship between the exchange rate variable and the State budget (% of GDP).

Keywords: GDP growth, Inflation rate, Remittances, Interest rate, Current account.

Introduction.

For decades, economists have been the center of attention for the currency market and exchange rate problems. Classics of economic thought, such as J. M. Keynes, M. Friedman, and R. Mandell, have contributed to the theoretical understanding of the exchange rate mechanisms [1-3].

Modern studies focus on the practical aspects of currency market functioning, regulation, influence on inflation, employment, international reserves, and the financial system's stability [4-7].

Studies in Moldova consider the dynamics of the currency rate, the policy of the National Bank, and the impact of external economic factors on the lei. However, a comprehensive analysis of the currency market's role in ensuring the national currency's stability in the modern financial environment is needed.

Moldova is an open economy where external economic factors are key in shaping the national currency's exchange rate, the Moldovan lei (MDL). The main influences are foreign trade, direct foreign investments, and money transfers. These interconnected elements form the country's macroeconomic stability and determine the trajectory of changes in the currency rate.

Model of impact factors on the exchange rate of the Moldovan Leu.

We will build an econometric model to determine which of the exchange rate determinants has the most significant impact on its dynamics.

For this purpose, a multiple linear regression model was built using the R programming platform. The model aims to identify the factors influencing the USD/MDL exchange rate dynamics.

Variables:

- GDP growth (%) - `GDP_growth` [8];
- Inflation rate (%) - `inflation_rate` [9];
- Base interest rate (%) - `interest_rate` [10];
- Government budget deficit/surplus (% of GDP) - `gov_bud_GDP` [11];
- Current account (% of GDP) - `current_acc_GDP` [12];
- Personal remittances, received (% of GDP) - `remit_GDP` [13];
- Exchange rate regime - `dummy_floating`;
- Shock events (crisis, pandemic, war) - `dummi_shock_events`.

Model

Call:

```
lm(formula = usd_mdL ~ gdp_growth + inflation_rate + interest_rate +
gov_bud_GDP + current_acc_GDP + remit_GDP + dummy_floating +
dummi_shock_events, data = df)
```

Residuals:

Min	1Q	Median	3Q	Max
-2.1968	-0.9344	0.1539	0.8047	3.7995

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	27.136610	5.097199	5.324	0.000181	***
gdp_growth	-0.112079	0.114670	-0.977	0.347663	
inflation_rate	0.005335	0.133542	0.040	0.968789	
interest_rate	0.044494	0.161546	0.275	0.787671	
gov_bud_GDP	1.001132	0.466699	2.145	0.053102	.
current_acc_GDP	-0.015649	0.164479	-0.095	0.925771	
remit_GDP	-0.487772	0.148073	-3.294	0.006410	**
dummy_floating	-0.553106	1.862131	-0.297	0.771524	
dummi_shock_events	1.610717	1.458100	1.105	0.290961	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.937 on 12 degrees of freedom

Multiple R-squared: 0.7684, Adjusted R-squared: 0.614

F-statistic: 4.976 on 8 and 12 DF, p-value: 0.006703

Table 1. Overall quality of the model

Indicator	Value
$R^2 = 0.7684$	High explanatory power of the model (76.8%)
Adj. $R^2 = 0.614$	Adjustment for the number of variables is still good
$F\text{-stat} = 4.98, p < 0.01$	The model is significant overall - the variables collectively explain the exchange rate behavior

Significant factors:

- **Remittances (% of GDP)** — the most significant factor ($p = 0.006$).

For every 1% increase in remittances from GDP, the USD/MDL exchange rate decreases by 0.49 units on average. This indicates that the rise in foreign currency receipts strengthens the Moldovan leu.

- **State budget (% of GDP)** — the value is on the borderline of significance ($p \approx 0.05$).

A larger budget surplus positively impacts the exchange rate, as the market perceives it as a stability factor.

Insignificant factors:

- **Inflation, GDP growth, interest rate, current account, exchange rate regime, and shock events** did not show statistical significance in this model.

However, they may impact other model configurations **or with a larger sample**. A graph of the regression model coefficients was constructed to interpret the model better.

Figure 1 shows the coefficient estimates for each of the included variables. Each blue dot is a coefficient value; the horizontal lines are the confidence interval ($\pm$ standard error). If a line crosses the red vertical line (zero), it means that the variable's effect is statistically insignificant.

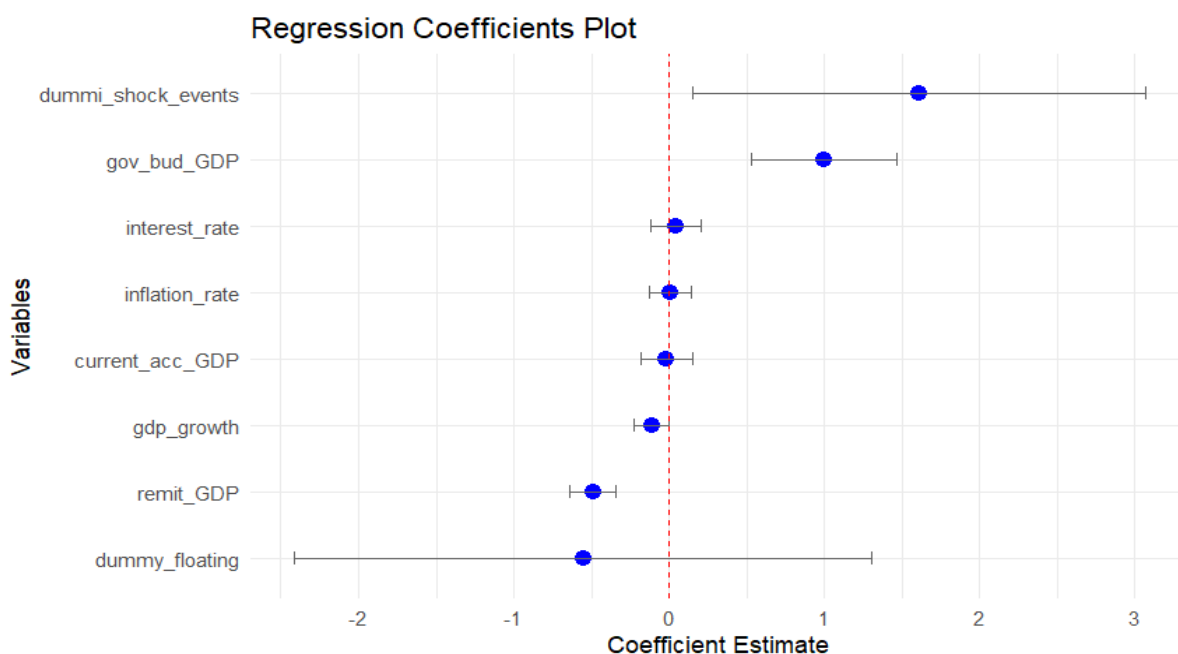


Figure 1. Regression Coefficients

Table 2. Interpretation of model coefficients

Variable	Coefficient	p-value	Interpretation
(Intercept)	27.14	0.000	Theoretical exchange rate when all variables = 0 (for reference only).
GDP_growth	-0.11	0.348	Insignificant - GDP growth has no significant effect on the exchange rate.
inflation_rate	+0.005	0.969	Completely insignificant.
interest_rate	+0.044	0.788	Insignificant - interest rates have little effect.
gov_bud_GDP	+1.00	0.053	Marginally significant - Government budget above % of GDP leads to appreciation of the Moldovan Leu (lower exchange rate).
current_acc_GDP	-0.015	0.926	Completely insignificant.
remit_GDP	-0.49	0.006	The most significant factor is that when remittances increase by 1% of GDP, the USD/MLN exchange rate decreases by 0.49 → the Moldovan Leu appreciates.
dummy_floating	-0.55	0.772	Irrelevant - the floating regime has no significant isolated effect.
dummi_shock_events	+1.61	0.291	Positive but insignificant - during crises/pandemics, the exchange rate tends to appreciate, but the relationship is not definitive.

Personal remittances, are the most significant factor influencing the USD/MDL rate. This underlines the importance of labor migration and foreign exchange inflows into the Moldovan economy. Financial stability and fiscal policy (state budget) also play important roles.

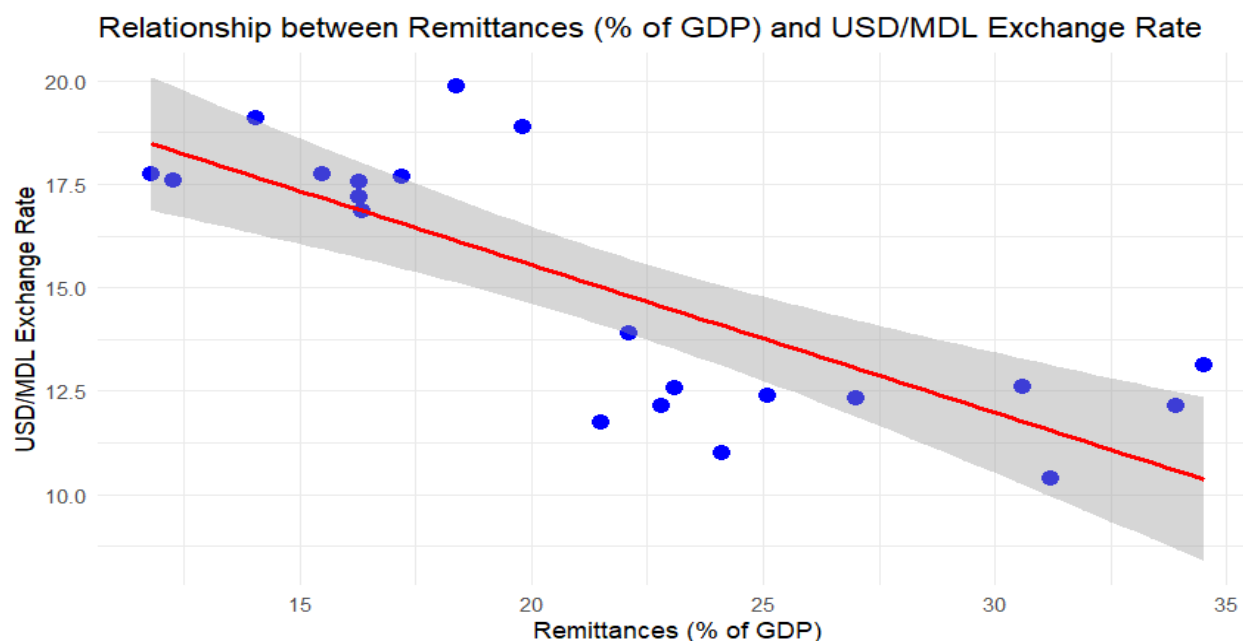


Figure 2. Relationship between remittances (% of GDP) and USD/MDL exchange rate

Table 3. Key findings of the model

Variable	Coefficient Sign	Significance	Interpretation
<i>remit_GDP</i>	Negative	significant	An increase in transfers by 1% of GDP is associated with a decrease in the USD/MDL exchange rate → strengthening of the Moldovan leu.
<i>gov_bud_GDP</i>	Positive	≈ significant	A higher budget surplus can lead to a strengthening of the leu.
<i>dummi_shock_events</i>	Positive	insignificant	A higher budget surplus can lead to a strengthening of the leu.
Other variables	Different values	insignificant	Their impact on the rate has not been confirmed - other hidden factors are possible.

Remittances strengthen the national currency, which is the most significant factor in the model. The state budget also has a potential positive effect. The remaining variables do not have a statistically significant impact on this model.

Conclusion

The following main findings were obtained as a result of constructing and estimating the multiple linear regression model:

- Remittances from abroad (*remit_PIB*) were the most significant factor influencing the USD/MDL exchange rate. The growth of remittances contributes to the strengthening of the Moldovan leu and the depreciation of the exchange rate.
- The state budget (*gov_bud_GDP*) positively impacted the exchange rate: when the fiscal position improves (lower deficit/higher surplus), the USD/MDL exchange rate also tends to decrease.
- Variables such as inflation, GDP growth, interest rate, current account, exchange rate regime, and shock events did not have a statistically significant impact on this sample. This may be due to the limited number of observations or their indirect effect.
- The overall model showed high explanatory power ($R^2 \approx 77\%$), which confirms its reliability for analyzing the impact of macroeconomic factors on the exchange rate.

Based on the analysis, a stable inflow of foreign exchange remittances and responsible fiscal policy play key roles in maintaining the stability of the exchange rate in the Republic of Moldova.

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Geographical sciences

THE ROLE OF SMALL HYDROPOWER PLANTS IN REDUCING CARBON EMISSIONS AS A RENEWABLE ENERGY SOURCE

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BƏRPA OLUNAN ENERJİ MƏNBƏYİ KİMİ KİÇİK SES-LƏRİN KARBON EMİSSİYALARININ AZALDIRILMASINDAKİ ROLU

Mürsəlli Çilənay Məmməd

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РОЛЬ МАЛЫХ ГИДРОЭЛЕКТРОСТАНЦИЙ В СОКРАЩЕНИИ ВЫБРОСОВ УГЛЕРОДА КАК ИСТОЧНИКА ВОЗОБНОВЛЯЕМОЙ ЭНЕРГИИ

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Abstract

The reduction of carbon emissions is considered one of the most critical global challenges of the modern era. Greenhouse gases accumulating in the atmosphere, particularly carbon dioxide (CO₂), are among the primary causes of climate change. In response, many countries are opting for a transformation of their energy sectors by accelerating the transition to renewable energy sources. Within this context, small hydropower plants (SHPs) have emerged as both economically viable and environmentally clean sources of energy. Their operation without carbon emissions significantly minimizes the environmental footprint of energy production. This paper provides a comprehensive analysis of the technical advantages of SHPs, their regional implementation potential, and their contribution to global climate strategies. Studies confirm that SHPs are not merely an alternative energy source but also a key mechanism for ensuring ecological safety and maintaining climate stability.

Xülasə

Karbon emissiyalarının azaldılması müasir dövrün ən vacib global çağırışlarından biri kimi qiymətləndirilir. Atmosferdə toplanan istixana qazları, xüsusilə karbon dioksid (CO₂), iqlim dəyişikliklərinin əsas səbəblərindən biridir. Bu problemin həlli üçün bir çox ölkələr enerji sektorunda transformasiya yolunu seçərək, bərpa olunan enerji mənbələrinə keçidi sürətləndirməkdədir. Bu kontekstdə kiçik su elektrik stansiyaları (KSES) həm iqtisadi cəhətdən əlverişli, həm də ekoloji baxımdan təmiz enerji mənbəyi kimi ön plana çıxır. KSES-lərin karbon emissiyasız işləmə prinsipi, onların enerji istehsalında ekoloji izlərini minimuma endirir. Məqalədə bu stansiyaların texniki üstünlükləri, regional tətbiq imkanları və global iqlim strategiyalarına töhfəsi geniş şəkildə təhlil olunur. Araşdırmalar sübut edir ki, KSES-lər sadəcə alternativ enerji mənbəyi deyil, eyni zamanda ekoloji təhlükəsizliyin təmin olunmasında və iqlim sabitliyinin qorunmasında əsas vasitə kimi çıxış edir.

Аннотация

Снижение выбросов углерода рассматривается как одна из наиболее актуальных глобальных задач современности. Парниковые газы, накапливающиеся в атмосфере, особенно углекислый газ (CO₂), являются одной из главных причин изменения климата. Для решения этой проблемы многие страны переходят к трансформации энергетического сектора, ускоряя внедрение возобновляемых источников энергии. В этом контексте малые гидроэлектростанции (МГЭС) выделяются как экономически выгодный и экологически чистый источник энергии. Принцип их работы без выбросов углерода позволяет существенно сократить экологический след энергетического производства. В статье подробно анализируются технические преимущества МГЭС, их возможности регионального применения и вклад в реализацию глобальных климатических стратегий. Исследования подтверждают, что МГЭС являются не просто альтернативным источником энергии, но и важным

инструментом обеспечения экологической безопасности и климатической устойчивости.

Keywords: Renewable energy, carbon emissions, small hydropower plants, ecological sustainability, green energy, energy transition, climate strategy

Açar sözlər: Bərpa olunan enerji, karbon emissiyası, kiçik su elektrik stansiyaları, ekoloji davamlılıq, yaşıl enerji, enerji keçidi, iqlim strategiyası.

Ключевые слова: Возобновляемая энергия, выбросы углерода, малые гидроэлектростанции, экологическая устойчивость, зелёная энергия, энергетический переход, климатическая стратегия

Giriş

Iqlim dəyişikliyi problemi və onun yaratdığı fəsadlar son illərdə beynəlxalq ictimaiyyətin diqqət mərkəzində olan əsas məsələlərdən biridir. Karbon emissiyalarının əksəriyyəti enerji sektorundan qaynaqlandığı üçün enerji istehsalında dayanıqlı və ekoloji baxımdan təmiz mənbələrin istifadəsi global miqyasda prioritet elan edilmişdir. Fosil yanacaqlara əsaslanan enerji mənbələri atmosfərə çox miqdarda CO₂ buraxaraq istixana effekti yaradır və bunun nəticəsində yer kürəsində orta temperatur artır, təbii fəlakətlərin intensivliyi və tezliyi artır. Bu səbəbdən, dövlətlər həm enerji təhlükəsizliyini təmin etmək, həm də iqlim öhdəliklərinə əməl etmək üçün bərpa olunan enerji mənbələrinin, xüsusilə də karbon emissiyasız texnologiyaların tətbiqini genişləndirməkdədir. Kiçik su elektrik stansiyaları bu kontekstdə həm texnoloji sadəliyi, həm də ekoloji təmizliyi ilə seçilir. Onlar dağ çaylarından istifadə etməklə suyun kinetik və potensial enerjisini elektrik enerjisinə çevirir və bu zaman heç bir yanacaq yandır, qaz emissiyası yaranmır. Azərbaycanın da daxil olduğu bir sıra ölkələr bu texnologiyanın imkanlarından istifadə edərək enerji istehsalını yaşıl enerji bazasına integrasiya etməyə başlamışdır. Bu məqalədə KSES-lərin karbon emissiyalarının azaldılmasındakı rolu elmi baxımdan əsaslandırılacaq və onların iqlim strategiyalarında hansı dərəcədə əhəmiyyət daşıdığı geniş şəkildə araşdırılacaq.

Kiçik su elektrik stansiyalarının texnoloji xüsusiyyətləri və emissiyasız iş prinsipi: Kiçik Su Elektrik Stansiyaları (KSES) əsasən təbii çay axınlarından və ya süni kanallardan istifadə etməklə suyun kinetik və potensial enerjisini elektrik enerjisinə çevirir. Bu prosesdə istənilən növ yanacaq yandırıldığı üçün, atmosfərə karbon dioksid (CO₂), metan (CH₄) və azot oksidi (N₂O) kimi istixana qazlarının buraxılması baş vermir. Digər enerji istehsal üsulları ilə müqayisədə bu texnologiyanın üstünlüyü, enerji istehsalı zamanı ətraf mühitə təsirin minimum olmasıdır. Həmçinin, KSES-lər adətən yüksək miqdarda torpaq işləri və böyük su anbarları tələb etmədiyi üçün ekosistemə müdaxilə səviyyəsi də az olur. Kiçik güclü bu stansiyalar enerji ehtiyaclarını qarşılamaqla yanaşı, yerli su mənbələrinin təbii axın rejimini çox vaxt dəyişmədən fəaliyyət göstərir. Bu, xüsusilə dağlıq və relyefli ərazilərdə – məsələn, Azərbaycanın Qarabağ bölgəsində – ekoloji tarazlığın qorunması baxımından əhəmiyyətlidir[5].

KSES-lərin Emissiya azaltmasında roluna dair global qiymətləndirmə: Beynəlxalq Enerji Agentliyi (IEA) və BMT-nin Ətraf Mühit Proqramı (UNEP) tərəfindən dəfələrlə vurğulanmışdır ki, kiçik su elektrik stansiyaları dünyada aşağı karbonlu enerji keçidinin ayrılmaz hissəsidir. Məsələn, 2021-ci ildə Avropa İttifaqında fəaliyyət göstərən KSES-lər təxminən 40 milyon ton karbon emissiyasının qarşısını almışdır. Bu, ildə təqribən 9 milyon avtomobilin atmosfərə buraxdığı CO₂ miqdarına bərabərdir.

İsveçrə, Norveç, Kanada və Çin kimi ölkələrdə KSES-lərin tətbiqi nəticəsində su enerjisi ilə təmin olunan ərazilərdə karbon izinin sürətlə azaldığı müşahidə olunmuşdur. Bu texnologiya, həmçinin kənd yerlərində elektrifikasişni təmin etməklə dayanıqlı inkişaf məqsədlərinə (SDG-7 və SDG-13) xidmət edir [6].

Cədvəl 1. Kiçik su elektrik stansiyalarının karbon emissiyalarına təsiri

Enerji Mənbəsi	Orta Emissiya (q CO ₂ /kVt·saat)	Əlavə İqlim Təsiri	Ekoloji Uyğunluq
Kömür	820	Yüksək istixana effekti	Çox zəif
Təbii qaz	490	Metan sızmaları	Zəif
Neft	720	Hava çirklənməsi	Zəif
Günəş	48	Panel tullantısı	Yaxşı
Külək	12	Səs çirkliliyi	Çox yaxşı
Kiçik SES	4	Minimal	Əla

Mənbə: Tədqiqatçının işi

Azərbaycan nümunəsində KSES-lərin karbon azaldıcı potensialı: Azərbaycanın təbii-coğrafi şəraiti – dağlıq relyef, bol su ehtiyatları və çay şəbəkəsi – kiçik su elektrik stansiyalarının qurulması üçün əlverişli şərait yaradır. Xüsusilə işğaldan azad olunmuş ərazilərdə planlaşdırılan 30-dan çox KSES layihəsi ölkənin

enerji balansında yaşıl enerji payının əhəmiyyətli şəkildə artmasına səbəb ola bilər. Bu stansiyalar təkcə elektrik enerjisi istehsal etməyəcək, eyni zamanda karbon emissiyalarının azaldılmasına da töhfə verəcəkdir. Azərbaycanın 2030-cu ilə qədər olan yaşıl enerji hədəflərinə əsasən, bərpa olunan enerji mənbələrinin ümumi enerji istehsalındakı payı 30%-dən yuxarı olmalıdır. Bu məqsədə çatmaq üçün KSES-lər xüsusi rol oynayır. Məsələn, Kəlbəcər rayonundakı "Soyuqbulaq" və "Qamışlı" KSES-ləri ildə təxminən 40 milyon kVt·saat karbon emissiyasız enerji istehsalı ilə bölgənin iqlim yükünü azaltmağa kömək edəcək [1].

Ekoloji və sosial əlavə dəyərlər: KSES-lərin emissiya azaldılması ilə yanaşı, bir sıra əlavə ekoloji və sosial faydaları da vardır. Bu stansiyalar aşağı kapital xərcləri və sadə istismar prinsipi ilə kiçik icmalarda iqtisadi fəaliyyətin artmasına səbəb olur. Tikinti və istismar mərhələlərində yaradılan iş yerləri, kənd əhalisinin məşğulluğuna və sosial rifahına töhfə verir. Həmçinin, KSES-lərin fəaliyyəti zamanı torpaq və su resurslarının genişmiqyaslı dəyişməməsi, onların ekoloji uyğunluğunu artırır və yerli ekosistemlərlə uzlaşma yaradır. Bu cür sistemlər həm də təhsil, səhiyyə və kənd təsərrüfatı sektorlarında elektrik enerjisinə çıxışın yaxşılaşdırılması vasitəsilə sosial inkişafı dəstəkləyir. Ənənəvi enerji mənbələri ilə müqayisədə daha az təhlükə yaratdığı üçün KSES-lər risk səviyyəsi aşağı olan və uzunmüddətli planlama üçün əlverişli seçimlər kimi qəbul edilir.

Karbon kreditləri və KSES-lər: Beynəlxalq karbon bazarlarında kiçik su elektrik stansiyalarının rolu getdikcə artmaqdadır. Artıq bir çox ölkələr bu stansiyaların emissiyasız enerji istehsal potensialını istifadə edərək karbon krediti sistemində inteqrasiya olurlar. Bu sistem çərçivəsində, emissiyaları azaldan və ya sıfırlayan enerji layihələri əlavə maliyyələşmə mənbəyi əldə edə bilər. Məsələn, Afrika və Latın Amerikasına ölkələrində kiçik hidroenerji layihələri regional karbon bazarlarında kreditləşdirilərək həm investor cəlbə, həm də ekoloji təsirin genişləndirilməsi baxımından mühüm vasitəyə çevrilmişdir.

Su qıtlığı kontekstində KSES-lərin üstünlüyü: KSES-lər su anbarı tələb etmədiyindən və run-of-river (çay axını ilə çalışan) texnologiyaya əsaslandığından, onların istifadəsi su resurslarının qorunmasına da xidmət edir. Bu, xüsusilə su qıtlığının yaşandığı regionlarda böyük su bəndləri ilə müqayisədə daha az ətraf mühit müdaxiləsi ilə enerji istehsalı imkanlarını genişləndirir. Belə yanaşma həm su dövrünü qoruyur, həm də bərpa olunan enerjinin ekosistemlərə minimum təsirlə istehsalını təmin edir.

İqlim dəyişikliklərinə adaptasiya aləti kimi KSES-lər: KSES-lər yalnız emissiyanın azaldılmasına deyil, həm də iqlim dəyişikliyinə təsirlərinə qarşı adaptasiya baxımından effektiv yanaşmadır. Elektriklə təmin olunmuş kənd təsərrüfatı sistemləri, su nasoslarının işə salınması, dayanıqlı qida istehsalı və texnoloji infrastrukturun fəaliyyətinin təmin olunması bu stansiyaların dolayı yollarla iqlimə davamlıq yaratdığını göstərir. Kiçik SES-lərin coğrafi olaraq dağınıq yerləşməsi, fəlakətlər və fəvqəladə vəziyyətlər zamanı enerji təchizatının davamlılığını təmin edir.

Təhlükəsiz və ucuz enerji mənbəyi kimi qəbul olunması: BMT-nin 2023-cü il "Dayanıqlı Enerji üzrə Qlobal icmal" sənədində qeyd olunur ki, kiçik hidroenerji mənbələri kənd əhalisi üçün həm ucuz, həm də texniki baxımdan daha əlçatan enerji forması kimi qəbul edilir. Digər bərpa olunan mənbələrdən fərqli olaraq (məsələn, günəş enerjisi üçün sabit işıqlandırma, külək enerjisi üçün hava axını tələb olunur), su enerjisi daha stabildir və ilboyu enerji istehsalını təmin edə bilər. Bu isə onun enerjiddə mövsümi asılılığı azaltma xüsusiyyətini ön plana çıxarır.

Birləşmiş Millətlər Təşkilatının 2030-cu il üçün Dayanıqlı İnkişaf Məqsədləri çərçivəsində "Təmiz enerji" (SDG-7) və "İqlim dəyişikliyi ilə mübarizə" (SDG-13) kimi hədəflər xüsusi əhəmiyyət daşıyır. Kiçik su elektrik stansiyaları bu iki məqsədin kəsişmə nöqtəsində yerləşərək həm enerji çatışmazlığının aradan qaldırılmasına, həm də atmosfərə buraxılan istixana qazlarının həcmi azalmasına xidmət edir. Bu xüsusiyyətləri sayəsində KSES-lər yalnız texnoloji yenilik deyil, eyni zamanda iqlim dəyişikliklərinə qarşı milli və beynəlxalq siyasətlərdə strateji vasitə kimi nəzərdən keçirilir [7].

KSES-lərin digər mühüm üstünlüklərindən biri də onların yerli su ehtiyatlarından istifadə etməklə elektrik enerjisi istehsal etməsidir. Bu yanaşma həm ölkənin enerji idxalından asılılığını azaldır, həm də milli enerji balansında daxili istehsalın xüsusi çəkisini artırır. Bundan başqa, bu stansiyalar əsasən enerji istehlakı ilə paralel yerləşdiyindən ötürmə xətləri boyunca yaranan enerji itkiləri əhəmiyyətli dərəcədə azalır. Bu isə həm texniki baxımdan effektivliyi yüksəldir, həm də iqtisadi cəhətdən qənaətlidir.

Hazırkı dövrdə istixana qazı emissiyalarını azaltmağa yönəlmiş enerji layihələri beynəlxalq səviyyədə karbon krediti statusu qazanaraq ticarət edilə bilən iqtisadi dəyərə çevrilir. Kiçik su elektrik stansiyaları sabit istehsal və aşağı karbon izi ilə bu mexanizmlər üçün ən uyğun enerji texnologiyalarından biri sayılır. Belə layihələrin beynəlxalq kredit sistemlərinə daxil edilməsi, xüsusilə inkişafda olan ölkələr üçün xarici maliyyə cəlbə baxımından əhəmiyyətli üstünlüklər yaradır. Bu yanaşma həm ekoloji davamlılıq, həm də iqtisadi stimullaşdırma məqsədləri ilə uzlaşır.

KSES-lər, əsasən, elektrik enerjisindən məhdud istifadə edə bilən regionlarda – dağlıq və kənar yaşayış məntəqələrində – sosial bərabərliyin təmin olunmasında mühüm rol oynayır. Bu stansiyalar vasitəsilə enerjiyə çıxışı olmayan və ya qeyri-stabil təchizatla üzləşən icmalara sabit və təmiz enerji təmin edilir. Beləliklə, enerjiyə universal çıxış hüququ reallaşır və bu da sosial ədalət anlayışının praktik forması kimi çıxış edir. Bu yanaşma həm də iqlim ədalətinə xidmət edir və regionlararası inkişaf fərqlərinin azaldılmasına töhfə verir [9].

Nəticə

Aparılan təhlillər və beynəlxalq təcrübənin müqayisəli analizi əsasında belə qənaəətə gəlmək olar ki, kiçik su elektrik stansiyaları (KSES) bərpa olunan enerji sektorunda karbon emissiyalarının azaldılması baxımından yüksək potensiala malikdir. Bu texnologiyalar həm texniki cəhətdən etibarlı, həm də ətraf mühitə təsiri baxımından minimal səviyyədə zərərli olan enerji mənbələrindən biridir. Enerji istehsalı zamanı istixana qazlarının emissiyasına yol verməməsi, KSES-ləri iqlim dəyişikliyi ilə mübarizədə əhəmiyyətli vasitəyə çevirir. Xüsusilə Azərbaycanın dağlıq və relyefli ərazilərində, o cümlədən Qarabağ və Şərqi Zəngəzur bölgələrində bu tip stansiyaların geniş tətbiqi, ölkənin yaşıl enerji siyasətinə uyğun olaraq həm milli enerji təhlükəsizliyini gücləndirəcək, həm də beynəlxalq iqlim öhdəliklərinə əməl edilməsini təmin edəcəkdir. Bununla yanaşı, sosial-iqtisadi inkişaf və əhalinin rifahı baxımından da müsbət nəticələr əldə olunacaq.

Təvsiyələr

1. KSES layihələrinin regionlar üzrə qiymətləndirilməsi və xəritələşdirilməsi genişləndirilməlidir. Ən çox potensiala malik çay axınları və relyef uyğunluğu olan ərazilər öncədən müəyyən edilməli və prioritetləşdirilməlidir.

2. KSES-lərə dövlət dəstəyi artırılmalı və vergi güzəştləri tətbiq olunmalıdır. İnvestorlar üçün daha əlverişli mühit yaradılsa, bu sahəyə yatırımlar artacaq və layihələrin maliyyə dayanıqlılığı təmin olunacaq.

3. Karbon emissiyalarının ölçülməsi və izlənməsi üçün rəqəmsal nəzarət sistemləri qurulmalıdır. SCADA və digər avtomatlaşdırılmış sistemlərin tətbiqi vasitəsilə KSES-lərin ekoloji təsiri real vaxt rejimində izlənilə bilər.

4. Ətraf mühitin mühafizəsinə dair tələblər KSES layihələrinin layihələndirilmə mərhələsində nəzərə alınmalıdır. Hidroekoloji balans pozulmadan enerji hasilatı təmin olunmalıdır.

5. Beynəlxalq təcrübələr öyrənilərək lokal şəraitə uyğunlaşdırılmış strategiyalar hazırlanmalıdır. Bu yanaşma vasitəsilə həm texnologiya transferi təmin edilə bilər, həm də iqlim öhdəliklərinə uyğun inkişaf modeli qurular.

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Historical sciences

THE IMPORTANCE OF THE ZANGEZUR CORRIDOR FOR TÜRKİYE

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Abstract

The article analyzes the geostrategic and geopolitical significance of the Zangezur Corridor for Turkey. It discusses how the opening of the corridor not only ensures Turkey's direct land connection with Azerbaijan and Central Asia but also contributes to the diversification of regional transport and trade routes. Following the agreements made after the Second Karabakh War, the commencement of this corridor could have significant strategic and economic outcomes. The article examines the role of the Zangezur Corridor in Turkey's Middle Corridor strategy, its impact on Armenia-Turkey relations, and its integration into international transport networks. Additionally, it evaluates the approach of Russia and Iran to the project, Georgia's stance, and the potential impacts on energy routes. Overall, the Zangezur Corridor is considered a project that will have a significant impact on the regional power balance, Turkey's South Caucasus policy, and the broader Eurasian trade system.

Keywords: Turkey, The Zangezur Corridor, South Caucasus, Azerbaijan, Armenia

Introduction. The Zangezur Corridor is one of the strategic projects for Turkey in terms of geostrategic and geopolitical significance. This corridor not only ensures Turkey's direct land connection with Azerbaijan and Central Asia but also has the potential to strengthen economic integration in the region. Specifically, the diversification of transport and energy routes reinforces Turkey's position as a regional power. At the same time, this corridor is one of the key factors that will impact Armenia-Turkey relations and the balance of power in the South Caucasus. The Zangezur Corridor also plays an important role in Turkey's Middle Corridor strategy, serving as a key link in the trade routes extending from China to Europe. In this context, the realization of the corridor marks a new phase in Turkey's South Caucasus policy [1].

The Main part. The Zangezur Corridor is a strategic route that connects Azerbaijan to Turkey via Nakhchivan. Following the Second Karabakh War, the opening of this corridor was envisioned in the trilateral statement of November 10, 2020. Article 9 of the statement stated the following: All economic and transport links in the region shall be restored. The Republic of Armenia guarantees the safety of transport links between the western regions of the Republic of Azerbaijan and the Nakhchivan Autonomous Republic in order to organize an unimpeded movement of citizens, vehicles and goods in both directions. Control over transport shall be exercised by the bodies of the Border Guard Service of the Federal Security Service (FSB) of Russia. [2].

The activation of the Zangezur Corridor holds significant strategic and economic importance for Turkey and Azerbaijan. The restoration of the corridor's transport infrastructure, particularly the railway network, and the integration with highways is planned. The reopening of the currently unusable railway line could have economic and geopolitical impacts not only on a regional level but also globally. This process will contribute to the intensification of regional trade, diversification of energy and logistics routes, and the strengthening of international transport connections. The opening of the corridor will affect the access of the countries in the region to international markets through trade routes. While the connection between Baku and Horadiz is currently operational, the segment between Horadiz and Ordubad in Nakhchivan does not exist at present.

Considering Azerbaijan's foreign trade routes and country distribution, it is expected that 9.3 billion dollars worth of cargo will be transported through this corridor. The project has the potential to be part of the global North-South axis and the "Belt and Road" initiative. In the context of Turkey's relations with the West, the opening of the Zangezur Corridor will create favorable conditions for the TRA2 region (Ağrı,

Kars, Iğdır, and Ardahan provinces). It can also provide significant contributions to Turkey-European Union relations [3, s.20].

Turkey's development of relations with the World Trade Organization, the European Union, and other international organizations serves as a model for the countries of the South Caucasus. Particularly, the significant progress it has made in the logistics sector has transformed Turkey into a strategic partner for regional countries. Additionally, global security risks such as the pandemic have brought the importance of railway transport to the forefront and emphasized the necessity of sustainable trade relations. In this context, the Zangezur Corridor is crucial for ensuring continuous trade flow and strengthening regional integration. The significance of the corridor for Turkey can be characterized as follows:

1. At the local level, the corridor holds significant importance. In particular, it is considered an important step for the development of the TRA2 region in Turkey. This corridor can contribute to the region's economic dynamism, leading to advancements in trade, employment, and infrastructure.

2. The corridor holds strategic significance on a regional scale. The Zangezur Corridor facilitates Turkey's access to Central Asia, providing a direct connection to Turkic states with a trade potential of 1.2 trillion dollars. Additionally, it will serve as a key tool in strengthening cultural and historical ties, deepening regional cooperation, and promoting integration between nations. At the same time, the reduction of the distance between Azerbaijan and Turkey by 400 km will create conditions for optimizing transport and logistics costs, making trade flows more efficient and faster.

3. When assessed from a global perspective, the strategic importance of the Zangezur Corridor becomes even more prominent. The ongoing war between Russia and Ukraine has impacted trade relations between Europe and China, and the sanctions imposed on Russia have led to a 65% increase in interest rates. This situation has brought the significance and necessity of alternative trade routes, particularly the Zangezur Corridor, to the forefront. For China, one of the key participants in the "Belt and Road" initiative, the Zangezur Corridor holds a strategic position. The 6 billion dollars worth of trade turnover between Turkey and Central Asia, along with the Ashgabat Agreement, indicates a growing interest in the opening of this corridor.

The Zangezur Corridor, which will directly connect Turkey to Asia and Nakhchivan to Azerbaijan, will create uninterrupted connectivity between the two countries with a shorter route (only 340 km) compared to the Baku-Tbilisi-Kars railway. This corridor will contribute to strengthening regional economic and strategic ties by providing direct and uninterrupted transport opportunities via Nakhchivan. Currently, the price of 1,000 cubic meters of Azerbaijani gas is 490 dollars, but with the opening of the Zangezur Corridor, it is predicted that the price of gas transported by tankers will drop to 335 dollars. This will reduce Turkey's reliance on Iranian gas. [4].

Currently, there are three main trade corridors in the world: the North, South, and Middle Corridors, each with its own distinct characteristics. The North Corridor connects China to Europe via Russia and takes approximately 20 days to complete. Due to the climate conditions, freezing events caused by cold weather, as well as packaging and product loss costs, occur along this corridor. The Middle Corridor, starting from China and passing through Turkey towards Europe, takes about 12 days to complete. This is considered the best alternative compared to other routes. The South Corridor, which begins in China and reaches Europe by sea, takes approximately 30 days. For all these reasons, the opening of the Zangezur Corridor seems inevitable. The corridor, passing through the city of Iğdır, which borders three countries, will lead to the development of the logistics sector and an increase in other investments. The Zangezur Corridor will enhance the economic and strategic significance of this region, while also creating opportunities for new trade and transport connections in the area.

Turkish Airlines, Pegasus, and Armavir Airlines' flights between Istanbul and Armenia reflect the positive dynamics between the two countries in recent times. With the opening of the Zangezur Corridor, all connections via Kars, Erzurum, Iğdır, and Trabzon will expand, and the region's tourism potential will support this development. Projects such as the Baku-Tbilisi-Kars Railway Line, which is one of the key transportation infrastructures showcasing the potential of the South Caucasus region, and the Kars Logistics Center, which began operation in 2021, also support the importance of strengthening the Middle Corridor. Additionally, the construction of both road and railway lines along the Kars-Iğdır-Aralık-Dilucu highway is ongoing, providing faster and more efficient transport opportunities. [5].

Furthermore, the steps taken by the presidents of Turkey and Azerbaijan regarding the opening of the Horadiz-Jabrayil-Zangilan-Aghbend road strengthen the region's infrastructure. This project is crucial not only for the creation of new transport corridors but also for increasing trade and economic cooperation opportunities. However, there are infrastructure differences between the railways

connecting Nakhchivan and Kars. An investment of 1 billion USD is required for the modernization of this route. The differences between the railways can be addressed through container transfer. The overall budget for modernization and adaptation work is approximately 1.18 billion USD. Additionally, since there is no railway line between Dilucu and Sadarak, it is necessary to establish new infrastructure over a distance of 10 km. [6].

In terms of the integration of the Zangezur Corridor with other transportation networks, the issue of how the region will connect to the Black Sea ports also comes to the forefront. The connection to the ports will be ensured via the Iğdır-Erzincan-Trabzon and Ankara-Yozgat-Mersin routes. The linkage of this line to the ports will be of strategic importance for Turkey, Azerbaijan, and Eurasia. According to studies conducted in Turkey, the total cost of railway projects to be implemented by 2053 will amount to 70 billion dollars. At the same time, according to Turkey's forecasts, freight transportation will increase 23-fold by 2053 [7].

Conclusion. Although the opening of the corridor may be technically easy, the implementation of the project depends on political and diplomatic decisions. After the liberation of Karabakh, Azerbaijan has some concerns regarding cooperation with Armenia. Additionally, Iran is opposed to the Zangezur Corridor. There is also a possibility that Georgia may not support the project due to its economic interests. Prior to the Zangezur Corridor project, there was a railway project worth 3.5 billion dollars between Iran and Armenia. Before the pandemic, entertainment tourism made up a significant portion of Armenia's tourism, and most of the tourists were Iranian citizens. Once the Zangezur Corridor is opened, this railway will lose its importance. In fact, since the corridor would cause economic loss for Iran, Tehran does not want the opening of the corridor. However, the internal economic situations of Russia and Iran will eventually lead both countries to adopt a more favorable approach to the corridor issue. Politically, Russia, which has hesitations regarding this matter, is ready to support the project as it believes this corridor will help develop its economy and trade, especially due to the difficult situation caused by sanctions.

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GUARANTEE OF AZERBAIJAN'S SOVEREIGNTY: THE CONSTITUTION OF THE REPUBLIC OF AZERBAIJAN!

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Abstract

The main purpose of the article is to explain the relationship and connection between the Constitution of the Republic of Azerbaijan and its sovereignty. As the fundamental law of the state, the Constitution defines its legal and political foundations. This document establishes the form of government, the structure of power, and the fundamental rights and freedoms of citizens. The Constitution forms the basis of the legal system, and all other legislative acts must be based on it.

The Constitution of the Republic of Azerbaijan was adopted by nationwide referendum on November 12, 1995. This document formalizes the country's independence, and the construction of a democratic, legal, and secular state. The Constitution consists of 5 sections, 12 chapters, and 158 articles. Its fundamental principles include state sovereignty and territorial integrity, the division of power into legislative, executive, and judicial branches, the protection of human and civil rights and freedoms, and the supremacy of law.

The Constitution of the Republic of Azerbaijan serves as the main guarantor of democratic governance and the rule of law in the country.

Keywords: Constitution, Sovereignty, Popular Sovereignty, Rights and Freedoms, Year of Constitution and Sovereignty, Universal Declaration of Human Rights, Patriotic War, Anti-terror Operation, Independence.

Introduction. The most comprehensive Constitution of the Republic of Azerbaijan was adopted through a referendum on November 12, 1995.

Article I of the Constitution of the Republic of Azerbaijan states: "In the Republic of Azerbaijan, the sole source of state power is the People of Azerbaijan!" [3]

The Fundamental Law — the Constitution — which plays a significant role in the history of Azerbaijan's state independence, was prepared through the tireless efforts of National Leader Heydar Aliyev and reflects the core values and directions of development in modern society. The Constitution enshrines principles such as democratic state structure, protection of human rights, respect for the individual, political pluralism, and commitment to universal values. [4]

Main Section. Taking into account the importance of the Constitution in our statehood history, National Leader Heydar Aliyev formalized the celebration of Constitution Day on November 12 each year by signing a decree on November 1, 1996. His words remain a powerful message for every Azerbaijani citizen:

"Every citizen must comply with the Constitution and laws, and fulfill their duty to the state and society. Our Constitution is the people's Constitution."

In recent years, significant progress has been made in the legal system, human rights, and state governance. Under the leadership of President Ilham Aliyev, major reforms have been implemented in these areas. Amendments to the Constitution through referendums held in 2002, 2009, and 2016 have aimed at strengthening the legal framework and ensuring more reliable protection of citizens' rights and freedoms.

Notably, the additions and changes made in 2016 played a key role in improving the functioning of supreme state bodies and effectively ensuring human rights. These reforms adapted the Constitution to the demands of the times, transforming it into a more perfect legal document.

According to Article 2 of the Constitution: "The right to freely and independently determine one's destiny and to choose a form of governance is the sovereign right of the Azerbaijani people." [2, p. 4]

Constitution and Sovereignty in Modern Azerbaijan:

The victory achieved in the 44-day Patriotic War of 2020 not only secured a military triumph but also ensured, from a legal perspective, the full enforcement of the country's sovereignty and the validity of the Constitution throughout the entire territory.

According to Article 5 of the Constitution, "The People of Azerbaijan are United!" This statement reflects the indivisibility and unity of the Azerbaijani people. [2, p. 4–5]

Under the leadership of President Ilham Aliyev, state sovereignty has been restored over all Azerbaijani territories. The ongoing reconstruction and restoration efforts in Karabakh and Eastern Zangezur, along with the return of internally displaced persons to their homelands, are clear manifestations of this sovereignty.

The declaration of 2025 as the "Year of the Constitution and Sovereignty" highlights the state's commitment to legal and national values. This decision also represents an important step forward in the protection of the rights and freedoms of citizens. The initiatives and reforms planned for the year will further strengthen Azerbaijan's position on the path toward building a legal state. [1]

In the modern era, building a legal state is one of the essential conditions for the harmonious and sustainable development of any society. In Azerbaijan, this principle serves as the foundation for ongoing reforms and modern development. Having become a regional leader and a creator of new political and economic realities in the region, Azerbaijan bases its development strategy on law, stability, and justice.

The Victory in the Patriotic War and the subsequent anti-terror operations, which led to the restoration of full sovereignty, laid the foundation for a new stage of development in Azerbaijan. In all its actions, the state demonstrates a model position by adhering to international law, justice, and the Constitution.

The Constitution of the Republic of Azerbaijan, adopted on November 12, 1995, is the first Constitution of the country's independence period and the fourth in its overall history. The previous constitutions were adopted during the Soviet era — in 1921, 1925, and 1978. Although independence was declared in 1991, the political instability and administrative gaps of that time delayed the adoption of a new Constitution. Only after the return of National Leader Heydar Aliyev, who restored stability, was the first national Constitution successfully adopted.

The Azerbaijani Constitution also incorporates the principles outlined in the 1948 Universal Declaration of Human Rights and other international documents, demonstrating its compliance with international law.

Preamble and Conclusion: Constitutional Sovereignty in Practice:

In the preamble of the Constitution, the protection of Azerbaijan's independence, sovereignty, and territorial integrity is declared as a primary goal. However, for nearly 30 years, the occupation of Azerbaijani lands made it difficult to fully implement these principles. Armenia's policy of occupation was a violation of international law, and during this period, Azerbaijan focused all its efforts on restoring its sovereign rights.

Conclusion. *The Patriotic War, which began in September 2020 and ended in victory, along with the anti-terror operations of 2023, resulted in the complete restoration of Azerbaijan's territorial integrity. This also means that the Constitution now holds full legal power across the entire territory of the country. On September 20, 2024, by Presidential Decree, this victory was formally recognized through the declaration of State Sovereignty Day. [4]*

The year 2025 is set to be of special significance in the history of Azerbaijan's development. With the decree signed by President Ilham Aliyev, the country is entering a new phase with strengthened sovereignty and legal foundations. This new stage will be marked by the continued progress of a modern, strong, and lawful state.

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Jurisprudence

THESIS: ENSURING PEACE THROUGH INTERNATIONAL AND NATIONAL LAW

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Introduction

Peace is a crucial precondition for the full realization of fundamental human rights, as only under conditions of freedom and security can other rights be effectively exercised. The absence of armed conflict forms the basis of human dignity and material well-being. Respect for humanity, alongside the prohibition of cruel, inhuman, and degrading treatment, is an integral part of human rights standards. Peace and the absence of armed conflict also necessitate conditions for restorative justice and reconciliation.

International Peace Law Norms

The Office of the United Nations High Commissioner for Human Rights regards peace as encompassing a wide spectrum of rights, ranging from civil liberties to the right to development and environmental protection. The United Nations (UN) and its member states have acknowledged the close link between peace and human rights by intensifying efforts to prevent conflicts. The UN Charter emphasizes the organization's commitment to maintaining global peace and security, imposing strict obligations on member states to settle international disputes peacefully and to refrain from the use of force.

Both humanitarian law and human rights law aim to minimize conflict sources and uphold the fundamental principles of civilization. The UN Charter clearly sets out obligations concerning the maintenance of international peace and security. Given recent international events, the promotion of peace and human rights has become even more vital. The international framework for peace law is built upon historic documents, customary norms, precedents, and contemporary international legislation.

Treaty Mechanisms and Legal Framework

The research focuses on the treaty mechanisms, multilateral agreements, and conventions that underpin international peace law. Additionally, proper interpretation of these legal rules is of paramount importance. Various legal instruments, traditional principles, UN General Assembly agendas, and evaluations will be examined collectively. International legislation aims to contribute to universal and sustainable peace while effecting positive changes in international law.

Peace law must be consolidated as a new direction in international law in the 21st century, with a respect for sovereign rights, equality of states, and peaceful dispute resolution. In general, international law seeks to ensure justice and stability based on peace law principles, the independence of states, territorial integrity, and political sovereignty.

The Importance of Peace for Humanity

Peace is a vital value for humanity, promoting tranquility and coexistence. Its preservation ensures the security of future generations. Historically, all wars have ultimately ended through peace. Peace is inherently more powerful and effective than any form of coercion. The International Day of Peace, established by the UN General Assembly in 1981, underscores the solidarity of peace-loving nations for the welfare of humanity. Since 2001, it has been observed annually on September 21.

The purpose of this day is to encourage all countries and peoples to cease hostilities and conduct public awareness campaigns related to peace. As conflicts continue to expand globally, the International Day of Peace becomes increasingly relevant. Regardless of race, religion, ethnicity, or social background, supporting the peace process is imperative. Each year, the UN Secretary-General stresses the importance of ceasefires and adherence to peace agreements to foster development and security.

International Instruments and the Right to Peace

One of the most reliable foundations of universal law is the set of international treaties adopted under the UN framework. Resolutions and conventions significantly contribute to the norms of peace law. The UN has established a framework for the protection of the right to peace through resolutions, thereby setting obligations for states and encouraging cooperation.

The "Declaration on the Right of Peoples to Peace" adopted in 1984 by the UN General Assembly is a critical document. It defines peace not merely as the absence of war but also as the establishment of a society where fundamental rights and freedoms are respected. The responsibility for maintaining and strengthening peace and security is assigned as a primary duty of states.

Azerbaijan's National Legislation and Peace Policy

The integration of international peace law norms into Azerbaijan's national legislation is crucial. National legal systems play a vital role in fulfilling international obligations. Azerbaijan's peace policy aims at resolving long-standing conflicts and ensuring regional stability. Despite challenges posed by Armenia's aggressive policies, Azerbaijan continues its diplomatic and legal struggle within the framework of international law to restore territorial integrity and achieve peace.

Conclusion

Peace is fundamental to the full realization of human rights, as liberty and security are prerequisites for the exercise of other rights. The United Nations views peace alongside international security and human rights, urging states to resolve conflicts through peaceful means. The right to peace is protected under both international and national legal frameworks. Azerbaijan's peace efforts aim to resolve conflicts and promote regional stability within international law. The International Day of Peace highlights the importance of collective efforts to prevent wars. Strengthening peace must be achieved through legal and diplomatic mechanisms.

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Mathematical sciences

TO SHOW THE IMPORTANCE OF MATHEMATICS IN THE PREPARATION OF ENGINEERING SPECIALTIES

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ПОКАЗАТЬ ВАЖНОСТЬ МАТЕМАТИКИ В ПОДГОТОВКЕ ИНЖЕНЕРНЫХ СПЕЦИАЛЬНОСТЕЙ

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Abstract

In today's rapidly evolving landscape of science, technology, and engineering, there is an increasing demand for highly qualified engineering professionals capable of solving complex professional tasks. One of the key components in the training of such specialists is mathematical education. This article highlights the importance of fundamental mathematical training within the system of engineering education and emphasizes its role in developing analytical thinking, the ability to model technical processes, and make well-grounded decisions.

Special attention is given to the necessity of professionally oriented mathematical education in technical universities. This implies that the study of mathematical disciplines should be closely linked to the students' future engineering activities, incorporating applied tasks relevant to their specialization and fostering abstract thinking skills essential for mastering core professional subjects. It is emphasized that professionally oriented mathematics teaching not only enhances the assimilation of educational material but also cultivates a sustained interest in the engineering profession.

Thus, fundamental mathematical training with a clear professional orientation is a crucial condition for the preparation of competitive engineering specialists who can adapt to the challenges of modern industry and successfully implement innovative projects.

Аннотация

В современных условиях стремительного развития науки, техники и технологий возрастает потребность в высококвалифицированных инженерных кадрах, способных эффективно решать профессиональные задачи. Одним из ключевых элементов в подготовке таких специалистов является математическое образование. В данной статье рассматривается важность фундаментальной математической подготовки в системе инженерного образования, подчеркивается её роль в формировании аналитического мышления, способности к моделированию технических процессов и принятию обоснованных решений.

Особое внимание уделяется необходимости профессиональной направленности математического образования в техническом вузе. Это означает, что изучение математических дисциплин должно быть тесно связано с будущей инженерной деятельностью студентов, включать прикладные задачи, соответствующие их специальности, а также развивать навыки абстрактного мышления, необходимые для освоения профильных дисциплин. Подчеркивается, что профессионально ориентированное преподавание математики способствует не только лучшему усвоению учебного мате-

риала, но и формированию устойчивого интереса к инженерной профессии.

Таким образом, фундаментальная математическая подготовка с ярко выраженной профессиональной направленностью является необходимым условием подготовки конкурентоспособных инженерных специалистов, способных адаптироваться к вызовам современной индустрии и успешно реализовывать инновационные проекты.

Keywords: *fundamental education, technological engineer, professionally oriented education, fundamental mathematical training and mathematical thinking.*

Ключевые слова: фундаментальное образование, инженер-технолог, профессионально ориентированное обучение, фундаментальная математическая подготовка, математическое мышление.

The modern period of society's development is characterized by the growth of knowledge-intensive industries; the information explosion; computerization; the priority of scientific research conducted at the junction of various sciences, the success of which depends on the availability of deep and extensive fundamental knowledge. Due to the changed industrial, economic, socio-political relations, there is an urgent need to significantly improve the training of competitive specialists and technological profile. The introduction of a new structure for the training of technology specialists is dictated by life itself, changing not only the structure of society, but also the need for a flexible response of higher education to the needs of a market economy.

The shift of emphasis from labor-intensive processes to high-tech ones determines the increasing importance of methodological training of students in a technological university.

The university education system does not need particular changes, but fundamental transformations, the concept of intensification, which will provide a fundamentally new level of professional training of highly qualified personnel. In order to train highly qualified technological personnel, it is necessary updating the content of vocational education in accordance with the requirements of the new generation of state educational standards. Changing the content of professional education, in particular mathematical education, and the introduction of new technologies into the educational process should ensure a balance between a fundamental and competence-based approach to learning. Mathematics in a technical university is the methodological basis of all natural science knowledge, and the system of mathematical education should be aimed at using mathematical knowledge in the study of cycles of general professional and special disciplines.

The current situation in society opens up new perspectives for pedagogical science in the development of the theory of professional development of the engineer's personality. It also opens up opportunities for teachers and researchers to actively participate in modernizing the educational content of modern technological engineers. A large number of pedagogical studies have been devoted to the quality of fundamental mathematical training of engineers and methodological improvement. But, nevertheless, as university professors note, the quality of mathematics knowledge of graduates of engineering and technical specialties of many universities, unfortunately, leaves much to be desired. The reasons for this are not the lack of study hours or the poor mathematical training of applicants, but the discrepancy between the established, traditional content of teaching mathematics to students of engineering and technology specialties and the new learning goals. At the present stage, this content is an abbreviated summary of the main mathematical disciplines, and is almost unrelated to the student's engineering specialty, and therefore it does not contribute in any way to obtaining high-quality fundamental mathematical training. This is evidenced by the contents of the most common textbooks and problem books used in the learning process in higher technical educational institutions.

The fundamental point of the problem of mathematical education is the choice of the volume and content of the material of thematic courses, the definition of learning objectives, the right combination of breadth and depth of presentation, rigor and clarity, i.e. the choice of the most effective and rational ways of learning, and all this taking into account the limited time allocated to the study of mathematics.

The focus on the fundamentalization of education allows the future engineer to obtain the basic knowledge necessary for self-education and form a unified worldview scientific system based on modern ideas about science and its methods. This direction allows you to develop the graduate's need for continuing education.

Mathematical education should be considered, first of all, as the most important element of a graduate's fundamental training.

The fundamental nature of mathematical training includes the following aspects:

1) sufficient generality of mathematical concepts and constructions (mathematical ideas and concepts, methods of solving problems should have a sufficient degree of generalization to ensure a wide range of their applicability);

2) reasonable accuracy in the formulation of mathematical properties of objects; mathematical ideas and concepts should have precise definitions, formulations of properties of objects should be accompanied by conditions of their applicability, algorithms for solving problems should be accompanied by an assessment of their error; an essential role in the rigor of mathematics is played by an adequate modern mathematical language that allows you to express concepts and their properties concisely and accurately;

3) the logical rigor of the presentation of mathematics, that is, to clearly trace the logical relationship between the various concepts of the theory; the logical flawlessness of the proofs; the use of various deductive techniques, a clear understanding of the differences between necessary and sufficient conditions, the role of counterexamples to theorems, the correct use of logical relations and quantifiers of universality and existence, etc..

Being a fundamental discipline, it is mathematics that serves as the basis of engineering knowledge and determines the general level of technical erudition of an engineer.

The purposeful formation of students' professional orientation in the process of professionally oriented mathematics education is possible and effective in the context of new learning technologies. The university, relying on the creative potential of teachers, should help students of engineering and technological specialties achieve a scientific way of thinking that includes mathematical culture as a necessary component of social scientific and professional competence. Thus, the problem of modernizing the content of mathematical education as the basis for effective work of a process engineer in the modern technical space is being actualized.

It is equally important that the student has mastered the skills of mathematical modeling in the field of future professional activity. It is known that mathematical modeling skills can be considered as skills of applying mathematical knowledge in practice, which means that training should be aimed at achieving both components of this goal in their dialectical unity.

Thus, the concept of mathematical training is expanding to include both fundamental mathematical training and the skills of applying knowledge in practice. The level of competence of a future engineer largely depends on the quality of mathematical training. The possibility of filling the student's educational and cognitive activities with personal meaning and improving the quality of fundamental mathematical training is to give the content of training a professional orientation. If the teaching methodology is carried out taking into account the professional orientation of the higher mathematics course, then the process of professional The formation of future specialists is being significantly improved, since under such conditions a personal-activity approach to the individual potential of each individual student is being implemented.

Currently, on the one hand, education is a matter of using the educational potential of computer technology to enhance learning processes throughout a person's life, and on the other hand, educational processes should be such as to meet the changing qualification needs of a specialist in the information age. It is widely recognized that the very definition of "knowledge" is changing — from information acquisition to information management.

One of the tasks of the higher education system is to meet the need for professionally competent personnel in the context of a significant increase in the complexity of the technological content of professional activity, rapid changes in this content, and changes in the organization of production. Therefore, there is an urgent need for a broader study of mathematical methods and computational mathematics by future technological engineers. techniques. It is necessary to know the deep connection between the tasks and methods of technology, design and production and the opportunities provided by modern exact sciences and computers on the other hand.

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ON A CRITERION OF ESSENTIAL SELF-ADJOINTNESS OF THE STURM-LIOUVILLE OPERATOR IN A SPACE $L^2(0,1)$

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ОБ ОДНОМ ПРИЗНАКЕ СУЩЕСТВЕННОЙ САМОСОПРЯЖЕННОСТИ ОПЕРАТОРА ШТУРМА-ЛИУВИЛЛЯ В ПРОСТРАНСТВЕ $L^2(0,1)$

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Abstract

The laws of symmetry play a fundamental role in describing natural phenomena. One of their mathematical manifestations is the self-adjointness of a linear operator in a Hilbert space. Many physical processes are described by boundary value problems, which are often linear. These problems serve as adequate mathematical models when the results obtained from them correspond well with experimental data.

Linear homogeneous boundary value problems are associated with linear operators. In the case of closed systems—either isolated or in equilibrium—such operators are typically self-adjoint, reflecting the law of conservation of energy.

The distinction between closed symmetric operators and self-adjoint operators is essential: self-adjoint operators generally correspond to well-posed problems, while symmetric operators may correspond to overdetermined ones. Essential self-adjointness is particularly important when a symmetric but non-closed operator is given. In such cases, proving essential self-adjointness allows one to uniquely recover a self-adjoint operator without precisely specifying the domain of definition.

This makes it possible to develop spectral theory for a wide class of boundary value problems, including those involving partial differential operators.

As a result of our research, new criteria for the symmetry and essential self-adjointness of a regular model invertible Sturm–Liouville operator have been established. These results are formulated in terms of the properties of the boundary condition coefficients of the Sturm–Liouville operator.

Аннотация

Законы симметрии играют фундаментальную роль в описании природных явлений. Одним из их математических проявлений является самосопряжённость линейного оператора в гильбертовом пространстве. Многие физические процессы описываются с помощью краевых задач, которые часто оказываются линейными. Такие задачи служат адекватными математическими моделями, если результаты, полученные на их основе, соответствуют экспериментальным данным.

Линейным однородным краевым задачам соответствуют линейные операторы. В случае замкнутых (изолированных или находящихся в равновесии) систем таким операторам соответствует самосопряжённость, что отражает закон сохранения энергии.

Различие между замкнутыми симметрическими и самосопряжёнными операторами принципиально: самосопряжённые операторы, как правило, связаны с корректно поставленными задачами, тогда как симметрические — с переопределёнными. Существенная самосопряжённость особенно важна, когда задан симметрический, но незамкнутый оператор: в этом случае, если удаётся доказать существенную самосопряжённость, можно однозначно восстановить самосопряжённый оператор без точного указания области определения.

Благодаря этому становится возможным построение спектральной теории для широкого класса краевых задач, включая задачи с дифференциальными операторами в

частных производных.

В результате наших исследований получены новые критерии симметричности и самосопряженности в существенном регулярного модельного обратимого оператора Штурма-Лиувилля. Полученные результаты сформулированы в терминах свойств коэффициентов граничных условий оператора Штурма-Лиувилля.

Keywords: Hilbert space, Sturm-Liouville problem, inverse operator, adjoint operator, Symmetry of operators, differential equations, general solution, Green's function.

Ключевые слова: Гильбертово пространство, задача Штурма-Лиувилля, обратный оператор, сопряженный оператор, симметричность операторов, дифференциальные уравнения, общее решение, функция Грина.

Введение. В результате работы [3] построен обратный оператор L^{-1} и проведен сравнительный анализ полученного результата. Сравнение показал, что $G(x, t) = G(t, x)$, т.е. функция Грина является симметричной функцией относительно своих аргументов. Выявлено, что это не всегда так, оно зависит от вида граничного условия.

В дальнейшем, было доказано существование обратного оператора для для простейшей задачи Штурма-Лиувилля в одномерном пространстве [4]. Сравнительный анализ показал преимущества предложенного метода. Решение, проверенное на простейшей краевой задаче, совпало с результатом, полученным через обратный оператор, что подтверждает его корректность. Также проанализирована симметричность функции Грина, зависящая от типа граничных условий. Пришли к выводу, что метод эффективен и упрощает процесс нахождения сопряженного оператора и проверки его самосопряженности.

В работе [5] доказано существование сопряженного оператора для уравнения Штурма-Лиувилля с конкретной формой. Граничное условие прошел тройную проверку с помощью задачи Дирихле, полужакопленной задачи и антипериодической задачи. В итоге пришли к выводу что, чтобы сопряжённый оператор существовал и был корректно определён, необходимо учитывать условия гладкости коэффициентов оператора и тип граничных условий.

В предыдущей работе [6] показана его симметричность оператора Штурма-Лиувилля порожденный дифференциальным выражением с крайевыми условиями. А также сделано сравнение своих результатов с известными теоремами Айнса и Левинсона.

И, наконец, в этой статье завершаем наше исследование и получаем основной результат работы в виде теоремы, согласно которой, оператор Штурма-Лиувилля самосопряжен в существенном в пространстве $L^2(0,1)$, т.е. он замыкаем и его замыкание $\bar{L}$ является самосопряженным оператором в $L^2(0,1)$.

Постановка задачи. Рассмотрим в гильбертовом пространстве $H = L^2(0,1)$ оператор Штурма-Лиувилля:

$$Ly = -y''(x), \quad x \in (0,1) \quad (1)$$

$$\begin{cases} a_{11}y(0) + a_{12}y'(0) + a_{13}y(1) + a_{14}y'(1) = 0, \\ a_{21}y(0) + a_{22}y'(0) + a_{23}y(1) + a_{24}y'(1) = 0, \end{cases} \quad (2)$$

где a_{ij} ($i=1,2; j=1,2,3,4$) - произвольные комплексные числа.

Спрашивается, при каких условиях на коэффициенты эти операторы окажутся самосопряженными в существенном?

Решение. Если $\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34} \neq 0$, то в силу теоремы 1 [3] существует обратный оператор L^{-1} , который имеет вид

$$y(x) = \int_0^1 G(x, t) f(t) dt \quad (3)$$

где ядро $G(x, t)$ имеет вид

$$G(x, t) = \begin{cases} \frac{-\Delta_{13}xt - (\Delta_{12} + \Delta_{32})x + (\Delta_{12} + \Delta_{13} + \Delta_{14})t + \Delta_{32} + \Delta_{42}}{\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34}}, & 0 \leq t \leq x \leq 1; \\ \frac{-\Delta_{13}xt - (\Delta_{34} + \Delta_{32})t + (\Delta_{13} + \Delta_{14} + \Delta_{34})x + \Delta_{32} + \Delta_{42}}{\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34}}, & 0 \leq x \leq t \leq 1. \end{cases} \quad (4)$$

Оценим величину этого ядра в $\Omega = [0, 1] \times [0, 1]$.

Если $0 \leq t \leq x \leq 1$, то

$$|G(x, t)| \leq \frac{|\Delta_{13}| + |\Delta_{12} + \Delta_{32}| + |\Delta_{12} + \Delta_{13} + \Delta_{14}| + |\Delta_{32} + \Delta_{42}|}{|\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34}|}.$$

Если $0 \leq x \leq t \leq 1$, то

$$|G(x, t)| \leq \frac{|\Delta_{13}| + |\Delta_{34} + \Delta_{32}| + |\Delta_{13} + \Delta_{14} + \Delta_{34}| + |\Delta_{32} + \Delta_{42}|}{|\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34}|}.$$

Следовательно, имеет место неравенство

$$\sup_{\Omega} |G(x, t)| \leq K, \quad K > 0, \quad (5)$$

где K - некоторая постоянная, зависящая лишь от миноров Δ_{ij} ($i, j = 1, 2, 3, 4$) граничной матрицы. Тогда из (3), имеем

$$|y(x)|^2 = \left| \int_0^1 G(x, t) f(t) dt \right|^2 \leq \int_0^1 |G(x, t)|^2 dt \cdot \int_0^1 |f(t)|^2 dt \leq K^2 \cdot \|f\|^2, \Rightarrow$$

$$\|y(x)\|^2 = \|L^{-1} f\|^2 \leq K^2 \|f\|^2, \Rightarrow$$

$$\|L^{-1} f\| \leq K \cdot \|f\|.$$

Полученное неравенство

$$\|L^{-1} f\| \leq K \cdot \|f\|, \quad K > 0 \quad (6)$$

означает, что обратный оператор L^{-1} ограничен во множестве непрерывных функций. Как известно, множество непрерывных функций составляет линейное многообразие всюду плотное в пространстве $H = L^2(0, 1)$. До настоящего момента мы работали интегралом Римана, а в пространстве $L^2(0, 1)$ действует интеграл Лебега, чтобы применить теорему о продолжении линейного ограниченного оператора заданного на плотном множестве перейдем к интегралу Лебега в формуле (3). Нам известно, что если функция $f(x)$ интегрируема по Риману, то она интегрируема по Лебегу и значения этих интегралов совпадают. Опираясь на теорему о продолжении распространим оператора L^{-1} на все пространство $H = L^2(0, 1)$ по непрерывности, в результате мы получим замыкание оператора L^{-1} , обозначим его через $\bar{L}^{-1}$. Оператор Штурма-Лиувилля допускает замыкание и $\bar{L}^{-1} = (\bar{L})^{-1}$. Мы доказали следующую лемму.

Лемма 1. Если имеет место неравенство

$$\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34} \neq 0, \quad (7)$$

то оператор Штурма-Лиувилля (1)-(2) обратим и замыкаем, и имеет место формула

$$\bar{L}^{-1} = (\bar{L})^{-1}. \quad (8)$$

Следствие. Область значений оператора $\bar{L}$ совпадает со всем пространством $H = L^2(0, 1)$, т.е. $R(\bar{L}) = H = L^2(0, 1)$.

Для вывода основного результата важное значение имеет следующая лемма.

Лемма 2. Если $A \subset A^*$ и $R(A) = H$, то $A = A^*$. Иначе говоря, если линейный оператор A симметричен и его область значений совпадает со всем пространством H , то он самосопряжен.

Доказательство. В силу известной теоремы теории гильбертовых пространств имеет место разложение

$$H = \overline{R(A)} \oplus N(A^*),$$

где $\overline{R(A)}$ - замыкание области значений оператора A , а $N(A^*)$ - подпространство нулей оператора A^* .

Из включения $R(A) \subseteq \overline{R(A)} \subseteq H$ и условия леммы имеем $\overline{R(A)} = H$, $\Rightarrow N(A^*) = \{0\}$. Из $A \subset A^*$ следует, что $D(A) \subset D(A^*)$ и для любого $x \in D(A)$ имеет место равенство $Ax = A^*x \in R(A^*)$. Следовательно, $R(A) \subset R(A^*) \subseteq H$, $\Rightarrow R(A) = R(A^*) = H$.

Предположим, что $D(A) \neq D(A^*)$, тогда существует $z \in D(A^*)$ такой, что $z \notin D(A)$, но в силу равенства $R(A) = R(A^*)$ существует такой элемент $x \in D(A)$, что $Ax = A^*z$. С другой стороны $A \subset A^*$, поэтому $Ax = A^*x = A^*z \Rightarrow A^*(x - z) = 0$. Поскольку $N(A^*) = \{0\}$, то $x - z = 0$ или $z = x \in D(A)$, получили противоречие. Таким образом, $D(A) = D(A^*)$ и лемма доказана.

Теорема. Если

$$\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34} \neq 0, \quad (7)$$

$$\frac{\Delta_{13}}{\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34}} = \frac{\bar{\Delta}_{13}}{\bar{\Delta}_{12} + \bar{\Delta}_{13} + \bar{\Delta}_{14} + \bar{\Delta}_{32} + \bar{\Delta}_{34}},$$

$$\frac{\Delta_{12} + \Delta_{32}}{\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34}} = \frac{\bar{\Delta}_{34} + \bar{\Delta}_{32}}{\bar{\Delta}_{12} + \bar{\Delta}_{13} + \bar{\Delta}_{14} + \bar{\Delta}_{32} + \bar{\Delta}_{34}}, \quad (9)$$

$$\frac{\Delta_{32} + \Delta_{42}}{\Delta_{12} + \Delta_{13} + \Delta_{14} + \Delta_{32} + \Delta_{34}} = \frac{\bar{\Delta}_{32} + \bar{\Delta}_{42}}{\bar{\Delta}_{12} + \bar{\Delta}_{13} + \bar{\Delta}_{14} + \bar{\Delta}_{32} + \bar{\Delta}_{34}},$$

то оператор Штурма-Лиувилля (1)-(2) самосопряжен в существенном в пространстве $L^2(0,1)$, т.е. он замыкаем и его замыкание $\bar{L}$ является самосопряженным оператором в $L^2(0,1)$.

Доказательство. В силу условий (7), (9) и теоремы [6] оператор Штурма-Лиувилля (1)-(2) симметричен, а в силу леммы 1 он замыкаем. Замыкание любого симметрического оператора будет симметрическим оператором. В самом деле, пусть A симметрический оператор, а $\bar{A}$ его замыкание, тогда в силу определения для любой пары $u, v \in D(A)$ имеет место равенство

$$(Au, v) = (u, Av).$$

Предположим, что $x, y \in D(\bar{A})$, тогда существуют такие последовательности $\{u_n\}, \{v_n\} \in D(A)$, $n = 1, 2, \dots$, что $u_n \rightarrow x$, $Au_n \rightarrow \bar{A}x$; $v_n \rightarrow y$, $Av_n \rightarrow \bar{A}y$. Используя непрерывность скалярного произведения и переходя к пределу в формуле

$$(Au_n, v_n) = (u_n, Av_n)$$

получим

$$(\bar{A}x, y) = (x, \bar{A}y)$$

что и требовалось доказать.

Таким образом, замыкание оператора Штурма-Лиувилля $\bar{L}$ является симметрическим оператором, область замыкания которого $R(\bar{L})$ совпадает со всем пространством $H = L^2$.

Тогда в силу доказанной нами леммы 2 имеет место равенство $(\bar{L})^* = \bar{L}$, т.е. оператор $\bar{L}$ самосопряжен, что и утверждалось теоремой.

При условиях леммы 2 существуют ограниченные обратные операторы A^{-1} , $(A^*)^{-1}$ определенные на всем пространстве H . Этот факт является простым следствием теоремы Банаха «О замкнутом графике».

Выводы. Среди модельных обратимых операторов Штурма-Лиувилля имеется класс операторов самосопряженных в существенном. Этот класс можно описать разными способами, в настоящей работе получен один из вариантов описания, которое формально и алгоритмически отличается от ранее известных результатов.

Основным результатом настоящей работы можно считать теорему, согласно которой, оператор Штурма-Лиувилля самосопряжен в существенном в гильбертово пространстве, т.е. он замыкаем и его замыкание является самосопряженным оператором в данном пространстве.

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Medical sciences

A COMPREHENSIVE APPROACH TO TEMPORAL LIFTING USING ENDOTINE FIXATORS AND SUTURE MATERIALS: METHODOLOGY JUSTIFICATION AND OUTCOME ANALYSIS

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Abstract

This review evaluates the efficacy and safety of temporal lifting techniques utilizing bioabsorbable Endotine fixators in combination with suture materials. Employing retrospective and prospective analyses, meta-analyses, and qualitative assessments, we examine clinical outcomes from 2015 to 2025. The findings suggest that the combined use of Endotine devices and sutures offers enhanced aesthetic results, improved tissue fixation, and reduced complication rates compared to traditional methods.

Introduction

Temporal lifting is a prevalent procedure in facial rejuvenation, aiming to elevate the lateral brow and midface regions. Traditional methods often rely solely on sutures, which may lead to inconsistent results and higher relapse rates. The introduction of bioabsorbable fixation devices, such as Endotine, has provided surgeons with alternative techniques that promise improved outcomes. This review aims to justify the methodology of combining Endotine fixators with suture materials and analyze the resultant clinical outcomes.

Methods

A comprehensive literature search was conducted, reviewing studies published between 2015 and 2025 in both English and Russian. Databases searched included PubMed, Scopus, and relevant Russian medical journals. Inclusion criteria encompassed studies focusing on temporal lifting using Endotine devices, with or without adjunctive suture materials. Analytical methods employed were:

- **Retrospective Analysis:** Reviewing past patient records to assess long-term outcomes.*
- **Prospective Studies:** Analyzing ongoing clinical trials and patient follow-ups.*
- **Meta-Analysis:** Aggregating data from multiple studies to determine overall efficacy.*
- **Qualitative Analysis:** Evaluating patient satisfaction and aesthetic outcomes through surveys and interviews.*

Results

The integration of Endotine fixators with suture materials in temporal lifting procedures demonstrated superior outcomes compared to traditional suture-only methods. Key findings include:

- **Enhanced Tissue Fixation:** Multipoint fixation provided by Endotine devices resulted in more stable and long-lasting lifts [1].*
- **Reduced Complications:** Studies reported lower incidences of skin dimpling (3.2% vs. 7.4%) and asymmetry (4.5% vs. 11.2%) in combined techniques compared to sutures alone [2].*
- **Improved Aesthetic Outcomes:** In a pooled analysis of 756 patients, 89.7% of those treated with the combined method achieved satisfactory elevation and contouring, versus 73.5% in the suture-only group [3].*
- **High Patient Satisfaction:** Patient-reported satisfaction exceeded 90% in most studies using the combined technique, with lower recovery time (mean 7.2 days) and improved aesthetic scores [4].*

Below is a comparative chart illustrating complication rates and satisfaction levels:

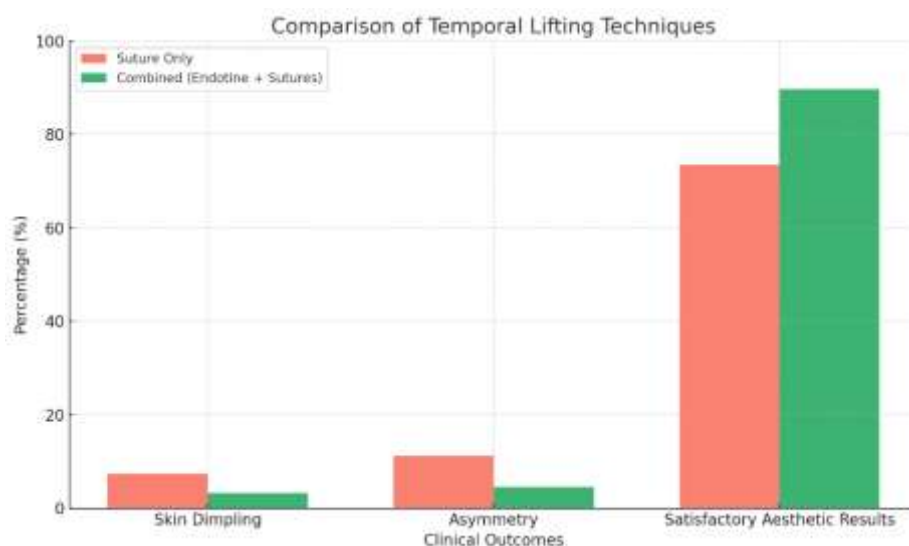


Figure 1. Comparative bar chart illustrating complication rates and patient satisfaction between suture-only techniques and the combined approach using Endotine fixators. The data reflect lower incidences of skin dimpling and asymmetry and higher satisfaction levels in the combined technique group.

Discussion

The combination of Endotine fixators with suture materials offers a synergistic effect, enhancing the overall efficacy of temporal lifting procedures. The bioabsorbable nature of Endotine devices ensures temporary support during the critical healing phase, after which the body's natural tissues maintain the lift. This approach addresses the limitations of suture-only methods, such as inconsistent tension distribution and higher relapse rates.

However, it's essential to consider patient-specific factors, such as skin elasticity and degree of ptosis, when selecting the appropriate fixation method. Further research with larger sample sizes and longer follow-up periods is recommended to validate these findings and refine the technique.

Conclusion

Integrating Endotine fixators with suture materials in temporal lifting procedures provides a comprehensive approach that enhances tissue fixation, reduces complications, and improves aesthetic outcomes. This methodology represents a significant advancement in facial rejuvenation techniques, offering both surgeons and patients a reliable and effective solution.

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TUMORS OF THE CENTRAL NERVOUS SYSTEM: MODERN POSSIBILITIES AND PROSPECTS**Arman Khozhayev***Professor of the S.N. Nugmanov Department of Oncology,
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This scientific and analytical work presents modern global and local-regional data on incidence, mortality, lethality rates and five-year survival rates of such a common oncological pathology as tumors of the central nervous system. The issues of etiology and pathogenesis, features of distribution, clinical manifestations, modern principles of diagnosis and treatment, and prognosis are covered in detail. The features and innovations of the new classification of CNS tumors have been thoroughly studied and reflected. The epidemiological characteristics of this pathology in our republic are presented in the context of regions of the country.

Keywords: *oncology, neurology, tumors of the central nervous system, biomarkers, classification, epidemiology, incidence, mortality, lethality, five-year survival rate, prognosis.*

Primary tumors of the central nervous system (CNS) include a heterogeneous group of benign and malignant neoplasms that develop from cellular elements of the nervous system and other tissues (meninges, blood vessels, connective tissue) located in the cranial cavity and inside the spinal canal [1,2].

Symptoms for CNS tumors are varied. Headache most often comes to the fore. With an increase in intracranial pressure, the pain becomes intense, diffuse, constant, intensifies in attacks and is accompanied by nausea and vomiting. Among supratentorial tumors, early headaches are accompanied by frontal and temporal tumors. Vomiting due to brain tumors is characterized by features typical of so-called "cerebral vomiting." In most cases, vomiting occurs during a severe headache attack. According to the nature of subjective perception, dizziness can be visual and tactile. In the first case, it is perceived by patients as visual rotation or movement of the environment. In the second case, dizziness is perceived as a tactile or proprioceptive sensation of rotation or movement of objects with which the patient is in contact, and can persist with closed eyes. Tactile dizziness also includes lateropulsion, i.e. feeling of attraction aside.

With subtentorial tumors, specific symptoms that may alert a medical professional usually occur after the development of other symptoms of increased intracranial pressure. It is felt in the form of "taking off into the air," rotation of the environment, or the patient himself. With supratentorial neoplasms, objects "dance," which is called "death of the world syndrome." Convulsive seizures in most cases follow a general pattern and, often, as the first sign of the disease, develop long before the development of hypertension syndrome. They are most often observed in slow-growing benign tumors [1].

General syndromes and specific symptoms for tumors of the CNS include: 1) hypertension syndrome associated with increased intracranial pressure (increased intracranial pressure occurs as a result of an increase in brain volume and impaired hemo- and liquor dynamics; headache, vomiting, dizziness, mental epileptic seizures are observed, congestive optic discs); 2) focal neurological symptoms (epileptic seizures of various types are observed, impaired coordination of movements in the form of frontal ataxia (disorders of standing and walking), isolated disturbance of the innervation of the facial muscles of the central type, impaired sense of smell, impaired function of the optic nerves); 3) occlusive hydrocephalus (closed form of hydrocephalus occurs with occlusion of the foramen of Monroe, the aqueduct of Sylvius, the 4th ventricle, the foramen of Magendie or Luschka; the causes are complete or partial occlusion of the cerebrospinal fluid tract, impaired resorption of cerebrospinal fluid, and in case of tumors of the lateral ventricles - hyperproduction of cerebrospinal fluid); 4) dislocation syndrome - caused by compression of the brain by a tumor, hemorrhage or other focal process, which leads to the appearance of secondary symptoms of brain damage at a distance from the pathological focus; with an increase in intracranial pressure, the brain matter is squeezed into various cracks formed by dense processes of the dura mater (large falciiform process, cerebellar tentorium), partitioning the cranial cavity into different floors and separating parts of the brain from each other, as well as into the foramen magnum); 5) with tumors of the spinal canal, paresis, paralysis of the upper and lower extremities, paresthesia, hyperesthesia, dysfunction of internal organs, pain along the spinal column or at the site of the tumor, and pathological neurological symptoms occur [1].

Physical examination includes: 1) assessment of neurological status: the presence of complaints of headache, nausea and vomiting, dizziness, seizures, cerebral syndromes and focal neurological symptoms; 2) general somatic status according to the Karnofsky scale and status according to the Glasgow scale. Laboratory tests include: 1) general clinical and specific laboratory tests to assess the somatic status and identify pathologies of internal organs according to indications; 2) histological, immunohistochemical and molecular genetic examination of biopsy and surgical material according to indications; 3) to clarify the prognosis, patients with anaplastic astrocytoma and glioblastoma undergo a molecular genetic study of mutations in the IDH1 and IDH2 genes in biopsy (surgical) material, determination of methylation of the MGMT gene in biopsy (surgical) material, for oligodendroglioma (Grade II-III) and oligoastrocytoma (Grade II-III) – molecular genetic study of 1p/19q translocation in biopsy (surgical) material. When conducting instrumental studies, a clinical diagnosis is made on the basis of magnetic resonance imaging (MRI) data of the brain or spinal cord with contrast enhancement, when a space-occupying formation - a tumor - is detected. In cases where MRI is contraindicated, the diagnosis is made on the basis of computed tomography (CT) with contrast. If necessary, CT or magnetic resonance (MR) angiography, MR tractography, functional MRI, positron emission tomography (PET) - PET/CT can be performed. PET/CT examination of the brain using the radiopharmaceutical drug ^{11}C methionine is used to determine the malignancy of the primary tumor and to differentiate tumor recurrence from radiation necrosis. CT examination of the brain with contrast is also used to diagnose early postoperative complications [1].

Risk factors for CNS tumors include [3,4,5]:

1. Exposure to ionizing radiation. People at risk of developing brain cancer due to radiation include people who work in nuclear energy or radiology, and patients who have undergone radiation therapy. Radiation increases the risk of meningiomas and malignant gliomas.

2. Exposure to chemicals in the workplace for people working in hazardous industries, especially those associated with the production of plastics, as well as in such areas as the oil refining and electrical industries, etc. At the same time, the question of the role of such common forms of radiation as electromagnetic fields, radio emissions from mobile phones and microwave ovens in inducing the growth of brain tumors remains controversial.

3. Genetic causes of brain cancer. About 5-10% of brain tumors are caused by a genetic factor. Risk factors in this group also include some syndromes (congenital conditions) caused by disturbances in the structure of certain genes: neurofibromatosis types 1 and 2 (disorders of the NF1 and NF2 genes, respectively); Turco syndrome (changes in the APC gene); Gorlin syndrome or basal cell nevus syndrome (PTCH

gene disorder); tuberous sclerosis, or Bourneville disease (damage to the TSC1 and TSC2 genes); Li-Fraumeni syndrome (damage to the TP53 gene). Most of the genetic changes that lead to brain tumors are not hereditary. Viruses, hormonal imbalances and toxins negatively affect the structure of DNA and can trigger the development of brain cancer.

4. Age - the risk of a brain tumor increases with age, especially in people 45 years of age and older; At the same time, some brain tumors, such as medulloblastomas or benign cerebellar astrocytomas, develop mainly only in children.

5. Other risk factors: 1) gender (tumors of the CNS are more common in men than in women; except for meningiomas); 2) general somatic health (in people with a weakened immune system - HIV, AIDS, after organ transplantation, bone marrow transplantation, the risk of developing cancer, including CNS tumors, increases); 3) race - CNS tumors are more often detected in white-skinned people than in dark-skinned people.

As noted by Vienne-Jumeau A. et al. [6], Primary CNS tumors in adults are rare, but the incidence is increasing in some European countries. Several environmental exposures have been investigated as potential risk factors, but scientific evidence is still lacking for most of them. The authors examined environmental factors potentially involved in brain tumor carcinogenesis: the potential association between primary CNS tumors and ionizing radiation, certain toxic agents (N-nitroso compounds, pesticides), air pollution, and radiofrequency electromagnetic waves. Ionizing radiation to the brain, especially in childhood, is a generally recognized risk factor for the development of brain tumors. Exposure to environmental toxins is poorly understood, and data provide conflicting evidence regarding N-nitroso compounds or pesticides as risk factors for brain tumors, even with prenatal exposure. Results from large prospective studies regarding environmental pollution and brain tumor risk are inconsistent. The effect of mobile phones on brain tumor risk for glioma and meningioma in adults has not been established, but the association with acoustic neuroma is emerging as robust. The effect of mobile phones on children has not yet been studied.

According to American researchers Ostrom Q.T. et al. [7], primary brain tumors account for approximately 1% of new cancer cases and approximately 2% of cancer deaths in the United States; however, they are the most common solid tumors in children. These tumors are highly heterogeneous and can be broadly classified into malignant and benign, and the incidence of specific histologies varies by age, sex, and race/ethnicity. Epidemiological studies have identified numerous potential risk factors, and to date the only confirmed association with CNS tumors is exposure to ionizing radiation (which increases the risk in both adults and children) and a history of allergies (which reduces the risk in adults). Studies of genetic risk factors have identified 32 germline variants associated with an increased risk of developing these tumors in adults (25 in glioma, 2 in meningioma, 3 in pituitary adenoma, and 2 in primary CNS lymphoma). Further studies are currently being conducted in other histological subtypes, as well as in various pediatric brain tumors. Although identifying risk factors for these tumors is difficult due to their rarity, many existing datasets can be used for future discoveries through interinstitutional collaborations. Many institutions continue to develop large clinical databases, including prediagnostic risk factor data, and developments in the molecular characterization of tumor subtypes continue to allow the study of more refined phenotypes.

Alegria-Loyola M.A. et al. [8], in their work, indicate that recent advances in the study of the underlying oncogenic mechanisms of these tumors have led to the creation of new classification systems, which, in turn, can improve the diagnostic approach and therapeutic planning. Most of these neoplasms occur sporadically, and several risk factors have been found to be associated with their development, not only exposure to ionizing radiation or electromagnetic fields, but also the presence of comorbidities such as diabetes, hypertension and Parkinson's disease. A relatively small proportion of primary CNS tumors arise against the background of hereditary syndromes.

In addition, there are publications such as the work of Fallahi P. et al. [9]. In it, the authors note that the scientific literature suggests a connection between military profession and the development of brain tumors; however, no Italian study has examined the impact of this work on the incidence of CNS tumors. In this study, information was obtained from patients recruited from the neurosurgical department of the University Hospital of Pisa, Italy, from 1990 to 1999. The study was conducted on a case-control basis. 161 newly diagnosed cases of brain tumors (glioma and meningioma, histologically confirmed), as well as 483 control patients (with other non-neoplastic neurological diseases such as trauma, hemorrhagic brain diseases, aneurysm, etc.) were recruited by matching cases and controls (1:3), by age (± 5 years) and gender. Cases and controls were interviewed at the Neurosurgical Department of the University Hospital of Pisa, Italy, and the professional histories of cases and controls were compared.

Cases and controls showed a statistically significant difference based on their profession (military vs. non-military). A statistically significant association was observed between brain tumors and military profession among the patients studied ($p = 0.013$). The researchers say further research is needed in this population to determine the reasons for the increased risk of developing CNS tumors. In addition, subsequent re-evaluation of other patients collected in recent years will be required to assess the trend of this association.

Ostrom Q.T. et al. presented a "CBTRUS statistical report: Primary brain and other central nervous system tumors diagnosed in the United States in 2013-2017" [10]. The authors note that the Central Brain Tumor Registry of the United States (CBTRUS), created in collaboration with the Centers for Disease Control and the National Cancer Institute (NCI), is the largest population-based registry focused exclusively on the CNS in the United States (US) and represents representing the entire population of the US. This report contains the most recent population-based data on primary brain tumors (malignant and benign) and supersedes all previous CBTRUS reports in terms of completeness and accuracy. All rates (incidence and mortality) are age-adjusted using the standard US population for 2000 and are presented per 100 thousand population. The age-adjusted annual incidence rate (AAAIR) for all CNS tumors was 23.79 (malignant AAAIR = 7.08, benign AAAIR = 16.71). The rate was higher for women compared to men (26.31 vs. 21.09), blacks compared to whites (23.88 vs. 23.83), and non-Hispanics compared to Hispanics (24.23 vs. 21.48). The most common malignant tumor of the brain and other CNS tumors was glioblastoma (14.5% of all tumors), and the most common non-malignant tumor was meningioma (38.3% of all tumors). Glioblastoma was more common in men, and meningioma was more common in women. In children and adolescents (ages 0-19 years), the incidence of all primary brain tumors and other CNS tumors was 6.14. Between 2013 and 2017, 81,246 deaths were reported from malignant brain tumors and other CNS tumors. This corresponds to an average annual mortality rate of 4.42. The five-year relative survival rate after diagnosis of malignant brain tumors and other CNS tumors was 23.5%, and for benign brain tumors and other CNS tumors it was 82.4%.

A very interesting and extraordinary work was published by Frandsen C.L.B. et al. [11]. The purpose of the study was to examine the association between fertility drugs and CNS tumors. This cohort study was based on the Danish Infertility Cohort and included 148,016 infertile women living in Denmark (1995-2017). The study cohort was linked to national registries to obtain information on specific fertility medication use, cancer diagnoses, covariates, emigration, and vital status. Cox proportional hazards regression models were used to calculate hazard ratios (HR) and 95% confidence intervals (CI) for all CNS tumors and separately for gliomas, meningiomas, and various benign tumors of the brain and other parts of the CNS. During an average of 11.3 years of follow-up, 328 women were diagnosed with CNS tumors. No significant association was observed between the use of the fertility drugs clomiphene citrate, gonadotropins, gonadotropin-releasing hormone and progesterone receptor modulators and CNS tumors. However, use of human chorionic gonadotropin was associated with a reduced incidence of meningiomas (RR 0.49, 95% CI 0.28-0.87). No clear associations with CNS tumors were observed as a function of time since first use or cumulative dose of any of the fertility drugs. As a result, the authors concluded that no association was observed between the use of most types of fertility drugs and CNS tumors. However, as the researchers point out, the findings only apply to premenopausal women and additional studies with a longer follow-up period are needed.

The new 2021 World Health Organization (WHO) classification of CNS tumors has opened up a number of possibilities when interpreting clinical data. Louis D.N. et al. [12] note that the fifth edition of the WHO Classification of CNS Tumors, published in 2021, is the sixth version of the international standard for the classification of tumors of the brain and spinal cord. Building on the updated 2016 fourth edition and the work of the Consortium to Advance Molecular and Practical Approaches to CNS Tumor Taxonomy, the 2021 fifth edition introduces major changes that enhance the role of molecular diagnostics in the classification of CNS tumors. At the same time, it remains faithful to other established approaches to tumor diagnosis, such as histology and immunohistochemistry. In doing so, the fifth edition establishes some different approaches to both the nomenclature and classification of CNS tumors, and also emphasizes the importance of comprehensive diagnosis and multilevel reporting. New tumor types and subtypes are being introduced, some of which are based on new diagnostic technologies such as DNA methylome profiling.

As Gritsch S. [13] et al. point out, the 2016 revised fourth edition of the WHO classification of tumors of the CNS incorporated molecular features with histological classification, which revolutionized the way primary tumors of the brain and spinal cord are conceptualized, and also provided new insights into their treatment and prognosis. The 2021 revised fifth edition of the WHO classification

further includes molecular changes for the classification of CNS tumors, updating the current understanding of the pathophysiology of many of these diseases. The authors review changes in the new classification of the most common primary adult tumors, gliomas (including astrocytomas, oligodendrogliomas, and ependymomas) and meningiomas, highlighting key genomic changes for each classification group to help clinicians interpret them when considering treatment options, including clinical trials and targeted therapies, and to discuss the prognosis of these tumors with their patients.

Kurokawa R. et al. [14] emphasize that the new WHO CNS5 classification describes in detail numerous recently identified tumor types, including those for which limited information is available on neuroimaging characteristics. The authors describe the major changes made to WHO CNS5, including revisions to tumor nomenclature. For example, WHO stage IV tumors in the fourth edition are equivalent to WHO stage IV CNS tumors in the fifth edition, and diffuse midline glioma, H3 K27M mutant, is equivalent to midline glioma, altered H3 K27. Regarding tumor typing, glioblastoma with isocitrate dehydrogenase (IDH) mutation was modified to astrocytoma with IDH mutation. Tumor classifications now classify IDH-mutant astrocytomas based on the presence or absence of a homozygous CDKN2A/B deletion. In addition, the molecular mechanisms of tumorigenesis as well as the clinical and imaging features of tumor types recently identified in WHO CNS5 are summarized. Given that WHO CNS5 has become the basis of daily practice, radiologists should be familiar with this new edition of the WHO CNS tumor classification system.

Meredith D.M., Alexandrescu S. [15] note that the 5th edition of the WHO classification of CNS tumors presents new concepts and updated recommendations regarding the diagnostic criteria for CNS tumors. Embryonal tumors of the CNS and nonmeningothelial mesenchymal tumors of the CNS can present challenges to practicing pathologists because histologic features are not always specific and integration of microscopic and molecular data is required. This review of embryonal and nonmeningothelial mesenchymal tumors of the CNS aims to provide updated information with an emphasis on WHO changes and additions, as well as recent discoveries of diagnostic, prognostic, and therapeutic implications. Tauziède-Espariat A. et al. [16] suggest that this version of the classification of CNS tumors aligned the terminology of mesenchymal tumors with their soft tissue counterparts. New tumor types were added, such as "FET-CREB fusion-positive intracranial mesenchymal tumor," "CIC-rearranged sarcoma," and "Primary intracranial sarcoma, DICER1 mutant." Other tumors (such as rhabdomyosarcoma) have remained in the current WHO classification because these tumor types may exhibit CNS specificity compared to their soft tissue counterparts. Pizzimenti C. et al. are unanimous with previous colleagues [17]. In their literature review, they summarized the clinical, histopathological and molecular features of CNS tumors with BCOR internal tandem duplication, intracranial mesenchymal tumors with FET/CREB fusion, CNS CIC rearrangement sarcomas and primary intracranial sarcoma with DICER1 mutant, according to the 2021 WHO classification of CNS tumors.

Now, regarding the various morphological forms of CNS tumors. Zhao Z. et al. [18] provide evidence that diffuse gliomas are the most common and lethal primary tumors of the CNS. The authors emphasize that the latest 2021 WHO classification of CNS tumors has significantly changed the approach to diagnosis and decision-making. As part of the Chinese Glioma Genome Atlas project, the researchers' goal was to provide genomic profiling of gliomas in a Chinese cohort. Over the past decade, 286 gliomas of varying degrees of malignancy have been collected. The Illumina HiSeq platform generated more than 75.8 million high-quality paired-end 150-bp reads per sample, for a total of 43.4 billion reads. Colleagues also collected clinical and pathological information from each patient and used it to annotate their genetic data. All patients were diagnosed and classified by a neurologist according to the new classification. This dataset provides important reference information for researchers and will significantly advance the understanding of glioma.

Next, about germ cell tumors. As indicated by Kong Z. et al. [19], germ cell tumors of the CNS are fairly rare intracranial tumors that are mainly found in pediatrics, with significant differences in incidence depending on region and gender. Histologically, germ cell tumors of the CNS can be divided into germinomas and non-germ cell tumors. The molecular pathology of CNS germ cell tumors, especially germinomas, is mainly based on the presence of isochromosome 12p, gain of KIT gene function, and a globally low DNA methylation profile. Diagnosis and differential diagnosis are made using imaging, detection of tumor markers, surgical biopsy, and cerebrospinal fluid cytology. Germinomas are often treated with whole-ventricular radiation therapy or neoadjuvant chemotherapy combined with reduced-dose whole-ventricular radiation therapy, whereas non-germ cell tumors are primarily treated with chemotherapy, surgical resection, and radiation therapy (individually or in combination), depending on the composition tumors. Since the main patient population is children, increasing overall survival and reducing treatment

side effects should be the main goals of future research.

As noted by Marker D.F., Pearce T.M. [20], germ cell tumors of the CNS arise predominantly in the middle parts of the CNS and affect young patients in the first to third decades of life. It is believed that CNS damage is a consequence of residual primordial germ cells with incomplete embryological migration. Clinically, germ cell tumors of the CNS manifest themselves as symptoms of ventricular obstruction or compression of the affected brain structures. Histologically, these tumors are similar to their gonadal and extragonadal counterparts. Diagnosis depends largely on morphology and immunohistochemical findings and may be complicated by the limited number of tumor samples. Currently, the role of molecular research is limited. Treatment of these lesions is difficult due to the involvement of deep and vital brain structures, so accurate pathological diagnosis is necessary for proper therapy. Diagnosis should include history, imaging studies, and evaluation of tumor markers in serum and cerebrospinal fluid. Current therapeutic strategies, including radiation therapy with or without chemotherapy, are highly effective, despite localization difficulties that often prevent complete total resection.

Very rare - primary melanocytic tumors of the CNS are described by Küsters-Vandeveld H.V. et al. [21]. As the authors point out, primary melanocytic tumors of the CNS represent a spectrum of rare tumors. They can be benign or malignant and occur in both adults and children, the latter often occurring in the setting of neurocutaneous melanosis. Until recently, the genetic changes in these tumors were largely unknown. This is in contrast to cutaneous and uveal melanomas, which are known to harbor a variety of oncogenic mutations that could be targeted for treatment with small molecule inhibitors in advanced stages. New insights into the molecular alterations underlying primary melanocytic CNS tumors have recently emerged, including various oncogenic mutations in tumors from adult patients (especially GNAQ, GNA11) and children (especially NRAS).

Also rare forms (only 4 cases), such as secondary INI1-deficient rhabdoid tumors of the CNS, are described by Nobusawa S. et al. [22]. The authors point out that atypical teratoid/rhabdoid tumors (AT/RT) are rare, highly malignant neoplasms of the CNS that occur predominantly in young children and are characterized by the presence of rhabdoid cells and inactivation of INI1 or (extremely rarely) BRG1. The vast majority of AT/RTs are recognized as primary tumors; however, rare RT/RT or INI1-deficient RT have been reported arising from other primary tumors. To better characterize secondary PT, the investigators performed histological and molecular analyzes of four PT arising from pleomorphic xanthoastrocytoma (PXA), anaplastic PXA, low-grade astrocytoma, or ependymoma. Histologically, although conventional AT/RTs are not typically composed primarily of rhabdoid cells, three secondary RTs were composed primarily of rhabdoid cells, two of which, arising from (anaplastic) PXA, exhibited marked nuclear pleomorphism reminiscent of those in precursor lesions. Regarding INI1 changes, although mutations including small indels are common in conventional AT/RT, only one secondary RT had a mutation. Moreover, along with previously reported cases, biallelic inactivation of INI1 in secondary RT was mainly due to biallelic focal and/or broad deletions. Although traditional AT/RTs have stable chromosomal profiles, e.g. the frequency of copy number changes involving chromosomes other than chromosome 22 is surprisingly low, comparative genomic array hybridization analysis has revealed numerous copy number changes in secondary RT.

The so-called ghost tumors of the CNS, which are indicated by Frassanito P. et al. [23] are also very rare tumors of the CNS. As the authors note, a ghost tumor (GhT) is a mass with radiographic features consistent with a tumor diagnosis that, upon further investigation, is not a tumor, although definitions in the literature are inconsistent and the incidence of GhT remains uncertain. A review of the relevant literature was conducted to identify pediatric patients in whom an initial misdiagnosis of a mass was described. An analysis of the differential features of the final diagnosis and related clinical and radiological issues was carried out. Based on the study, GhT was classified as follows: GhT I – lesions that disappear spontaneously during observation, also known as “vanishing tumors”; GhT II, non-neoplastic tumor-like mass lesions, also known as “tumor-like lesions”; GhT III, anatomical variants of normal structures that mimic a tumor, also called “false tumors.” The most misleading conditions and critical points in the differential diagnosis of these cases are discussed. The following conclusions are drawn: GhT is a phenomenon with significant implications for treatment and outcomes. In this context, the integration of clinical and radiological data is critical for a thorough differential diagnosis and a consistent diagnostic approach, which is necessary to make adequate treatment decisions. A thorough x-ray examination is required. Atypical radiological images should raise a high level of suspicion, including incidental lesions, which are increasingly encountered in daily practice as a result of increased access to radiological testing, increased imaging sensitivity and exposure to defensive medicine. If necessary, watchful waiting should be considered.

A very pressing issue, which is also covered in literary sources, is the presence of CNS tumors during pregnancy. Eckenstein M., Thomas A.A. note [24] that CNS tumors, which typically affect the very young or very old but span a spectrum of disease, can occur in any age group. Women of reproductive age are more likely to suffer from benign tumors, including pituitary adenomas and meningiomas, as well as aggressive intracranial malignancies, such as brain metastases and glioblastoma, which are rare during pregnancy. Definitive treatment of CNS tumors may involve multimodal therapy including surgery, radiation therapy, and chemotherapy, and each of these treatments carries risks for the mother and developing fetus. CNS tumors often present with complex and painful symptoms, such as headache and seizures, which must be monitored throughout pregnancy. Decisions about timing of treatment during pregnancy or delaying treatment until delivery, continuation or elective termination of pregnancy, and future family planning and fertility are complex and require a multidisciplinary health care team to assess the consequences for both mother and child. There are no guidelines or consensus recommendations for the treatment of brain tumors during pregnancy, so individual treatment decisions are made by the treating team based on experimental data, extrapolation of recommendations for nonpregnant patients, and patient values and preferences.

Now let's discuss the aspects of diagnosing CNS tumors. EANO recommendations for the diagnosis and treatment of diffuse adult gliomas are given by Weller M. et al. [25]. The authors point out that in response to major changes in diagnostic algorithms and the publication of mature results from various large clinical trials, the European Association of Neuro-Oncology (EANO) has recognized the need to provide updated recommendations for the diagnosis and treatment of adult patients with diffuse gliomas. Through these evidence-based guidelines, the EANO Task Force provides recommendations for the diagnosis, treatment, and follow-up of adult patients with diffuse gliomas. The diagnostic component is based on the updated WHO classification of CNS tumors and subsequent recommendations from the Consortium to Inform Molecular and Practical Approaches to CNS Tumor Taxonomy - not formally WHO (CIMPACT-NOW). Regarding therapy, the authors formulated recommendations based on the results of recent practice-changing clinical trials and also provided recommendations for neuropathological and neuroradiological evaluation. In these guidelines, our colleagues defined the role of the primary treatment modalities of surgery, radiation therapy, and systemic pharmacotherapy, embracing current advances and recognizing that unnecessary interventions and costs should be avoided. This document is intended to be a reference resource for professionals involved in the management of adult patients with diffuse gliomas, patients and caregivers, and healthcare professionals.

Advances in diagnostic immunohistochemistry of primary CNS tumors were presented by Meredith D.M. [26]. The author notes that as genomic characterization becomes increasingly necessary for the accurate diagnosis of CNS tumors, the identification of rapidly detectable biomarkers is equally important to avoid excessive costs and delays in initiating therapy. A colleague describes new immunohistochemical markers that can be used to determine mutation status, activation of signaling pathways, drugable targets, and cellular origin in many different tumor types. In particular, recently added to the WHO classification of CNS tumors are gliomas with IDH mutation, diffuse midline glioma, epithelioid glioblastoma, angiocentric glioma, ependymoma with RELA rearrangement, embryonal tumors (medulloblastoma, atypical teratoid/rhabdoid glioma), pineoblastoma, embryonal tumor with multilayered rosettes and other genetically defined high-grade neuroepithelial tumors and meningiomas associated with germline changes.

Sledzińska P. et al. [27] in their study describe prognostic and predictive biomarkers of gliomas. The authors note that gliomas are the most common tumors of the CNS. New technologies, including genetic testing and advanced statistical methods, are revolutionizing the therapeutic approach to patients and opening up new treatment options. Moreover, the 2021 WHO classification of CNS tumors fundamentally changed the classification of gliomas and included multiple molecular biomarkers. In adult patients, IDH mutations are a positive prognostic marker and have the greatest prognostic significance. However, CDKN2A deletion in IDH-mutant astrocytomas is a marker of higher grade of malignancy. Moreover, the presence of TERT promoter mutations, EGFR alterations, or a combination of chromosome 7 gain and chromosome 10 loss converts IDH-wild-type astrocytoma to glioblastoma. In pediatric patients, changes in H3F3A are the most important markers predicting worse outcome. MGMT promoter methylation has the greatest clinical significance in predicting responses to temozolomide (TMZ). Conversely, mismatch repair defects cause a hypermutation phenotype predictive of poor response to TMZ. Finally, the authors discuss liquid biopsy as a promising diagnostic and prognostic tool, but further work is needed to translate these new technologies into clinical practice.

The importance of the family of disintegrins and metalloproteinases (ADAM) in malignant tumors

of the CNS is discussed by Łukaszewicz-Zajac M. et al. [28]. The authors point out that despite significant advances in diagnostic methods in medicine, CNS tumors, especially the most common of them, gliomas, remain incurable with similar incidence and mortality rates. A growing body of literature suggests that extracellular matrix degradation by matrix metalloproteinases (MMP) may be involved in the pathogenesis of CNS tumors. However, a subfamily of MMP known as disintegrin and metalloproteinase (ADAM) proteins are unique due to both adhesive and proteolytic activities. The authors note that ADAM12, ADAMTS4 and 5 have already been proven to be involved in the proliferation and invasion of glioma cells. In addition, ADAM8 and ADAM19 correlate with glioma cell invasiveness and unfavorable survival, while ADAM9, -10 and -17 are associated with tumor stage and histological type of gliomas, and can be used as prognostic factors. Finally, colleagues conclude that several ADAM may serve as potential diagnostic and prognostic biomarkers, as well as therapeutic targets, for CNS malignancies. However, future studies on the biology of ADAM should be conducted to elucidate new strategies for tumor diagnosis and treatment of patients with these malignancies.

Khan I.N. et al. [29] also talk about modern new biomarkers of CNS tumors and the possibilities of their diagnostic, prognostic, and therapeutic use. In their work, the authors note that recent investments in research related to the discovery of specific tumor biomarkers important for effective diagnosis and prognosis are beginning to bear fruit. Key biomarkers have the potential to outweigh traditional radiological or pathological methods, providing specificity for early detection when combined with tumor molecular profiling and clinical associations. Few biomarkers have been approved by regulatory authorities for the treatment of CNS tumors, despite the evaluation of a large number of CNS tumor-related markers in clinical trials. Traditional CNS tumor biomarkers include 1p/19q co-deletion, O6-methylguanine-DNA methyltransferase methylation, and IDH1/IDH2 mutations. Recently tested CNS tumor biomarkers include VEGFR-2, EGFRvIII, IL2, PDGFR, MMP, BRAF, STAT3, PTEN, TERT, AKT, NF2, and BCL2. Additional studies have identified more and more novel microRNA, circular RNA, and long noncoding RNA as promising biomarkers. Microvesicle studies point to exosomes as promising, less invasive biomarkers that can be isolated from the serum of cancer patients. In addition, cancer stem cell-related (CSC) molecules such as CD133, SOX2, and Nestin, used as CNS tumor biomarkers, can provide effective monitoring of cancer progression and/or surveillance for the emergence of new drug-resistant cells. Established protocols using new molecular markers in diagnosis, prognosis and drug development will usher in a new era of precision and personalized neuro-oncology. It is expected that the presented data will help optimize the process of biomarker research and development.

The visualization of primary CNS tumors before and after treatment in the molecular and genetic epoch is discussed by Ahn S.S. and Cha S. [30]. They point out that recent advances in the molecular and genetic characterization of CNS tumors have opened a new page in the classification, diagnosis, and prognostic evaluation of tumors. In this emerging and rapidly evolving era of molecular genetics, imaging plays a critical role in preoperative diagnosis and surgical planning, molecular marker prediction, targeted treatment planning, and posttherapeutic evaluation of CNS tumors. The authors provide an overview of modern imaging methods related to the molecular genetic classification of CNS tumors. Researchers have emphasized correlations between imaging features and specific molecular genetic markers and post-therapy imaging used for therapeutic evaluation.

Also, modern advances in the field of imaging of CNS tumors are reported by Huang R.Y., Pope W.B. [31]. In this article, the authors review recent advances in the use of standard and advanced imaging techniques for the diagnosis and treatment of CNS tumors, including glioma and brain metastases. With the recent shift from a histological approach to classifying CNS tumors to an approach that integrates histology with molecular information about the tumor, imaging approaches for CNS tumors have also been adapted to this new framework. Several challenges associated with the diagnosis and treatment of CNS tumors, such as tumor differentiation from treatment-related imaging changes, require further progress to bring advanced imaging techniques to clinical use.

An interesting and advanced method for molecular pathological profiling of selected CNS tumors using MLPA is described by Dolinová I. et al. [32]. The authors note that modern progress and growing knowledge about the genetic causes of cancer are opening up new possibilities for its treatment. However, it is necessary to combine the results obtained using classical pathological methods with sensitive, multiplex molecular pathological methods. A method that meets the necessary criteria is MLPA, based on a multiplex PCR reaction. This method detects both changes in gene copy number and DNA methylation, and, equally important, point mutations. The MLPA reaction is applicable even to highly fragmented DNA. At the same time, it is a reliable method that can be used on standard thermal cyclers: the fluorescent label on the tip requires automatic sequencers. Up to 50 genetic markers can be tested in one

reaction, allowing diagnostic and prognostic conclusions to be drawn. All these features lead to the routine use of MLPA analysis not only in diagnosis but also in cancer research.

The current role and future potential of detecting circulating tumor DNA (ctDNA) in the cerebrospinal fluid for the diagnosis and treatment of pediatric CNS tumors is presented by Miller A.M., Karajannis M.A. [33]. The authors point out to clinicians that most CNS tumors in children are located in distinct anatomical regions, making surgical resection, and in some cases even biopsy, risky or impossible. This diagnostic difficulty, coupled with the move toward molecular classification for diagnosis, has highlighted the urgent need to develop minimally invasive ways to obtain diagnostic information. In non-CNS solid tumors, detection of ctDNA in plasma and other body fluids has become part of routine practice and clinical trial design to guide molecular targeted therapy selection and longitudinal monitoring. However, in primary CNS tumors, detection of ctDNA in plasma is challenging. This is likely due, at least in part, to anatomical factors such as the blood-brain barrier. Because of the proximity of primary CNS tumors to the cerebrospinal fluid (CSF) space, researchers have turned to CSF as a rich alternative source of ctDNA. Although numerous studies have now demonstrated the feasibility of detecting CSF ctDNA in various types of pediatric CNS tumors, the optimal role and utility of CSF ctDNA in the clinical setting has not been established. Additionally, this work explores the promising opportunities that lie ahead for the integration of CSF ctDNA liquid biopsy into clinical care and clinical trial design.

Speaking about the treatment of CNS tumors, it is multifaceted and corresponds to accepted protocols. For example, Redjal N. et al. [34], in their work on guidelines for the treatment of CNS tumors, emphasize that evidence-based clinical practice guidelines for the treatment of CNS tumors continue to be developed and updated through the work of the Joint Tumor Section of the Congress of Neurological Surgeons and the American Neurological Association. The guidelines are created using the most current and clinically relevant evidence using systematic methodologies that categorize the available evidence and provide recommendations for clinical practice. This update summarizes the Tumor Section recommendations developed over the past 5 years for non-functioning pituitary adenomas, low-grade gliomas, vestibular schwannomas, and metastatic brain tumors.

The modern role of radiation therapy in the treatment of malignant tumors of the CNS is discussed by Farooqi A. et al. [35]. The researchers note that the current WHO classification of CNS tumors has undergone significant restructuring, and for the first time, gliomas are classified according to both molecular and histological parameters that determine the treatment of glioma. Radiation for intermediate-risk meningiomas improves progression-free survival compared with historical controls, and studies of atypical meningiomas are ongoing. For brain metastases, the use of stereotactic radiosurgery has entered clinical practice for a larger number of lesions. In addition, whole-brain irradiation while sparing the hippocampus holds promise for preserving neurocognitive function. This work summarizes the evolving role of radiation therapy in the treatment of CNS malignancies.

The role of partial therapy in the treatment of tumors of the skull base and CNS tumors is revealed in their study by Diehl C.D. et al. [36]. The authors point to the fact that radiation therapy is the basis of interdisciplinary treatment of tumors of the skull base and brain. Technical innovations over the past two decades have allowed for more precise treatment with better preservation of adjacent healthy tissue to prevent treatment-related side effects that affect patients' quality of life. Proton and charged ion particle therapy provides favorable kinetics with a sharp accumulation of dose at a well-defined depth (Bragg peak) and a sharp decline in radiation beyond this maximum. This review highlights the role of particle therapy in the treatment of primary brain tumors and skull base tumors.

The effectiveness of therapeutic targeting of membrane-bound proteins in CNS tumors was reported by Roy P.K. et al. [37]. Colleagues draw attention to the fact that the activity of the most complex system, which is the CNS, is deeply regulated by a huge number of membrane-associated proteins (MAP). A slight change stimulates huge chemical changes, and the induced reaction is organized by MAP, which acts as a receptor for that chemical or a channel that allows for the flow of ions. Small changes in the activity or expression of these MAP lead to serious consequences such as cognitive impairment, memory loss, or cancer. CNS tumors are heterogeneous in nature and difficult to treat due to random mutations in MAP; for example, overexpression of EGFRvIII/TGF β R/VEGFR, alteration of adhesion molecules α 5 β 3, integrin/SEMA3A, imbalance of ion channel proteins, etc. Extensive research is currently being carried out to develop new therapeutic approaches using these proteins, such as targeted cytotoxic radiotherapy, drug delivery, and prodrug activation, blocking receptors such as GluA1, development of a viral vector against a cell surface receptor. The combinatorial approach of these strategies along with the traditional one may turn out to be more promising.

The pharmacokinetic properties of anticancer drugs for the treatment of CNS tumors are covered

in detail in their work by Jacus M.O. et al. [38]. The authors emphasize that despite significant improvements in outcomes for patients with hematologic malignancies and solid tumors over the past 10 years, patients with primary or metastatic brain tumors continue to have a poor prognosis. The primary reason for this is the inability of many chemotherapy drugs to enter the brain and brain tumors in concentrations high enough to produce antitumor effects due to unique barriers and efflux transporters. Several studies have recently been published examining the CNS pharmacokinetics of various anticancer drugs in patients with primary and metastatic brain tumors. To summarize recent advances in the field, this review critically examines studies published over the past 9 years examining the brain and cerebrospinal fluid penetration of clinically available anticancer agents in patients with CNS tumors. Researchers note that despite advances in the treatment of many types of cancer, CNS tumors continue to be one of the most difficult to treat malignancies, accounting for a significant portion of cancer deaths in adults and children. Between 1995 and 2011, 5-year survival rates ranged from ~5% for patients with glioblastoma to ~83% for patients with ependymal tumors, with little change in survival over this time period. In children under 19 years of age, malignant brain tumors are the leading cause of cancer death. Five-year survival rates for pediatric CNS tumors vary widely depending on tumor type: patients with glioblastoma tumors have an 18% survival rate, compared with patients with pilocytic astrocytoma, who have a 97% survival rate. In addition to primary CNS tumors, the incidence of CNS metastases in patients with hematologic malignancies and solid tumors is increasing, and treatment options for these patients remain limited. The incidence and poor prognosis of patients with primary CNS tumors and CNS metastases highlight the need to develop new and more successful treatments. It is critical that researchers in drug development for these indications utilize knowledge of the unique pharmacokinetic properties required for drug penetration into the CNS, as well as the biological properties of the disease. Although many studies have been published describing the pharmacokinetics of drugs used to treat brain tumors in the CNS, interpretation of the results can be controversial due to differences in study designs and methodologies. Therefore, the purpose of this review is to provide a comprehensive and critical assessment of pharmacokinetic studies conducted from 2006 to the present that have examined the CNS distribution of drugs used to treat primary CNS tumors or CNS metastases.

I would also like to dwell on the work of Gatson N.T.N. [39], dedicated to the treatment of CNS tumors during pregnancy. This article discusses current recommendations and special considerations for the treatment of CNS tumors in pregnant women and provides case examples to highlight important clinical concepts. The researchers note that given that nearly 60% of all intracranial and spinal tumors, including both primary and metastatic tumors, malignant or benign, are diagnosed in women, it is fair to draw attention to the unique management considerations that relate to women during specific phases of their lives, such as pregnancy. The pregnancy phase is characterized by changes in hormonal, immunological and other physiological reactions. Although substantial evidence supports the influence of pregnancy on tumor tumorigenicity, the cumulative effect of the pregnancy state on brain tumor biology remains elusive. Moreover, as innovative cancer treatments and surveillance technologies develop, healthcare providers must consider new potential risks to safely maintain a pregnancy. The authors emphasize that informed neuro-oncology practice regarding safer surgical, radiation, medical, device, and imaging modalities is critical to maintaining pregnancy and fertility in cancer patients. Expanding this knowledge depends on advocacy and commitment to developing equitable and interdisciplinary research in this area. It also requires a focus on patient-reported outcomes and patient-centered conversations to provide the best care for pregnant women with CNS tumors.

Now, as for this pathology in our country. The incidence of CNS tumors in the Republic of Kazakhstan in 2022 was 4.2 (4.1 - men; 4.3 - women) per 100 thousand population with a growth rate compared to the previous year of 4.5% (4.0 - in 2021 year), which in absolute numbers amounted to 815 people (765 cases in 2021), taking 16th rank. The share of cases diagnosed for the first time in life, recorded by oncology organizations, was 2.3%, the same as a year earlier. At the same time, 387 people fell ill among men (specific gravity - 2.6%, rank 12), women - 428 (specific gravity - 2.1%, rank 14). Despite the fact that more women fell ill, the share and ranking of places turned out to be lower. This is, of course, due to the high incidence of breast cancer in the female population (5171 people) and oncogynecological pathology - cervical cancer (1934 women), uterine cancer (1315 cases) and ovarian cancer (1201 women [40].

The incidence of CNS tumors was found to be higher than the national average in 9 regions of the country: Zhetysay - 7.4 (maximum); Aktobe - 6.2; Almaty city - 5.4; Pavlodar - 5.0; Karaganda - 4.8; Kostanay - 4.7; North Kazakhstan - 4.6; Zhambyl - 4.5 and Akmola - 4.3. In parity with the republican average - Astana. The indicator is also lower than the national average in 9 regions: in Shymkent city - 2.2 (the

lowest level); Turkestan - 2.3; West Kazakhstan – 2.8; Abay - 3.1; Mangystau - 3.5; Almaty and Kyzylorda – 3.8; East Kazakhstan and Atyrau - 4.1 regions per 100 thousand population.

The mortality rate from this pathology was 1.6 (men – 1.9; women – 1.4) per 100 thousand population. In the structure of causes of mortality for people of both sexes in 2022, this pathology ranks 13th, amounting to 2.4%, and in absolute numbers - 319 people. Of these: 182 are men (share: 2.6%, 12th place); 137 – women (share – 2.2%, 13th place).

The regions where the mortality rate from CNS tumors is higher than the national average (1.6 per 100 thousand population) include: North Kazakhstan – 3.2 (maximum level); East Kazakhstan – 3.0; Pavlodar - 2.4; Kostanay - 2.2; Karaganda - 2.1; Zhetysu and Almaty city – 2.0; Akmola and Astana - 1.9; Zhambyl and West Kazakhstan – 1.8. The lowest indicators were noted in Kyzylorda - 0.6 (minimum level); Shymkent city – 0.7; Mangystau - 0.9; Almaty – 1.0; Turkestan and Aktobe - 1.1; Abay and Atyrau regions – 1.5 regions per 100 thousand population [40].

The number of deaths from malignant tumors of the CNS that were not registered with oncology organizations and were diagnosed posthumously in the Republic of Kazakhstan was 15 people; at the same time, the share was 1.8% and 6th ranking place.

At the same time, the one-year mortality rate was 18.2%, taking, together with malignant tumors of connective and soft tissues, 11th ranking place in this indicator. The ratio between one-year mortality and neglect (stage IV) was 11.3 in 2022 and this is the highest figure among all nosological forms of malignant neoplasms in our country. At the same time, let us recall that the furthest distance from “1” is the worst ratio between the indicators of one-year mortality and neglect. In other words, this is the worst indicator, and the closest “competitor” - esophageal cancer - lagged behind by more than 2 times (the ratio between one-year mortality and neglect is 5.2).

The regions where the proportion of patients with early stage I of the pathology in question is above the national average (6.3% - 6th rank among the worst indicators) include the following regions: Astana city - 39.6%; (maximum indicator); North Kazakhstan - 20.0%; Aktobe - 14.0% and Almaty city - 8.9%.

The lowest rates of early diagnosis were stated in: Abay, Almaty, East Kazakhstan, West Kazakhstan, Zhambyl, Zhetysu, Mangystau, Kyzylorda, Kostanay, Turkestan and Shymkent city - 0.0% (i.e., not a single patient with tumors of the CNS detected at stage I of the disease); Pavlodar - 2.8%; Karaganda - 3.2%; Atyrau - 3.6% and Akmola - 5.9% regions of the country [40].

Unfortunately, for a number of reasons, which include objective reasons, only every fourth patient with malignant neoplasms of the CNS is detected in the early (I-II) stages of this pathology.

The regions where the proportion of patients with CNS tumors detected at stages I-II is above the national average (23.3% - 4th rank “from the bottom”) include the following regions. There are 3 regions in the top three uncontested leaders: Aktobe - 86.0% (the maximum value in the republic); Shymkent city - 84.0% and Pavlodar - 72.2%. Next, by a large margin, are: Astana city - 41.5%; North Kazakhstan - 36.0%; Karaganda - 29.0% of the region and Almaty city - 28.6%. At the same time, not a single patient was identified at the early stages in: Abay, Almaty, Zhambyl, Zhetysu, Mangystau, Kyzylorda and Kostanay regions - 0.0%. Low rates of early diagnosis were also stated: in Turkestan - 2.1%; East Kazakhstan – 4.0%; West Kazakhstan – 6.3%; Atyrau - 7.1% and Akmola - 8.8% regions of our republic [40].

As is clearly seen from the above data across the country, there is a very wide range in early diagnosis indicators, from very good to depressing. Of course, it is necessary to take into account migration processes and other factors influencing early diagnosis rates, but nevertheless, the results speak for themselves.

The proportion of stage IV CNS tumors among all nosological forms of malignant neoplasms was 3.8%. Despite the fact that this is only the 24th ranking place for this indicator, there are no illusions in this regard, since in the early (I-II) stages, as noted above, 23.3% of patients were identified. The overwhelming number of patients with CNS tumors were identified at locally advanced stage III of the disease with locoregional involvement, amounting to 72.9%.

As for the average republican indicator of the share of stage IV, the Karaganda region stands out against this background, where this parameter was 35.5%. This is followed by the following regions: Pavlodar - 5.6%; Turkestan - 4.3%; Shymkent city – 4.0%; Astana city – 1.9%; Aktobe - 1.8%; Almaty city – 0.9%. In the remaining 12 areas, advanced stage IV was not detected [40].

Statistical data on patients diagnosed with malignant neoplasm who have been under observation for 5 years or more and continue to be observed in 2022 showed that the number of patients under the supervision of oncological organizations in Kazakhstan for more than five years continued to grow and at the end of the reporting year amounted to 110790 people, with an increase of 6.6% (2021 - 103,935 people, +4.4%) (form No. 7). The share of this category of patients or five-year survival rate for malignant

neoplasms with an upward trend is 55.3% (55.0% in 2021).

We cannot ignore such an important clinical aspect as the coverage in the Republic of Kazakhstan of special treatment for patients diagnosed with a malignant neoplasm of the CNS for the first time in their lives. At the end of 2022, the absolute number of people who completed specialized treatment was 334 people, with even more continuing treatment - 344 patients. The following results were obtained in percentage terms by methods and types of treatment. Only 19.8% of patients received surgical treatment, only radiation – 16.8%, only medication – 4.8%, combined – 31.4%, complex – 21.9% and chemotherapy – 2.1%.

Further regarding the five-year survival rate of patients. As for CNS tumors, at the end of 2022, 4,730 people were registered at the dispensary, or 24.3 per 100 thousand population. At the end of 2021 - 4487 patients or 23.5 per 100 thousand population, respectively.

At the same time, the mortality rate of the observed contingents in 2022 decreased compared to the previous year and amounted to 6.7% in 2022 (8.1% in 2021).

The five-year survival rate of patients with CNS tumors was 55.6% in 2022 and 54.2% in 2021 [40].

Summarizing the above, we can conclude that malignant neoplasms of the CNS occupy a significant place among all existing malignant tumors of other localizations. At the same time, despite the small percentage of patients detected at stage IV, taking into account a number of factors, early diagnostic indicators do not allow oncologists to “sleep peacefully”, since locally advanced stage III, which significantly predominates over all stages, in addition to its prevalence itself, gives a large number of complications in connection with the location of vital centers and tissue structures near the primary focus and locoregional metastases. The variability and veiling of symptoms, its similarity with various non-core processes, leads to neglect of the disease. All this requires both oncologists and, first of all, primary health care workers and, of course, neurologists to increase the level of oncological alertness, inform the population about early symptoms that may indicate this pathology or the onset of proliferative changes and carrying out high-tech diagnostic measures and, as a result, timely treatment. People at risk due to a genetic factor are recommended to visit a neurologist annually and, if necessary, undergo examination.

The new version of the WHO CNS5 Tumor Classification has opened up a number of possibilities for the interpretation of clinical data, as well as major changes that increase the role of molecular diagnostics in the classification of CNS tumors and discoveries of diagnostic, prognostic and therapeutic value by informing specialists about molecular and practical approaches to CNS tumor taxonomy. The molecular mechanisms of oncogenesis have been systematized. Both updated recommendations regarding diagnostic criteria for CNS tumors and new tumor types and subtypes are presented, some of which are based on new diagnostic technologies such as DNA methyloma profiling.

An epidemiological assessment of the situation with tumors of the central nervous system in our country suggests that there are sometimes significant differences between regions not only in incidence rates, but also in the parameters of early diagnosis and mortality from this pathology. In connection with the above, this pathology continues to be a serious problem of modern clinical oncology.

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Pedagogical sciences

FORMATION OF ENVIRONMENTAL EDUCATION AND CULTURE OF STUDENTS BASED ON THE NATIONAL NATURE PARKS OF KAZAKHSTAN

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Abstract

This article examines the issue of fostering students' environmental education and culture based on the national parks of Kazakhstan. The aim of the study is to analyze the effectiveness of integrating natural parks into the environmental education process and propose ways to improve it. The study explores the environmental education system in Kazakhstan, educational and cognitive activities conducted in natural parks, as well as the importance of ecological expeditions and scientific research. Additionally, the role of ecological projects and volunteer initiatives in developing students' environmental awareness is analyzed. The research findings indicate that educational activities conducted in a natural setting are significantly more effective in fostering environmental culture compared to traditional methods. The integration of national parks into the educational process, the promotion of ecological projects, and the use of digital technologies can enhance the quality of environmental education.

Keywords: *environmental education, national parks, ecological culture, environmental awareness, sustainable development, nature conservation, ecological tourism, ecological projects, environmental sustainability, volunteer initiatives.*

Introduction.

Currently, environmental issues are relevant at the world level. Depletion of natural resources, reduction of Biological Diversity, climate change and environmental pollution are some of the most serious challenges facing humanity. To solve these problems, one of the main tasks is to raise the environmental awareness of society and form the responsibility of the younger generation for nature. Improving the system of environmental education in Kazakhstan and using national natural parks in this process is one of the most effective ways to form an ecological culture [1]. In this regard, the development of environmental education of students based on the National Natural Parks of Kazakhstan is considered as an urgent problem. The problem under study is currently being studied from a scientific and pedagogical point of view. The theoretical and methodological foundations of environmental education and upbringing are considered in the works of a number of scientists. Although Kazakh and foreign researchers have studied the importance and methods of forming an ecological culture, the problem of comprehensively considering national natural parks as a means of environmental education still needs a deeper study. In this regard, the scientific novelty of the study is the identification of effective methods and mechanisms for the formation of environmental education on the basis of National Natural Parks of Kazakhstan.

The problem under study is currently being studied from a scientific and pedagogical point of view. The theoretical and methodological foundations of environmental education and upbringing are considered in the works of a number of scientists. Although Kazakh and foreign researchers have studied the importance and methods of forming an ecological culture, the problem of comprehensively considering national natural parks as a means of environmental education still needs a deeper study. In this regard, the scientific novelty of the study is the identification of effective methods and mechanisms for the formation of environmental education on the basis of National Natural Parks of Kazakhstan. The main goal of the study is to identify effective ways of formation of environmental education and culture of students based on the National Natural Parks of Kazakhstan. To achieve this goal, the following tasks are set: to determine the role of national natural parks in the system of environmental education, to analyze the methods of environmental education on their basis and to propose scientific and methodological foundations for the formation of environmental culture in educational institutions. The importance of the study is determined by the development of effective methods for the formation of the ecological culture of students and their application in practice. Environmental education is effective only if it is carried out

on a practical basis, and not limited to theoretical knowledge. National natural parks of Kazakhstan, as such a practical educational environment, can play an important role in the formation of ecological culture. The results of the study contribute to improving environmental education in the education system, increasing the responsibility of future generations to protect nature and implementing the principles of sustainable development.

Materials and methods. The study used methods of theoretical analysis and pedagogical experiment. Scientific papers, legislative documents and international experience were analyzed to determine the role of environmental education and national natural parks in Kazakhstan. The experiment was carried out with 15 students studying in the 7th grade of a comprehensive school. Virtual trips and environmental events were organized for students in national natural parks (Zailiyskiy-Alatau, Borovoe, Katon-Karagay). In order to determine the level of knowledge, emotional relationships and practical actions, survey and control methods were used. The results obtained were analyzed quantitatively and qualitatively.

Results.

Experimental work was carried out on the formation of environmental education and culture of students using the potential of national natural parks of Kazakhstan (Zailiyskiy-Alatau, Borovoe, Katon-Karagay, etc.). Students' environmental knowledge, emotional attitude to nature, the level of participation in environmental activities and norms of environmental behavior were evaluated. Before the experiment, the majority of students showed low and medium levels of environmental literacy, and after the experiment, the indicator of high levels increased significantly.

Table 1

Assessment of the effectiveness of the formation of environmental education and Culture on the basis of National Natural Parks

Nº	Evaluation criteria	Low level (%)	Medium level (%)	High level (%)
	<i>Before the experiment</i>			
1	<i>Ecological knowledge level</i>	40%	47%	13%
2	<i>Interest and emotional attitude to nature</i>	47%	40%	13%
3	<i>Participation in environmental protection efforts</i>	53%	40%	7%
4	<i>Environmental culture and norms of behavior</i>	60%	33%	7%
	<i>After the experiment</i>			
1	<i>Ecological knowledge level</i>	7%	33%	60%
2	<i>Interest and emotional attitude to nature</i>	0%	20%	80%
3	<i>Environmental protection activities</i>	13%	27%	60%
4	<i>Environmental culture and norms of behavior</i>	13%	27%	60%

As shown in the table, the indicators after the experiment increased significantly. Especially high results were obtained according to the criteria of "emotional attitude to nature" and "level of Environmental Education".

As a result of the experiment, the effectiveness of the work on the formation of environmental education and Culture on the example of National Natural Parks of Kazakhstan was proved. Students' responsibility for nature and environmental literacy increased, which improved their careful attitude to nature in everyday life.

Discussion

Based on the results obtained, it can be seen that the activities and classes carried out on the basis of national natural parks had a positive impact on the formation of environmental education and culture of students. Prior to the experiment, most students were not interested in environmental education and conservation activities or did not show activity in this direction. However, the work carried out aroused the interest of students and taught them to consciously and responsibly approach the problems of the environment.

On the other hand, positive dynamics were observed in terms of emotional attitude and practical actions aimed at protecting nature. This contributed to the increase in environmental awareness of students, as well as the formation of a true internal motivation for the protection of nature. The fact that students began to take care of nature was noticed in their behavior and habits in everyday life, which, in turn, became the basis for an increase in the overall ecological culture. The study also proves that the effective integration of national natural parks into the educational process is a real and effective method for the development of environmental education and culture.

Through this method, students begin not only to understand environmental issues more deeply, but also to understand their personal responsibilities in relation to nature. Our study, dedicated to the formation of environmental education and culture of students based on the National Natural Parks of

Kazakhstan, showed the importance of environmental activities in the educational process. As a result of surveys and observations, it was found that the ecological culture of students is formed at different levels depending on age. Although the attitude of Primary School students to environmental education and the environment is relatively low, it has been observed that they are interested in nature and quickly perceive new information. In the middle and senior grades, as well as among students, it has been observed that environmental awareness is formed at a higher level, which indicates that they tend to take a more conscious approach to the protection of nature and the environment [2].

In the course of environmental education, it was found that practical classes and excursions to natural parks have a positive impact on the ecological culture of students. After participating in environmental events, it can be seen that the ecological consciousness and attitude of students to nature have significantly changed. The results of this study coincide with the research of world and Kazakhstani scientists in the field of environmental education [3].

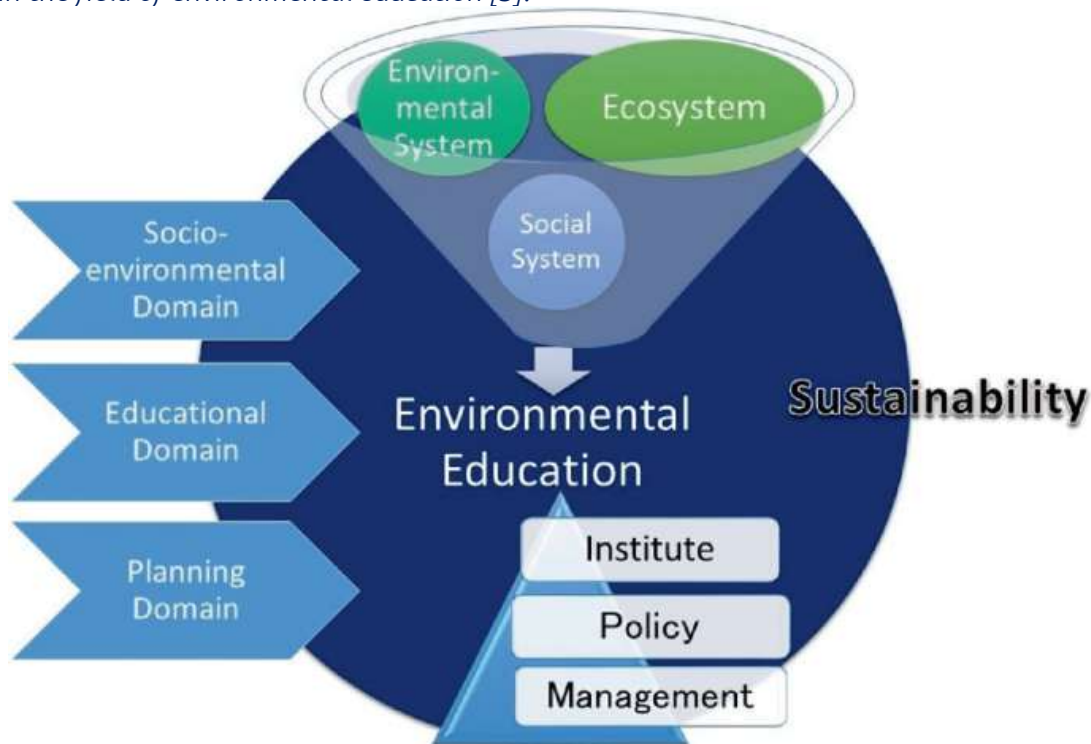


Figure 2-comparative analysis of Environmental education practices

In international practice, the use of natural parks and reserves in environmental education is widely used. For example, in the United States and Europe, environmental education programs for schoolchildren and students are organized in special natural reserves. Numerous studies have shown that education in the natural environment contributes to the rapid assimilation of environmental values by students. For example, in his work, Jensen emphasizes that one of the most effective ways to form an ecological culture is to connect students directly with nature. His study has proven that classes held in natural parks are much more effective than traditional ecology lessons at school. This conclusion fully coincides with the results of our study, since there was an increase in the environmental awareness of students after organized practical classes in natural parks [4].

Kazakh researchers also emphasize the need to strengthen environmental education. For example, Ospanova and Suleimenova in their research talk about the lack of practical methods in the system of environmental education in the country and emphasize the importance of ecological expeditions and practical classes held in natural parks. Our study supports this point of view, as work with students shows that knowledge gained in the natural environment forms their ecological consciousness more efficiently than traditional classroom lessons [5]. In Asian countries, innovative approaches to environmental education are widely used. For example, in Japan, environmental projects, expeditions to natural parks, and practical classes are included in school curricula to form an ecological culture. Research conducted by Japanese scientists shows that the combination of theory and practice plays a huge role in the development of environmental awareness. This echoes the results of our study, as it was found that students who participated in environmental activities had a significantly increased responsibility for the protection of nature [6].

The data obtained during the study showed that several main factors influence the formation of an ecological culture. First of all, the introduction of natural parks in the process of environmental education contributes to improving students' knowledge of the environment and the formation of their conscious vision of the need for nature protection. Secondly, the age of students affects the level of development of their environmental consciousness. Although the level of acceptance of environmental knowledge varies depending on age, the importance of practical activities has been observed in all age groups. One of the most important conclusions obtained during the study is the effectiveness of environmental activities. The level of ecological culture of students who participated in environmental projects, practical classes in natural parks and volunteer movements was significantly higher. This conclusion indicates the need for widespread introduction of practical classes conducted in the natural environment in educational programs for the development of environmental awareness.

The impact of media and digital technologies on environmental education is becoming especially important today. Along with the development of Information Technology, the process of Environmental Education has also reached a new level. Social networks, mobile applications, and online platforms are widely used to disseminate information about environmental issues. Virtual excursions, mobile games and animated films developed for the purpose of Environmental Education play a significant role in the formation of the ecological culture of students. In addition, social networks make it possible to organize environmental movements and campaigns, involve the public in environmental issues. The importance of environmental education on the basis of national natural parks is growing. It is possible to form an ecological culture of students by improving the system of environmental education in Kazakhstan, conducting educational and educational events in natural parks, organizing environmental expeditions and developing ecotourism. There is an opportunity to increase the effectiveness of environmental education by introducing natural parks into curricula, supporting environmental projects and volunteer movements, as well as using media and digital technologies. Thus, for the formation of a culture of conservation, it is necessary to use integrated and systematic approaches, which will contribute to strengthening students' responsibility for the environment.

Conclusion.

The study of the problem of the formation of environmental education and culture of students based on the National Natural Parks of Kazakhstan once again proved the importance of education in the natural environment. Environmental education is a comprehensive process aimed at educating the younger generation to respect nature, protect it and adhere to the principles of sustainable development. The results of the study show that natural parks are the most effective platform for environmental education and education, as they allow schoolchildren and students to establish direct contact with nature, a deeper understanding of the importance of the environment and the formation of environmental awareness. The results of the study revealed the importance of active use of national natural parks in the educational process. To increase the effectiveness of environmental education, it is necessary to include natural parks in training programs, organize practical classes and Field Research. In addition, for the development of environmental awareness, it is proposed to support environmental projects, activate volunteer movements and use digital technologies in environmental education. The use of national natural parks as a center for environmental education will increase students' responsibility for nature and form their ecological culture. This has a positive impact not only on the protection of the environment, but also on the sustainable development of society. Therefore, the implementation of environmental education in the natural environment and the transformation of national natural parks into a key part of this process should be considered as an important direction of environmental education.

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METHODOLOGICAL BASIS FOR USING ROLE PLAYING GAMES TO DEVELOP INTERCULTURAL COMMUNICATION SKILLS IN A FOREIGN LANGUAGE

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Abstract

This article examines the methodological foundations of using role-playing games (RPGs) to develop intercultural communication skills in foreign language education. The theoretical chapter highlights key frameworks, including Communicative Language Teaching and Sociocultural Theory, emphasizing RPGs' ability to simulate real-life cultural interactions. Intercultural competence, encompassing cultural awareness and empathy, is identified as essential for language learners.

The practical chapter outlines strategies for implementing RPGs, such as designing culturally diverse scenarios and encouraging active participation. Techniques for preparation, facilitation, and reflection are discussed, along with solutions to common challenges. The article aims to guide educators in enhancing learners' intercultural skills effectively.

Keywords: *Role-playing games, intercultural communication, language education, cultural competence, experiential learning, teaching strategies, classroom techniques.*

Introduction

In today's interconnected world, intercultural communication skills have become a crucial component of foreign language education. As people from diverse backgrounds engage more frequently in global communication, the ability to understand, respect, and adapt to cultural differences is essential for effective interaction. Language learners must go beyond linguistic competence and develop the ability to navigate cultural nuances, which requires more than traditional classroom instruction.

Role-playing games (RPGs) have emerged as a dynamic and effective tool to address this challenge. By simulating real-world scenarios, RPGs provide learners with the opportunity to practice communication in culturally diverse contexts, fostering both language proficiency and intercultural awareness. This article explores the methodological basis for using RPGs to develop intercultural communication skills in a foreign language. The theoretical chapter examines key educational frameworks and theories that support the use of RPGs in language learning, while the practical chapter provides strategies, activities, and techniques for implementing RPGs in the classroom. Through this exploration, the article aims to guide educators in integrating RPGs into their teaching practices to enhance students' intercultural competence and language skills.

Theoretical chapter: foundations of role-playing games in language learning

Role-Playing Games in Education

Role-playing games (RPGs) are increasingly recognized as a valuable tool in language education due to their ability to engage students in active, contextualized communication. As noted by Oasistan et al. [1], role-playing allows learners to step into different roles, offering them an opportunity to practice real-world language use and cultural exchanges in a simulated environment. RPGs move beyond traditional language drills, enabling learners to experience language within diverse sociocultural contexts. In this sense, they provide a safe, low-risk setting for experimentation and reflection on cultural practices. The history of RPGs in education shows a steady evolution from simple classroom simulations to more complex, digitally-mediated experiences, as highlighted by The Role of Games in the Process of Teaching Foreign Languages [4]. These developments suggest that RPGs can offer a more interactive and immersive learning experience than conventional teaching methods.

Theoretical Frameworks Supporting RPGs in Language Learning. Role-playing games are grounded in several influential language learning theories that emphasize interaction, experiential learning, and cultural competence.

Communicative Language Teaching (CLT)

Communicative Language Teaching (CLT), a widely recognized approach, prioritizes communication in authentic contexts. RPGs align well with CLT principles, as they create opportunities for real

communication, mirroring situations students may encounter in everyday interactions. *Role Play - An Effective Approach to Developing Overall Communicative Competence* [3] notes that role-play activities push students to use the language creatively and adaptively, focusing on meaning rather than just form.

Sociocultural Theory (Vygotsky)

Vygotsky's Sociocultural Theory emphasizes the importance of social interaction and cultural context in the learning process. In this view, learning is not an isolated cognitive task but a socially mediated process. By participating in role-play, students engage with peers, practicing language in social contexts that reflect cultural diversity. As Vygotsky suggests, these interactions enable learners to internalize new knowledge through dialogue, scaffolding, and collaboration, essential components of effective language development.

Practical chapter: strategies and techniques for using role-playing games in intercultural communication skills development

Cultural Role-Play Dialogues

In this activity, students take on roles in dialogues that simulate real-life interactions between individuals from different cultural backgrounds. For example, one student could play the role of a tourist visiting a foreign country, while another could take the role of a local shopkeeper. The aim is for students to navigate cultural differences in their conversations, such as differences in politeness, gestures, or conflict resolution strategies. This type of role-play helps students develop both their language skills and their ability to communicate effectively across cultures.

Problem-Solving Scenarios

Problem-solving role-plays are designed to simulate complex intercultural issues that require students to collaborate and find solutions. These scenarios could involve negotiating cultural misunderstandings, addressing conflicts between cultural values, or making decisions that take into account cultural differences. For instance, students could role-play a situation where two colleagues from different cultural backgrounds must collaborate on a project, but they have different approaches to communication or time management. These activities encourage students to think critically, negotiate, and practice adaptive communication strategies.

Simulating Cultural Immersion Experiences

Another technique is to simulate cultural immersion through role-play, where students assume the roles of individuals who are living in a foreign country. Students can practice navigating everyday situations such as ordering food at a restaurant, asking for directions, or attending a social event. In these activities, students are challenged to use the language in a culturally appropriate manner, while also gaining insight into the norms and practices of the target culture. This type of role-play is particularly beneficial in enhancing students' ability to adapt to different cultural environments.

Using Technology and Digital Tools

The use of technology can enhance the role-playing experience, particularly in the context of virtual or hybrid classrooms. Online platforms, interactive apps, or virtual reality tools can provide immersive environments where students engage in role-plays with peers from different cultural backgrounds. This not only increases the realism of the scenarios but also offers students the opportunity to practice intercultural communication in diverse global contexts. Oasistan et al. [1] highlight the effectiveness of technology-enhanced role-playing games in promoting intercultural competence, as they provide opportunities for students to interact with virtual characters or real people from various cultures.

Cultural Competence Rubrics

Using rubrics to assess students' cultural competence is another useful strategy. These rubrics can evaluate students' ability to understand and navigate cultural differences, as well as their effectiveness in communicating across cultures. The criteria might include aspects such as cultural awareness, empathy, adaptability, and communication strategies.

Methodology

Research Design

This research employed a qualitative approach to explore the effectiveness of role-playing games in developing intercultural communication skills among third-year university students. A qualitative methodology was chosen because the study focused on observing behavioral changes, language adaptation, and intercultural sensitivity, which are better captured through descriptive analysis rather than numerical data.

Participants

The participants of the study were 20 third-year students majoring in English Philology at South Kazakhstan Pedagogical University. All participants were native speakers of Kazakh with an intermediate

to upper-intermediate (B1–B2) level of English proficiency. The students, aged between 20 and 22, voluntarily took part in the research as part of their academic practice.

Setting and Duration

The practical sessions were conducted over a seven-week period, with two sessions per week. Each session lasted 50 minutes. The lessons took place in a regular classroom environment equipped with basic audiovisual materials.

Data Collection Methods

To gather rich qualitative data, the following methods were used:

1. *Observation:* Detailed notes were taken during role-playing sessions, focusing on students' communication strategies, language use, and nonverbal behavior.
2. *Student Reflections:* After each role-play, students completed brief written reflections on their experiences, highlighting challenges faced and strategies used.
3. *Peer Feedback:* Students provided feedback to each other based on specific criteria related to intercultural communication (e.g., appropriateness of behavior, clarity of expression, cultural sensitivity).

Procedure

The research procedure consisted of three main stages:

1. *Preparation:* Students received basic theoretical input on intercultural communication, cultural differences, and key language strategies.
2. *Role-Playing Activities:* Students participated in structured role-playing scenarios representing real-world intercultural encounters. Each scenario was designed to challenge students to adapt their language and behavior to different cultural contexts.
3. *Reflection and Feedback:* After each activity, students engaged in reflective discussions and peer feedback sessions to consolidate their learning.

Data Analysis

The collected data were analyzed using a thematic analysis approach. Common patterns, behaviors, and communication strategies were identified across student reflections, observations, and feedback. Special attention was paid to indicators of intercultural competence, such as flexibility in communication, awareness of cultural norms, and appropriate language use.

Ethical Considerations

Participation in the study was voluntary. All students were informed about the purpose of the research and consented to the use of their anonymized reflections and role-play observations for research purposes. Confidentiality was maintained throughout the study.

Results

The practical implementation of role-playing games as a method for developing intercultural communication skills among third-year university students yielded highly positive and observable results. Over the course of the practice sessions, data were systematically collected through classroom observations, student reflection sheets, peer feedback forms, and teacher field notes. The analysis of these data revealed several important findings, illustrating the effectiveness of role-playing games in enhancing students' intercultural competence.

Improvement in Intercultural Awareness

One of the most significant outcomes observed was a marked improvement in students' intercultural awareness. Students demonstrated increased sensitivity toward cultural differences in communication styles, norms, values, and behaviors. After participating in multiple role-playing scenarios, 85% of students noted in their written reflections that they became more aware of the importance of adapting speech patterns, nonverbal gestures, and interactional strategies according to the cultural background of their interlocutors.

Students began to recognize specific intercultural elements such as appropriate levels of formality, acceptable proxemics (use of personal space), eye contact norms, and the distinction between direct and indirect communication styles. These observations were particularly evident in role-plays involving culturally diverse interactions.

For example, in a scenario simulating a business meeting between American and Japanese participants, students accurately identified and adapted to the Japanese preference for indirect negotiation strategies and the American tendency toward directness and efficiency-focused dialogue. This showed that students not only understood theoretical differences but could also apply their knowledge in practice.

Moreover, students frequently reflected on the importance of avoiding ethnocentrism — the tendency to view one's own culture as the standard — and emphasized the need for open-mindedness and flexibility when communicating with individuals from different cultural backgrounds.

Development of Communicative Flexibility

Another key result was the development of communicative flexibility among the participants. Many students shifted away from rigid, scripted language use typical of textbook exercises and instead adopted a more dynamic, context-sensitive approach to communication. They demonstrated an ability to adjust tone, vocabulary, politeness strategies, and even nonverbal cues to fit the specific cultural and situational context of the role-play scenarios.

Throughout the practice sessions, students became more skilled at using strategies for polite disagreement, negotiating meaning, giving nuanced opinions, and making culturally appropriate requests.

For example, during a travel-related role-play where a tourist had to resolve a misunderstanding at a hotel, students successfully employed polite language structures such as "I apologize for the confusion" and "Would it be possible to...", instead of more direct or potentially confrontational phrases.

This flexibility is a crucial element of intercultural competence, as it enables communicators to adapt to unfamiliar social norms and to maintain effective communication despite cultural differences. The ability to monitor and adjust one's communicative behavior in real-time indicates a sophisticated level of intercultural understanding.

Increased Confidence in Intercultural Communication

The practice sessions also led to a noticeable increase in students' confidence when engaging in intercultural communication. Reflection sheets and informal post-session interviews indicated that by the end of the practice period, 90% of students felt more comfortable initiating and maintaining conversations with individuals from diverse cultural backgrounds.

Students reported a reduction in communication anxiety, particularly in situations where mistakes or misunderstandings could occur. They increasingly viewed mistakes not as failures, but as opportunities for learning and relationship-building, in line with the communicative approach that values interaction over linguistic perfection.

For example, one student reflected: "Even if I make grammar mistakes, now I know that it is more important to be polite and try to understand the other person's culture. I feel less afraid to speak with foreigners now because I focus on respect and kindness first."

This attitudinal shift is critical for future real-world communication, as intercultural interactions often require patience, empathy, and resilience in the face of ambiguity or unexpected cultural differences.

Language Development

Although the primary focus of the research was the development of intercultural competence, language improvement was also a significant secondary outcome. Students demonstrated notable enrichment of their pragmatic competence — that is, their ability to use language appropriately in various social and cultural contexts.

Key areas of linguistic growth included:

- The use of polite and indirect requests.
- Diplomatic language for giving feedback and disagreeing.
- Vocabulary related to cultural practices, etiquette, and customs.

For example, in post-activity discussions and debriefing sessions, students increasingly used expressions such as:

- "Would you mind if...?"
- "In our culture, it is considered polite to..."
- "I understand your point of view; however, in my country, we usually..."

Such language use indicates an improvement not only in grammatical accuracy but also in sociolinguistic and pragmatic awareness — essential components of communicative competence.

Students also reported that role-playing helped them to internalize functional language patterns more effectively than traditional memorization techniques, confirming findings in previous studies on experiential learning.

Common Difficulties

Despite the overall success of the role-playing methodology, several common difficulties were identified during the practice period.

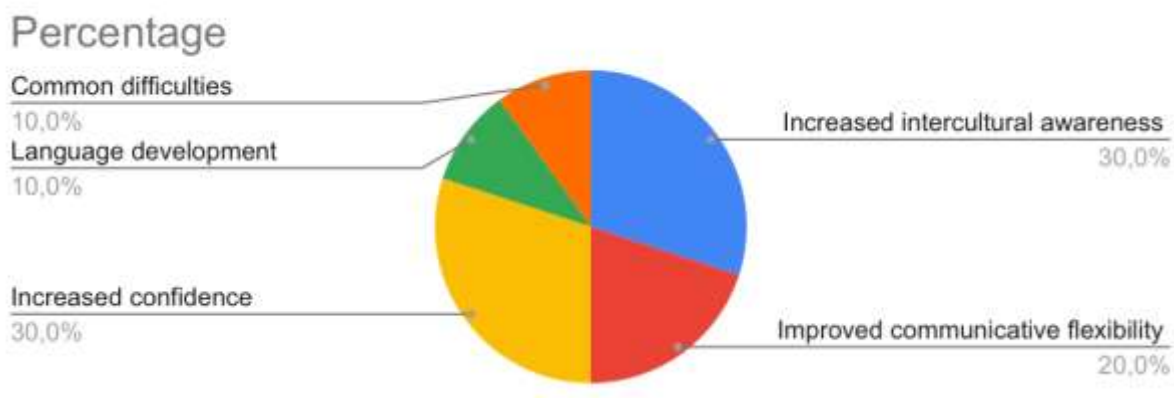
First, some students initially struggled with aspects of nonverbal communication, such as managing eye contact appropriately, interpreting gestures correctly, or respecting personal space norms.

Nonverbal cues are deeply culturally embedded, and misunderstanding them can lead to communication breakdowns.

For example, students sometimes maintained prolonged eye contact when playing characters from cultures where such behavior is considered disrespectful, requiring corrective feedback and reflection.

Secondly, a tendency to overgeneralize cultural characteristics was noted, especially in the early sessions. Some students made stereotypical statements (e.g., "All Japanese are very shy"), reflecting a superficial understanding of cultural norms. However, continuous feedback and critical discussions helped students recognize the danger of stereotyping and encouraged them to adopt a more nuanced, individualized approach to cultural interpretation.

Thirdly, balancing the authenticity of the role-play with the need for accurate language use proved challenging for lower-intermediate students. In some cases, students prioritized "acting" over careful language production, leading to minor breakdowns in fluency or coherence. This finding suggests the importance of scaffolding role-play activities according to students' linguistic levels and providing appropriate language support.



Conclusion

Role-playing games (RPGs) offer an effective and dynamic approach to enhancing intercultural communication skills in foreign language learning. By immersing students in culturally rich, interactive scenarios, RPGs not only promote language proficiency but also foster cultural understanding, empathy, and adaptability. The theoretical foundations of RPGs, grounded in communicative language teaching, sociocultural theory, and experiential learning, underscore their potential to support language learners in real-world communication contexts.

The research conducted among third-year university students confirmed the effectiveness of role-playing games as a methodological tool for developing intercultural communication skills in foreign language learning. Through carefully structured role-play scenarios, students were able to simulate authentic intercultural interactions, practice adaptive communication strategies, and enhance their cultural awareness in a supportive environment.

The practical implementation demonstrated that role-playing activities foster not only linguistic competence but also key intercultural skills such as empathy, flexibility, and the ability to navigate cultural differences. Students actively engaged in diverse cultural contexts, learned to adjust their verbal and nonverbal communication, and reflected critically on their experiences, contributing to deeper intercultural understanding.

The qualitative results showed notable improvements in students' communicative adaptability, confidence in intercultural exchanges, and pragmatic language use. At the same time, the practice revealed common challenges, such as managing nonverbal communication and avoiding cultural stereotyping, indicating areas for further pedagogical focus.

Thus, the integration of role-playing games into foreign language curricula offers a powerful means to prepare students for real-world intercultural communication. By combining experiential learning principles with linguistic practice, educators can cultivate learners' intercultural competence and equip them to function effectively in diverse global settings. Future research could explore the long-term impact of role-playing activities and the use of digital tools to further enhance intercultural training in language education.

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ARTIFICIAL INTELLIGENCE IN SCIENCE EDUCATION: PEDAGOGY IN THE MODERN ERA**Suiinish Tileushi**1st year student

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Abstract

This paper explores the role Artificial Intelligence(AI) plays in the modern science pedagogy through provision of personalized learning process and countless multifunctional platforms. As AI technology grows rapidly, it presents educational institutions with the opportunity to redefine the traditional teaching methods and adjust to new technologies in order to enhance the learning outcomes. The purpose of this paper is to analyze the strengths, weaknesses, opportunities as well as potential threats of implementing AI into the science education system. This study employs a secondary research methodology, thereby analyzing and synthesizing various scholarly articles, examining the similarities and contrasts within the field to identify common patterns and themes. The key findings suggest that in order to fully harness the strengths and opportunities of AI-based science education, such as individualized learning process, inclusivity, students' enhanced motivation and improved academic performance, the constraints, such as limited information, overreliance on data and technology, and potential risks, including data privacy concerns and algorithm bias, should be addressed first.

Keywords: AI, AI technology, AI tools, science education, physics, chemistry, learning, teaching, inclusivity.

Introduction

Artificial Intelligence has been gaining immense popularity in the education field in the last decade. With the rise of AI tools, such as Virtual Reality(VR), Augmented Reality(AR), chatbots and many other instances, education system has experienced a transforming shift. Implementation of AI tools is revolutionizing the science education field by changing the ways students and teachers interact with the learning process. By offering personalized learning process, AI tools have boosted student's academic performance, their motivation and interest in the STEM fields as well as enhanced the learning outcomes for both students and teachers. However, while educational institutions are seeking ways to integrate the tools, it is also important to note the possible constraints, limitations and risks that this decision might pose. This essay's aim is to analyze how AI tools can be effectively utilized through personalized learning experience, virtual and collaborative platforms, while also addressing the constraints such as inflexibility towards information, limitations, such as dependency on technology and limited knowledge, and potential risks regarding data privacy, security and algorithm bias. First, promises AI tools hold in the science education field will be discussed. After that, the limitations and potential risks will be presented. Thirdly, SWOT analysis will be done. Finally, recommendations will be provided regarding the further research into this topic.

Methodology

In order to write the article, method of literature review was used. This research synthesized findings from four articles selected from Google Scholar, that investigated the role of Artificial Intelligence (AI) in the science education. The chosen articles offered a diverse perspective on the role of AI technology in science education, highlighting the benefits, limitations as well as recommendations. Each article was examined for its methodology, key findings and implications. After that, common patterns and trends were identified in the opportunities, challenges and recommendations. This article aims to explore the role of AI tools in science education, including the opportunities, challenges and possible promises.

Discussions

The studies analyzed include diverse AI-based tools such as intelligent tutoring systems, adaptive learning platforms, Augmented Reality(AR), Virtual Reality(VR), mixed-reality applications for the teaching and learning, eye-tracking technology, robotics application, machine learning, natural language processing, computer vision, virtual teachers as well as chatbots like ChatGPT.

Various AI-based tools provide personalized instruction and learning experience catered to the individual needs of a student, therefore, managing gaps in academic achievement (Almasri, 2024; Eden et al., 2024; Jalilova and Musayeva, 2025). Such individualization addresses the barriers students may have regarding deeper scientific concepts more effectively than the traditional methods of teaching, thus, contributing to enhanced academic performance in scientific subjects. Jalilova and Musayeva (2025) linked appropriate assessment of student's learning, tracking progress, timely feedback and targeted intervention based on the student's individual need with their strengthened understanding of complex matters. Furthermore, students comprehension of complex topics in subjects such as chemistry were addressed through different AI-based visual aids, for instance, VR and AR, contributing to a heightened ability to visualize and understand topics that are physically impossible to witness, such as molecular concepts, structures, reactivity dynamics and etcetera (Chiu, 2021). Almasri (2024) added to this point by stating that this thorough understanding induced better test results, thus, improving academic performance of students. Moreover, assessment of student's understanding helps AI-based tools to investigate student's reasoning and cognitive process, therefore tailoring to their personal learning experience (Chiu, 2021). Hence, individualization of AI-based tools, adjusting to student's personal learning style, experience and need, enhances student's educational success through visual aid, appropriate assessment and unique feedback.

Individualized feedback through AI and its ability to predict in the learning environment has been linked with students' magnified interest and excitement for the science based subjects (Almasri, 2024). Moreover, Chiu (2021) argues that integration of AI-based tools, such as VR, AR and eye-tracking technology and robotics application, to chemistry lessons and laboratory experiments has boosted students' motivation to study and increased their engagement with the subject. This could be explained by the visual aids provided by AI helping students to understand the subject in a more comprehensive way as stated above. Therefore, it is more exciting and motivating for students to learn through AI-based technology.

AI technology, such as natural language processing, machine learning and computer vision, hold the potential to close the discrepancies in access for marginalized and disadvantaged populations by promoting equitable access to science education through creatively integrated pedagogical strategies (Jalilova and Musayeva, 2025). This stems from the accommodation to different learning style that include students' learning ability, pace and potentially their cultural background. Additionally, the AI technology types mentioned in this paragraph promote enhanced social interaction and supportive learning due to the provision of tools and platforms that support inclusive and collaborative education. The examples of such platforms are Labster, where students are encouraged to work on virtual laboratory works together that are created by the AI algorithms or PeerWise, a platform that uses AI tools to boost peer assessment and feedback (Jalilova and Musayeva, 2025). This, in turn, improves equitable access to science education by giving students the opportunity to benefit from peer interactions as well as collaborative engagements.

In addition, Almasri (2024) discussed the positive attitudes both students and teachers have regarding the use of AI in the educational environment. While it boosts motivation and enhances students' excitement and understanding for the science based subjects, AI usage lets teachers reduce their efforts significantly thanks to successful utilization of chatbots such as ChatGPT to create tests, quizzes and different sorts of materials. Moreover, it helps them increase student engagement. Thus, both students and teachers benefit from the successful utilization of AI in the educational setting. However, there are certain limitations concerning the use of AI that will be addressed in the next paragraph.

For AI-based tools to have a promising future in the educational environment, it is essential to ensure that they are used properly ethically as well as any further limitations should be discussed and resolved. The potential risks of using these tools are data privacy and security, algorithm bias, inflexibility in data processing, knowledge that is limited to date or to a certain requirement as well as the opportunity of technical infrastructure provision, which significantly affects access for the underserved parts of the population.

First of all, Jalilova and Musayeva (2025) state that the ethical concerns that should be addressed for the effective use of AI in the school curriculum are data privacy, data security, transparency or accountability and algorithm bias. This is largely due to AI-based tools' data collection that includes

student's personal data, such as their academic performance and other personal information. The concern lies in the fact that the provided data may be compromised, leaked or misused, leading to a potential damage to the student's wellbeing. Moreover, if AI-based tools are entrusted with the grading process, it is crucial to train the models to show transparency and objectivity to ensure accountability. Furthermore, algorithmic bias might exacerbate the existing discrimination, resulting in discrepancies in inclusivity. This happens when data presented to AI disproportionately represents certain demographic groups, thereby creating a gap in equality as AI tends to only process the data that it is provided with (Jalilova and Musayeva, 2025). Therefore, it is vital to take the mentioned issues into careful consideration during the implementation of such tools in the educational sphere for responsible use and wellbeing of students.

Almasri (2024) discussed further limitations of AI in science education such as inflexibility in certain contexts, limited to a certain requirement knowledge due to data dependency as well as unreliable and variable information. AI-based tools work with data that is provided to train their models. Therefore, the dependency on the accuracy of data may raise concerns regarding its limits, including the date and limited knowledge capacity as it is not able to answer beyond the collected information. Moreover, the study demonstrated the inflexibility of AI tools when processing data, as it was found to be particularly hard for the tools to address complex science-based concepts. Hence, it is necessary for teachers to adapt the capabilities of these tools to cater to the needs of the students as well as the learning environment. Moreover, as AI relies on the data collection, the information and knowledge it provides may significantly vary from one another, thus, concerning the accuracy and reliability of the data. Therefore, it is critical to regulate such dysfunctions as unreliable and variable data, inflexibility and limited knowledge in order to fully harness the potential of AI-based tools (Almasri, 2024).

Results

This paper has analyzed different aspects of the implementation of AI-based tools in science education including the existing strengths and weaknesses as well as future promises and potential dangers. Hence, results will be provided in the SWOT analysis form.

SWOT Analysis of AI Integration in Science Education

Strengths:

- AI tools enable personalized instruction catered to the individual needs, learning styles and differences of the student, thereby promoting inclusivity, especially for the underserved layers of the student population.
- AI tools are capable of tracking progress of the students, providing timely feedback and intervening when students struggle with certain topics while taking into account the individuality of the students and their needs, thereby enhancing academic capabilities of the students.
- AI tools enhance student's motivation and interest in science and improve student's academic performance by providing comprehensible materials and visual aid, thereby making learning more interactive as well as understandable.
- AI tools provide different collaborative environments through different platforms, such as Labster and PeerWise, thereby encouraging social interaction and inclusivity among peers.
- AI tools are perceived positively by students and teachers, thereby supporting the smooth integration of the tools into the science education system and leading to improved learning outcomes.

Weaknesses:

- There is a concern regarding the personal data privacy and security of students that might be compromised, leaked or misused, harming the student's right to privacy and wellbeing in the process.
- Possible exacerbation of existing inequalities due to unregulated algorithmic bias and disproportioned representation of specific demographic populations.
- AI tools have certain limitations regarding the currency of the data as well as its accuracy, potentially leading to misinformation and inaccuracy in the education system, which is very alarming for science based subjects. There are limits regarding the infrastructure as well due to the fact that it might not be affordable for underprivileged parts of the world.
- AI tools might face difficulties analyzing more complex scientific concepts, for instance in physics and chemistry, thereby limiting their capabilities to properly teach or assist in the science education system.
- AI tools are entirely dependent on the data provided for the models, thereby leading to variable, inaccurate or biased information. Moreover, questions about transparency and accountability are raised regarding the concept of tracking students' progress through these tools.

Opportunities:

- *AI technology has the potential to reduce discrimination and contribute significantly to inclusivity and diversity as well as expand access to quality science education across geographic borders by providing platforms and tools tailored to specific student needs. This is especially promising for students with limited abilities.*

- *Widespread integration of immersive VR, AR and other types of AI technologies might revolutionize the way science based subjects are seen and understood, leading to better comprehension and possible future inventions, as this results in better motivation and interest among students.*

- *Experimenting with different versions of AI and taking into consideration potentially innovative ways to teach such as gamifying specific tools might revolutionize the pedagogical strategies and the concept of teaching, leading to a more effective educational system.*

- *Implementing AI tools in science based education might further the idea into other fields, challenging and impacting the traditional teaching and learning ways positively.*

- *Integration of AI technology has the opportunity to change the workforce of STEM in the future, however, more research should be done in this regard.*

Threats:

- *Overreliance on technology, especially AI tools, might lead to decreased critical thinking abilities among students if the tools are integrated improperly in the science curriculum, thereby hindering to actual knowledge acquisition.*

- *Improperly developed models of these technologies might exacerbate the current inequalities due to the bias in their programs, thereby amplifying the discrimination against certain groups instead of mitigating the issue. Therefore, responsible creation and integration of these tools are required in order for proper use of AI in the field of science education.*

- *AI tools, like any other technology models, are vulnerable to cyber-attacks and technical issues, resulting in students' personal data leak, thereby raising questions on whether it is safe to use such tools in the school systems. Moreover, technical failures can disrupt the learning process. More research should be done in this regard to understand how to minimize risks, such as data leak and technical failures.*

While AI tools hold promising future in the science education field, it is essential to conduct more research on its creation, implementation and use to mitigate the risks and ethical concerns. It is imperative to perform research on the innovative applications of AI with a major focus on the long-term effect on the students' learning process and taking into account all the weaknesses and risks these tools have as well as to provide teachers with proper training and support strategies in this field. Jalilova and Mu-sayeva (2025) offered the next recommendations in order to responsibly integrate AI tools into the science education system.

- 1. More research should be conducted on AI technology's long-term impact in the sphere of science education in order to understand the effectiveness and sustainability of the integrated programs.*

- 2. More research should be carried out concerning the ethical risks, such as algorithm bias, personal data privacy and security, reliability of the information, in order to efficiently reduce them.*

- 3. More research should be performed on how different groups of population adapt to these technologies in order to adjust the tools to their needs and to promote the promised inclusivity.*

- 4. Further research should be conducted to investigate AI's feedback system and formative assessment, which might enhance self-learning in the long term. Chiu (2021) agrees with this point.*

- 5. More investigation is needed in combining the AI based education with the traditional form of schooling in order to find the optimal outcome that harvests the strengths and opportunities of both to the maximum capacity and mitigates the risks and weaknesses to the fullest extent.*

- 6. Provision of proper teacher training programs and successful integration of AI in these programs should be examined to effectively implement the tools for both students and teachers. Chiu (2021) and Almasri (2024) also highlight the importance this point.*

- 7. More studies should be conducted on how AI tools are perceived in the science education to understand where the resistance may arise. This gives the opportunity to understand potential drawbacks of the system and solve the issues accordingly in order to maximize the utilization.*

- 8. The integration of AI tools into the school curriculum, such as course organization, content creation and resource recommendations, should be further investigated in order to successfully implement the tools.*

- 9. Lastly, more collaborations on this research topic should be done and the impact of this integration on the future of the STEM workforce should be analyzed in order to fully assess the*

capabilities of AI. This helps educational institutions and policy makers to advance the AI applications further.

Moreover, Chiu (2021) highlights the next important points:

1. Conducting more research on machine learning and learning analytics might enhance the implementation of AI in this field.
2. More research needs to be performed to understand the impact and application of gamified versions of AI based tools for learning.
3. Effective provision of immersive learning for laboratories needs to be investigated in order to utilize the laboratory experience to its full extent.

Conclusion

AI has the potential to revolutionize the current science education system through benefits, namely personalized learning process that provides timely feedback and assessment, promotion of inclusivity, students' heightened motivation in studying as well as increased interest in the STEM subjects as well as assisting the teachers. However, the integration of these technologies also pose challenges including data security and privacy, algorithm bias, limited knowledge, constrained adjustability in data and significant dependency on technology. In order for the use of AI tools to be optimized, these challenges need to be addressed first. Hence, further research should focus mainly on the successful utilization of these tools through addressing the challenges, thereby ensuring the responsible implementation of AI in the science education field.

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INTEGRATING INFORMATICS INTO THE STEM EDUCATION SYSTEM: A COMPARATIVE STUDY OF PRACTICES IN CHINA, JAPAN, AND KAZAKHSTAN

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Abstract

This paper presents a comprehensive comparative analysis of informatics integration into STEM education across China, Japan, and Kazakhstan. Using a mixed-methods approach—national curriculum review, teacher surveys (n=150), and an Integration Index combining curriculum coverage, teacher training, and infrastructure support—we quantify and contrast each country's progress. Results show China leading with an 85 % curriculum coverage, 40 annual teacher-training hours, and an Integration Index of 0.90; Japan follows at 78 %, 35 hours, and 0.85; Kazakhstan trails at 60 %, 20 hours, and 0.70. We discuss policy drivers, pedagogical models, and resource allocation, then provide targeted recommendations for emerging systems seeking to accelerate informatics adoption.

Keywords: *Informatics integration, STEM education, Comparative study, China, Japan, Kazakhstan.*

Introduction

For most, it means only science and mathematics, even though the products of technology and engineering have so greatly influenced everyday life. A true STEM education should increase students' understanding of how things work and improve their use of technologies. STEM education should also introduce more engineering during precollege education. Engineering is directly involved in problem solving and innovation, two themes with high priorities on every nation's agenda. Given its economic importance to society, students should learn about engineering and develop some of the skills and abilities associated with the design process. The good news is that the National Assessment Governing Board has recognized the importance of this issue and recently approved the evaluation of technology and engineering education through examinations that will be given to U.S. The rapid evolution of digital technologies has transformed the knowledge economy, placing computational thinking and computer science at the heart of STEM disciplines. In response, many countries are embedding informatics into K–12 curricula to foster 21st-century skills. While China and Japan have implemented large-scale reforms, Kazakhstan's initiatives are more recent and incremental. This study aims to: quantify current integration metrics, identify underlying enablers and barriers, and derive best practices for systems in transition [1].

STEM literacy demands the design of "STEM curricula" centered on practical skills that bridge theory and practice and foster problem-solving abilities. Such curricula rest on three core components: conceptual knowledge, operational (procedural) knowledge, and problem-solving knowledge. Practical STEM skills encompass both conceptual and procedural knowledge, as well as the ability to apply engineering methods and tools within a technological education environment. Scientific praxis engages students kinesthetically, helping them grasp abstract concepts concretely, construct mental models, and boosting their motivation and commitment. Moreover, STEM curricula are structured to cultivate creative and effective problem-solving by encouraging learners to make connections between knowledge and skills across a variety of contexts [2].

Scholars highlight that early exposure to computing concepts boosts problem-solving and creativity. The UNESCO ICT Competency Framework emphasizes teacher preparation as the linchpin for successful integration. China's 2022 national standard mandates compulsory informatics content from grade 7, supported by a centralized teacher certification program. Japan's Ministry of Education issues annual ICT guidelines with strong industry-academia partnerships but grants prefectures curricular

autonomy. Kazakhstan’s Strategy «Kazakhstan-2050» prioritizes digital literacy, yet teacher training is limited by budget constraints. Early pilot programs in Almaty and Nur-Sultan report mixed outcomes.

Methodology

We reviewed official curriculum standards, policy white papers, and statistical reports published between 2022 and 2024 for all three countries. A standardized questionnaire gathered data on annual teacher training hours, perceived integration effectiveness, and access to digital resources. Follow-up interviews (n=30) probed policy implementation challenges.

We normalized three indicators—curriculum coverage, teacher training, and infrastructure availability—on a 0–1 scale, then computed a weighted average (weights: 0.4, 0.3, 0.3 respectively). STEM literacy requires curricula that unite theory and practice to develop students’ problem-solving abilities and engineering mindsets. Such curricula rest on three key components:

- Conceptual Knowledge (CK): Understanding the core theoretical principles of each discipline;
- Procedural Knowledge (PK): Mastery of tools, methods, and algorithmic thinking;
- Problem-Solving Knowledge: The ability to apply both CK and PK to real-world tasks and projects.

In China, informatics modules are centrally mandated and introduced as a standalone “Computer Science” subject beginning in Grade 7. CK and PK are taught through integrated, project-based assignments that immerse students in authentic engineering challenges [3].

In Japan, MEXT’s ICT integration guidelines are implemented flexibly at the prefectural level. Project-based learning (PBL) and industry–academia partnerships support STEM literacy by having students combine theoretical CK with PK skills—such as programming and circuit design—while working on real industrial problems.

In Kazakhstan, pilot initiatives under the “Kazakhstan-2050” strategy focus on digital literacy and introductory programming. Currently, CK attainment is moderate and PK remains limited, with most instruction centered on basic coding principles and office-software tools. To advance, the system aims to expand PBL approaches and engage students in genuine engineering problem-solving at all grade levels [4].

Thus, STEM literacy is not merely the acquisition of theoretical content; it is a holistic process that merges CK and PK within collaborative projects to cultivate creative problem-solvers. While China and Japan embed these practices through centralized standards and project-based frameworks, Kazakhstan must coordinate resources and broaden hands-on projects throughout its curriculum to achieve similar outcomes.

Table 1. Comparative metrics of informatics integration.

Country	Curriculum Coverage (%)	Teacher Training Hours (per year)	Integration Index
China	85	40	0.90
Japan	78	35	0.85
Kazakhstan	60	20	0.70

China’s enforced standards yield the highest coverage, with informatics modules integrated into mathematics and science streams. Japan’s prefectural autonomy generates variability but maintains rigorous subject depth. Kazakhstan’s curricula include optional informatics electives

China provides mandatory 40-hour annual workshops led by provincial centers of excellence. Japan’s 35-hour in-service programs leverage university-industry collaborations. Kazakhstan averages only 20 hours, often focusing on basic ICT skills rather than pedagogical methods.

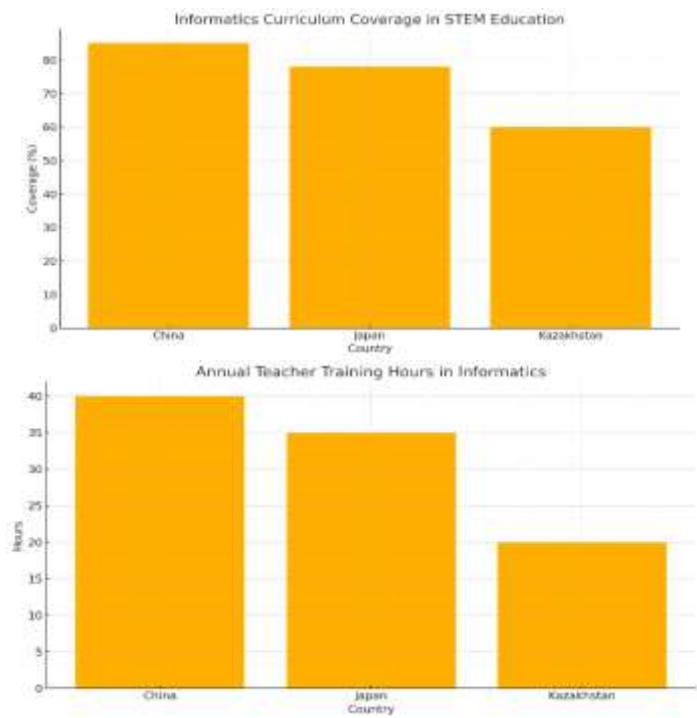


Figure 1. STEM education across China, Japan, and Kazakhstan

Below is a draft manuscript prepared for submission to an Elsevier journal. It includes a comparative table (Table 1) and two figures illustrating key metrics of informatics integration into STEM education across China, Japan, and Kazakhstan fig 1.

The composite Index reflects both policy robustness and resource allocation, highlighting gaps in emerging systems.

Discussion

All three countries acknowledge the importance of informatics in STEM, yet equity and teacher readiness vary. China’s centralized model secures policy alignment but struggles with regional disparities. Japan’s autonomy fosters innovative curricula but yields inconsistent quality. Kazakhstan’s hybrid approach successfully engages communities yet lacks sustained in-class support [5].

Centralized mandates in China ensure consistency, while Japan’s decentralized model promotes local innovation but complicates equity. Kazakhstan must balance national standards with regional capacity-building. Project-based learning (PBL) in China and Japan fosters collaboration and problem-solving. Kazakhstan pilots reveal the need to shift from rote ICT drills to PBL for deeper engagement. Public-private partnerships in China and Japan supply digital labs and online platforms. Kazakhstan can leverage international grants and industry collaborations to scale infrastructure [6].

The comparative analysis reveals distinct strengths and challenges in each country’s approach to integrating informatics into STEM education. By examining policy mechanisms, pedagogical strategies, infrastructure deployment, and learner outcomes, we identify actionable insights for educators and policymakers.

China’s centralized mandate ensures uniform standards and rapid scaling of informatics content. The Ministry of Education’s top-down approach facilitates consistent teacher certification and resource allocation; however, it can limit local innovation and responsiveness to regional needs. Conversely, Japan’s decentralized model grants prefectures autonomy to tailor ICT guidelines, fostering experimentation and industry partnerships at the local level but resulting in uneven integration and potential equity gaps. Kazakhstan’s emerging policy framework under the “Kazakhstan-2050” initiative sets a strong national vision for digital literacy, yet lacks detailed implementation guidelines and sustainable funding channels for teacher development and infrastructure. A balanced governance model that combines clear national standards with localized adaptation mechanisms may yield optimal outcomes.

Project-Based Learning (PBL) emerges as a critical pedagogical strategy across China and Japan, enabling students to apply CK and PK in authentic contexts. In China, provincial Centers of Excellence design interdisciplinary projects that blend computational thinking with science and engineering challenges, promoting collaboration and iterative problem-solving. Japan’s industry-academia partnerships enrich PBL with real-world case studies and mentorship, strengthening student engagement and relevance. Kazakhstan’s pilots demonstrate the initial efficacy of PBL but lack scale and sustained teacher

support. Embedding PBL into national curricula and providing ongoing professional development workshops could enhance teachers' capacity to facilitate student-led inquiry and reflection [7].

High-quality digital infrastructure underpins effective STEM education. China's investment in regional digital labs and cloud-based platforms expands access to coding environments, simulation tools, and collaborative workspaces. Japan leverages longstanding public-private partnerships, enabling schools to pilot emerging technologies such as IoT sensors and robotics kits. Kazakhstan's limited infrastructure—often confined to computer labs with outdated hardware—constrains hands-on experimentation. Strategic alliances with technology firms and international organizations can supply affordable hardware, software licenses, and technical training, bridging resource gaps.

Quantitative metrics (e.g., curriculum coverage, training hours) provide insight into system-level integration, but student-level outcomes reveal equity considerations. In China and Japan, high-performing regions report strong gains in computational thinking skills and increased enrollment in advanced STEM tracks; yet, rural and underserved areas lag behind. Kazakhstan's urban pilots show promising student motivation and foundational coding proficiency, but rural penetration remains minimal. Targeted interventions—such as mobile coding labs, blended learning modules, and scholarship programs—are necessary to ensure equitable access to STEM competencies.

While China's uniform policy accelerates adoption, Japan's localized innovation fosters contextualized learning experiences. Kazakhstan can leverage both approaches by establishing clear national benchmarks for informatics proficiency and empowering regions to customize curricula based on local needs and industry strengths. Future research should examine longitudinal impacts on student career pathways and the cost-effectiveness of different integration models. Additionally, cross-national collaboration on open educational resources and teacher exchange programs could catalyze shared learning and continuous improvement.

To accelerate informatics integration, we recommend that Kazakhstan:

1. Establish National Standards: Adopt compulsory informatics modules from secondary grades.
2. Scale Teacher Certification: Introduce tiered certification with clear competency benchmarks.
3. Form Strategic Partnerships: Engage tech firms and NGOs to equip schools with digital resources.
4. Promote PBL Approaches: Incorporate project-based curricula to enhance computational thinking.

This study relies on self-reported training hours and may understate informal professional development. Future work should include longitudinal student outcome data and cost-benefit analyses of integration models.

Conclusions

To accelerate informatics integration, we recommend that Kazakhstan:

1. Establish National Standards: Adopt compulsory informatics modules from secondary grades.
2. Scale Teacher Certification: Introduce tiered certification with clear competency benchmarks.
3. Form Strategic Partnerships: Engage tech firms and NGOs to equip schools with digital resources.
4. Promote PBL Approaches: Incorporate project-based curricula to enhance computational thinking.

Limitations and Future Research
This study relies on self-reported training hours and may understate informal professional development. Future work should include longitudinal student outcome data and cost-benefit analyses of integration models [8].

The objective of this study is to analyze those educational interventions referring to themselves as STEM education, in the interest of offering a vision on what we researchers and educators talk about when we talk about STEM education. In so doing, the analysis of the selected educational experiences points to the existence of multiple ideas on what STEM education is and how to implement it.

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SOCIOCULTURAL KNOWLEDGE AND SKILLS - EFFECTIVE MEANS OF STUDENTS' VOCABULARY DEVELOPMENT

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СОЦИОКУЛЬТУРНЫЕ ЗНАНИЯ И НАВЫКИ - ЭФФЕКТИВНЫЕ СРЕДСТВА РАЗВИТИЯ ЛЕКСИКИ СТУДЕНТОВ

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Abstract

The article is devoted to the peculiarities of lexical skills formation; different principles, methods and approaches to vocabulary teaching are also considered. The essence of lexical skill is the ability to instantly recall a word standard from the long-term memory depending on the specific speech task; to include it in the speech chain. Researchers consider lexical skill as a component of speech skill, as well as an independent elementary skill, also distinguishes in lexical skill the ability to combine lexical units with each other and the ability to include elements of speech patterns in speech.

Аннотация

Статья посвящена особенностям формирования лексических навыков, также рассматриваются разные принципы, методы и подходы к обучению лексике. Сущность лексического навыка - способность мгновенно вызывать из долговременной памяти эталон слова в зависимости от конкретной речевой задачи; включать его в речевую цепь. Исследователи рассматривают лексический навык как компонент речевого навыка, так и как самостоятельный элементарный навык, также различает в лексическом навыке способность сочетать лексические единицы друг с другом и способность включать элементы речевых образцов в речь.

Keywords: *lexis, lexical skill, lexical unit, unit of speech, semanticisation.*

Ключевые слова: *лексика, лексический навык, лексическая единица, единица речи, семантизация.*

Обучение лексической стороне речи является важнейшим фактором развития межкультурной коммуникации. В репродуктивной речевой деятельности владение словом, знание его значения недостаточно, важно владеть связями слова и уметь выполнять образование на их основе различных словосочетаний. Содержание обучения лексической стороне речи включает в себя не только объяснение значения слова, но и его употребление и формы. Чтобы правильно понять слово со слуха и адекватно его озвучить, необходимо знать его звуковую форму, а, чтобы узнать слово при чтении и уметь написать его правильно – его грамматическую форму. На этапе ознакомления со словом необходимо сообщить обучаемым об особенностях образования грамматических форм, если такие имеются, во избежание ошибок при использовании данного слова. При обучении иностранному языку освоение лексического материала имеет системообразующее значение. Ведь в лексике заложена та основа, благодаря которой и происходит общение людей между собой.

Компонентом содержания обучения лексике является лексический навык. Главной практической задачей обучения лексическому материалу иностранного языка в старшей школе значится формирование у учеников лексических навыков как главного компонента экспрессивных и рецептивных видов речевой деятельности. Рассмотрим подробнее характеристику лексического навыка.

Исследователи дают разные определения «лексического навыка».

Лексический навык – это способность мгновенно вызывать из долговременной памяти эталон слова в зависимости от конкретной речевой задачи и включить его в речевую цепь (Р.К. Миньяр-Белоручев). Лексический навык – это синтезированное действие по выбору лексической единицы адекватно замыслу и ее правильному сочетанию с другими, совершаемое в навыковых параметрах, обеспечивающее использование данной лексической единицы и служащее одним из условий выполнения речевой деятельности.

Продуктивный лексический навык – это навык интуитивно правильного словоупотребления и словообразования в устной и письменной речи в соответствии с ситуациями общения и целями коммуникации.

Рецептивный лексический навык – это навык узнавания и понимания при восприятии на слух или при чтении лексических явлений - структуры слова и его употребления.

устойчивость (правильное восприятие и понимание изучаемых явлений в различных контекстах устной и письменной речи, а также воспроизведение их в нормальном темпе и без существенных ошибок);

самостоятельность (возможность переноса одного вида деятельности в другой, то есть, предполагается, что учащиеся могут оперировать усвоенным лексическим материалом как в говорении и письме, так и в аудировании, и в чтении);

обусловленность (зависимость "запуска" лексического навыка от внешнего или внутреннего стимула);

репродуктивность (стереотипное воспроизведение действий, совершаемых лексическим навыком);

лексическая оснащенность (лексический навык оперирует лексическими единицами и их комплексами, то есть словами, устойчивыми словосочетаниями или готовыми фразами).

В иностранных языках, слова могут иметь несколько значений, поэтому необходимо ознакомить студентов с наиболее часто употребляемыми значениями слов. Помимо значения слова необходимо показать и его коннотацию, а именно ассоциации, которые вызывает это слово, его подтекст, который связан с употреблением данного слова.

Методологический компонент содержания обучения лексике включает необходимые разъяснения, памятки и инструкции по использованию словарей, форме ведения индивидуальных словарей и карточек с новой лексикой, о способах систематизации изученной лексики. Это те знания и умения, которые позволяют студенту работать самостоятельно и независимо от внешних условий [1, с. 96].

Обучение лексической стороне речи необходимо проводить таким образом, чтобы студенты постоянно ощущали то, что слова нужны им для выражения мыслей и их распознавания. Только ясная речевая перспектива, по мнению Роговой Г.В., обуславливает мотивированность и успешность овладения словарем.

Рогова Г.В. также считает важным непрерывность пополнения и расширения словарного запаса студентами на протяжении всего процесса обучения. Пробудить у обучающихся интерес к данной работе – задача педагога. Определение объема индивидуального словаря студента возможно с помощью специально разработанных тестов. Убедительным свидетельством овладения иностранной лексикой является его участие в устном общении и при чтении.

Усилия, затрачиваемые на усвоение слов, определяются конкретными их свойствами, в частности совпадения/несовпадения в объеме значений с родным языком, принадлежностью к абстрактному/конкретному понятию, к знаменательному/служебному слову, а главное – «нужностью» для выражения мыслей [1, с. 105].

Речевой установкой можно как сузить высказывание до односложного ответа, так и расширить его, объединив смежные семантические поля в обобщенное семантическое поле. Проблемный характер речевой установки является важным фактором, влияющим на положительную динамику семантического поля.

Таким образом, целесообразнее увеличивать активный словарь не за счет механического введения новой лексики, а за счет творческого применения уже изученной в новых контекстах.

По определению Солововой Е.В., активный словарь – это та лексика, которой человек постоянно пользуется в устном речевом общении, т.е. те слова, которые находятся «на кончике языка», как говорят англичане. Если слово долго не употребляется, оно переходит в пассивный словарь, т.е. может быть узнано при чтении и аудировании, но не используется в речи. Помимо этих четко ограниченных «замкнутых словарных минимумов», важно развивать также потенциальный словарь учащихся. Потенциальный словарь носит «открытый» и индивидуальный

характер. Он возникает на основе самостоятельной семантизации студентами неизученной лексики в момент чтения. Его объем и развивающийся на основе этого объема лексический навык находятся в прямой зависимости от степени овладения каждым обучающимся активным и пассивным минимумами [2, с. 56].

Лексический навык в методике обучения иностранным языкам рассматривается с различных точек зрения. Навыки – это закреплённые операции с материалом (в данном случае лексическим), автоматизированное действие, которое формируется в процессе речевой деятельности.

Сущность лексического навыка – способность мгновенно вызывать из долговременной памяти эталон слова в зависимости от конкретной речевой задачи; включать его в речевую цепь. Исследователи рассматривают лексический навык как компонент речевого навыка, так и как самостоятельный элементарный навык, также различают в лексическом навыке способность сочетать лексические единицы друг с другом и способность включать элементы речевых образцов в речь.

С.Ф. Шатилов определяет речевой экспрессивный лексический навык, как навык интуитивно правильного словоупотребления и словообразования в устной и письменной речи в соответствии с условиями ситуации общения и целями коммуникации [3, с. 110].

С позиции деятельностного подхода, навык как относительно самостоятельное действие в системе учебной деятельности, поскольку продуктивный лексический навык предусматривает осуществление ряда операций, таких как перевод лексической единицы из долговременной памяти в оперативную, сочетание слов по смыслу и форме, использование их при говорении и письме. Лексический навык, по определению Щукина А.Н., – способность автоматизировано вызывать из долговременной памяти слово, словосочетание или готовую фразу, соответствующие коммуникативной задаче лексической единицы [4]. Для лучшего понимания слов в речи нужно, чтобы в памяти сохранялись звуковые и графические образы, связанные с их значением. Для этого необходимо в лексических играх применять как устные задания, помогающие усвоить звуковую форму слов, так и письменные, помогающие запомнить их графический образ. Итак, рассмотрев определения лексического навыка, данные многими авторами, можно сделать вывод, что все они говорят о том, что лексический навык – это способность осуществлять автоматически и самостоятельно ряд действий и операций, связанных с вызовом слова из долговременной памяти и с соотносением его с другой лексической единицей. Цель обучения лексической стороне речи есть формирование продуктивного (обуславливающего развитие умений говорения и письма) и рецептивного (как условия осуществления чтения и аудирования) лексических навыков. Продуктивный лексический навык – синтезированное действие по вызову лексической единицы (ЛЕ) адекватно коммуникативной задаче и её правильному сочетанию с другими (ЛЕ). Продуктивный лексический навык обуславливается такими видами деятельности как говорение и письмо, которые требуют наиболее активного действия мозга и использования лексики. Рецептивный лексический навык – это синтезированное действие по распознаванию графического и фонологического образа (ЛЕ) и соотносению формы слова с его значением. При рецептивных действиях должно произойти узнавание (ЛЕ) на слух или на графике и мгновенное соотношение его контекстной формы (род, число, время) с его содержанием. Филатов В.М. отмечает, что при осуществлении говорения и письма необходимы следующие навыки, умения и знания:

а) продуктивные навыки: • правильно выбирать слова/словосочетания в соответствии с коммуникативным намерением; • правильно сочетать слова в синтагмах и предложениях: • владеть лексико-смысловыми и лексико-тематическими ассоциациями; • сочетать новые слова с ранее усвоенными; • выбирать строевые слова и сочетать их со знаменательными; • выбирать нужное слово из синонимических и антонимических оппозиций; • выполнять эквивалентные замены; • владеть механизмом распространения и сокращения предложений; • приспосабливаться к индивидуальным особенностям говорящего, обладать быстрой реакцией и др.;

б) рецептивные навыки (слушание, чтение): • соотносить звуковой/зрительный образ слова с семантикой; • узнавать и понимать изученные слова/словосочетания в речевом потоке/графическом тексте; • раскрывать значение слов с помощью контекста; • понимать значение слов с опорой на звуковые/графические признаки (аффиксацию, заимствованные слова и т.д.); • дифференцировать сходные по звучанию и написанию слова; • владеть механизмом рецептивного комбинирования; • широко пользоваться прогнозированием и ориентирами восприятия для создания установки на выполнение определенной деятельности с новым (или ранее усвоенным) лексическим материалом и др.;

в) социокультурные знания и умения в области лексики: • знание безэквивалентной лексики и умение понимать ее в текстах (в том числе с использованием справочников); • знание лексики, обозначающей предметы и объекты повседневного быта стран изучаемого языка (денежные единицы, меры веса, длины, обозначения времени, дорожные знаки и др.); • знание речевых и этикетных формул (особенностей обращения взрослых к детям, школьников к учителям, партнеров по общению разных возрастных и социальных групп) и умение строить речевое поведение в соответствии с нормами общения, принятыми в стране изучаемого языка;

г) лингвистические знания в области лексики: • знание правил словообразования лексических единиц и их сочетаемости; • знание строевых и служебных слов как средств связи в предложениях и текстах; • знание этимологии отдельных слов; • знание понятий, значение которых выражается по-разному в различных языках [5, с. 416].

Состав лексических операций, входящих в различные виды речевой деятельности:

1. При репродукции к составу лексических операций относятся: • Нахождение в долговременной памяти и актуализации нужной лексической единицы по мгновенному импульсу, исходящему из речевого центра и связанному с намерением что-то высказать, благодаря которому формируется содержание высказывания; • Сочетание между собой «найденных», таким образом и включённых в оперативную память лексических единиц с соблюдением правил лексической и грамматической сочетаемости соответствующих норме данного языка; • Применение лексических единиц (путём их произношения или написания) в составе синтагмы и фраз (внешне-речевое воспроизведение).

2. При рецепции выполняются следующие лексические операции: • Узнавание и вычленение лексических единиц из речевой цепи в процессе слушания (чтения); • Семантизация лексических единиц (с учётом их синтагменной, фразовой и сверхфразовой аранжировки); • Объединение (интеграция) лексических значений в ходе формирования синтагменного, фразового и сверхфразового смысла. Уяснение состава лексических операций помогает выбирать основные типы и виды лексических игр, направленных на их закрепление, а применение лексических игр на уроке способствует развитию лексических навыков.

Словообразование является одним из важных компонентов при развитии лексического навыка. Оно также может подвергаться интерференции со стороны родного языка и это необходимо учитывать в процессе обучения иностранному языку.

Таким образом, как видно из приведенных классификаций, восприятие и осмысление нового слова являются первой стадией формирования лексических навыков. Этой стадии соответствует этап ознакомления с новой лексикой, который определяет прочность ее усвоения. Здесь осуществляется раскрытие лексического значения нового слова. Педагоги сходятся во мнении, что важную роль играет выбор способа семантизации слова, то есть процесс раскрытия значения слова. Считается, что этот этап должен быть экономичен во времени и эффективен для запоминания. Важно объяснить обучающимся коммуникативную функцию слова, т.е. что с помощью этого слова можно сказать или передать в некой ситуации общения.

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Philological sciences

THE IMPORTANCE OF READING COMPREHENSION IN ENGLISH LANGUAGE EXAMS FOR LANGUAGE LEARNING

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Abstract

Reading comprehension plays a crucial role in English language exams and is central to the overall process of language learning. It is more than just understanding written text; it is a skill that enhances vocabulary, grammar, critical thinking, and overall language proficiency. By focusing on reading comprehension, learners not only improve their ability to interpret and analyze written material, but also deepen their understanding of how the language functions in various contexts. One of the primary reasons why reading comprehension is so important in English language exams is its connection to other language skills. For instance, when students engage with reading texts, they encounter new words, sentence structures, and grammatical patterns. This exposure helps build their vocabulary and strengthens their understanding of syntax, which are essential for effective speaking and writing. In language exams like IELTS, TOEFL, and Cambridge English tests, reading comprehension is often tested alongside listening, speaking, and writing skills, highlighting its fundamental role in assessing overall language proficiency.

Introduction. Moreover, reading comprehension fosters critical thinking. In many language exams, students are required to go beyond basic understanding and interpret meaning, analyze tone, identify themes, or recognize implied ideas within the text. These tasks require students to actively engage with the material and apply their reasoning skills to make sense of the text. As students become better at reading comprehension, they develop the ability to think critically about language and its use, which is invaluable not just for exams, but for academic and professional life as well.

Reading comprehension also contributes to fluency in language learning. As students read more, they become more accustomed to the rhythm and flow of the language. This repeated exposure helps them develop a natural sense of how the language sounds and feels, which ultimately improves their speaking and listening skills. Moreover, when students understand what they read, they gain confidence in using the language for real-world communication, whether in discussions, writing essays, or understanding spoken content in daily life.

The main part. When learning English, it is crucial to develop various skills. Among these skills, reading comprehension is one of the most important. In English language exams, the reading comprehension section not only helps improve test results but also ensures a deeper understanding of language learning. (Alderson, 2000)

The Basics of Reading Comprehension and Language Learning

Reading comprehension primarily consists of two components: understanding the text and extracting relevant information. As students' reading comprehension skills in English improve, they better understand the structure of the language, vocabulary, and sentence construction. This also enhances their grammatical and lexical knowledge. (Grabe & Stoller, 2011)

The Importance of Reading Comprehension Skills in English Language Exams

In exams, reading comprehension generally requires independent reading, identifying the main points of a text, understanding the details, and interpreting this information. This skill not only increases the student's exam success but also makes the language learning process more effective. These skills are essential in IELTS, TOEFL, and Cambridge English exams because reading comprehension provides students with experience that relates to other areas of language. (Nation & Newton, 2009)

The Language Learning Process and Reading Comprehension

The language learning process requires not only theoretical knowledge but also practical experience. The reading comprehension section encourages students to analyze the text they read, identify main ideas, and focus on understanding details. In this process, students also better internalize various aspects of the language—grammar, style, and vocabulary. (Carrell & Eisterhold, 1983)

The Impact of Improved Reading Comprehension Skills on Language

As reading skills improve, students learn more new words and phrases, which enhances their speaking and writing abilities. Students with high-level reading skills are able to understand subtle nuances in texts, thereby increasing their ability to acquire new information. This makes language learning more effective and faster. (Richards & Renandya, 2002)

In English language exams, reading comprehension not only affects test results but also enhances all areas of the language learning process. Helping students develop this skill aids them in understanding language learning more effectively and deeply. It also ensures they acquire better speaking and writing abilities in the future. (Grabe & Stoller, 2011)

Conclusion

Finally, reading comprehension is crucial for test success. In many language exams, the reading section consists of multiple-choice questions, short-answer responses, or essay writing tasks that assess students' ability to extract key information, understand the context, and convey their understanding accurately. A strong ability to comprehend texts directly impacts how well students perform on these tasks. Those who are skilled in reading comprehension can answer questions more accurately, write more coherent responses, and ultimately score higher in exams.

In conclusion, reading comprehension is an indispensable skill in English language exams. It goes beyond test preparation, significantly contributing to a deeper understanding of the language. By improving reading comprehension, learners enhance their vocabulary, grammar, critical thinking abilities, and overall fluency, which are essential for success in both exams and real-life communication. As such, students should focus on developing their reading comprehension skills as part of a broader strategy for mastering the English language.

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TECHNOLOGIES OF WRITING ORGANIZATION AND IDEA GENERATION

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Abstract

In the modern era of digital communication and knowledge sharing, the process of writing and idea generation has been transformed by various technological advancements. This paper examines contemporary technologies that support writing organization and stimulate the generation of ideas. By analyzing digital tools, cognitive strategies, and educational technologies, the article reveals how these systems enhance writing productivity, creativity, and coherence. Special attention is given to AI-based applications, mind mapping software, and collaborative platforms.

Keywords: writing technologies, idea generation, digital tools, writing process, cognitive strategies, artificial intelligence.

1. INTRODUCTION.

Writing, a core academic and professional skill, demands both creative ideation and logical structuring. In recent years, the integration of technology into the writing process has redefined traditional methods of content creation. Writers now rely on digital tools not only for editing and formatting but also for brainstorming, organizing, and developing complex ideas. This study explores the technologies that enhance writing organization and support idea generation across various contexts.

The process of writing can be viewed through two interrelated dimensions: cognitive processes (idea generation) and structural planning (organization). Cognitive writing theories, such as Flower and Hayes's model, emphasize the recursive nature of writing, where planning, translating, and reviewing interact dynamically. Technologies that support these components have become instrumental in improving writing outcomes. [1]

2. TECHNOLOGIES FOR IDEA GENERATION.

Mind Mapping Tools. Mind mapping software such as MindMeister, XMind, and Coggle allows writers to visually organize their thoughts. These tools facilitate associative thinking, helping users to explore connections between concepts and expand their ideas organically.

Mind mapping software such as MindMeister, XMind, and Coggle allows writers to visually organize their thoughts. These tools facilitate associative thinking, helping users to explore connections between concepts and expand their ideas organically.

AI-Based Assistants. AI applications like ChatGPT, Jasper, and Sudowrite provide intelligent prompts, suggest content ideas, and simulate brainstorming partners. These tools can help writers overcome writer's block by generating alternative phrasings or perspectives. [2]

Digital Note-Taking Platforms. Apps such as Notion, Evernote, and Roam Research serve as repositories for thoughts and research. Their non-linear, hyperlink-friendly formats mirror the associative nature of human memory, aiding in the creative process.

3. TECHNOLOGIES FOR WRITING ORGANIZATION.

Programs like Scrivener and Milanote provide hierarchical structures for organizing chapters, scenes, and arguments. Such platforms are essential for long-form writing, allowing the writer to maintain a coherent narrative or argumentative flow. Zotero, Mendeley, and EndNote support academic writing by managing references and enabling integration with word processors. This streamlines the inclusion of evidence and supports the logical progression of ideas. Tools like Grammarly, Hemingway Editor, and ProWritingAid assist in refining language, improving clarity, and maintaining tone consistency. By automating error detection, these tools free the writer to focus more on content development. [3]

In educational settings, the integration of writing technologies fosters student engagement, autonomy, and collaboration. Teachers can guide students in using these tools for peer review, group brainstorming, and project-based learning. Additionally, such tools can be tailored to accommodate different learning styles and abilities.

Despite their benefits, these technologies raise concerns related to authorship, over-reliance on automation, and privacy. Educators and writers must strike a balance between leveraging digital support and developing critical thinking and writing skills independently.

One of the primary concerns is the growing dependence on technological aids, which may inhibit the development of fundamental cognitive and linguistic skills. When writers rely too heavily on AI-driven tools for idea generation, grammar correction, or even content creation, there is a risk of diminishing their ability to think critically, plan independently, and write with originality. This is particularly concerning in educational settings, where the ultimate goal is to cultivate independent thinkers and proficient communicators. [4]

The rise of generative AI tools such as ChatGPT and Jasper has sparked debates around authorship, plagiarism, and originality. In academic and professional contexts, using AI to generate text without proper attribution can blur the lines between assistance and misconduct. Educators and institutions must establish clear guidelines on the ethical use of such tools to preserve academic integrity while embracing technological innovation. [5]

Not all users have equal access to advanced writing technologies. Socioeconomic disparities, limited internet access, and insufficient digital literacy can prevent individuals—especially students in under-resourced regions—from benefiting fully from these tools. Moreover, some platforms are available only in certain languages or require subscription fees, which may limit their inclusivity and global applicability.

Many writing tools collect user data, including drafts, notes, and personal content. Without transparent data policies and secure infrastructures, users may unknowingly expose sensitive information. This is especially relevant for journalists, researchers, and students working with confidential material. Therefore, data protection must be a priority for developers of such platforms.

AI-powered writing assistants are often trained on large datasets that may reflect dominant cultural norms, linguistic patterns, or ideological biases. As a result, they may unintentionally reinforce stereotypes or marginalize non-standard forms of language. This can affect inclusivity and limit the expression of diverse voices and perspectives in written communication.

4. CONCLUSION

Technologies designed to support writing organization and idea generation have become indispensable tools for students, educators, researchers, and professional writers alike. They streamline the creative process, aid in structuring complex arguments, and offer personalized support for overcoming cognitive and linguistic challenges. From AI-driven platforms that simulate brainstorming sessions to sophisticated outlining and citation management systems, these tools not only increase efficiency but also enhance the quality and coherence of written communication.

Moreover, technological solutions empower writers to approach the act of composition more strategically. They encourage reflective thinking, promote iterative drafting, and facilitate collaboration across geographic and disciplinary boundaries. For learners, these technologies foster autonomy and engagement, enabling a shift from passive content consumption to active knowledge production.

However, the reliance on digital tools also necessitates critical awareness. Writers must balance the convenience of automation with the development of authentic voice and reasoning skills. Ethical considerations, such as academic integrity and authorship in AI-assisted writing, must be addressed in educational and professional contexts.

In conclusion, the integration of technology into writing and idea generation processes represents not merely a trend but a fundamental shift in how we conceptualize, produce, and communicate ideas. As these tools continue to evolve, their thoughtful application will remain key to nurturing creativity, improving communication, and fostering intellectual growth in the digital age.

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METAPHOR AS AN OBJECT OF LINGUISTIC RESEARCH

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МЕТАФОРА КАК ОБЪЕКТ ЛИНГВИСТИЧЕСКИХ ИССЛЕДОВАНИЙ

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Abstract

The modern anthropocentric scientific paradigm is aimed at studying the conceptual picture of the world from the standpoint of man. Accordingly, in linguistics, the study of the role of the human factor in language comes to the forefront, i.e. the problem of the role of language in man and man in language. In the linguistic picture of the world of speakers of different languages and cultures, metaphor occupies an important place, since man, as *homo cogitans*, is characterized by thinking in images and associations, imagining the new in the likeness of what is already known to him. Being the embodiment of the mentality and culture of an ethnic group, metaphor arouses great research interest and is studied from various points of view: philosophical, linguistic, literary, linguacultural, linguacognitive, etc. etc. Since metaphor, starting with the works of ancient philosophers (Aristotle, Quintilian, Cicero, Demetrius of Faler, Hermogenes, etc.), in the Middle Ages - the grammarians of Port-Royal, in the Renaissance - Augustine and others, later - Hegel and others, to this day is the object of almost all humanitarian scientific disciplines and is actively studied, it is quite natural to have a large arsenal of research that requires monitoring and systematization. Each stage of studying metaphor poses new challenges for researchers, expanding the field of scientific knowledge: the definition of this concept is specified, various classifications of metaphors are proposed, considering them from the standpoint of describing the phenomena associated with it. Based on this, the purpose of this article is to review linguistic research devoted to the linguistic nature of metaphor. It is of interest to know which aspects of metaphor are of greatest interest to researchers representing various linguistic traditions of the near and far abroad, as well as in domestic linguistics. When studying metaphor from a linguacultural position, the starting point of the study is cultural realities and its artifacts, and language units are the background, i.e. the researcher "goes" from culture to language, while in linguacognitive studies - from language to culture. It is of interest to identify the cognitive structures underlying each metaphor, the methods used to carry out this process, and the conclusions that researchers of various scientific fields come to. In the linguopragmatic approach, metaphor is considered from the point of view of communicative strategies for the successful implementation of their intentions; from a sociolinguistic position - the origin and functioning of metaphor in different social strata; from a lexicographic position - problems of dictionary description of metaphors in lexicographic works of various typology; from a discourseological position - various technologies used by the addresser in order to influence the addressee and identify the features of the implementation of metaphor in different types of institutional discourse; from a stylistic position - the use of metaphor and its varieties in the idio-style of the author of a work of art; in phraseology - a metaphorical component in the semantics of phraseological units, etc.

Аннотация

Современная антропоцентрическая научная парадигма направлена на исследование концептуальной картины мира с позиций человека. Соответственно в лингвистике на первый план выдвигается изучение роли человеческого фактора в языке, т.е. проблема роли языка в человеке и человека в языке. В языковой картине мира носителей различных языков и культур важное место занимает метафора, поскольку человеку как *homo cogitans* свойственно мыслить образами и ассоциациями, представляя новое по подобию уже известного ему. Будучи воплощением менталитета и культуры этноса, метафора вызывает большой исследовательский интерес и изучается с различных точек зрения: философских, лингвистических, литературоведческих, лингвокультурологических, лингвокогнитивной и мн. др. Поскольку метафора, начиная с трудов античных философов (Аристотель, Квинтилиант, Цицерон, Деметрий Фелерский, Гермоден и др.), в Средневековье – грамматистов Пор-Рояля, в эпоху Возрождения – Августина и др., позже – Гегеля и др. по сей день является объектом практически всех гуманитарных научных дисциплин активно исследуется, вполне естественно наличие большого арсенала исследований, который требует мониторинга и систематизации. Каждый этап изучения метафоры ставит перед исследователями новые задачи, расширяя поле научного познания: уточняется дефиниция данного понятия, предлагаются различные классификации метафор, рассматривая их с позиций описания связанных с ней явлений. Исходя из этого, целью данной статьи является обзор языковедческих исследований, посвященный лингвистической природе метафоры. Представляет интерес, какие аспекты метафоры наибольший интерес вызывает у исследователей-представителей различных лингвистических традиций дальнего и ближнего зарубежья, а также в отечественном языкознании. При изучении метафоры с лингвокультурологических позиций исследование исходной точкой являются культурные реалии и ее артефакты, а языковые единицы являются фоном, т.е. исследователь «идет» от культуры к языку, тогда как в лингвокогнитивных исследованиях – от языка к культуре. Представляет интерес выявление когнитивных структур, лежащих в основе каждой метафоры, при помощи каких методов осуществляется этот процесс, к каким выводам приходят исследователи различных научных направлений. При лингвопрагматическом подходе метафора рассматривается с точки зрения коммуникативных стратегий для успешной реализации своих интенций; с социолингвистических позиций – происхождение и функционирование метафоры в разных социальных слоях; с лексикографических позиций – проблемы словарного описания метафор в лексикографических произведениях различной типологии; с дискурсологических позиций – различные технологии, используемые адресантом, с целью воздействия на адресата и выявление особенностей реализации метафоры в разных видах институционального дискурса; со стилистических позиций – использование метафоры и ее разновидности в идиостиле автора художественного произведения; во фразеологии – метафорический компонент в семантике фразеологизмов и мн. др.

Keywords: metaphor, typology, functioning of metaphor, cognitive structures, mentality.

Ключевые слова: метафора, типология, функционирование метафоры, когнитивные структуры, менталитет.

Бесконечность научного познания также подтверждается неисчерпаемым количеством исследований многогранного феномена метафоры с античности по сегодняшний день, всякий раз раскрывая ее новые грани. Так на современном этапе, когда все языковые явления изучаются с позиций человека, изучение лингвистической природы метафоры поднимается на новый уровень. Качественно новым подходом является когнитивный, поскольку, действительно, метафора играет огромную роль в формировании индивидуальной личностной языковой картины мира, в результате которого осуществляется интеграция вербального и чувственно-образного представления человека о мире. В связи с этим активно развиваются два направления – семантическое (языковое) и когнитивное.

Изучением природы метафоры занимаются ученые как зарубежной и отечественной лингвистики. Так, в дальнейшем зарубежье данной проблеме посвящены труды следующих ученых: Дж.Лакофф, М.Джонсон, М.Блэк, Дж.Серль, Д.Ротбарт, Е.Киттей, Дж.Карбонелл, В.Гертнер, Х.Кларк и П.Люси, Р.Гиббс, А. Пайвио и др.

В ближнем зарубежье: Н.Д.Арутюнова, Г.Н.Скляревская, Л.А.Кудрявцева, Ж.А.Вардзелашвили, О.Н.Лагута, М.Н.Лапина, О.Б.Пономарева, Н.П. Тропина, Д.Балота, Я.Босман, Р.Гиббс, С.В.Агеев, К.И.Алексеев, А.А.Залевская, А.Н.Баранов, З.Д.Попова и И.А.Стернин, В.Н.Телия, В.В.Петров, О.М.Бессонова, Ю.В. Кравцова и др.

В отечественной лингвистике: Г.Б. Алмабаева, Е.О. Артыкова, А.Ж. Калиева, А.Ж. Жапарова, К.К. Кенжеханова, И.К. Азимбаева, У.О. Бекназарова, Г.К.Абзулдинова, К.К. Рысберген, Б.К. Хасангалинова, С.С. Исакова, А.С. Исакова, Г.К. Хасанов, Г. Кайреденова, Есиркепова, М.Ш.Мусатаева, Л.В.Екшембеева, Г.К.Ихсангалиева, Ж.А. Нуршаихова, Ж.С.Нуржанова, Н.А.Шахметова, Г.С.Самсенова и др.

Представителями семантического направления в лингвистике дальнего зарубежья являются М.Блэк, Дж.Серль, Д.Ротбарт, Е. Киттей и др.

Истоки изучения метафорической семантики восходят к трудам М.Блэка, поэтому, как и всякий классический труд, его идеи были объектом тщательного анализа [1,2]. В рамках данной статьи мы лишь контурно отметим его основные идеи, реализованные в его трудах. Одним из его вкладов в теорию метафоры является идея фильтрации (позже — проекции), расширившая понятие метафорического переноса, суть которой заключается в том, что общие представления объекта/субъекта фильтруются, т.е. детализируются в соответствии с характеристиками сравниваемого объекта/субъекта [3]. Заслугой М.Блэка заключается в выдвижении на первый план коннотативной семантики. Как известно, каждый исследователь анализирует объект исследования в рамках актуальной для его времени научной парадигмы. Так, это выразилось в том, что в трудах его единомышленников в соответствии с актуальными для того времени логическими учениями и формализованными семантическими моделями метафорическая семантика рассматривалась сквозь призму референциальной концепции.

Традиционной является точка зрения о возникновении метафоры за счет расширения семантической базы исходного слова за счет метафорического переноса основного значения базовой лексемы. Безусловно, существуют и другие точки зрения ученых, предпочитающих более гибкие и менее формализованные методы анализа [4].

Многоаспектная природа метафоры вызывает очень много, порой очень противоречивых, подходов. Так, по Дж.Серлю, метафорический перенос находится в гиперо-гипонимических отношениях с более широкой моделью интерпретации высказываний и является отражением метафорического мышления говорящего [5].

Мы разделяем точку зрения ученых, которые считают, при наличии различных точек зрения на природу метафоры, остается вопрос: каковы критерии переноса того или иного конкретного признака из множества других на объект переноса.

Рассмотрим концепции, опирающиеся на структурно-системное описание, автором одной из которых является Д.Ротбарт. По его мнению, в метафорическом переносе участвует лишь часть основного значения, которое состоит из инварианта и варианта. В метафорическом переносе участвует лишь инвариантное значение, выделяющее релевантные черты и усиливают определённые характеристики объекта [6]. Безусловно, если предмет малоизвестен, то очень сложно усилить его характеристики. В этом случае метафорический перенос структурирует новое содержание, меняя свою традиционную функцию, что является в некотором смысле основанием обращения к теории семантического поля, заложенного в трудах Ф. де Соссюра.

Следующее поколение ученых, занимающееся разработкой проблемы метафоры, развивают идею Ф. де Соссюра о необходимости разграничения плана выражения и плана содержания [7]. В связи с этим уместно обратиться к мнению одного из ведущих ученых по теории метафоры, Е.Киттея, который считает невозможным объяснение лингвистической природы метафорического переноса без учета лексического, семантического и содержательного полей [8]. Расшифровка означает, что лексическое поле представляет лишь набор не связанных между собой, не интерпретированных слов; содержательное поле — фрагмент реального мира, обозначаемая словами, а семантическое поле выявляет совпадения между предыдущими двумя полями, при обнаружении которых объединяет их в одно семантическое поле. Как видно, наблюдается наложение одного семантического поля на другое.

Несомненно, теория семантического поля объясняет структуру метафорического переноса, но объяснить механизм точного и быстрого выбора именно тех или иных признаков и их метафорического переноса на другой субъект/объект не может. И, чтобы получить ответ на этот вопрос, необходимо обратиться к исследованиям по когнитивной метафоре таких ученых, как Дж.Лакофф, М.Джонсон, Дж. Карбонелл, В. Гертнер, Х.Кларк и П.Люси, Р.Гиббс, А. Пайвио и др.

Как известно, человек с позиции обыденного сознания мыслит не формальными логическими выводами (дедукцией или индукцией), а аналогиями, перенося знания из одной области на другую. Соответственно он познает новые неизвестные ему предметы, процессы, явления посредством сравнения, сопоставления, образов, ассоциаций с другими известными ему вещами. Иначе говоря, метафора, с когнитивной позиции, рассматривается как отражение одного из базовых процессов мышления, являясь инструментом, помогающим понять неизвестное через уже знакомое. Различные метафоры формируют разные когнитивные рамки, влияющие на понимание проблемы и способы её решения.

Представляет интерес теория нормативной иерархии инвариантности, разработанная на основе богатого фактического материала Дж. Карбонеллом и представляющая собой список концептуальных связей, ранжированных по степени вероятности их сохранения при переносе:

1. Цели субъектов. Если в исходной области есть цели, они почти всегда сохраняются и переносятся в новую область. Даже если в целевой области нет явных субъектов, цели могут проецироваться на олицетворённые элементы. Например, в метафоре «Инфляция — это война» инфляция воспринимается как противник, с которым нужно бороться.

2. Стратегии и планирование. Способы достижения целей, включая стратегии противоборства или сотрудничества, также сохраняются и помогают организовать поведение в новой области. Метафора в этом случае упорядочивает мышление и помогает ориентироваться в незнакомой ситуации.

3. Причинно-следственные связи. Если исходная область обладает чёткой каузальной структурой, она, как правило, сохраняется при переносе. Например, в аналогии между лечением болезни и экономическими мерами предполагается, что действия (медикаменты или реформы) приведут к выздоровлению [9].

Как известно, научное познание бесконечно: каждая предыдущая ступень познания является импульсом к зарождению новых проблем, решением которых занимаются ученые на следующей ступени. Так, некоторые ограничения семантического подхода нашли частичное решение в когнитивной модели Дж.Карбонелла, она тоже порождает некоторые вопросы: уделяется исключительное внимание переносу знаний и не учитывается языковая форма метафоры [10]. Эта модель предполагает наличие чётко организованных областей знания, тогда как в реальности многие проблемы не имеют такой структуры и не предполагают единственно верного решения.

Когнитивная природа метафоры находит дальнейшее развитие в работах В. Гертнера, предлагающего формализовать семантический перенос [11] и исследовать, как дети формируют метафоры [12]. Особенно актуальной тема переноса знаний стала в последние годы, когда она стала ключевой в области искусственного интеллекта и создания экспертных систем.

Безусловно, сравнительно молодая когнитивная наука пока охватывает не все нюансы метафорического переноса. Остается открытым вопрос о механизме структуризации новых областей знания в процессе переноса. В семантических моделях это происходило через систему смысловых отношений, а вот в рамках аналогий этот процесс остаётся туманным. Видимо, язык — это основной инструмент, с помощью которого мы формируем новое видение действительности.

Весомый вклад в изучение природы метафоры психологический подход, в котором можно выделить две тенденции:

1) Попытка ответить на вопрос; почему понимание метафоры может базироваться на подобии между сравниваемыми областями содержания. Предлагаются идеи о концептах «небуквального сходства», о геометрических моделях подобия, а также выявляются характерные свойства метафоры: асимметрия, несоответствие, гипербола, прототипичность и другие [13-16].

2) акцент на процессуальных моделях понимания метафоры, т.е. на буквальном значении высказывания: понимание любого небуквального высказывания (будь то ирония, метафора или косвенная просьба) начинается с выявления его прямого значения [17].

Психолингвисты метафору рассматривают как неразделимое единство образного и языкового. Например, по мнению А. Паивию, метафора возникает в результате взаимодействия двух систем: образной (конкретные объекты и восприятия, формирующие перцептивную картину мира и целостный характер метафоры) и вербальной (языковая обработка и создание абстрактных знаний, объяснение роли языковых навыков в её понимании) [18, 19].

В ближней зарубежной лингвистике ученые рассматривают следующий круг проблем: поиск научного обоснования метафоры как языкового явления, в связи с чем работы таких исследователей, как Д.Н. Шмелев, Ю.Д. Апресян, Н.Д. Арутюнова, Ю.И. Левин, В.Н. Телия, Н.А. Басилая, Н.А. Кожевникова, Г.Н. Скляревская и др., заложили основу формирования самостоятельной дисциплины — лингвометафорологии. Как отмечает Скляревская [20], за последние десятилетия из отдельных наблюдений стала складываться лингвистическая теория метафоры, включающая значительное число ценных идей и аналитических подходов. Однако как самостоятельная область языкознания лингвометафорология оформилась лишь в начале XXI века.

На сегодняшний день в рамках лингвистического изучения метафоры существует более десяти направлений: от лексикологического и семасиологического до психолингвистического, когнитивного и лингвокультурологического [21-23]. Особенно активны исследования в семасиологическом, ономасиологическом, психолингвистическом, лингвокогнитивном и лингвокультурологическом аспектах. В семасиологии и ономасиологии метафора трактуется как результат вторичной номинации, и изучаются её семантические структуры. В ономасиологическом подходе акцент делается на описании типичных моделей метафоризации в рамках деривационной семантики.

С точки зрения психолингвистики и когнитивной лингвистики, метафора рассматривается как ментальный механизм, участвующий в порождении и восприятии смысла (Д. Балота, Я. Босман, Р. Гиббс, С.В. Агеев, К.И. Алексеев, А.А. Залевская).

В лингвокультурологическом подходе (Ж.А. Вардзелашвили, З.Ю. Петрова, З.И. Резанова, Г.Н. Скляревская) метафора осмысливается в контексте языковой картины мира и этнокультурной концептосферы.

Ю. Кравцова развивает семантико-когнитивный подход [23], при котором метафора рассматривается как ментально-языковое явление, формирующее и отражающее образ мира. Этот подход основан на работах Е.С. Кубряковой, А.П. Бабушкина, Н.Н. Болдырева, Е.В. Лукашевич, З.Д. Поповой и И.А. Стернина, И.С. Кобозева и др., в работах которых метафора понимается как результат когнитивной деятельности, где аналогии и ассоциативные связи служат основой номинации.

В казахстанской лингвистике при изучении метафоры исследователи уделяют внимание следующим аспектам метафоры: когнитивная теория метафоры (Г.Б. Алмабаева, Е.О. Артыкова, А.Ж. Калиева, А.Ж. Жапарова, К.К. Кенжеханова, И.К. Азимбаева, У.О. Бекназарова), метафора как репрезентант концепта (Г.К. Абзуддинова и др.), метафора в ономастике (К.К. Рысберген и др.), реализация метафоры в терминологии (Б.К. Хасангалинова, С.С. Исакова, А.С. Исакова и др.), компонентный анализ метафоры (Г.К. Хасанов, Г. Кайреденова и др.), индивидуально-авторское использование метафоры (Есиркепова и др.), метафоры в институциональных дискурсах (М.Ш. Мусатаева, Л.В. Екшембеева, Г.К. Ихсангалиева, Ж.А. Нуршаихова, Ж.С. Нуржанова, Н.А. Шахметова, Г.С. Самсенова и др.).

Современные казахстанские исследователи активно развивают когнитивную теорию метафоры, рассматривая её как универсальный механизм концептуализации и структурирования действительности. В рамках этого направления метафора изучается как ментально-языковой инструмент, отражающий языковую, ментальную и культурную деятельность человека. Так, в своей работе Г.Б. Алмабаева, Е.О. Артыкова, А.Ж. Калиева рассматривают метафору с позиций когнитивной лингвистики как ментально-языковой механизм, лежащий в основе формирования и вербализации концептуальной картины мира [29]. Авторы анализируют метафоризацию в художественном дискурсе как способ моделирования действительности, соединяющий абстрактные и конкретные объекты через образное мышление. Особое внимание уделяется функциям метафоры в поэтическом тексте — как средству семантической деривации, концептуализации чувственного опыта и выражения этнокультурных архетипов. В статье

обосновывается, что метафора представляет собой не только троп, но и когнитивный инструмент, обеспечивающий взаимодействие языка, сознания и культуры.

А.Ж. Жапарова, К.К. Кенжеханова и И.К. Азимбаева делают акцент на концептуальной теории метафоры в русле когнитивной лингвистики. Авторы рассматривают метафору как базовый когнитивный механизм, лежащий в основе процессов мышления, понимания и интерпретации окружающего мира. Особое внимание уделяется механизмам концептуального отображения и типологии метафор (онтологическая, ориентационная), а также роли метафоры в формировании новой смысловой реальности. Метафора здесь трактуется как фундаментальный способ перехода знаний между семантическими доменами [30].

У.О. Бекназарова рассматривает метафору как сложный и многофункциональный феномен, обладающий широкой функциональной нагрузкой в языковой системе. Автор рассматривает метафору как средство не только эстетической выразительности, но и когнитивного отражения мира, подчеркивая её номинативную, информационную и мнемоническую функции. Особенно значимым является взгляд на метафору как на «жанды білім көзі» (живой источник знания), через который осуществляется моделирование универсальной и этнокультурной картины мира [31].

В свою очередь, Г.К. Абзулдинова в диссертационном исследовании сосредотачивается на метафоризации когнитивной области «учёба» в русском языке. Автор выявляет основные метафорические модели, через которые в языковом сознании носителей репрезентируется процесс обучения, такие как «учёба — путь», «учёба — свет», «учёба — бой» и др. Анализируется аксиологическое измерение концепта, гендерные асимметрии и трансформации в молодежном сленге. Метафора здесь выступает как способ концептуального освоения социально значимой области, отражающий культурные и ценностные установки лингвосоциума [32].

К.К. Рысберген фокусируется на лингвокогнитивном потенциале метафоры в ономастике, доказывая, что метафоризация играет ключевую роль в наименовании географических объектов. Автор показывает, как в структуре топонимов и мифонимов отражается коллективное этнокультурное сознание, а через соматические и бытовые метафоры кодируются архетипические представления народа о пространстве и мире в целом. Исследование демонстрирует, что метафора становится средством сохранения культурной памяти и ценностей [33].

Б.К. Хасангалиева, С.С. Исакова и А.С. Исакова рассматривают метафору как продуктивный инструмент терминовтворачества в профессиональном дискурсе офтальмологии. Авторы показывают, как когнитивные механизмы метафоризации используются в наименовании специализированных понятий, способствуя концептуальной структуризации научного знания. Термин-метафора анализируется как результат сложного взаимодействия когнитивных и номинативных процессов, обеспечивающий доступную и наглядную вербализацию сложных феноменов. Сопоставление казахского и английского языков выявляет универсальные и специфические особенности метафоризации в научной сфере [34].

Г.К. Хасанов, Г. Кайреденова в своей статье системно анализируют когнитивные основания метафоры, раскрывая её связь с концептосферой, категоризацией и ментальными структурами личности. Он подчеркивает, что когнитивная метафора возникает как результат взаимодействия языкового и концептуального сознания, и служит выражением когнитивной картины мира. Особое внимание уделяется поэтическому сознанию, где метафора становится способом индивидуальной интерпретации универсальных смыслов [35].

К.К.Есиркепова в статье «Концептуальное использование метафор» акцентирует внимание на индивидуальных авторских метафорах в поэзии, рассматривая их как ключ к эстетике и стилистике. Она подчеркивает, что метафора выполняет не только изобразительно-выразительную, но и когнитивную функцию, участвуя в создании новых смыслов и смысловых ассоциаций. Анализируя поэзию Фаризы Онгарсыновой, автор показывает, как метафоры рождают глубокие символические образы, формируют уникальный поэтический стиль и отражают национальную культурную специфику. Автор опирается на мнение Б. Хасанова, Р. А. Будагова и других исследователей, утверждая, что метафора позволяет поэту выразить внутренние переживания и коллективное сознание народа в индивидуализированной форме [36].

Н. А. Шахметова и Г. С. Самсенова в учебном пособии «Актуальные проблемы языкознания: когнитивная природа метафоры» рассматривают метафору как фундаментальный когнитивный механизм. В книге подробно анализируются пути эволюции лингвистического понимания метафоры — от её риторико-эстетической функции в античности до ключевого

инструмента концептуализации в рамках когнитивной лингвистики. Согласно авторам, метафора служит способом осмысления и структурирования действительности, переносом признаков из сферы-источника в сферу-мишень. Теоретическая часть работы уделяет внимание роли метафоры в формировании языковой картины мира, а практическая — предлагает методику когнитивного анализа политического дискурса на материале речей казахстанских политиков. Исследование подчёркивает важность метафоры в межкультурной коммуникации и в национально-культурных представлениях, формирующих восприятие мира [37].

Таким образом, на каждом этапе развития лингвистической науки в соответствии с актуальной научной парадигмой перед учеными встают новые исследовательские задачи, открывающие новые грани феномена метафоры. В связи с антропоцентрической научной парадигмой на первый план выдвигается проблема изучения механизмов познавательной деятельности и роль метафоры в этих процессах. Перспективными представляются сопоставительные исследования метафоры в когнитивной проекции, что позволит глубже понять особенности национального метафорического мышления носителей разных языков и культур, а также механизмы метафоризации в языке и сознании.

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MODERN EXPERIMENTAL-PHONETIC AND PHONOLOGICAL ANALYSIS OF THE SOSVI DIALECT AS A WAY TO VERIFY FIELD DATA

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СОВРЕМЕННЫЙ ЭКСПЕРИМЕНТАЛЬНО-ФОНЕТИЧЕСКИЙ И ФОНОЛОГИЧЕСКИЙ АНАЛИЗ СОСЬВИНСКОГО ДИАЛЕКТА КАК СПОСОБ ВЕРИФИКАЦИИ ПОЛЕВЫХ ДАННЫХ

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Abstract

The article presents the results of an extended study of the field material of the Sosvin Mansi dialect of the village of Lombovozh. Its experimental-phonological analysis was carried out with the help of the modern data processing system LingvoDoc. The comparison of the system of vowel sounds obtained as a result of this analysis with other phonetic systems of the Sosvi dialect proposed by linguists of the 20th century allowed us to conclude that it is necessary to further clarify the phonetic system of this Mansi dialect.

Аннотация

В статье приводятся результаты расширенного исследования полевого материала сосьвинского мансийского диалекта села Ломбовож. Его экспериментально-фонологический анализ был выполнен с помощью современной системы обработки данных LingvoDoc. Сопоставление полученной в результате этого анализа системы гласных звуков с другими фонетическими системами сосьвинского диалекта, предложенными лингвистами XX в., позволило прийти к заключению о необходимости дальнейшего уточнения фонетической системы этого мансийского диалекта.

Keywords: *Mansi language, Sosvin dialect, phonetics, phonology, experimental study, LingvoDoc.*

Ключевые слова: *мансийский язык, сосьвинский диалект, фонетика, фонология, экспериментальное исследование, LingvoDoc.*

Введение

Исследование фонетической системы мансийского языка, несмотря на введение его в научный оборот зарубежными учеными еще во второй половине XIX в., было осуществлено только в XX в. и связано в основном с именами советских ученых, подробнее см. [Кошелюк 2021]. Наиболее ранние попытки всесторонне изучить этот аспект языка предприняли сотрудники Института народов Севера в 1930-е годы. Лингвисты В. Н. Чернецов, И. Я. Чернецова, А. И. Емельянов, А. Н. Баландин и др. совершали экспедиции в районы расселения манси для сбора полевого материала и его дальнейшей инструментальной обработки. Итогом этих исследований стал первый коллективный труд «Языки и письменность народов Севера» [Языки..., 1937], где было предложено описание мансийской фонетики [Ромбандеева 2017, 13].

Переломным этапом в исследовании этого аспекта мансийского языка стала деятельность ученых второй половины XX в. А. Н. Баландина, М. П. Вахрушевой, Е. И. Ромбандеевой и др. Этому послужило понимание «необходимости оперирования надежными данными, исключающими субъективность перцептивной фонетики, что привело к активному использованию аппаратных методов в изучении звуковых систем различных языков мира» [Селютина 2016: 68], в том числе и мансийского. Использование классического фонологического анализа, а также экспериментально-фонетических методов соматических исследований, включая в дальнейшем рентгенографирование, лингвографирование, лабиографирование и другие методики, позволило лингвистам к концу XX в. значительно расширить знания о фонетике мансийского языка. Весомый вклад в развитие этой области был привнесен Е. И. Ромбандеевой,

чьи экспериментальные исследования различных мансийских диалектов, проводившиеся в 1960-80-е годы на базе фонологической школы Ленинградского государственного университета под руководством Л. В. Бондарко (1959 г.), В. М. Наделяева (1962 г.), М. И. Матусевич (1967 г.), позволили детально изучить системы консонантизма и вокализма мансийского языка [Ромбандеева 2017: 15]. Результатом этой работы стали публикации трудов «Мансийский язык: учебное пособие для педагогических училищ» [Баландин, Вахрушева 1957], «Мансийский (вогульский) язык» [Ромбандеева 1973], «Сыгвинский диалект мансийского (вогульского) языка» [Ромбандеева 1995]. Позже фонетика мансийского языка изучалась Ю. А. Тамбовцевым на базе лаборатории экспериментально-фонетических исследований Института истории, филологии и философии Сибирского отделения Академии Наук СССР (ЛЭФИ ИФЛ СО РАН): «Гласные мансийского языка по данным рентгенографирования (на материале среднесосьвинского говора» [Тамбовцев 1980], «Kombinierbarkeit von Vokalen und Konsonanten im Wogulischen» [Tambovcev 1982], «Vowel Frequency Characteristics of the First Syllable in Mansi» [Tambovcev 1984] и др. Среди зарубежных исследователей можно отметить работы [Murphy 1968], [Keresztes László 1998], [Riese 2001], [Fejes 2008], посвященные различным аспектам мансийской фонологии. При этом монографические экспериментально-фонетические исследования по мансийскому языку к настоящему времени отсутствуют [Бурыкин 2000: 154].

К концу XX – началу XXI в. в экспериментальные исследования, прежде основанные на сугубо лингвистических и аппаратных способах обработки языкового материала, стали внедряться инновационные методы: магнитно-резонансное томографирование (МРТ), дигитальное рентгенографирование (ДРГ) и ларингографирование (ДЛГ), электромиографирование и т.д. [Селюткина 2016: 72]. Во многих лингвистических лабораториях мира широкий отклик получило также использование специализированных компьютерных программ для анализа спектрограмм звуковых файлов. Прорывом среди подобного рода разработок можно назвать «Praat», для которой на платформе «LingvoDoc» были созданы дополнительные программы, позволяющие анализировать сразу материал целого словаря и строить графики формантных облаков гласных.

«Praat (doing phonetics by computer)» был создан на базе университета Амстердама Полом Бюерсма и Дэвидом Вининком в качестве анализатора звучащей речи. Первый релиз состоялся в 1991, последнее обновление программы произошло 28 февраля 2021 г. С помощью «Praat» возможно не только анализировать и синтезировать звуковой материал, но и отображать его осциллограммы и спектрограммы (подробнее см. <https://www.fon.hum.uva.nl/praat/>). Разработка многофункциональной лингвистической платформы «LingvoDoc» была начата под руководством Ю. В. Норманской в 2012 г. и изначально представляла собой инструмент для составления этимологических и медиасловарей, поддерживающий открытие звуковых разметок в программе «Praat». На сегодняшний день программа значительно расширила свой функционал и позволяет создавать не только словари, но также их корпуса и конкордансы (преимущественно программа ориентирована на исчезающие и находящиеся на грани исчезновения языки России). С 2017 г. в «LingvoDoc» стало возможным проведение полного анализа языкового материала с автоматической проверкой обработанных данных, лингвистам доступны такие опции как осуществление фонетического (акустического) и фонематического исследований, поиск этимологий, реконструкция когнатов диалектов и нескольких языков, добавление звука и разметки, подготовленной в системе «Praat», и многие другие действия (подробнее см. <http://lingvodoc.ispras.ru/>). Сейчас программа активно развивается на базе Института системного программирования РАН (Москва). Таким образом, с помощью программ «Praat» и «LingvoDoc» для современных лингвистов стало доступным проведение анализа звукового материала на совершенно новом уровне, обеспечивающем более детализированный и точный результат обработки данных по сравнению с методами и техниками экспериментальных исследований прошлых лет.

В настоящем разделе представлен обзор системы вокализма первого слога для северомансийского сосьвинского диалекта, построенной в результате современной экспериментально-фонологической обработки звуков посредством программы «LingvoDoc», и уже существующих систем для этого диалекта, предложенных исследователями XX в., с целью дополнения их новыми сведениями.

Материал исследования

Несмотря на то, что разработанные на сегодняшний день системы вокализма мансийского языка признаются корректными многими лингвистами, они так или иначе

противоречат друг другу. Условно их можно объединить в две основные группы по именам исследователей, чьи мнения совпадают [Riese 2001: 12], [Keresztes 1998:392]:

1) «Штейнитц-Хонти»

Таб. 1.

Система вокализма первого слога северномансийского диалекта по [Steinitz 1955: 32-36], [Honti 1982: 16].

Ряд	Негубные	Губные
Верхний	ē ī	u ū
Нижний	aā	o ō

2) «Кальман-Ромбандеева-Керестеш»

Таб. 2.

Система гласных фонем первого слога северных мансийских диалектов по [Kálmán 1984: 73-76], [Ромбандеева 1973: 17-28], [Keresztes 1998:392-393].

Ряд Подъем	Передний		Средний		Задний	
	негубные	губные	негубные	губные	негубные	губные
Верхний	i ĭ					u, ū
Средний	ē (e)					o ō
Нижний			aā			

Система вокализма для сосвинского говора Б.Кальмана, опубликованная в его работе «Das nordwogulische Phonemsystem» [Kálmán 1984] строится на полевом материале 1957-1958 гг. Анализируя собранные данные, исследователь пришел к выводу, что транскрипция мансийского языка, предложенная до него [Steinitz 1955: 32-36], не совсем корректна: в ряде слов ученым был обнаружен аллофон ĭ (в словах 'жеребенок', 'лоб', 'дерево', 'книга', 'филин', 'он танцует' и т.д.), регулярно появляющийся после и перед согласным j или палатализованными согласными ħ, l', t' (Kálmán 1984, 74-75). Гласные фонемы, выявленные для северной диалектной группы (верхнелозьвинского, сосвинского и сызвинского говоров) Л. Хонти, являются результатом многолетних исследований венгерского исследователя и строится на данных экспедиции А. Каннисто и собственных наработках лингвиста (Honti 1988; Kálmán 1976, 1988; Kannisto, Liimola 1951, 1955, 1956, 1958, 1959, 1963; Liimola 1963; Sinor 1988). В материалах Л. Хонти, как и у В. Штейнитца, фонема ā отсутствует (см. [Honti 1987]).

Известны и другие системы вокализма для северных мансийских диалектов. Например, отличающийся от представленных выше взгляд на мансийский вокализм представлен в издании 1957 года «Мансийский язык: учебное пособие для педагогических училищ» [Баландин, Вахрушева 1957]. В книге предпринята первая попытка дать комплексную характеристику мансийского языка. Лингвисты выделяют шесть гласных фонем в сосвинском диалекте мансийского языка: а, о, у, и, ы, э (Таб. 3). При этом, гласные фонемы а, о, у могут быть и нейтральными, и долгими; гласный э всегда долгим, кроме случаев, когда он стоит в безударной позиции второго слога [Баландин, Вахрушева 1957, 20].

По сравнению с системой вокализма по Кальману-Ромбандеевой-Керестешу, в материалах [Баландин, Вахрушева 1957] не представлены долгие фонемы и (ī) и э (ē), и в отличие от данных [Steinitz 1955: 32-36], [Honti 1982: 16], [Kálmán 1984: 73-76], [Ромбандеева 1973: 17-28], [Keresztes 1998:392-393], отдельно выделяется ы (ĭ).

Таб. 3.

Система гласных фонем первого слога сосвинского диалекта [Баландин, Вахрушева 1957].

Ряд Подъем	Передний		Средний		Задний	
	негубные	губные	негубные	губные	негубные	губные
Верхний	и		ы			у (ū) ¹⁶
Средний	э					о (ō)
Нижний					а (ā)	

В [Migrhu 1968: 13] предложена точка зрения на мансийскую фонологию, полностью совпадающая с В. Штейнитцем и Л. Хонти: исследователь сходится во мнении с предшественниками и последователями в отношении гласных и, о, аи их долгих вариантов, но исключает наличие фонем ĭu e, и ĭ (Таб. 4).

¹⁶ В круглых скобках отмечены фонемы, характерные для позиции первого слога, но редко встречающиеся.

Таб. 4.

Система вокализма первого слога для сосьвинского диалекта [Murphy 1968: 13].

Ряд Подъем	Передний		Средний		Задний	
	негубные	губные	негубные	губные	негубные	губные
Верхний	i					и (i)
Средний	e					о (o)
Нижний					а, а̃	

Уточнение системы вокализма сыгвинского и сосьвинского северных диалектов мансийского языка представлено Е. И. Ромбандеевой в изданиях [Ромбандеева 1995; 2017], где собраны результаты экспериментально-фонетического и фонологического исследования ученого. Работа над фонемным составом сыгвинского диалекта была проведена под руководством М. И. Матусевич в 1959 и 1967 годах в фонетической лаборатории Ленинградского государственного университета. Позднее, под руководством В. М. Наделяева, были сделаны рентгеноснимки способа образования всех гласных и некоторых согласных, вызвавших сомнение относительно места их образования. Информантом выступила сама Е. И. Ромбандеева. Также исследователь не раз участвовала в экспедициях в район р. Сыгва для сбора полевого материала и записи текстов не только сыгвинского, но и сосьвинского и обского диалектов. Собранный за все экспедиционные годы материал составляет более 4.000 страниц рукописных текстов, а также магнитофонные записи на 5 ч. звучания [Ромбандеева 1995: 11-12].

Для обозначения фонем сыгвинского диалекта Е.И. Ромбандеевой были использованы знаки, принятые в общей финно-угорской традиции (Таб. 5). В этом диалекте, по мнению исследователя, насчитывается 15 гласных и 19 согласных фонем [Ромбандеева 1995: 17].

Таб. 5.

Общая система вокализма сыгвинского диалекта, выполненная на основе материалов 1970-х г. [Ромбандеева 1995: 17].

Место артикуляции Положение языка (подъем)	Передний		передне-средний		задне-средний		задний	
	ил.-лаб.	лаб.	ил.-лаб.	лаб.	ил.-лаб.	лаб.	ил.-лаб.	лаб.
верхний1	i							ц и
верхний2	ī							ū
средний1	e		ə ¹⁷		ɨ			о
средний2	ē (ē)		ē ¹⁸		ĩ			ō
Низкий			а					
самый низкий					ɑ			

Фонетические данные по сосьвинскому диалекту мансийского языка приводятся в монографии Е. И. Ромбандеевой «Современный мансийский язык: лексика, фонетика, графика, орфография, морфология, словообразование» [Ромбандеева 2017]. Полевой материал, положенный в основу исследования, был собран лингвистом в разные годы в период с 1958 по 1969 гг. и охватил практически все известные места расселения манси. Информантами выступили в основном люди старшего поколения в возрасте 50-90 лет. В результате экспедиций Е. И. Ромбандеевой был собран языковой материал на 10 тысяч страниц рукописных текстов. Обработка данных также была проведена на базе лаборатории экспериментальной фонетики ЛГУ под началом проф. М. И. Матусевич и В. М. Наделяева [Ромбандеева 2017, 2-4].

В результате проведенной лабораторной работы по изучению фонемного состава мансийского языка было установлено, что в сосьвинском диалекте мансийского языка выделяется 12 гласных фонем (Таб. 6). Как пишет Е. И. Ромбандеева, «наиболее существенной особенностью гласных мансийского языка является фонематическая оппозиция долгих и кратких (квантитативный признак)» [Ромбандеева 2017, 22].

Как видно из таблицы, в сравнении с данными Б. Кальмана и Л. Керестеша в [Ромбандеева 2017] представлено больше фонем: i, ī, e, ē, ə~ĩ, ɨ~ĩ; относительно системы вокализма В. Штейнитца, Л. Хонти и Л. Мёрфи добавляются фонемы ī, e, i, ə~ĩ, ɨ~ĩ, а в сравнении с [Баландин, Вахрушева 1957] – ī, ē, ə~ĩ.

¹⁷ Не встречается в первом слоге.

¹⁸ Не встречается в первом слоге.

Таб. 6.

Система вокализма сосьвинского диалекта [Ромбандеева 2017: 23].

система вокализма современного диалекта (Гомельская 2011: 23).						
Ряд Подъем	Передний		Средний		Задний	
	Неогубленные				Огубленные	
	краткие	долгие	краткие	долгие	краткие	долгие
Верхний	i	ī			u	ū
Средний	e	ē	ɨ~ɪ ¹⁹	ə~ɛ ²⁰	o	ō
Нижний			a	ā		

Исходя из приведенного материала, мы видим, насколько неоднозначна система вокализма по первому слогу не только одной диалектной группы мансийского языка, но и его поддиалектов: Б. Кальман и Л. Керестеш насчитывают в сосьвинском диалекте 10 гласных фонем, В. Штейнитц, Л. Хонти (верхнелозьвинский, сосьвинский, сыгвинский) – 8, А. Н. Баландин и М. П. Вахрушева (сосьвинский) – 9, Л. Мёрфи для сосьвинского – 8, Е. И. Ромбандеева – 13 (сыгвинский) и 10 фонем (сосьвинский).

Привлечение нового полевого материала, обработанного с помощью современных фонетических программ, позволяет провести верификацию этих данных. В качестве такого источника был выбран словарь сосьвинского диалекта с. Ломбовож (Таб. 7). Запись этого источника проводилась в г. Новосибирске

В настоящее время словарь размещен на лингвистической платформе «LingvoDoc»²¹ и состоит из 234 лексем с размещенной звуковой разметкой, выполненной предварительно в программе «Praat». Известно, что материал этого словаря был собран новосибирскими учеными в 1975 г. в Лаборатории экспериментально-фонетических исследований в 1975 г. [Норманская, Кошелюк 2017: 151], но его введение в научный оборот и первичная экспериментальная обработка была проведена сотрудницей лаборатории лингвистической антропологии Томского государственного университета Е. В. Ковалевой лишь в 2017 году. Информантом выступил П. Е. Шешкин из д. Ломбовож, Ломбовожского сельсовета.

Таб. 7.

Система гласных звуков северного сосьвинского диалекта с. Ломбовож (1975 г.).

	Передние	Ненапряженные передние	Средние	Ненапряженные задние	Задние
Верхние	ii:		ii: ɥɥ:		uu:
Ненапряженные верхние		ɪɪ:	ĩĩ:	ʊ	
Средне-верхние	e e:		ɵ		ʏ o o:
Средние			ə		
Средне-нижние	ɛɛ: æ		ʒə		ɔ
Ненапряженные нижние	æ		ɐ		
Нижние	a a: ǣ				ɑ: ɒ

Таб. 7.

Система гласных звуков северного сосьвинского диалекта с. Ломбовож (1975 г.).

	Передние	Ненапряженные передние	Средние	Ненапряженные задние	Задние
Верхние	ii:		ii: ɥɥ:		uu:
Ненапряженные верхние		ɪɪ:	ĩĩ:	ʊ	
Средне-верхние	e e:		ɵ		ʏ o o:
Средние			ə		
Средне-нижние	ɛɛ: æ		ʒə		ɔ
Ненапряженные нижние	æ		ɐ		
Нижние	a a: ǣ				ɑ: ɒ

По данным фонетического анализа, выполненного в системе «LingvoDoc», состав гласных сосьвинского диалекта с. Ломбовож составляет 33 аллофона²² (Таб. 7), объединенных алгоритмами Phonology²³ в 9 фонем: a, i, o, u, ɨ, ɛ, e, ə²⁴ (наличие не менее 8 примеров с

¹⁹ Не встречается в первом слоге.

²⁰ Не встречается в первом слоге.

²¹ См. <http://lingvodoc.ispras.ru/dictionary/688/9870/perspective/688/9871/view>.

²² Подробнее с результатами анализа можно ознакомиться, скачав фонологический анализ словаря на платформе LingvoDoc (Tools ->PhoneticAnalysis).

²³ Подробнее с результатами анализа можно ознакомиться, скачав фонологический анализ словаря на платформе LingvoDoc (Tools ->Phonology).

²⁴ Не встречается в первом слоге.

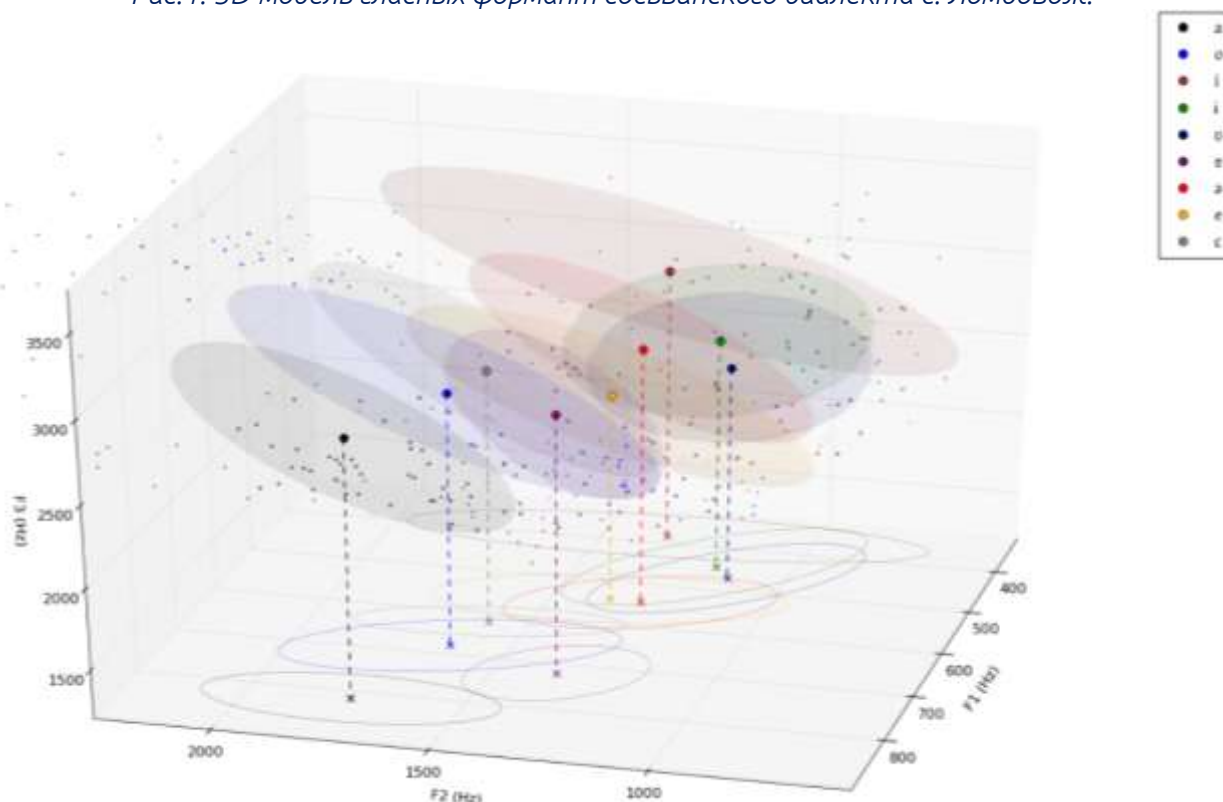
наибольшей долготой предполагаемого гласного засчитывалось как существующий аллофон). В сопоставлении с представленными выше традиционными системами гласных, в полевых материалах северного мансийского диалекта количество фонем совпадает с данными Штейнитца, Хонти и Мёрфи, но имеют различия по качеству: *ɯ*, *ɛ*, *ɛ* ранее не зафиксированы ни в одной из них.

В разделе представлена попытка соотнести эти фонетические варианты гласных с традиционной транскрипцией, чтобы проверить, действительно ли можно говорить о наличии в сосвинском мансийском диалекте подобного набора фонем. Так, ниже мы провели сравнительный анализ показателей фонем полевого материала в сопоставлении со средними значениями параметров F1 и F2 для гласных по данным МФА (IPA).

1. Интервалы формант гласных, по данным полевых записей сосвинского диалекта с. Ломбовож

О правильности выделения той или иной фонемы мы можем заключить, обратившись к 3D-модели, сформированной программой LingvoDoc на основе результатов фонологического анализа (Рис. 1):

Рис. 1. 3D-модель гласных формант сосвинского диалекта с. Ломбовож.



Говорить о правомерности выделения фонемы схожих дифференциальных признаков (ряд, подъем, лабиализованность) и звучания можно на основании того, насколько сильно пересечение их облаков. В данном случае о возможной ошибке может говорить близость расположения облаков формант *i* и *ɯ*. Но в пользу правильности выделения этих звуков для сосвинского диалекта с. Ломбовож говорит тот факт, что гласный *ɯ* является ненапряженным огубленным заднего ряда верхнего подъема, а *i* — неогубленным гласным среднего ряда верхнего подъема.

Таким образом, согласно формантной 3D-модели сосвинского диалекта с. Ломбовож, мы можем говорить о довольно корректной обработке фонетического материала. Однако для того, чтобы подобное заключение можно было считать правомерным, мы провели сопоставление выделенных с помощью программы Praat параметров гласных фонем полевых данных со средними значениями гласных международного фонетического алфавита.

В нижеприведенной таблице (Таб. 8) отмечены все полученные в результате обработки полевого материала в программе Praat гласные фонемы с указанием их минимального и максимального диапазона. Сопоставление этих данных с данными МФА выявило некоторые неточности в проведенном ранее Е. В. Ковалевой фонологическом анализе.

Таб. 8.

Форманты гласных первого слога сосвинского диалекта с. Ломбовож.

Аллофон	Диапазон	
	Минимальный показатель F1 (Гц)	Максимальный показатель F2 (Гц)
a	514,088-941,115	1641,192-2290,902
i	341,263-619,996	1138,123-1502,069
o	692,61-786,262	1594,894-1893,258
u	501,565-659,786	1147,43-1593,267
ɪ	385,291-427,651	1092,098-1500,312
e	735,104-835,24	1379,79-1565,969
ə	575,691-644,74	1266,588-1547,925
ɛ	608,491-679,402	1488,502-1856,715
e	580,356-638,697	1635,976-2151,768

В соответствии с МФА [Catford 2001, 154], средние показатели а равны F1 850 и F2 1610 Гц, что соответствует значениям F1-F2 мансийских полевых данных для этого аллофона по F1, но, согласно F2, мансийская а имеет более высокую частоту – 1950 Гц; для у по МФА характерны следующие значения: F1 235 Гц, F2 2100 Гц – в исследуемом материале он обозначается как i и имеет показатели F1 341,263-619,996 Гц и F2 1138,123-1502,069 Гц. Значительное расхождение указывает на неверно определенный аллофон. Предполагаем, что по заданным параметрам, по МФА ему ближе всего неогубленный гласный заднего ряда верхнего подъема ɯ F1 300 Гц, F2 1390 Гц.

Аллофон o, по МФА, имеет средние значения F1 360 Гц и F2 640 Гц, но его показатели, согласно полевым данным с. Ломбовож, превосходят указанные пределы примерно в 2 раза – F1 692,61-786,262 Гц и F2 1594,894-1893,258 Гц, что свидетельствует о необходимости уточнить, насколько правильно было проведено выделение этого варианта фонемы. При соотношении среднего-арифметического числа указанных параметров с показателями других огубленных гласных системы МФА, сходств между ними выявлено не было.

Диапазон ненапряженного огубленного гласного заднего ряда верхнего подъема ɯ составляет F1 501,565-659,786 Гц и F2 1147,43-1593,267 Гц. Предполагаем, что выделение такого аллофона также нуждается в корректировке, так как его значения ближе всего соотносятся с усредненными параметрами другого гласного международного фонетического алфавита – ʊ (F1 460 Гц, F2 1310 Гц). Аллофон e, согласно данным экспериментально-фонетической программы Praat, имеет показатели F1 735,104-835,24 и F2 1379,79-1565,969 Гц, что отличается от средних показателей этого гласного по МФА. Вероятно, обозначение e также следует несколько скорректировать: по параметрам он в большей степени соотносится с неогубленным гласным переднего ряда нижнего подъема a.

Показатели аллофона ɛ полевых данных и его средние значения F1 610 Гц, F2 1900 Гц для соответствующего гласного по МФА можно назвать сопоставимыми по F1, но расходящимся в отношении параметра F2, где полевым данным соответствуют: F1 608,491-679,402 и F2 1488,502-1856,715 Гц. Согласно данным МФА, усредненные значения аллофона e равны F1 390 Гц и F2 2300 Гц, при этом показатели для этого гласного, полученные в результате обработки полевого материала, имеют следующие значения: F1 580,356-638,697 Гц, F2 1635,976-2151,768 Гц. Отметим, что эти параметры максимально близки значениям F1-F2 для ɛ по МФА, а также приближены к этому же аллофону, но выделенному Е. В. Ковалевой в результате анализа полевых данных сосвинского мансийского диалекта с. Ломбовож. Однако, однозначно говорить об ошибочном обозначении аллофона e и необходимости его переименования мы не можем, ввиду довольно значительного расхождения их показателей по верхней границе F2 на 295,053 Гц.

Параметры ə по МФА составляют примерно F1 500 и F2 1510 Гц, что соответствует средним значениям F1 и F2 для этого аллофона в рассматриваемых полевых данных. Характеристики аллофона неогубленного гласного переднего ряда верхнего подъема i (F1 385,291-427,651 Гц, F2 1092,098-1500,312 Гц) значительно расходятся с усредненными значениями этой гласной по МФА, где i имеет параметры F1 240 Гц, F2 2400 Гц.

Таким образом, в результате сравнительного анализа показателей формант полевых данных с. Ломбовож со средними значениями соответствующих гласных МФА, мы допускаем вероятность несколько некорректного обозначения i, ɯ, e, а также можем предположить наличие нескольких уникальных для мансийского языка аллофонов, чьи формантные показатели отличаются от общеизвестных показателей МФА, полученных в результате анализа, в

основном, европейских языков, и указывающих на ранее типологически неописанную фонетическую уникальность этого языка – а, о, ε, е, і.

II. Нейтральность по длительности/Долгота (фонологический признак)

Согласно рассматриваемым полевым данным, в северном мансийском диалекте обнаруживаются долгие и нейтральные по длительности фонемы. Приводим списки слов на каждую фонему²⁵ в порядке увеличения длительности звуков, являющихся вариантами реализации данных фонем:

а

pa:χvə	‘захотел?’	а 0.097 мсек.
χasnεjiv	‘карандаш’	а 0.110 мсек.
pa:ɬjiv	‘вместо’	а 0.114 мсек.
ma:n	‘мыодни’	а 0.125 мсек.
ma:nsi	‘манси’	а 0.126 мсек.

ā

- 1) pa:χvə ‘захотел?’ – а 0.097 мсек.;
 - 2) χasnεjiv ‘карандаш’ – а 0.110 мсек.;
 - 3) pa:ɬjiv ‘вместо’ – а 0.114 мсек.;
 - 4) ma:n ‘мы одни’ – а 0.125 мсек.;
 - 5) ma:nsi ‘манси’ – а 0.126 мсек.;
- ### ā
- 1) pa:ɬit ‘длина, расстояние; в течение, в продолжение какого-л. времени’ – а 0.195 мсек.;
 - 2) va:s ‘утка’ – а 0.200 мсек.;
 - 3) ma:vi ‘мы’ – а 0.201 мсек.;
 - 4) sa:v ‘много; заводь, возвышенное место на низине’ – а 0.202 мсек.;
 - 5) sa:s ‘селезень; береста; колено’ – а 0.206 мсек.;
 - 6) pa:n ‘вы многие’ – а 0.208 мсек.;
 - 7) sa:v ‘лень; нужда’ – а 0.209 мсек.;
 - 8) a:niə ‘куча, толпа, стадо, стая; наряд, украшение; красивый, нарядный’ – а 0.211 мсек.;
 - 9) ya:ɣ ‘бык-олень’ – а 0.213 мсек.;
 - 10) ta:ɬt ‘еда, пища’ – а 0.214 мсек.;
 - 11) a:ni ‘теперь, сейчас’ – а 0.216 мсек.;
 - 12) a:ɣri ‘рыбный запор’ – а 0.222 мсек.;
 - 13) sa:ns ‘колено’ – а 0.224 мсек.;
 - 14) ra:t ‘стук’ – а 0.224 мсек.;
 - 15) a:ɬi ‘южный, верхний по течению реки’ – а 0.224 мсек.;
 - 16) a:vi ‘дверь’ – а 0.229 мсек.;
 - 17) ta:ɬ ‘зима, год, зимний; хвоя’ – а 0.231 мсек.;
 - 18) pa:nk ‘лиственница’ – а 0.233 мсек.;
 - 19) χa:ɣe ‘широкий, редкий (о лесе)’ – а 0.236 мсек.;
 - 20) a:ni ‘рог’ – а 0.255 мсек.;
 - 21) ra:si ‘рысь’ – а 0.268 мсек.;
 - 22) va:j ‘лось?’ – а 0.283 мсек.;
 - 23) ma: ‘земля, место, местность, страна’ – а 0.289 мсек.;

ε²⁶

- 1) ɣεaɣiɬ ‘на дороге’ – ε 0.140 мсек.;
- 2) ɬε:ni ‘белка’ – ε 0.179 мсек.;

²⁵ На нейтральные звук приводим по 5 примеров, ввиду достаточного количества подтверждений наличия этих формант, на долгие – все встреченные в источнике слова, в которых указанный формант встречается в первом слоге и имеет интервал более 0,017 мсек.

²⁶ На нейтральный гласный формант ε в исследуемом материале обнаружено всего два примера.

ɛ

- 1) *ɛ:ntɛp* 'пояс, ремень, кушак' – *ɛ* 0.206 мсек.;
- 2) *ɛɛ:mi* 'темный, черный' – *ɛ* 0.223 мсек.;
- 3) *ɛɛ:t* 'ложь, обман, притворство, лень; редкий (о предмете)' – *ɛ* 0.263 мсек.;
- 4) *ɛɛ:ɣi* 'с помощью кого-либо, благодаря кому-либо' – *ɛ* 0.223 мсек.;
- 5) *ɛ:si* 'младшая сестра, младшая сестра отца, младшая двоюродная сестра' – *ɛ* 0.285 мсек.;
- 6) *ɛɛ:* 'женщина' – *ɛ* 0.303 мсек.;
- 7) *ɛɛ:n* 'вы двое' – *ɛ* 0.222 мсек.;

e²⁷

- 1) *vermɛnkvə* 'мочь, смочь; суметь' – *e* 0.095 мсек.;
- 2) *ɛɛ:ɛmɛnkv* 'вспыхнуть, воспламениться, разгореться (об огне)' – *e* 0.132 мсек.;

ē

- 1) *se:p* 'карман' – *e* 0.214 мсек.;
- 2) *pe:ɣm* 'язык (анат.)' – *e* 0.253 мсек.;
- 3) *ɛɛ:ɣi* 'жаркий, горячий, теплый; жарко, тепло' – *e* 0.192 мсек.;

o

- 1) *ponɣɛt* 'вверх' – *o* 0.082 мсек.;
- 2) *voxoɲ* 'иголка, игла (швейная)' – *o* 0.106 мсек.;
- 3) *xoɣɛj* 'дятел' – *o* 0.119 мсек.;
- 4) *posim* 'дым' – *o* 0.124 мсек.;
- 5) *xontɛn* 'война' – *o* 0.146 мсек.;

ō

- 1) *go:si* 'отмель, песчаный берег (место рыбной ловли)' – *o* 0.205 мсек.;
- 2) *so:t* 'лук' – *o* 0.209 мсек.;
- 3) *to:tɛp* 'ящик' – *o* 0.213 мсек.;
- 4) *vo:lik* 'гладкий, скользкий; скользко' – *o* 0.238 мсек.;
- 5) *so:g* 'голень' – *o* 0.270 мсек.;

i

- 1) *kiɣiɲ* 'в (внутри предмета), в (внутрь предмета)' – *i* 0.094 мсек.;
- 2) *sim* 'сердце; середина, сердцевина; центр' – *i* 0.119 мсек.;
- 3) *mis* 'корова' – *i* 0.132 мсек.;
- 4) *piti* 'гнездо' – *i* 0.151 мсек.;
- 5) *piɣiɲ* 'ночь, ночью?' – *i* 0.175 мсек.;

ī

- 1) *i:ses* 'окно' – *i* 0.183 мсек.;
- 2) *vi:lit* 'лицо' – *i* 0.212 мсек.;

ī

- 1) *tiɲiɲ* 'дорогой, ценный' – *ī* 0.116 мсек.;
- 2) *viɣiɲ* 'красный, бордовый, рыжий' – *ī* 0.116 мсек.;
- 3) *siɲgi* 'окунь' – *ī* 0.129 мсек.;
- 4) *sis* 'за, пока (в течение времени)' – *ī* 0.147 мсек.;
- 5) *tiɛ* 'основание, комель; здесь, тут' – *ī* 0.151 мсек.;

ī

- 1) *ti:ɣi* 'отсюда, сейчас' – *ī* 0.213 мсек.;

u

- 1) *suliə* 'бутылка' – *u* 0.111 мсек.;
- 2) *ɲusapɣiɛdə* 'нужда, бедность, нищета; бедный, неимущий' – *u* 0.127 мсек.;
- 3) *urtiiv* 'взамен, вместо чего-либо' – *u* 0.144 мсек.;
- 4) *surtti* 'олень' – *u* 0.151 мсек.;
- 5) *usiɣu* 'незаконнорожденный' – *u* 0.154 мсек.;

ū

- 1) *u:mi* 'гнездо (на дереве), дупло (с гнездом)' – *u* 0.206 мсек.;

Как видно из представленного материала, в сосьвинском мансийском с. Ломбовож ввиду достаточного количества примеров с уверенностью можно говорить только о наличии одного

27 На нейтральный гласный формант *e* в исследуемом материале обнаружено всего три примера.

долгого форманта – *ā*. Также мы можем предположить вероятность существования долгого звука *ē* и отсутствие нейтрального *ε* и исключить наличие нейтрального и долгого *e/ē*, однако эти выводы требуют дальнейшей проверки на более полных данных. Анализ фонетических систем, предложенных предшественниками, показал следующие сходства и различия с полевыми данными:

1) все исследователи сходятся во мнении, что для северного мансийского диалекта характерно наличие нейтральных и долгих гласных *a/ā*, *o/ō*, *u/ū*;

2) неоднозначные данные мы встречаем относительно исследуемой фонологической характеристики звуков *i*: часть исследователей выделяет долготу для этого форманта, часть – нет; в полевых данных с. Ломбовож долготы для *i* также не подтверждается;

3) мнение некоторых исследователей также расходится в отношении звука *e*: по данным Кальмана и Хонти выделяется лишь долгий формант *ē*, при этом Баландин/Вахрушева говорят о наличии лишь нейтральной характеристики для этого звука, а Ромбандеева [Ромбандеева 1957; 2017] предлагает для сыгвинского и сосьвинского мансийского как нейтральную, так и долгую форманту и *e*.

4) в наиболее ранних материалах (Кальман, Хонти) не выделяется гласный формант *i* (ы), но уже в данных Баландина/Вахрушевой зафиксирован этот звук как нейтральный, а, начиная с 1970-х, Е.И. Ромбандеева вводит как нейтральный, так и долгий формант в фонологическую систему северных сыгвинского и сосьвинского диалектов. В отношении полевых данных с. Ломбовож мы можем говорить только о наличии нейтральной характеристики гласного *i*.

Как видно из представленного материала, в сосьвинском мансийском с. Ломбовож однозначно можно говорить только о наличии одного долгого форманта – *ā*. Также мы можем предположить вероятность существования долгого звука *ē* и отсутствие нейтрального *ε* и исключить наличие нейтрального и долгого *e/ē*.

Анализ фонетических систем, предложенных предшественниками, показал следующие сходства и различия с полевыми данными:

1) все исследователи сходятся во мнении, что для северного мансийского диалекта характерно наличие нейтральных по длительности и долгих гласных *a/ā*, *o/ō*, *u/ū*, однако для сосьвинского мансийского с. Ломбовож долготы *o* и *u* не подтверждается;

2) неоднозначные данные мы встречаем относительно исследуемой фонологической характеристики звуков *i*: часть исследователей выделяет долготу для этой фонемы, часть – нет; в полевых данных с. Ломбовож долготы для *i* также не подтверждается;

3) мнение некоторых исследователей также расходится в отношении звука *e*: по данным Кальмана и Хонти выделяется лишь долгий формант *ē*, при этом Баландин/Вахрушева говорят о наличии лишь нейтральной характеристики для этого звука, а Ромбандеева [Ромбандеева 1957; 2017] предлагает для сыгвинского и сосьвинского мансийского как нейтральную, так и долгую форманту и *e*.

4) в наиболее ранних материалах (Кальман, Хонти) не выделяется гласный формант *i* (ы), но уже в данных Баландина/Вахрушевой зафиксирован этот звук как нейтральный, а, начиная с 1970-х, Е.И. Ромбандеева вводит как нейтральный, так и долгий формант в фонологическую систему северных сыгвинского и сосьвинского диалектов. В отношении полевых данных с. Ломбовож мы можем говорить только о наличии нейтральной характеристики гласного *i*.

III. Фонологические различия данных полевого материала с. Ломбовож

В процессе исследования полевого материала с. Ломбовож был обнаружен ряд расхождений с наиболее полным (и доступным нам) фонологическим инвентарем северного сосьвинского мансийского диалекта, предложенного Е. И. Ромбандеевой²⁸.

(Ромбандеева 1982) у – Полевые данные и

1) сосьв. нусапрыжде 'нужда, нищета, бедность, бедный, неимущий', *nusapɾiʒdə* 'нужда, нищета, бедность, бедный, неимущий' (F1 369,739-F2 991,572);

2) сосьв. сулья 'бутылка', *suľə* 'бутылка' (F1 348,906-F2 968,659);

3) сосьв. сус 'блоха', *sus* 'блоха' (F1 366,999-F2 993,764);

4) сосьв. хумпыт 'волны (мн. ч.)', *хитрзət* 'волны (мн.ч.)' (F1 485,877-F2 817,876);

5) сосьв. уртыиг 'взамен, вместо чего-либо', *urtiɨv* 'взамен, вместо чего-либо' (F1 541,109-F2 1299,434);

²⁸ Данные приводятся по словарю сосьвинского мансийского диалекта [Ромбандеева, Кузакова 1982].

6) сосьв. усягу, усягыл 'незаконнорожденный', *usiaγu* 'незаконнорожденный' (F1 516,837-F2 1064,892);

7) сосьв. сурты 'олень', *surtti* 'олень' (F1 466,476-F2 1017,57);

Средний показатель для форманта и по данным МФА имеет значения F1 250 Гц, F2 595 Гц. Среднее значение представленных слов равно следующему: F1 442,269 Гц, F2 1021,966 Гц. Предполагаем, что подобное расхождение может говорить либо о неверно обозначенном звуке в полевых данных, либо свидетельствует об особом для мансийского языка звука, не соотносимого с общепринятым «европейским».

Полевые данные ч - (Ромбандеева, Кузакова 1982) **у**

1) сосьв. тув 'лето, туда', *tuv* 'лето, туда' (F1 501,568-F2 1318,871);

2) сосьв. русь 'русский, добротный', *rusi* 'русский, добротный' (F1 735,841-F2 1799,327);

3) сосьв. суп 'речь, рот', *syp* 'речь, рот' (F1 643,25-F2 1634,183);

4) сосьв. рума 'приятель, товарищ (другой национальности)', *ruma* 'приятель, товарищ (другой национальности)' (F1 659,786-F2 1390,745);

5) сосьв. ум улысь '?', *umys* '?' (F1 407,797-F2 1021,288);

6) сосьв. хўлтэп 'выдра', *hultep* 'выдра' (F1 617,462-F2 1593,267);

7) сосьв. хумбыт 'воины', *humbit* 'воины' (F1 473,137-F2 792,42);

8) сосьв. нуми 'верхний', *numi* 'верхний' (F1 449,092-F2 969,415);

9) сосьв. мувыр, мовыр 'дубинка, колотушка, колот для сбивания шишек', *muvir* 'дубинка, колотушка, колот для сбивания шишек' (F1 500,999-F2 983,697);

10) сосьв. усь-пулы 'еще сильнее', *uspy* 'еще сильнее' (F1 599,502-F2 1418,85);

11) сосьв. вўль 'клёст', *vul* 'клёст' (F1 654,488-F2 1365,554);

12) сосьв. ўльпа 'кедр', *ulpe* 'кедр' (F1 568,261-F2 1552,074);

13) сосьв. тўрхул 'карась', *turxul* 'карась' (F1 625,245-F2 1311,303);

14) сосьв. хури 'изображение', *huri* 'изображение' (F1 429,5-F2 1393,19);

15) сосьв. мули 'косяк, стая', *mul* 'косяк, стая' (F1 584,111-F2 1393,347);

16) сосьв. мувылтахи, мовылтахи 'кругом, вокруг', *muvekhi* 'кругом, вокруг' (F1 526,998-F2 1016,923);

17) сосьв. вуы 'передний', *vuvi* 'передний' (F1 501,565-F2 1147,43);

18) сосьв. пўрысь 'свинья', *puris* 'свинья' (F1 515,42-F2 1436,983);

19) сосьв. ульнус 'свободный', *ulnys* 'свободный' (F1 560,477-F2 1171,169);

20) сосьв. усьты 'только что, сейчас', *usiti* 'только что, сейчас' (F1 489,888-F2 1023,118);

22) сосьв. тўйт 'снег', *tujt* 'снег' (F1 414,347-F2 1074,148);

23) сосьв. сунсункве 'смотреть, глядеть, видеть', *sunzunkve* 'смотреть, глядеть, видеть' (F1 440,097-F2 1123,932);

Средние показатели приведенных слов имеют значения F1 540,855 Гц, F2 1269,601 Гц. Параметры и по данным МФА равны F1 250 Гц, F2 595 Гц; приблизительное среднее значение гласного *u* – F1 400 Гц, F2 1450 Гц. Очевидно, выделение гласного *u* для приведенных слов в материалах Е. И. Ромбандеевой является ошибочным и нуждается в корректировке. Учитывая разницу в параметрах гласных звуков *u* и полевых данных с. Ломбовож, можно говорить о верно принятом решении Е. В. Ковалевой предложить для них разное обозначение.

Полевые данные ɛ - (Ромбандеева, Кузакова 1982) **е**

1) сосьв. рет 'ложь, обман, притворство, лень, редкий (о предмете)', *ret* 'ложь, обман, притворство, лень, редкий (о предмете)' (F1 655,133-F2 1760,429);

2) сосьв. генгыт 'на дороге', *genyit* 'на дороге' (F1 663,247-F2 1856,715);

3) сосьв. кёр 'железо, железный', *ker* 'железо, железный' (F1 718,771-F2 1769,898);

4) сосьв. рёгыл 'с помощью кого-либо, благодаря кому-либо', *reyul* 'с помощью кого-либо, благодаря кому-либо' (F1 618,368-F2 1674,916);

Полевые данные ɛ - (Ромбандеева, Кузакова 1982) **э**

1) сосьв. эсь 'младшая сестра, младшая двоюродная сестра', *es* 'младшая сестра, младшая двоюродная сестра' (F1 660,063-F2 1614,299);

2) сосьв. энтап 'пояс, кушак, ремень', *entep* 'пояс, ремень, кушак' (F1 608,943-F2 1648,129);

3) сосьв. сэмыл 'темный, черный', *semil* 'темный, черный' (F1 679,402-F2 1733,627);

4) сосьв. нэн 'вы двое', *nen* 'вы двое' (F1 608,491-F2 1488,502);

5) сосьв. лэнын 'белка', *lenin* 'белка' (F1 590,243-F2 1599,668);

6) сосьв. нэ 'женщина', *ne* 'женщина' (F1 566,889-F2 1399,205);

Для *ε* средний формантный показатель МФА равен F1 610 Гц, F2 1900 Гц, при этом в исследуемом материале для первой группы слов он имеет параметры F1 663,879 Гц, F2 1756,489 Гц и для второй группы слов – F1 619,005 Гц, F2 1691,793 Гц. Для звука *e* средний показатель МФА равен F1 390 Гц и F2 2300 Гц, что не соотносимо с параметрами рассматриваемого форманта. Полагаем, решение Е.И. Ковалевой не обозначать в этих словах звуки *e* и *ε* является обоснованным, ввиду незначительной разницы в их показателях, но в обоих случаях формант *ε* имеет значительное расхождение в значениях F2 со средним общепринятым, что свидетельствует о его уникальности, либо не совсем корректном обозначении.

Полевые данные а – (Ромбандеева, Кузакова 1982) *э*

1) сосьв. нэнкен 'вы двое одни', пап'вы двое одни' (F1 925,43-F2 1290,593);

Полевые данные а – (Ромбандеева, Кузакова 1982) *о*

1) сосьв. вóтым 'седой', vatɬm'седой' (F1 779,136-F2 1571,346);

Усредненные значения гласного звука *а* по данным МФА равны следующему: F1 850 Гц, F2 1610 Гц; для *э* (*ε*) – F1 600 Гц, F2 1900 Гц; для *о* – F1 360 Гц, F2 640 Гц. Таким образом, выделенный исследователями формант в этих примерах, по нашему мнению, более соответствует другому звуку – *е*, нежели *а*, *э*, *о*.

Полевые данные з – (Ромбандеева, Кузакова 1982) *э̃*

1) сосьв. тэ̃лы 'зима', tɬɬ'зима, зимний; зимой, на зиму' (F1 713,801-F2 1287,636);

Полевые данные з – (Ромбандеева, Кузакова 1982) *е̃*

1) сосьв. мёсыг 'извилина, излучина', mɬsiɣ'извилина, излучина' (F1 791,913-F2 1718,164);

Согласно МФА, средний показатель для форманта *з* приблизительно равен F1 600 Гц, F2 1400 Гц, форманта *э* (*ε*) – F1 600 Гц, F2 1900 Гц; для *е* – F1 390 Гц, F2 2300 Гц. Предполагаем, гласный в словах 'зима, зимний' и 'извилина, излучина' ближе всего форманту *æ* и, следовательно, нуждается в корректировке.

Полевые данные о – (Ромбандеева, Кузакова 1982) *ā*

1) сосьв. хāсын, хāсункве 'умел', хосун'умел' (F1 822,463-F2 1795,162).

Показатели форманта *о* в этом примере не являются соотносимыми со средними значениями формант *о* (F1 360 Гц, F2 640 Гц). Вероятно, Е. И. Ромбандеевой звук *а* (F1 850 Гц, F2 1610 Гц) для слова 'умел' был определен верно.

Полевые данные э – (Ромбандеева, Кузакова 1982) *ū*

1) сосьв. ўта 'сирень', ɔvtɐ'сирень' (F1 621,253-F2 1346,447);

Средний показатель для форманта *э* по данным МФА имеет значения F1 500 Гц, F2 700 Гц. Разница в параметрах этого звука свидетельствует о необходимости уточнения, насколько правильно было проведено его выделение.

Заключение

Проведенное комплексное исследование полевого материала с. Ломбовож с помощью экспериментально-фонетического и фонологического анализа, выполненного на базе платформы LingvoDoc, позволяет заключить, насколько точно исследователями XX в. и современными лингвистами была описана фонетическая система северного мансийского диалекта.

Так, в результате сравнительного анализа показателей гласных формант полевого материала, выявленных Е. В. Ковалевой, со средними значениями соответствующих звуков МФА, мы обнаружили ряд аллофонов, нуждающихся в уточнении (*ɨ*, *ʊ*, *ɐ*). При этом был выявлен ряд уникальных звуков (*а*, *о*, *ε*, *е*, *і*, *и*), обладающих нехарактерными показателями для общепринятых параметров F1-F2 международного фонетического алфавита, основанного, в основном, на данных анализа европейских языков.

Кроме того, при исследовании нейтральности-долготы гласных формант для сосьвинского мансийского диалекта было подтверждено наличие долгого звука *ā*, нейтральных *а*, *о*, *и*, *і*, при этом мнения исследователей разошлись в отношении формант *е* и *і*. Не исключаем, что это может быть связано с развитием языка во времени: рассматриваемый материал охватывает период от первой трети до конца XX в.

В результате изучения различий в трактовке гласных формант было выявлено фонологически точное деление гласного звука и для ряда слов в современной обработке полевого материала с. Ломбовож. Однако, в материале сосьвинского диалекта, на котором Е. И. Ромбандеевой была построена одна из общепринятых фонетических систем второй половины XX в., также обнаруживаются более корректные обозначения гласных формант.

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Сокращения

МФА – международный фонетический алфавит; **F1** – самый низкий показатель частоты форманта; **F2** – самый высокий показатель частоты форманта; **Гц** – герц (единица частоты колебаний); **мсек.** – миллисекунда (показатель интенсивности звука); **см.** – смотри; **в.** – век; **др.** – другой/другие; **т.д.** – так далее.

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THE ROLE OF THE READING COMPREHENSION SECTION IN RUSSIAN LANGUAGE EXAMS**Tarana Guliyeva**

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РОЛЬ РАЗДЕЛА «ПОНИМАНИЕ ПРОЧИТАННОГО» НА ЭКЗАМЕНАХ ПО РУССКОМУ ЯЗЫКУ**Тарана Гулиева**

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Введение

Экзамены по русскому языку являются важным инструментом для оценки знаний студентов в различных аспектах языка. Одним из самых значимых разделов является раздел "Понимание прочитанного", который оценивает не только способность студентов понимать отдельные слова и предложения, но и их способность правильно воспринимать общий смысл текста и интерпретировать его. Этот раздел особенно важен в экзаменах по русскому языку, так как он является важным шагом на пути активного использования языка. Русский язык изучается во всем мире, и эти экзамены направлены на оценку знаний языка и культурных особенностей (Макарова, 2020).

1. Цели раздела "Понимание прочитанного"

Основной целью раздела "Понимание прочитанного" является оценка способности студентов правильно понимать текст и отвечать на вопросы, основанные на прочитанном. Этот раздел оценивает не только знание языка, но и способность студента воспринимать смысл текста, понимать логические связи, анализировать различные идеи и выявлять основные идеи текста (Семенова, 2018).

Это требует от студента не только знания грамматики и лексики языка, но и умения анализировать текст и понимать его более глубоко. Правильное восприятие текста и интерпретация его содержания являются важными этапами в обучении языку и способствуют развитию других навыков.

2. Значение навыков понимания прочитанного

Навыки понимания прочитанного играют важную роль в обучении языку, так как они способствуют развитию многих аспектов языка, таких как грамматика, лексика, синтаксис и стиль. Эти навыки также развивают способность студента к анализу, формируют его отношение к различным текстам и помогают понять тексты, написанные в разных стилях (Коваленко, 2019).

В экзаменах раздел "Понимание прочитанного" оценивает, насколько студент способен воспринимать текст правильно и анализировать его содержание. Это способствует развитию навыков анализа, умения делать логические выводы и воспринимать основные идеи текста (Петрова, 2017).

3. Структура и требования раздела в экзамене

В экзаменах по русскому языку раздел "Понимание прочитанного" обычно состоит из нескольких текстов и вопросов, связанных с ними. Тексты могут быть на различные темы: от повседневной жизни до литературы и науки. Вопросы, как правило, могут быть в различных форматах: множественный выбор, заполнение пропусков и краткие ответы. Эти вопросы направлены на то, чтобы проверить, насколько хорошо студент понимает основную идею текста, детали и логические связи между различными частями текста. Также студент должен уметь интерпретировать стиль текста, цель автора и общий тон произведения (Семенова, 2018).

Некоторые экзамены предлагают тексты на актуальные темы современности, в то время как другие включают литературные или исторические материалы. Это помогает студентам развивать навыки восприятия и анализа различных типов текстов (Макарова, 2020).

4. Влияние раздела "Понимание прочитанного" на студентов

Раздел "Понимание прочитанного" в экзамене играет не только роль в оценке знаний языка, но и способствует развитию общего уровня языковой грамотности. Этот раздел помогает студентам лучше понимать и интерпретировать структуру текста, использовать различные языковые конструкции и выявлять связи между идеями. Также навыки понимания прочитанного развивают способность студентов анализировать тексты и применять свои знания на практике (Коваленко, 2019).

Студенты, проходящие этот раздел, не только совершенствуют свои языковые знания, но и развивают способность к межкультурному анализу и открытость к различным идеям и точкам зрения. Это очень важно для изучающих русский язык, поскольку понимание языка и культуры тесно связано и способствует более глубокому усвоению языка (Петрова, 2017).

Пример задания для раздела "Понимание прочитанного" на экзамене по русскому языку

Текст:

"Путешествие в Москву"

В Москве много интересных мест, которые стоит посетить. Одним из самых известных является Красная площадь. Это сердце города, и здесь расположены такие исторические здания, как Московский Кремль и собор Василия Блаженного. Каждый турист должен увидеть эти памятники архитектуры.

Кроме того, Москва славится своими музеями. Например, Пушкинский музей изобразительных искусств, где можно увидеть картины и скульптуры известных художников. Также стоит посетить Третьяковскую галерею, в которой собрано множество произведений русских мастеров.

Но Москва – это не только исторические места. В городе много парков и скверов, где можно отдохнуть, прогуляться или покататься на велосипеде. Один из таких парков – Царицыно, где находятся красивые дворцы и пруд.

Если вы хотите узнать больше о культуре и истории России, Москва – это идеальное место для путешествия.

Вопросы:

1. Какие исторические здания расположены на Красной площади?

- а) Третьяковская галерея
- б) Московский Кремль и собор Василия Блаженного
- в) Пушкинский музей
- г) Царицыно

2. Какой музей в Москве является самым известным для поклонников изобразительного искусства?

- а) Третьяковская галерея
- б) Пушкинский музей изобразительных искусств
- в) Кремль
- г) Парк Царицыно

3. Что можно сделать в московских парках?

- а) Только прогуляться
- б) Прогулки, отдых и катание на велосипеде
- в) Только отдыхать
- г) Смотреть на памятники

4. Что самое интересное в Москве для туристов, по мнению автора?

- а) Третьяковская галерея
- б) Красная площадь, Кремль и собор Василия Блаженного
- в) Музеи и парки
- г) Весь город

Ответы:

1. б) Московский Кремль и собор Василия Блаженного
2. б) Пушкинский музей изобразительных искусств
3. б) Прогулки, отдых и катание на велосипеде
4. б) Красная площадь, Кремль и собор Василия Блаженного

Этот пример задания помогает проверить способность студента к восприятию и анализу текста, выделению основных идей и фактов, а также развитию навыков ответа на вопросы, основанные на прочитанном материале.

Заключение.

Раздел "Понимание прочитанного" в экзаменах по русскому языку играет ключевую роль в оценке знаний и навыков студентов. Этот раздел не только проверяет знание языка, но и развивает способность к анализу и интерпретации текста, что является важным элементом обучения русскому языку. Навыки понимания прочитанного способствуют улучшению общей языковой компетенции и расширению культурных горизонтов студентов, что делает этот раздел незаменимым в экзаменах по русскому языку.

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Sociological sciences

EDUCATION'S IMPACT: ADDICTION TREATMENT ATTITUDES & AWARENESS

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Abstract

Recent research highlights the growing concern of smartphone addiction, which has become a significant public health issue. Emerging treatment modalities, such as Cognitive Behavioral Therapy (CBT) combined with mindfulness practices and community support rooted in spirituality, offer promising approaches. This meta-analysis examines studies from the last decade to explore the correlation between socio-economic class, education level, and awareness or aversion to psychological therapies, mindfulness practices, and technology de-addiction resources. Findings suggest that individuals from higher socio-economic backgrounds and those with higher education levels tend to show more positive attitudes toward such therapeutic interventions, while those from lower socio-economic strata may demonstrate greater skepticism or aversion. These insights can help inform how physicians might incorporate CBT-infused mindfulness and community-based spiritual support as part of comprehensive treatment plans, especially for smartphone addiction. The meta-analysis highlights a strong, positive association between these factors, suggesting that socio-economic and educational barriers may play a crucial role in the adoption of these emerging treatment strategies

Keywords: impact, young people, social formation, education, modern society, social responsibility

Introduction

The world is connected. A general person has all the comforts of a modern life, and yet he is more stressed than ever. Whilst a variety of issues plagues the modern man, the new age emerging poison is technology addiction, in which we will discuss specifically smartphone addiction, and explore the correlations between social class, education level and whether they affect decisions regarding choices of the public regarding psychological therapies and spiritual mindfulness practices as primary, or supplementation to de-addiction resources.

A variety of factors influence the direction of treatments for psychological addictions; however, we are to focus on Technology addiction, with emphasis on Smartphone Addiction. One of the most of the pertinent questions anyone wishing for self-preservation asks for: How to live longer, happier, healthier. The data suggests that one large, yet often overlooked factor is social class, with regards to socioeconomic data and mental health status. (Macintyre, 2018), (McLaughlin, 2012)(6) (Allen, 2012)(7)

It is necessary here to clarify exactly what is meant by Social Class, Spiritual Mindfulness, and Smartphone Addiction.

Social class is defined as a hierarchical categorization of individuals or groups within a society, determined by factors such as socioeconomic status, education, occupation, and income (Graybeal, 2001) (1), (Macintyre, 2018). (2). Historically, the working class with the conservative values have been less likely to seek or engage with mental health and psychological therapies (Macintyre, 2018)(2) (Morton O. Wagenfeld, 1981)(4). Socioeconomic status (SESS) is classified by the American Psychological Journal as not only indicative of one's income but also of educational attainment, occupational prestige subjective perceptions but moreover is as well indicative of quality-of-life attributes and opportunities afforded. APJ also considers it to be a consistent predictor of a vast array of psychological outcomes.

Burgeoning evidence points to significant growing evidence between mental health and economic disparity (Fri)(3) (Pickett, 2010) (5), as its consequences majorly impact mental health, by multifaceted factors and consequences, as demonstrated by (Macintyre, 2018)

Spirituality is often touted as different from science, as some sort of pseudo or a de Noveu thought from the rigor of scientific academics. In the literature, the term tends to be used to referred to as a personal belief system that involves a sense of connection to something greater than oneself, which can

provide a framework for understanding one's place in the world and give meaning and purpose to one's life (is defined as a personal belief system that involves a sense of connection to something greater than oneself, 2021)). (8)

Mindfulness is a state of being, in the moment, connecting in the present without judgement.

Mindfulness and Cognitive behavioural therapy are based on many common tenets. Mindfulness is based on the same fundamental principles as cognitive behavioural therapy, which aims to help individuals identify and modify negative thought patterns to improve mental health and well-being. Mindfulness meditation practices have been incorporated into many modern therapeutic interventions. (Daniel Gutierrez, 2020) (9). (Weis, 2021)(10). Our nervous regulatory system is often stressed with the demands of modern lifestyle, and many have often colloquially defined the sensation as "being on all the time" As both may have soothing effect on the CNS, due to the repetitive set of actions.

Digital addiction can be defined as a behavioural addiction characterized by an overuse or misuse of digital technology that results in physical, social, emotional, or cognitive impairment. Digital addiction is also referred to an impulse control disorder that involves the obsessive use of digital devices, digital technologies, and digital platforms, i.e. internet, video game, online platforms, mobile devices, digital gadgets, and social network platform. It is an emerging domain of Cyberpsychology (Singh, Amarjit Kumar and Pawan Kumar Singh; 2019). In this paper we shall focus on smartphone addiction, which whilst isn't yet classified as a addiction in psychiatry, however it meets the criteria for behavioral addiction as proposed by Kardefelt-Winther et al. (2017) (17)

According to We Are Social Digital's 2021 report, annual growth rates in internet, social media and mobile user statistics; The number of internet users increased by 7.3% (317 million), the number of social media users increased by 13.2% (490 million), and the number of mobile users increased by 1.8% (93 million). In addition, when we look at the World Internet usage statistics, the general number of users is 4.66 billion people (59.5% of the world's population). Internet users use the Internet for an average of 7 hours a day. According to We Are Social Digital's 2021 report, the number of social media users has reached 4.20 billion. More than half of the world's population is a social media user. Almost all of the social media users log into their social media accounts via mobile devices (Bayrak, 2021). (13)

How does a medical professional or therapist look at treatments for their patients? Is there any basis on designing treatment plans streamlined to each economic data, on the basis of objective success of the treatments.

2. Context and Background.

It is important to note that we are to refer (Rodney P. Joseph, 2017)idea of spirituality, which is more fluid than rigid ideals peddled today (Rodney P. Joseph, 2017)(12), gives the idea that 'spirituality is more general, unstructured, personalized and naturally occurring phenomenon in which a person seeks closeness and or connection between himself and a higher power or purpose.' Historically, people have often tend to turn to religion and spirituality, often as emotional, mental and community support.

Although addiction has been defined as "a pathological condition that one cannot tolerate without continuous administration of substances," it is now also increasingly been observed in gaming, online world and other digital addictions. Growing literature has confirmed that there's an emerging trend of increased smartphone usage in young and emerging adulthood, ages 18 to 29. (Min Kwon, 2013), (Arnett, 2014) (11)

Social Class and Mental Health: Social class has long been associated with disparities in access to mental health services, awareness of available resources, and attitudes toward psychological and therapeutic interventions. Lower social classes may face financial and logistical barriers to accessing therapy, and cultural or societal stigma may shape perceptions of mental health and therapy. (Macintyre, 2018)

Education and Psychological Resources: Education level is often linked to greater awareness of mental health issues and the availability of various psychological resources. Higher levels of education may facilitate openness to engaging in formal therapy, mindfulness practices, or technological tools for mental health improvement due to better access to information and fewer cultural stigmas.

Psychological Therapies, Mindfulness, and Technology: While therapies such as Cognitive Behavioural Therapy (CBT), talk therapy, and mindfulness-based stress reduction (MBSR) have gained popularity, there remain significant differences in their uptake based on social and educational factors. Additionally, the growing field of digital mental health resources—such as apps for mindfulness, cognitive training, and technology de-addiction tools—offers new ways for people to engage in psychological wellness, but these tools may also have varied acceptance across different social groups.

3. Key Areas of Focus.

Awareness of Psychological Therapies: Investigation of how knowledge of various mental health

therapies (traditional therapies like CBT, talk therapy, or modern interventions like online therapy) varies across social classes and education levels.

Attitudes Toward Therapy: Exploration of whether individuals from lower social classes or with lower educational backgrounds are more likely to reject or be sceptical of psychological therapies, and the reasons behind such averseness (e.g., stigma, lack of trust in mental health professionals, financial barriers).

Spiritual Mindfulness Practices: Assessment of how social class and education impact engagement with spiritual practices like meditation, yoga, or mindfulness. Are these practices viewed as a valuable alternative to psychological therapies, and how accessible are they across different social groups?

Technological De-addiction Resources: Examination of the awareness and attitudes toward using technology-based solutions (e.g., apps for screen-time management, digital detox programs, or mental health apps) for de-addiction, and whether these resources are more popular in higher education or wealthier social classes.

Barriers to Access and Engagement: Identify the barriers to accessing mental health resources (including psychological therapies and mindfulness practices) in different social classes, focusing on financial, cultural, and logistical factors. Does access to technology for de-addiction vary based on economic status?

4. Hypotheses.

Primary Hypothesis: Individuals from higher social classes and those with higher educational levels will have greater awareness of psychological therapies, spiritual mindfulness practices, and technological de-addiction resources, and will be more likely to engage with these resources.

Secondary Hypothesis: Lower social class and educational level will be correlated with higher averseness to psychological therapies and mindfulness practices due to stigma, lack of trust in mental health services, and limited access to resources.

Moderating Variables: The correlation between social class, education, and attitudes toward these resources might be influenced by other variables, such as cultural background, race, economic factors, geographic location, age, and prior mental health experiences. For illustration, correlation between race and deaddiction methods. (Frederick X Gibbons 1, 2018) (19) (Benjamin Lê Cook 1, 2011) (20)

5. Methodology.

Systematic review and meta-analysis of outcomes research studies published in the last 10 years.

Data Collection:

Given below are a few data tables from (Bolat, 2021) (14)

The results of the Kruskal Wallis-H Test, which was conducted to determine whether the scores of the Spirituality

Scale differ according to the variable of duration of social media use

Table 1:

Group	Variables	N	χ^2	sd	p
Social media usage time	Coping	724	12.45	5	0.029
	Transcendence	724	7.59	5	0.181
	Spiritual life	724	7.24	5	0.203
	Search for meaning	724	3.55	5	0.616
	Spiritual pleasure	724	1.68	5	0.891
	Connection	724	9.65	5	0.086
	Harmony with nature	724	4.88	5	0.430
	Total Point	724	7.45	5	0.189

As can be seen in the table 4, according to the results of the Kruskal Wallis-H test performed to determine whether the Spirituality Scale scores differ significantly according to the variable of duration of social media use, it is seen that only the scores of the spiritual coping sub-dimension differ significantly according to the duration of use variable ($= 12,45; p < .05$). According to the results of the Mann Whitney $\square U$ test, which was performed to determine between which groups this significant difference occurred, the group with only 1-6 months of use and the group with 8-10 years in favor of the group that used less ($U = 418.5; z = -2.40; p < .05$) were found to differ statistically significantly ($p < .01$).

Table 2

The results of the independent groups t test conducted to determine whether the Social Media Addiction Scale scores differ according to the gender variable.

Social Media Addiction	Genus	n	$\bar{x}$	ss	Sh _x	t test		
						t	sd	p
Virtual tolerance	Woman	399	2.47	0.74	0.04	1.866	722	0.062
	Man	325	2.37	0.74	0.04			
Virtual communication	Woman	399	0.61	0.21	0.01	-0.521	722	0.602
	Man	325	0.62	0.23	0.01			
Total score	Woman	399	2.35	0.65	0.03			
	Man	325	2.31	0.71	0.04	0.719	722	0.473

As can be seen in the table 2, it was determined that the scores obtained from the scale did not differ significantly according to the gender variable, according to the results of the independent groups t-test performed to determine whether the Social Media Addiction Scale scores differed significantly according to the gender variable ($p > .05$).

They also capitulated that gender did not majorly impact the data.

Mindfulness and spirituality also often emphasize on a nature connection, often by breathing exercise and spending time in nature, which has been found beneficial for mental health, with documented reduction in anxiety, stress and depression. (21, 22, 23, 24) A positive trend has also been noted in attention, emotional regulation and positive emotions. Over the last decade, a growing interest emerged for incorporating mindfulness into nature-based interventions, since mindfulness also promotes awareness and attention, self- and emotion-regulation, and reduces symptoms of depression and perceived stress. Examples include forest bathing, wilderness therapy [25, 26, 27, 28] and interventions with nature and mindfulness for students [29,30] and healthy workplaces [31]. However, this field is still in its infancy [32] (Dorthe Djernis 1, 2023) (33)

Surveys and Questionnaires: Administration of surveys to assess participants' awareness of, and attitudes toward, psychological therapies (e.g., counselling, CBT), mindfulness practices (e.g., meditation, yoga), and technological resources (e.g., apps for mental health, digital detox tools). Include questions about frequency of use, perceived benefits, and barriers to engagement.

Interviews: Conduction of in-depth interviews with a subset of participants to explore their personal experiences, attitudes, and beliefs about therapy, mindfulness, and technology. As well as Exploration of cultural factors, stigma, and practical obstacles (e.g., time, cost) that influence decisions, out to be done in future studies.

Focus Groups: Holding focus groups within different socio-economic strata to discuss common perceptions of mental health, therapy, and mindfulness practices. These group discussions can help contextualize individual survey and interview responses.

Quantitative Data: Analysis of the relationship between social class, education, and attitudes toward these therapies using statistical tools like regression analysis to identify significant patterns and correlations.

Scales for Social media addiction: Smartphone addiction scale (SAS) (Min Kwon, Development and Validation of a Smartphone Addiction Scale (SAS), 2013) (15)

Scales for Spirituality: Sirin Scale.

Scales for socioeconomic demarcations: Socioeconomic status refers to the absolute or relative levels of economic resources, power, and prestige closely associated with wealth of an individual, community, or country. (34) As per CDC, it also encompasses education, Housing Security, Food insecurity, Income and employment status.

Qualitative Data: Performance of thematic analysis on interview and focus group transcripts to identify common themes, such as mistrust of therapy, positive/negative attitudes toward mindfulness practices, or technological barriers.

6. **Potential Variables:** Race, gender, sexuality, location, external factors, parental time, age of child, history of mental illnesses and addictions, genetics, socialbility.

Independent Variables:

Social class: As per the common three stratum model:

Low : The lower or working class is sometimes separated into those who are employed as wage or hourly workers, and an underclass—those who are long-term unemployed and/or homeless, especially those receiving welfare from the state. Members of the working class are sometimes called blue-collar

workers.

Middle: The middle class is the most contested of the three categories, consisting of the broad group of people in contemporary society who fall socioeconomically between the lower class and upper class

Upper: The upper class is the social class composed of those who are wealthy, well-born, or both. They usually wield the greatest political power. (35)

Education level: No high school diploma, High school diploma, College graduate, Post-graduate.

Access to technology: e.g., smartphone ownership, internet access. (give stat here)

Dependent Variables:

Awareness of psychological therapies (measured by knowledge of available treatments and services).

Attitudes toward psychological therapies (measured by likeliness to seek therapy, perceived effectiveness, and trust in mental health professionals).

Engagement with spiritual mindfulness practices (e.g., frequency of meditation, yoga, or mindfulness app use).

Engagement with technological de-addiction resources (e.g., use of apps for managing screen time, digital detox programs).

8. Outcomes:

Front Integr Neuroscience 2022 Sep 2.

The impact of mindfulness meditation on social and moral behavior: Does mindfulness enhance other-oriented motivation or decrease monetary reward salience?

Susanna Feruglio, Maria Serena Panasiti, Cristiano Crescentini Salvatore Maria Aglioti, Giorgia Ponsi (36)

The scientific interest in mindfulness meditation (MM) has significantly increased in the last two decades due to its well-documented beneficial effects on physical (Greeson and Chin, 2019) and psychological health (Brown et al., 2015). MM is a practice that relies upon techniques of mental training, encouraging individuals to focus, with an open, gentle, and self-compassionate attitude, on their internal experiences, such as bodily sensations, thoughts, and emotions (Lutz et al., 2008). The mechanisms of action through which MM exerts its effects are multiple: attentional control, emotion regulation, body awareness, and change in perspective on the self (Hölzel et al., 2011).

Social Class and Awareness: The study is likely to find that individuals from higher social classes and with higher educational levels are more aware of psychological therapies, mindfulness practices, and technological resources. This could be linked to better access to information, resources, and networks that promote mental health awareness.

British Journal of Guidance & Counselling, Aug 2009.

37(3):375-3 The weight of class': Clients' experiences of how perceived differences in social class between counsellor and client affect the therapeutic relationship

British Journal of Guidance & Counselling (37)

In their study, they report that clients with the same class background as their therapists felt more understood, and that an experienced class difference was associated with a sense of injustice and shame in clients with lower socioeconomic status.

Averseness to Therapy: Lower social class groups might exhibit more scepticism or aversion to formal psychological therapies, either due to financial barriers, mistrust, or cultural norms that stigmatize mental health treatment.

Spiritual Mindfulness Practices: Those with higher education may be more likely to engage with mindfulness practices, as they might have greater access to wellness information and the financial means to participate in yoga or meditation classes.

Technological De-addiction: Middle and upper social classes may be more likely to use and invest in technological solutions for de-addiction (such as apps that help monitor screen time), whereas lower-income individuals may face barriers to accessing or using such tools effectively.

Mindfulness and Spirituality have a number of prophylactic safeguards and treatments for anxiety, and multiple stress related disorders. Smartphone addictions have been linked to addictive behaviour, and even strongly linked to depression and anxiety. Zubair (by Zubair Ahmed Ratan 1, 2021) (18)

It is an innate capacity that can be trained, e.g., through the mindfulness-based stress reduction program (MBSR) created by Jon Kabat-Zinn [14]. The health-promoting effects of mindfulness based interventions (MBIs) were extensively documented in recent decades and include reduction in symptoms of stress, anxiety and depression [15,16]. Thus there is a strong case for connectivity of Mindfulness and

Cognitive Behavioural therapy, and a combination of two can be implemented in an effective treatment plan for Smartphone and Digital addiction.

Soc Psychiatry Psychiatr Epidemiol 2022 Nov 23;58(4):581–603, The association between social class and the impact of treatment for mental health problems: a systematic review and narrative synthesis

Phoebe Barnett , Iyinoluwa Oshinowo Christopher Cooper , Clare Taylor , Shubulade Smith , Stephen Pilling

Evidence suggests that lower social class may be associated with reduced access to primary and secondary mental health care and increased likelihood of access via crisis services, and patients of lower social class may not benefit from all mental health interventions, with reduced effectiveness. While limited, there was some indication that psychosocial interventions could encourage increased employment rates.

Psychotherapy Process and Social Class by Nicholas Ladany, Maryann Krikorian

<https://doi.org/10.1093/oxfordhb/9780195398250.013.0007>. Pages 118–121. Published: 01 May 2013

We define social class along a financial continuum, specifically, the extent to which a person has financial resources to access basic human rights (as defined by the United Nations Universal Declaration of Human Rights) and pursue a healthy quality of life.

In conclusion, social class is associated with the effectiveness of psychological interventions, but it may also be improved following treatment. Social class should be an inherent consideration in intervention design, both to prevent barriers to access and also to improve intervention effectiveness. Interventions should be adapted to allow benefits to be gained across social classes, and to ensure that robust measurement of social mobility outcomes is part of intervention trials. In turn, this may prevent social class from inhibiting potential treatment gains, weakening the association between poor mental health and reduced social mobility.

The Profound Connection Between Spirituality and Social Change

A need for people skilled in conversation to bridge the divide between spirituality and civic engagement.

Int J Environ Res Public Health 2020 Feb 18;17(4):1306. Socioeconomic Status, Parental Education, School Connectedness and Individual Socio-Cultural Resources in Vulnerability for Drug Use among Students

Gilberto Gerra , Elisa Benedetti, Giuliano Resce, Roberta Potente , Arianna Cutilli, Sabrina Molinaro.

We also included a proxy for individual socio-cultural resources by using the fact of reading books for pleasure as a signal of engagement in cultural leisure activities. It has been shown that socioeconomic status heavily influences access to relevant networks (e.g., internet, newspapers and libraries) for socio-cultural resources

From a policy perspective, the evidence provided in this paper may prove particularly important for the more general issue of inequality of opportunities, suggesting that drug policies should be combined with actions aimed at removing of all barriers to social inclusion that are imputable to the socioeconomic background of adolescents. A priority for future research is to identify effective policy levers that may act in this direction.

Front Public Health 2022 Dec 15;10:911560. doi: [10.3389/fpubh.2022.911560](https://doi.org/10.3389/fpubh.2022.911560)

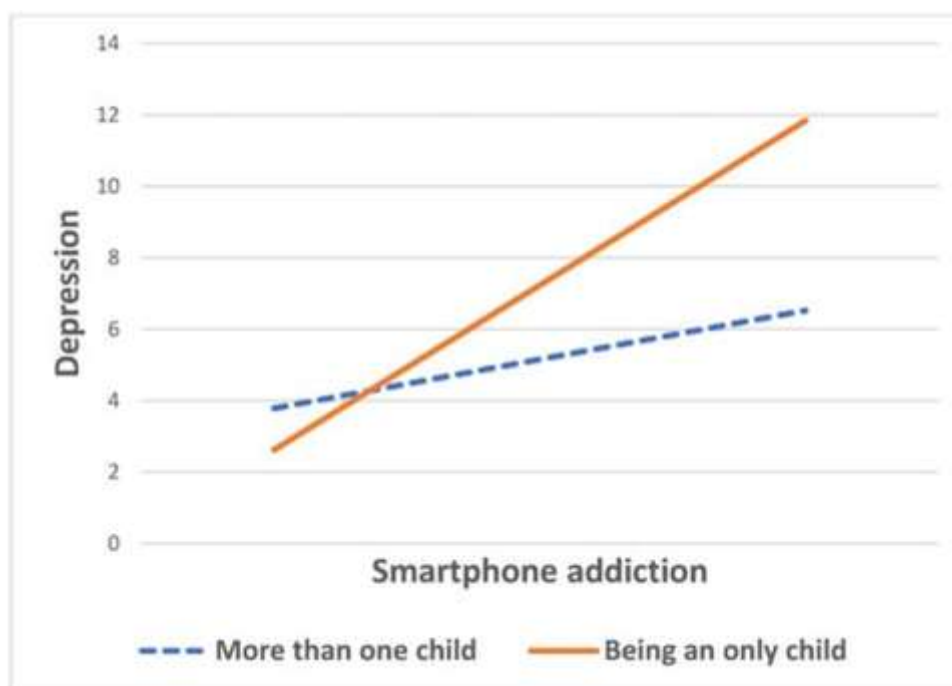
Association between mobile phone addiction and social support among mainland Chinese teenagers: A meta-analysis Xiao Wan , Haitao Huang, Ruiying Jia , Dandan Liang, Guangli Lu, Chaoran Chen PMID: [36589942](https://pubmed.ncbi.nlm.nih.gov/36589942/) PMCID: [PMC9798221](https://pubmed.ncbi.nlm.nih.gov/PMC9798221/)

This study suggests that the mobile phone addiction level of teenagers could be reduced by increasing social support, and actions to improve their social support levels should be proposed based on their gender and regional differences.

Healthcare (Basel) 2021 Oct 11;9(10):1350. doi: [10.3390/healthcare9101350](https://doi.org/10.3390/healthcare9101350)

Smartphone Addiction and Depression among Low-Income Boys since COVID-19: The Moderating Effect of Being an Only Child

Jaewon Lee, Hyejung Lim, Jennifer Allen, Gyuhyun Choi, Jiyu Jung.



Above table shows data of: Moderating effect of being an only child on the relationship between smartphone addiction and depression among low-income boys.

9. Implications for Intervention.

Is there any hesitance on using modern de-addiction resources, correlative to socio-economic standing? Is a question that need further and extensive studying. Further study is strongly recommended, especially as this is a new age problem, with impact on the current and future workforce.

Targeted Awareness Campaigns: Targeted health campaigns for diverse population, especially for middle and working class, inclusive of race, gender and other vulnerable factors (such as single parent household, or both parents working)

Improving Access: Strongly recommend improving access to psychological therapies, mindfulness practices, and digital wellness resources in lower socio-economic communities, possibly through subsidized programs, community workshops, or school and college programs

Conclusion.

The correlation between social class, education, and attitudes towards mental health resources is a complex and multifaceted issue, in need of much research and exploration, especially in a world marked by increasing dystopian divide of wealth.

Statistically significant relations have been marked between scores of spirituality scale and social media scale. Social media addiction score has been found to be inversely proportional to spiritual scores. (Bolat, 2021).

Single children are found to be disproportionately vulnerable, as well as children whose parents do not have a high educational background.

SEs are found to play a major role.

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SPECIFICS OF NEEDS IN CREATING EMPLOYMENT CONDITIONS FOR PERSONS WITH DISABILITIES

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Abstract

The paper's central argument is that regularities in the history of societal development, including the formation of groups and classes, can be scientifically covered by examining the ways in which established theoretical approaches can be improved based on modern requirements. The state issue related to the economic side of new social relations is also examined. The paper then goes on to discuss new directions in work with weak social strata in the world.

Historically, there have been stereotypes about individuals with disabilities, including the misconception that they are unable or unwilling to work. However, advancements in science, technology, medicine, and labor have led to a shift in societal attitudes and the need for new policies and legislation to protect and support disabled individuals. The employment of disabled people is a significant social problem that requires careful consideration. This article aims to explore the specific needs for creating conditions that facilitate the employment of disabled people.

Keywords: Labor law, adaptation, personal dependence, quota, syndication, social equality, able-bodied disabled person, labor-adaptation rehabilitation, adaptation of special workplaces.

The present study explores the implications of public policy in a developing nation, with a focus on the advancement of science and technology and the enhancement of social conditions within civil society. The theoretical framework underpinning the study is the theory of determining social stratification in society, which broadens the scope of modern research by exploring the historical environment. The study examines how urbanization, ecology, and other factors impact individuals' lives, highlighting the role of legal mechanisms in regulating the relationships among groups in society.

The right to work is recognized as a natural and inalienable right of all citizens, including those with disabilities, defined as individuals with limited work capacity. The occurrence of various diseases resulting from environmental and other global catastrophes should not, if feasible, impede the full integration of disabled individuals into society, recognizing their equal needs as those of physically healthy individuals. The employment of persons with disabilities is characterized by several distinctive features, including the transition from step-by-step education to inclusive education, the integration of vocational education into the general educational system, and the emergence of new specialist training programs. The Law on Approval of the National Plan to Ensure the Rights and Improve the Quality of Life of Persons with Disabilities in the Republic of Kazakhstan until 2025, as outlined in the Resolution of the Government of the Republic of Kazakhstan dated May 28, 2019, No. 326, underscores the necessity for a multifaceted approach to addressing the challenges faced by persons with disabilities. The formation of a contemporary system of social assistance to people with disabilities, founded on the principles of social equality, social justice, and tolerance, necessitates the concurrent resolution of two fundamental tasks:

- The objective is twofold, first, to ensure comprehensive social protection, and second, to establish conditions that facilitate access to all material and spiritual benefits. Furthermore, it is essential;
- To ensure that individuals are able to fulfill their responsibilities as members of society [1].

One of the most salient social barriers to the integration of persons with disabilities in modern Kazakhstan is the segmentation of labor and the exclusion of persons with disabilities. Persons with disabilities form part of the secondary market in the system of labor segmentation, which is characterized by low wages, unstable work, low opportunities for qualification, employment, and promotion. Segmentation emerges as a form of social closure, manifested in the stereotypical desire to employ disabled people only in specialized enterprises.

The term "disabled person" refers to an individual living with a health disorder that results in persistent impairment of bodily functions due to diseases, injuries, or defects, consequently leading to

limitations in daily living and necessitating social protection [2]. The integration of disabled individuals into the labor force, that is, into the economic structure of enterprises and production, entails specific considerations. These considerations encompass legal, economic, production, communicative, and psychological aspects of interaction between disabled individuals and the external environment.

The technologies of social work with disabled people, which aim to facilitate their integration into society, align with the prevailing methods in the scientific and practical domains. The employment needs of able-bodied groups of disabled people are of particular significance, given their unique characteristics. These groups can be classified based on various criteria.

By function of application, the following technologies should be distinguished:

- Psychological (the influence of specialists affects psychological processes, situations, and functions);
- Medical-social (the object of influence is the physical condition, related social aspects of the disabled person's existence);
- Social-psychological (influencing processes in the system of human-group relations);
- Financial-economic (allows to provide those in need with benefits, privileges and other material resources).

According to the field of application, the following technologies are distinguished:

- Diagnosis (activity to recognize and analyze social problems and pathologies);
- Correction (a system of measures aimed at correcting the client's shortcomings of pedagogical, psychological, and social nature, corresponding to the standards accepted in society);
- Rehabilitation of disabled persons "a system of medical, psychological, pedagogical, social and economic measures aimed at eliminating or maximally compensating for life limitations caused by health impairment in case of persistent disorders of the organism's activity. The goal of rehabilitation is to restore the social status of a disabled person, to achieve material independence and social adaptation" [3].

A considerable proportion of disabled individuals who wish to be employed are unable to access rehabilitation services and employment opportunities. This phenomenon is pervasive across many nations. In accordance with international legal standards, each state is obligated to formulate, implement, and periodically assess a national policy on the employment and vocational rehabilitation of disabled individuals. This policy should encompass measures to empower disabled individuals to obtain, retain, and transition into disability-friendly employment opportunities.

- Prevention (prevention of social and personal risks);
- Adaptation (facilitating a person's entry into a relatively unfamiliar society or cultural system).

For a person labor activity is not only a way of economic support of his existence, but also a fact of realization of his abilities (including creative ones), and his accession to social values. Work allows every citizen to respect himself, to realize his personality, to be a full-fledged part of modern society. "In Soviet times, the only criterion for establishing disability was the limitation of labor opportunities. The state was obliged to financially support a disabled person, so the issues of social adaptation and employment were not even raised. The only state program to create jobs for persons with disabilities was the creation of specialized enterprises where disabled people could do unskilled work in isolation (gluing boxes together, assembling sockets, etc". To solve the problem, the Law "On Social Protection of Disabled Persons in the Republic of Kazakhstan" introduced mechanisms, specifics of solving this problem. Disability began to be classified not only by labor capabilities, but also by the resolution of other factors of life limitation. The system of quota of jobs for the disabled was introduced, the concepts of "special jobs for the disabled" and "special working conditions for the disabled" were applied. New categories of able-bodied disabled people (able-bodied disabled people, labor-adaptation rehabilitation, adaptation of special workplaces) have appeared in sociological science [5]. The main problems were the lack of effective state programs and qualified specialists capable of solving these problems. And recently, the importance of the development of the social movement of disabled people on the part of the state authorities becomes a positive side of the manifestation of humanistic relations.

An acute social problem, the solution of which is recognized as one of the essential state tasks. On the one hand, it is caused by the humane desire to facilitate the life of people who have become disabled due to health disorders and need special assistance and protection. On the other hand, there is an obvious need to solve the very difficult problem of optimizing state compensation expenditures for the needs of the disabled. This can be achieved by increasing the socio-economic independence of these people: addressing the need to provide effective work for people who have access to labor activity. The progress

of the state program of employment of able-bodied persons with disabilities, adopted in the country in 2019, until 2025 indicates[6]. Currently, the issues of employment of persons with disabilities are not adequately addressed regardless of legislative guarantees, targeted programs, other government measures.

In other words, disability is not a problem of one person, but of the whole society. The new stage of employment of disabled people, the introduction of digital technologies and other skills of the holder of the state right to work.

Conclusion. In addition, our country also applies the legislative mechanisms in force in other countries, according to which all quotas on jobs for the disabled have to pay additional taxes and fees at the expense of enterprises. This, in turn, is important in that the state allocates funds for the creation and improvement of already created jobs. Improving the jobs and other conditions of persons with disabilities in enterprises and public sector organizations requires new opportunities.

Employer barriers to the employment of persons with disabilities in enterprises are, in fact, support for certain disabilities from an economic point of view. The existence of mechanisms for comprehensive coverage of legal issues in the modern context is the key to a normal economic full life in social relations. This is a complex issue that belongs to the policy of social development of our state.

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Technical sciences

ANALYSIS OF THE CURRENT STATE OF CRYPTOGRAPHIC PROTECTION OF INFORMATION IN COMPUTER NETWORKS

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КОМПЬЮТЕРЛІК ЖЕЛІЛЕРДЕГІ АҚПАРАТТЫ КРИПТОГРАФИЯЛЫҚ ҚОРҒАУДЫҢ ҚАЗІРГІ ЖАҒДАЙЫН ТАЛДАУ

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Abstract

This article analyzes the current state of cryptographic methods used to protect information in computer networks. As a crucial aspect of ensuring information security, the role of cryptography is explored, along with the importance of encryption algorithms and key management systems. The authors systematize the structure of modern cryptosystems, outline the requirements placed on them, and present approaches aimed at enhancing the efficiency of cryptographic protection.

Аңдатпа

Бұл мақалада компьютерлік желілердегі ақпаратты қорғауда криптографиялық әдістерді қолданудың қазіргі жағдайына талдау жасалды. Ақпараттық қауіпсіздікті қамтамасыз етудің маңызды бағыты ретінде криптографияның рөлі қарастырылып, шифрлау алгоритмдері мен кілттерді басқару жүйелерінің маңыздылығы сипатталады. Авторлар заманауи криптожүйелердің құрылымын, олар қойылатын талаптарды және криптоқорғаудың тиімділігін арттыруға бағытталған тәсілдерді жүйелеп ұсынады.

Keywords: Cryptography, information security, encryption algorithm, cryptosystem, key management, hash function, cryptographic protocol.

Кілттік сөздер: Криптография, ақпараттық қауіпсіздік, шифрлау алгоритмі, криптожүйе, кілттерді басқару, хэш-функция, криптографиялық хаттама.

Қазіргі кезде компьютерлік және телекоммуникациялық жүйелердегі ақпараттық қауіпсіздік – өте өзекті мәселе. Тәжірибе көрсеткендей, компьютерлік желі неғұрлым ауқымды және үлкенірек, әрі оған қосылған компьютерлерге неғұрлым құндырақ ақпарат сеніп тапсырылса, соғұрлым материалдық айда табу үшін немесе еріккен әуестікпен қалыпты жұмысын бұзу мақсатында шабуылдаушылар саны да арта түседі [1].

Шабуылдарға тосқауыл қоятын мемлекеттік шекаралар да жоқ. Ғаламдық Internet желісі мен басқаларында үнемі жүйелік әкімшілерге қарсы компьютерлік бұзғыш-қарақшылар соғысатын виртуалды соғыс үздіксіз жүреді. Осыған байланысты түрлі компьютерлік жүйелер

мен желілерді қолданушы орасан көп көпшілік үшін ақпараттық қауіпсіздік құралдарын қолдану маңызы артуда.

Ақпараттық қауіпсіздікті қамтамасыз етудің ерекше маңызды бағыттарының бірі – криптографиялық қорғау. Электронды төлемді жүзеге асыру, құпия ақпараттарды ашық байланыс желілерімен жіберу, түрлі қажеттіліктегі компьютерлік желілерде жасырын ақпараттарды сақтау мүмкіндігі криптографиялық әдістерге негізделген. Осының барлығы криптографиялық құралдарды дамыту мен жетілдірудің, оның ішінде жаңа жоғары нәтижелі құралдарды әзірлеудің маңыздылығын күшейте түседі [2].

Бұл міндеттерді шешу үшін ақпараттарды криптографиялық қорғау заманауи құралдарды саласында қалыптасқан жағдайды терең талдап, олардың күшті және әлсіз жақтарын анықтау, сараптау негізінде осындай құралдарды әзірлеуге жаңа тәсілдер мен тұжырымдамалар, бағыттар ұсыну қажет.

Криптография дегеніміз ақпараттың мазмұнын жасыру, оның бұрмалануы және оған рұқсатсыз кіруге мүмкіндік бермеу мақсатында хабарламаларды өзге түрге ауыстыру құралдары, тәсілдері мен принциптерін біріктіретін білім саласы.

Криптография – бұл криптографиялық түрлендіруге, яғни құпия алгоритмдер бойынша мәліметтерді өзге түрге ауыстыруға негізделген, қалыпты өту жағдайынан мақсатты түрде ауытқытудан ақпараттық әрекеттестік үдерістерін қорғау тәсілдерін зерттеу болып табылады [3].

Байланыс каналдары бойынша жіберілетін немесе ақпараттарды өңдеу желілерінде сақтаулы мәліметтермен рұқсатсыз танысудан және оларды әдейі бұрмалаудан қорғау криптографияның маңызды міндеті. Криптография аталған мәселені қорғалатын мәліметтерді шифрлау арқылы шешеді, бұл дегеніміз қарама-қарсы екі өңдеуді – шифрлауды және шифрды ашуды қолдану.

Аталған түрлендірулердің әрқайсысын жүзеге асыратын алгоритмдер жұбы шифрды құрайды. Екінші алгоритмнің құпиялылығы мәліметтермен рұқсатсыз танысуға мүмкіндік бермейді, ал бірінші алгоритмнің құпиялылығы жалған мәліметтерді орналастыруға мүмкіндік бермейді. Шифрды ашу алгоритімін білмей шифрланған түрлендірулер бойынша ашық мәліметтерді алу дешифрлеу арқылы жүргізіледі.

Криптографиялық түрлендірулер алгоритмі дегеніміз шығатын ашық мәтінді шифрланған мәтінге түрлендіру және керісінше түрлендіру бойынша, шифрлау кілтіне тәуелді операциялардың мазмұнымен жүйелілігін анықтайтын математикалық ережелер жиынтығы. Заманауи шифрлау алгоритмі ЭЕМ – ге арналған бағдарлама түріндегі, шифрлау алгоритімін жүзеге асыратын интегралды тізбек – крипточип негізгі бөлігі болып табылатын белгілі бір электронды құрылғылар арқылы жүзеге асырылады [4].

Кез-келген криптографиялық алгоритм кілттің қорғалу деңгейіне байланысты болады. Бұл кезде туындайтын негізгі мәселе – кілтті корректілі бақылау болып табылады. Аталған мәселе арнайы криптографиялық хаттамалар қолдану арқылы шешілуі мүмкін.

Криптографиялық хаттама – шифрлау кілттері мен криптоалгоритмді қолдануды анықтайтын ережелер мен рәсімдер жиынтығы.

Криптографиялық алгоритм, хаттамалар және кілттерді басқару рәсімдер жиынтығы криптографиялық жиынын құрайды. Ресми тұрғыдан ол жүйе ашық мәтінді шифрланған мәтінге ұқсас қайтымды түрлендірулерді анықтайды.

Криптожүйе белгілі анықталған әдістеме бойынша жұмыс істейді (процедура бойынша, 1-сурет). Ол шифрлаудың бір немесе одан да көп алгоритмдерінен (математикалық формулалар); осы шифрлау алгоритмдеріне қолданылатын кілттерден; кілттерді басқару жүйелерінен; шифрланбаған мәтіннен; және шифрланған мәтіннен (шифрмәтін) тұрады.



1 сурет - Криптожүйе жұмысының методологиясы

Методологияға сай мәтінге алдымен шифрлау алгоритмі және одан шифрмәтін алуға арналған кілт қолданылады. Сосын шифрмәтін тиісті орынға жіберіледі, ол жерде мәтінді қайта алу мақсатында шифрдан шығару үшін дәл сол алгоритм қолданылады. Методологияға сонымен қатар кілттерді жасау және оларды тарату рәсімдері кіреді. 2 – суретте классикалық криптографияны зерттеудің негізгі нысандары көрсетілген, А және В – заңды тұтынушылар, W – қарсылас немесе криптосарапшы.



2 сурет - Байланыс каналы бойынша ақпаратты жеткізу кезіндегі криптоқорғау

Шифрлау (encryption) және шифрдан шығару (decryption) рәсімдерін келесі түрде көрсетуге болады: $C = E_k(M)$ – шифрлау, $M = D_k(C)$ – шифрдан шығару, M және C – ашық (plaintext) және шифрланған (cipher text) мәтіндер, k_e және k_d – шифрлау және шифрдан шығару кілттері; E_k және D_k – k_e кілтімен шифрлау және k_d кілтімен шифрдан шығару функциялары, сонымен бірге кез-келген M ашық мәтіні үшін тура $D_k(E_k(M)) = M$.

Заманауи криптожүйелер апараттық, сонымен қатар бағдарламалық түрде жүзеге асырылады. Жүзеге асырылу тәсіліне қарамай оларға келесі жалпыға орта талаптар қойылады:

- шифрдың криптосараптамаға қарсы тұру тұрақтылығы өте жоғары болуы қажет, шифрды ашу мүмкіндігі кілттерді толығымен талдап – қарастыру тапсырмаларын шешу арқылы және заманауи компьютерлердің мүмкіндік шегінен тыс деңгейде (желілік есептеулерді ұйымдастыру мүмкіндіктерін есепке ала отырып) немесе қымбат бағалы есептеу жүйелерін қолдануды талап ету арқылы шешіледі;

- криптотұрақтылық алгоритмнің құпиялылығымен емес, кілттің құпиялылығымен қамтамасыз етіледі (жалпы қолдану (алгоритмге ықтимал бұзушы қол жеткізе алады) және шектеулі қолдану (алгоритм құпия түрде болады) криптожүйелері боып бөлінеді);

- шифрланған хабарлама тек кілт арқылы ғана оқылуы тиіс;

- бұзушыға бастапқы мәліметтердің және осыған сай шифрланған мәліметтердің көп бөлігі белгілі болған жағдайда да шифр тұрақты болуы қажет;

- кілттің немесе бастапқы мәтіннің шамалы өзгеруі шифрланған мәтін түрінің маңызды өзгеруіне әкеліп соғуы қажет;

- шифрлау алгоритмінің құрылымдық элементтері өзгермейтін болуы қажет;

- шифрмәтіннің бастапқы ақпараттан көлемі бойынша айырмасы аз болуы қажет; шифрлау үдерісінде хабарламаға енгізілген қосымша биттер шифрланған мәтінде толығымен және сенімді түрде жасырылуы қажет;

- шифрлау кезінде туындайтын қателіктер, ақпараттың жоғалуына немесе бұрмалануына әкеліп соқпауы қажет;

- шифрлау үдерісі кезінде бірізділікпен қолданылатын, кілттер арасындағы оңай және тез анықталатын тәуелділіктер болмауы қажет;

- көптеген, болуы мүмкін кілттердің кез – келгені теңдей криптоберіктікті қамтамасыз етуі қажет (кілттердің біркелкілік (біртекетес) жазықтығын қамтамасыз ету);

- шифрлау уақыты көп болмауы қажет;

- шифрлау құны жабылатын ақпарат құнымен теңгерілуі қажет.

Криптографияның классикалық міндеті шифрмәтін немесе криптограмма деп аталатын, кейбір белгілердің кездейсоқ реттілігі сияқты көрінетін, қандай да бір бастапқы мәтіннің (ашық мәтін) қайтымды түрленуі болып табылады.

Бұл кезде шифр – пакетте ашық хабарламада бар белгілер де, жаңа белгілер де болуы мүмкін. Жалпы жағдайда бастапқы мәтіндегі және криптограммадағы белгілер саны әр түрлі болуы мүмкін. Белгілі дешифрлау ресімін қолдану арқылы бастапқы мәтінді сол мағанада және толық қалпына келтіру мүмкіндігі бұлжымас талап болып табылады [5].

Қорғаудың ең жоғарғы дәрежесін қамтамасыз етуге қабілетті криптографиялық тәсілдер көбіне дискреттік ақпаратты қорғауға арналған.

Ақпаратты криптографиялық қорғаудың мәні бастапқы мәтінді шифрлаудың белгілі алгоритмдарын қолдану және арнайы кілттерсіз тіпті шифрлау алгоритмін білгеннің өзінде де бастапқы мәтінді қалпына келтіру мүмкін болмайтын, немесе өте қиынға түседі, сондықтан арнайы кілттер (кодтар) енгізу арқылы жүзеге асырылады. Шифрлау кезінде кілт қолданудың маңызды екі артықшылығы бар. Біріншіден, түрлі адресаттарға хабарлама жіберу үшін кілттері әртүрлі бір алгоритмді қолдану мүмкіндігі. Екіншіден, егер кілттің құпиялылығы бұзылса, шифрлау алгоритмін өзгертпей ақ, кілтті оңай ауыстыру мүмкіндігі. Осылайша шифрлау жүйесінің қауіпсіздігі шифрлау алгоритмінің құпиялылығына емес, қолданылатын кілттің құпиялылығына байланысты болады. Осы жағдайлардың әсерінен шифрлау алгоритмдері құпиялылықты және сақтауды қажет етпейді, және көпшілікке қолжетімді болып келеді [6].

Ақпаратты криптографиялық қорғау тәсілдері тиімділігінің басты көрсеткіші – бұзудың түрлі тәсілдеріне, яғни жабық мәтінді рұқсатсыз дешифрлауға төтеп беруінде. Ақпаратты заманауи криптографиялық қорғау тәсілдері үшін төтеп берудің төменгі шекарасын анықтайтын бұзудың әмбебап (тұрпатты) әдістері бар. Осындай бұзу тәсілдері: барлық мүмкін кілттерді тексеріп шығу, шифрлау сөздігін құру негізінде шабуылдау (блокты шифрлау үшін), коллизий негізінде шабуылдау. Техниканың қазіргі даму деңгейінде, мамандардың бағалауы бойынша толық тексеру шегі 70 битті (270 қиыстыру) құрайды. Осыған байланысты симметриялы криптографиялық тәсілдер үшін қауіпсіздік талаптарын қанағаттандыратын кілттің ұзындығы 128 биттен кем болмауы тиіс.

Криптоқорғау тәсілдері мен құралдарын жүйелеу

Криптографияның қарқынды дамуы оны жүзеге асыру тәсілдері мен құралдары санының күрт артуын туғызды. Осы жағдайға байланысты оларды жүйелеу, бірінші кезекте, түрлі жүйелік нышандары бойынша жіктеу қажеттілігі туындады. Криптографиялық тәсілдердің жіктелуі әр түрлі болуы мүмкін, бірақ көбінесе олар кілттердің түріне, шифрланатын ақпарат блогының өлшеміне, шифрлау үдерісі кезінде мәліметтерді түрлендіру операцияларының сипатына, қорғалатын ақпараттарды кодтау принциптеріне қарай жіктеледі. Осы тұрғыдан алғанда, олардың түрлері 3-суретте көрсетілген:



3 сурет - Ақпараттарды криптографиялық жабудың тәсілдері

Криптожүйелердің маңызды элементі хэш-функция болып табылады. Оларды есептеп шығу біршама оңайлығымен сипатталады, бірақ шифрдан шығару мүмкін емес дерлік. Хэш-функцияның бастапқы мәліметтері айнымалы ұзындықта болады және белгілі өлшемдегі қатарды қайтарады (кейде хабарлама дайджесті деп аталады), әдетте 128 бит.

Хэш-функцияны қолдану (хэштау) қандай да болсын құпия кілтті қолдану арқылы да, қолданбай да орындалуы мүмкін. Ол ақпаратты қорғаудың түрлі тәсілдерінде кеңінен қолданылады, оның ішінде, егер электронды қол қоюды қолдану мүмкін емес (мысалыға, үлкен ресурс сыйымдылыққа байланысты) немесе артық болған жағдайда, кез-келген мәліметтердің тұтастығын растау үшін қолданылады. Сонымен қатар, аталған тәсіл электронды қол қою (барлық мәліметтерге түгел емес, әдетте хэш мәліметтерге «қол қойылады») тізбектерінде, тұтынушыларды танып білу түрлі тізбектерінде (шынымен өзі айтқан тұлға екендігін тексеру кезінде) қолданылады.

Тәжірибеде қолданылатын хэш-функциялар да стандартталған. Осындай стандартталған хэш функциялардың жиынтығы бір шама кем, олардың әрқайсысы шифрланатын нысанның қорғалуының белгілі деңгейін қамтамасыздандыруға бағытталған белгілі бір пайдалану сипаттамасымен ерекшеленеді.

Әдебиет көздерін сараптау көрсеткендей, хэш функциялардың келесі түрлері сұранысқа ие (1-кесте).

1-кесте - Хэш функциялардың келесі түрлері

Түрі	Түсіндірмелер
MD2	Ең шабан, 8-биттік машина үшін үйлесімделген
MD4	Ең жылдам, 32-биттік машина үшін үйлесімделген. Жақын арада бұзылған
MD5	MD – функциялардың ішіндегі ең көп таралғаны. MD4 ұқсас, бірақ қауіпсіздікті жоғарлату құралдары оны MD4ке қарағанда 33% баяулатады. Мәліметтердің тұтастығын қамтамасыз етеді. Қауіпсіз деп есептеледі
SHA (Secure Hash Algorithm)	Айнымалы өлшемді бастапқы мәліметтерден хэш-функцияның 160 биттік мәнін құрады. NIST ұсынылып, АҚШ үкіметі стандарт ретінде қабылдады. DSS стандартында қолдануға арналған

Симметриялық шифрлау. Ақпараттарды шифрлау және шифрдан шығару үшін бір ғана кілт қолданылатын симметриялық криптожүйелер криптожүйелердің үлкен класын құрайды. Кілттер түрлі болуы да мүмкін, бірақ олар екі жаққа да бірінен бірі есептеліп шығатын болса, алгоритм әрине симметриялық шифрлауға жатады.

Симметриялық кілтті шифрдың жалпы идеясы 4-суретте көрсетілген.

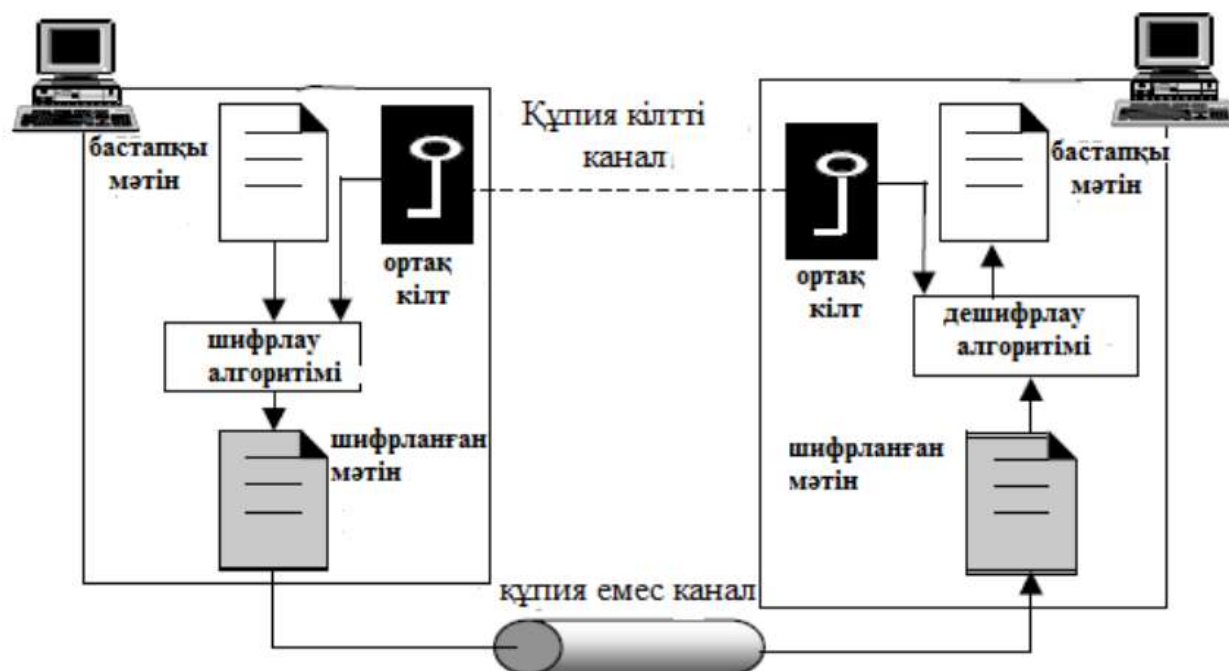
Симметриялық криптожүйелердегі шифрлау және дешифрлау алгоритмдері жалпы жағдайларда бір-бірінің өзгешеленген нұсқасы болып келеді. Егер P – ашық мәтін, C – шифрланған мәтін, ал K – кілт болса, алгоритм $E_k(x)$ шифрланған мәтінді құрады, дешифрлау алгоритмі $D_k(x)$ шифрланған мәтіннен бастапқы мәтінді қалпына келтіреді.

Шифрлау: $C = E_k(P)$,

Дешифрлау: $P = D_k(C)$, мұндағы, $D_k(E_k(x)) = E_k(D_k(x)) = x$

Симметриялық шифрлау екі түрге бөлінеді: блоктық және толассыз, бірақ кейбір жіктеулерде оларды бөлмейді және толассыз шифрлау – бұл бірлік ұзындықтағы блоктарды шифрлау деп есептелетіндігін де атап өтуге болады. Егер ақпарат алдын ала белгіленген ұзындықтағы блоктарға (мысалы, 64 немесе 128 бит) бөлінсе, шифрлау блокты деп аталады.

Осы кезде түрлі криптоалгоритмдерде немесе бір алгоритмнің түрлі жұмыс режимдерінде блоктар бір бірінен тәуелсіз түрде де, ағымдағы блокты шифрлау нәтижесі алдыңғы блоктың мәніне немесе алдыңғы блокты шифрлау нәтижесіне байланысты болатын- байланысқан түрде де шифрлануы мүмкін. Ақпаратты блоктарға бөлу мүмкін болмаған жағдайда толассыз шифрлау қолданылады – айталық, қандай да бір мәліметтер ағыны болсын, ол блок қалыптастыру үшін жеткіліксіз, сондықтан келесі мәліметтерді күтіп отырмай, әрбір белгісін шифрлайды және жібереді. Толассыз шифрлау алгоритмі мәліметтерді бір-бір биттен немесе бір-бір белгіден шифрлайды.



4 сурет - Симметриялық кілтпен шифрлау

Шифрлардың блоктық және толассыз болып бөлінуі есептеу техникасы құралдарында шифрлаушы түрлендірулерді жүзеге асырудың алгоритмдік және техникалық ерекшеліктеріне байланысты (процессордың разрядтылығы, микротізбектердің жылдамдығы, компьютер жадының көлемі және т.б.). Шифрлау толассыз емес, блоктық деп есептелетін, алфавит қуатының нақты мәнін көрсетуге болмайды. Тіпті, техниканың дамуына қарай, бұл сипаттама да алфавит қуатының ұлғаюына алып келеді. Мысалы, қазіргі кезде 16- және 32- разрядты процессор қолданылуда, ал болашақ шифрлау техникалары 64- разрядты процессорға жобалануда. Осыған байланысты, шифрларды құру кезінде 2^{32} и 2м қуатты алфавиттер қолданылуы мүмкін.

Көптеген итерациялық блокты шифрлау негізіндегі идея, қарапайым криптографиялық түрлендірулерді реттеп қолданатын, берік криптографиялық жүйені құру болып табылады. Қарапайым криптографиялық түрлендірулер арқылы көп рет шифрлау принципін алғаш рет Шеннон жұмысында ұсынған. Осы мақсатта орнын ауыстыру және қойылым қою түріндегі түрлендірулер қолданылады. Бұл түрлендірулердің алғашқысы түрленетін ақпараттық блоктың жеке белгілерінің орнын ауыстырады, ал екіншісі түрленетін ақпараттық блоктың әрбір белгісін (немесе белгілер тобын) сол алфавиттен алынған басқа белгімен ауыстыралады (сол алфавиттен сол өлшемдегі белгілер тобымен).

Аталған түрлендірулерді жүзеге асыратын тараптар *P_блок* (*P_box*, permutation box) және *S_блок* (*S_box*, substitution box) деп аталады. Мысал ретінде 1989 жылы КСРО қабылданған ресейлік шифрлау стандартты «криптографиялық түрлендірулер алгоритмі ГОСТ28147_89» келтірейік. Егер алгоритмді жалпы түрде сипаттасақ, - бұл 32 циклды шифрлаудың Фейстельдің тізбегі бойынша құрылған блоктық шифр. Ақпараттық блоктың ұзындығы – 64 бит, кілттің ұзындығы 256 бит. Симметриялық криптография стандартында – шифр AES – блоктың ұзындығы 128 бит деп анықталған. Крипто алгоритмнің блоктарының ұзындығы айнымалы және кілтерінің ұзындығы әр түрлі. Кілт ұзындығы мен блок ұзындығы бір-біріне байланыссыз, 128, 192 немесе 256 битке тең болуы мүмкін.

Блок шифрлау кезінде ашық мәтін алдын – ала ұзындығы бірдей блоктарға бөлінеді. Белгіленген ұзындықтағы 1 мәліметтер блогына (ашық текст блогына немесе кейбір гомомоланған реттілігіне) өзіндік криптографиялық түрлендірулер алгоритмі мен қарастырылған блоктық шифрлар жасалады, нәтижесінде ұзындығы дәл сондай шифрланған мәтін блогы алынады. Осыдан кейін мәліметтердің келесі блогы да осындай өзгеріске түседі.

Толассыз шифрлар ашық мәтінді бір операция кезінде бір элементті өзгерту арқылы шифрланған мәтінге түрлендіреді (толассыз – элемент артынан элемент). Мысалы ашық мәтін биттері кейбір кездейсоқ реттіліктегі биттермен бірге екінші модуль арқылы қойылады.

Итерация (қайталау) принципі ашық мәтіннің бір блогын бірдей циклдерден (раундтар) тұратын, көп реттік түрлендіру болып табылады. Көбіне әрбір раундта мәліметтерді түрлендіру арнайы алгоритм бойынша бастапқы құпия кілттен алынған қосымша кілттер көмегімен жүзеге асырылады.

Асимметриялық криптографияның арқасында құпиялы кілттерді үлестіру проблемасы шешілген болатын, бірақ жаңа проблема туды – ашық кілттердің дәлелдеу проблемасы. Бұл проблеманың мағынасы – кейбір А абоненттық ашық кілтін алғанда, пайдаланушы осы кілт дәл А абоненттікі деп сенімді болу керек. Ашық кілттерді сертификациялау проблеманы шешуде үлкен роль цифрлық жасау атқарды. Көп абоненттері бар асимметриялық криптографияны қолданылатын байланыс жүйелерде арнайы ұйымдастыру арқылы пайдалана бастады. Бұл ұйымдастыру құрылымдар сенімді үшінші жағының ролін атқарады және абоненттердің ашық кілттерін өз цифрлық жолдарымен куәландырады. Сонымен, ашық кілті бар криптожүйелерді пайдаланатын таратылған байланыс жүйелерде, ашық кілттер (Public Key Infrastructure - PKI) деген ұғым енгізіледі. Оған кіреді бағдарлама-аппараттық құралдар кешені, және де ашық кілттерді басқару үшін қажетті сервисты қамтамасыз ететін ұйымдастыру-техникалық және әкімшілік іс-шаралар. Ашық кілттер инфрақұрылымның негізгі элементі сертификациялау орталығы (куәландыру орталығы) (Certification authority, CA). Ол барлық процедураларды бақылайды: кілттерді жасау, тіркеу, сақтау және жаңарту, ашық кілттердің сертификаттарын және кері шақырып алынған сертификаттар тізімін.

Симметриялық криптожүйелердің маңызды кемшілігі құпия шифрлау кілттерін жеткізіу (тарату) және қолдану қауіпсіздігін қамтамасыз етудің күрделілігі. Бұл кемшілік асимметриялық криптожүйелерде жойылған, ақпаратты шифрлау үшін ашық деп аталатын бір кілт қолданылады, ал шифрдан шығару үшін жабық(құпия) деп аталатын басқа кілт қолданылады.

Қорытынды

Қазіргі заманғы ақпараттық ортада ақпаратты сенімді қорғау – кезек күттірмейтін қажеттілік. Мақалада көрсетілгендей, криптографиялық әдістер – ақпараттық қауіпсіздіктің негізі болып табылады. Криптографиялық алгоритмдер мен хаттамалардың тұрақтылығы, кілттердің сенімділігі ақпаратты бұзушылықтан қорғаудың басты факторлары саналады. Осыған байланысты, криптожүйелерді жетілдіру мен оларды тиімді қолданудың жаңа жолдарын іздеу – ғылыми және практикалық маңызды бағыт болып қала береді.

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ANALYSIS AND STUDY OF THE POSSIBLE CAUSES OF THE PRODUCTION ACCIDENT OF AN ELECTRIC ARC FURNACE

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Abstract

The construction features of electric arc furnaces (EAF) and the processes in them in steel production were studied using available materials and the Internet. A failed electric arc furnace was investigated and studied. It was found that the requirements for production and steel casting were met when charging and putting the furnace into operation. The technology for producing steel in a situation of the first melt after a long downtime was met. In all likelihood, the production accident with EAF occurred as a result of an unforeseen event or as a result of circumstances that could not be noticed, detected and prevented during the production process.

Keywords: *electric arc furnace, steel casting, production accident*

1. Introduction

1. 1. Steel production in electric arc furnaces

When producing steel in electric furnaces, the heat necessary to carry out metallurgical processes is obtained from the electrical energy used. Therefore, the processed material does not change its composition under the influence of the fuel. Electric furnaces have a number of advantages compared to conventional furnaces: the ability to produce steel with a lower sulfur content, as well as much better deoxidation; the content of non-metallic inclusions can be minimized and minimal combustion of alloying elements can be achieved; they allow rapid heating to high temperatures and the creation of an oxidizing or reducing atmosphere. This makes electric furnaces particularly reliable for producing high-quality carbon and alloy steels. The electric arc furnace is a cylindrical vessel made of steel sheet. The floor and walls are lined with acidic or basic refractory material, and the vault is built with refractory bricks. In larger furnaces, the vault is movable. Usually, graphite electrodes are lowered through three holes in the arch, which are secured so that they can move vertically with special mechanisms. The furnace is most often filled through a door located opposite the opening for discharging the finished steel. In larger furnaces, the filling is done through the movable arch. To discharge the slag and steel casting, the whole furnace with the electrodes can be tilted using a hydraulic drive. The starting materials for producing steel in an electric arc furnace are secondary ferrous metals. The composition of the starting materials determines the nature of the process. When the starting materials contain a significant amount of harmful impurities, the so-called "production of steel with complete oxidation of the impurities" is carried out. When the content of harmful impurities is within the permissible limits, the so-called "production of steel with partial oxidation of the impurities" is carried out. The nature of the cladding of the EAF also depends on the purity of the starting materials. Most often, electric arc furnaces are of a cladding-based nature [1,2].

1.2 Technological and technical features of electric arc furnace No. 3

To improve the efficiency of the EDF, the following technical solutions have been adopted and implemented: cooling of the roof (except for the small central roof made of refractory material); cooling of the shell walls using water-cooled panels with forced circulation (closed circuit); automatic regulation of the electrodes with a high reaction speed to maintain constant electrode current and arc voltage (optimal values); correct electrode circuit, such as to allow uniform melting of the scrap and at the same time to reduce the effect of electric arc radiation on the panels and the shell refractory; eccentric bottom casting system (EBT); casting of the melt without slag, with minimal receptivity to non-metallic elements (O_2 , N_2 , H_2) and minimal temperature losses; fifth hole for charging furnace additives; installation of the shell, intended to optimize the accessible volume and minimize the temperature unevenness of the liquid steel, in order to reduce the thermal load on the refractory lining; installation of the external panels. The

implemented technical solutions allow for the optimization of working practices with a significant reduction in: the time between castings; electricity consumption; electrode wear; refractory lining wear; furnace maintenance times; manual interventions by operators. Moreover, they allow for making melting and casting operations safer; improving the quality of the production; retaining slag inside the shell, thus making the subsequent refining of the steel inside the ladle easier. EDF No. 3 is equipped with modules that allow for the injection of oxygen into the metal bath. Technological features include:

- “liquid mirror” practice. The maximum capacity of the furnace allows the practice of liquid mirror, which consists of retaining inside the furnace a quantity of molten steel of about 10% of the weight of the scrap charge. The liquid steel that remains in the furnace allows faster melting due to the better productivity of the burners and the oxygen tube. Consequently, the electrodes can “penetrate” the scrap quickly with “long arcs”, thus allowing not only a reduction in melting time, but also a reduction in electrode wear and better arc stability during the open melting phases, which are the most critical for the operation.

- foamed slag: it covers the electric arc to protect the cooled panels and the refractory lining of the shell from the heat emitted by the arc; moreover, it reduces noise, increases electricity production and reduces vibrations from the electrode holder arms, effectively transmitting the energy to the arc and improving metal yield.

- high impedance operation: long arc furnace operation and high impedance are advantageous as they result in low electrical losses and high arc stability; reduce power supply disturbances; reduce mechanical stress.

- stirring of the metal bath is used to homogenize the temperature of the steel and to analyze the quality of the steel, thus favoring the thermal exchange between the slag and the steel and improving the diffusion of additives in the metal bath.

1.3. Construction features

EDF No. 3 has a cooled roof. The roof is made of a tubular support structure with a set of steel panels suspended from it. In the central part there is an hole to accommodate the refractory roof with holes for the electrodes. In the small roof there is an additional hole for charging alloying additives and calcium salts. The small roof is completely independent of the roof and can be easily removed and replaced. Diametrically opposite to the lifting system, the roof includes an oval hole for connecting a smoke extraction elbow made up of water-cooled pipes. Such a system allows the roof to be cooled without a large refractory coating. The EDF also has a device for lifting the electrodes. The system is made up of electrodes consisting of a steel structure with guides welded to it; these guides slide on 4 pairs of guide wheels assembled on supports that are tightened to the supporting body.

The EDF has a modular DANARC system. The requirement for low electrical energy consumption requires additional chemical energy. The chemical energy supply as gas and carbon combusted with oxygen can be controlled for the best possible use of the energy content in the reaction products. The DANARC modules represent the latest development in chemical energy supply. The system is designed to inject oxygen, carbon and fuel to obtain a highly efficient contribution to the melting. The DANARC module consists of a double injector block (the injector blocks do not have to be adjacent) which operates fixed to the side wall of the furnace. The two types of injectors are called Oxygenjet (oxygen nozzle) and Carbojet (carbon nozzle). The Oxygenjet is a water-cooled injector of oxygen and natural gas. It has two operating modes as a burner and as an oxygen supply tube. The Carbonjet is a water-cooled injector of oxygen, natural gas and carbon. It has two operating modes as a burner and as a carbon supply tube. The EDF uses UHP graphite electrodes. Graphite electrodes have the physical, chemical and electrical properties necessary for melting steel, since the arc in the preheating furnace is a significant source of heat. The characteristics of the electrodes must corresponded with the technical specifications of the DANIELI company.

Cooling system. Water is mainly used as the cooling fluid during the controlled cooling of the furnace components that are subjected to thermal radiation. This is the reason why special attention was paid to the design and construction of the cooling system. The system is closed-circuit, except for the free cooling system of the electrodes; it is fed with clean and filtered industrial water coming from the water purification system and supplies the circuits of the furnace components that need to be cooled according to a certain diagram. If water is missing (when the pumping station is damaged or there is no power supply), the circuits (especially in the power supply unit for the roof structure) are supplied by emergency water coming from an elevated gravimetric tank with pressure and minimum flow rate to protect people or equipment from damage [2,3].

2. Technological process of production and pouring in EDF No. 3

The electric arc furnace works with secondary ferrous metals raw material, which is called scrap. Secondary ferrous metals (scrap) are received in the scrap yard by rail cars or trucks. Secondary ferrous metals are supplied by certified companies authorized to purchase and deliver scrap. Companies supplying scrap deliver the scrap to the secondary ferrous metals workshop accompanied by the relevant documents: certificate of origin, type of scrap: alloyed scrap, secondary ferrous metals. Secondary ferrous metals are from the Republic of Bulgaria and imported from abroad. A system has been introduced according to which secondary ferrous metals are classified according to 16 quality indicators. The most important of them are the presence of non-ferrous metals, the presence of non-metallic components, the presence of closed containers (under pressure), radiation control. Scrap is received from the scrap yard pre-sorted. The quality of the secondary ferrous metals is determined during sorting. According to the quality and size, they are distributed to the appropriate sorting field. In order to be fed to the furnace, the scrap is loaded into steel baskets, called bins. In the sorting workshop, the baskets are loaded by filling them with the help of magnets and grabs mounted on the cranes. After filling and weighing each basket, it is transported with a heavy-duty conveyor called a bin truck. Using a 180-ton crane, the scrap from the baskets is poured into the furnace, the vault of which is previously opened. After closing the furnace vault, the operator gives a command to close the furnace switch. The electrodes remain under voltage. The process of melting the secondary ferrous metals (melt) begins. The melting process is also combined with oxidative refining processes. Usually, the furnace is loaded with three or four baskets depending on the density of the scrap. Consecutively, after melting the first basket, the second one is placed; after melting the second-third, etc. After melting the last basket, heating of the metal bath to a temperature of 1600-1650°C follows (begins). The duration of one melt is 70-75 minutes. After reaching the required temperature and the desired carbon content, the melt is poured into a steel bucket. Then the process of out-of-furnace treatment begins. Together with the secondary ferrous metals, slag-forming materials - lime, magnesite and carburizers - are fed into the furnace. Anthracite, 1-3 mm in size, is also injected to foam the slag. The process is intensified with the help of oxygen gas, fed through the relevant modules of the furnace.

EDP No. 3 has an automated dual control system. There are manual control elements on the Main Control Panel: functional keyboards: for control/drive of the electrodes; for control/drive of the roof; for general electrical control; for control/drive of the slag door and movement of the furnace and control of the cooling system. There are control elements on the Local Control Panel: enabling/disabling local control elements; EBT movement control system; weight control; manual control elements for tilting the furnace and visualizing the tilted position; control/drive of the gas injection process; general emergency button. There is a system for automatic adjustment of the electrodes for operation: the automatic combined movement of the electrodes (raising/lowering) is performed by pressing the corresponding button on the Main Control Panel. The movement of the electrodes depends on the position of the roof and is controlled by an automatic system before opening the roof and after closing it. The automatic operation of the electrodes (raising/lowering) is controlled by the furnace regulator when the electrodes are released; the furnace electrical switch is closed; the automatic operation is controlled only by the Main Panel; the type of regulation is selected by the operator via the corresponding button on the Main Panel selector [2,3,4].

3. Probable causes of the production accident at EDP No. 3

After analysis of the technical documentation and on-site inspection, it was established that the nature of the "explosion" with predominantly slag ejection and a minimal amount of metal indicates that the process (accident) was caused "from above", and did not develop in the molten metal with a subsequent explosion. This is also confirmed by the main damage to the furnace we have identified: damage to the furnace vault lifting mechanism; damage to the furnace vault: knocked out panels, thrown out refractory bricks; damage to the small vault (delta section); damaged electrode holders; damaged elbow for air extraction from the furnace; -damaged main masonry on the eastern side of the furnace (the spare is in place); disconnected water connections.

Figures 1-4 present photographs of some of the more serious damage to the furnace.



Figures 1÷4. Major damages identified in the EDP

At the preliminary investigation stage, we identified the following possible (probable) causes of the production accident subject to analyzes:

1. Failure to perform the intended technological operations before starting the furnace.
2. Condition and type of the supplied secondary ferrous metals (scrap); presence of closed containers, such as gas cylinders, which can cause explosive reactions.
3. Violation of the production technology.
4. Unforeseen leakage of water from the water-cooled panels of the furnace behind the refractory masonry.
5. Explosion inside the electric furnace, mainly due to water (even in small quantities) in the charged scrap, which starts some explosive chemical-physical reactions, or to micro-leaks in the cooling system of the roof or shell, which are more frequent and insidious, despite the optimal quality of the cooled panels. These leaks, even the smallest ones, can be recognized during scrap charging in the form of spatters either by the color of the scrap or by the arrangement in the furnace, since in case of leaks it sticks to the furnace wall affected by the water leak and becomes dark instead of red-orange. Scrap accumulated around this area will collapse into the metal bath after an explosive exothermic reaction due to the significant gas evolution together with the sudden evaporation of the water that wetted the scrap. We have detected splashes of liquid metal on the water-cooled panels, but these could also be the result of the explosion.
6. Unpredictable tilting of the furnace forward (pouring side) with the EBT closed. As a result, the explosions. As a result, the molten steel in the EBT area would reach dangerous levels and come into contact with the cooled shell panels, with the risk of serious explosions.
7. Unpredictable breakage and collapse of one or more electrodes in the shell. Usually the breakage occurs at the electrode joints. It is necessary to strictly follow the instructions for preparing the electrodes, performing qualified procedures for transferring and joining the electrode columns, preparing the joints, placing the connecting nipple, preparing the electrode elements.
8. Chemical-physical reactions in the liquid steel. Some physico-chemical reactions in the liquid steel inside the shell can develop and cause explosions or overflow of the liquid steel from the furnace. They can be due to oxidation reactions in the bath or to sudden collapse of scrap from the furnace walls. However, the reaction starts slowly and can be avoided.
9. Unpredictable water leakage from the water-cooled panels of the large furnace arch.

4. Conclusion

After studying and analyzing the available technical documentation and inspecting the EDP No. 3 in the condition immediately after the accident and after the dismantling of the furnace, we found that the requirements for production and steel casting were met when loading and putting the furnace into operation. The technology for producing steel in a situation of the first melt after a long downtime was met. Factors 3.5, 3.7 and 3.9 remain as possible (probable) causes of the production accident with EDP No. 3. We have not established any culpable behavior of an official who did not comply with the technology of the production and metal casting process, as a result of which the production accident with EDP No. 3 occurred, which is causally related to the accident that occurred. In our opinion, in all likelihood, the production accident with EDP No. 3 occurred as a result of an unpredictable (unforeseeable) event or as a result of circumstances that could not be noticed, detected and prevented during the production process, i.e. f. in all likelihood a random event occurred.

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RESEARCH INTO THE PROCESS OF OBTAINING MINERAL FERTILIZERS USING NON-TRADITIONAL RAW MATERIALS

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The problem of mineral fertilizer production at present is that most of the existing technologies are aimed at the use of high-quality mineral raw materials and are quite complex, energy-intensive, and also require the use of expensive reagents. The main problems associated with the use of mineral fertilizers are the following: nitrogen fertilizers acidify the soil due to physiological acidity; potassium chloride fertilizers, although they increase productivity, significantly reduce the quality of the product.

Taking into account the above, studies have been conducted to study the physicochemical regularities of the technology for the production of mineral fertilizers with improved indicators based on non-traditional low-quality mineral raw materials using waste from various industries.

The relevance of the work is that against the background of the depletion of high-quality mineral raw materials, it is necessary to develop new technologies for obtaining mineral fertilizers with an optimal ratio of NPK and improved physicochemical properties using non-traditional natural raw materials and waste from various industries.

The ecological purity of the prepared fertilizers is one of the main points, and in this regard, new fertilizers should not have a negative impact on the environment.

The scientific capacity of the proposed technology, even the process of converting low-quality raw materials into a targeted product using known technologies, is the main goal of the work. Thus, the set of unresolved problems in the field of obtaining mineral fertilizers based on low-quality natural raw materials using various industrial wastes played a key role in determining the purpose and setting the objectives of the research.

To achieve this goal, the following tasks were set:

- to justify the selection of non-traditional raw materials and types of industrial waste for new technologies of mineral fertilizers with improved physicochemical properties;*
- to study the physicochemical properties of the processing of magnesium-containing carbonate raw materials (dolomite, dolomite magnesite waste in the production of refractory materials) to obtain mineral fertilizers with an optimal ratio of nutrients, as well as magnesium compounds;*

The scientific novelty of the work is that the main quality criteria of the fertilizers obtained have been determined, the optimal composition of the fertilizers has been determined, and fertilizers with improved physicochemical properties have been obtained from magnesium-containing carbonate rocks (dolomite, dolomitized magnesite).

The practical significance of the work is that a new method for obtaining mineral fertilizers based on the process of converting low-quality raw materials into a target product has been developed.

Research has been conducted to produce phosphorus fertilizers containing all available forms of phosphorus for the utilization of waste from certain industrial sectors.

The proposed technology will significantly expand the range of raw materials for the production of mineral fertilizers by involving non-traditional raw materials and industrial waste (magnesite and dolomite processing waste from refractory production, construction debris, sulfate-soda mixture - aluminum production waste, alkaline combustion products, etc.) in the processing. The production and future use of new fertilizers with improved physicochemical properties will significantly reduce environmental pollution.

The process of activating phosphorite flour with ammonium salts of various concentrations was studied in detail, the most suitable conditions for obtaining water-soluble phosphate forms were determined, and the effect of the pH of the medium on the effectiveness of activation was taken into account. The results show that the use of ammonium sulfate

provides the decomposition of fluorapatite and calcite, which increases the amount of phosphorus absorbed.

To meet the ever-increasing demand for phosphorus fertilizers, one of the most urgent problems is the processing of low-quality phosphorite rock into phosphorus-based fertilizers with technical and economic indicators.

The most rational way to process low-quality phosphorite rock is its chemical activation with mineral acid salts (Table 1).

Table 1.

Chemical composition of complex fertilizers obtained as a result of the activation of low-quality phosphorite with ammonium salts, %

Mass ratio F:AS	Composition of components, %					Suspension pH	
	N	P ₂ O ₅ common	P ₂ O ₅ appropriated	P ₂ O ₅ water soluble	SO ₃	Before activation	After activation
(NH₄)₂SO₄							
0,2:2	20,09	1,59	1,41	0,91	55,36	3,9	6,59
0,31:2	17,29	3,48	2,49	0,73	48,59	3,7	6,71
0,6:2	14,28	5,87	4,11	0,52	40,71	3,5	6,83
2:2	10,81	9,12	5,62	0,35	30,79	3,3	6,95
NH₄NO₃							
0,2:2	31,39	1,59	1,31	0,42	-	4,9	6,68
0,31:2	27,76	3,52	2,72	0,31	-	4,7	6,79
0,6:2	23,42	5,91	4,13	0,23	-	4,6	6,85
2:2	17,45	9,24	6,25	0,25	-	4,5	6,88
NH₄H₂PO₄							
0,2:2	11,41	56,92	56,79	55,21	-	4,5	4,88
0,31:2	9,69	52,25	51,13	49,24	-	4,4	5,79
0,6:2	8,11	46,62	44,25	40,32	-	4,3	6,17
2:2	6,23	39,38	34,17	31,25	-	3,8	6,39
NH₄Cl							
0,2:2	24,15	1,82	1,39	0,51	-	4,8	6,63
0,31:2	21,41	3,64	2,81	0,45	-	4,7	6,79
0,6:2	17,59	5,78	4,32	0,37	-	4,6	6,87
2:2	13,48	8,86	5,87	0,23	-	4,5	6,89

Note: F - phosphorite flour, AS - ammonium salt (fertilizer).

Non-traditional processing of phosphates allows organizing the production of slow-acting complex fertilizers. In order to develop the technology for obtaining new types of phosphorus-containing fertilizers from phosphate flour, the process of decomposition with mineral acids currently used in agriculture has been studied. It is known that the process of activation of phosphate raw materials occurs mainly in conditions of soil moisture. To determine the effectiveness of mineral salts in the activation of phosphorite flour, various mass ratios of starting materials are mixed with ammonium salts of various concentrations (4-22%) for 35 minutes. The degree of activation of phosphorite flour depends on the pH of the solution medium. It has been established that as the concentration of solutions of ammonium salts increases, the pH of the medium begins to decrease.

The pH of the medium of phosphorite flour activated with ammonium sulfate was determined to be 6.84-7.22. Under the influence of ammonium sulfate solution, the decomposition of fluorapatite and calcite, the main minerals of phosphorite, occurs. Thus, ammonium sulfate decomposes with the formation of an acidic environment (as a result of hydrolysis), and acid ions react with calcite and fluorapatite. As a result, water-soluble and assimilable forms of phosphorus are formed in the solution.

Increasing the amount of phosphate flour in an ammonium sulfate solution leads to a decrease in the degree of activation and decarbonization of the raw material (table 2). For example, the degree of activation of phosphate flour containing 0.95 g of P₂O₅ in a 3% ammonium sulfate solution decreases by 50.21%, and the degree of decarbonization by 1.9 times. When phosphorite flour containing 1.79 and 3.60 g of P₂O₅ is processed in a solution of the same concentration, the degree of activation of the raw material decreases by an average of 1.6 and 1.9 times, and the degree of decarbonization by 3.27 and 6.46 times, respectively. These results are presented in table 2.

Table 2.

The degree of activation and decarbonization of phosphorite treated with ammonium salts.

Mass ratio, F:AS	Activation rate, %	Decarbonization rate, %
(NH ₄) ₂ SO ₄		
0,2:2	81,79	60,34
0,31:2	70,13	44,89
0,6:2	68,24	35,51
2:2	62,71	28,45
NH ₄ NO ₃		
0,2:2	79,49	48,27
0,31:2	75,87	42,61
0,6:2	69,69	33,79
2:2	67,23	27,23
NH ₄ H ₂ PO ₄		
0,2:2	99,78	52,4
0,31:2	97,76	47,5
0,6:2	94,74	39,8
2:2	86,45	28,6
NH ₄ Cl		
0,2:2	80,72	41,22
0,31:2	78,15	26,58
0,6:2	72,76	21,52
2:2	66,58	16,81

Studies have shown that the process of activating phosphate flour with ammonium nitrate is the same as with ammonium sulfate, but the degree of activation is relatively low. In this case, the degree of activation of phosphorite flour also depends on the concentration of ammonium nitrate solution, that is, the pH of the solution medium. The degree of activation and decarbonization of phosphate flour increases with an increase in the concentration and ratio of ammonium nitrate solution.

The mechanism of activation of phosphorite flour with monoammonium phosphate and ammonium chloride practically does not differ from the data given above.

Based on the studies, it was determined that it is possible to obtain complex mixed slow-release fertilizers with different nutrient ratios based on the activation of low-grade phosphorite flour with ammonium salts (fertilizers).

A technological scheme for the production of complex mixed fertilizers based on low-grade phosphate flour and standard fertilizers containing ammonium ions has been developed (Fig. 1).

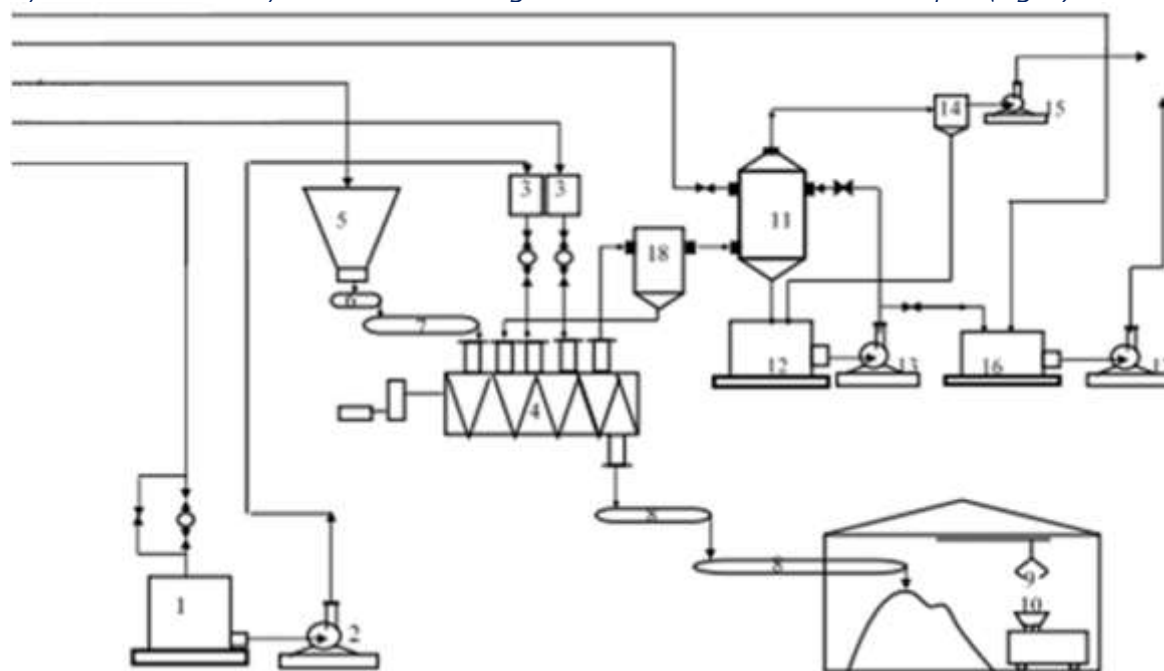


Figure 1. Technological scheme of the production of complex mixed fertilizers consisting of phosphorite rocks and ammonium salts (fertilizers).

1, 12 – tanks; 2, 13, 17 – pumps; 3 – batcher; 4 – screw reactor; 5 – bunker; 6, 7 – belt batcher; 8 – conveyors; 9 – grab crane; 10 – bunker; 11 – absorber; 14 – splash guard; 15 – fan; 16 – tank; 18 – cyclone.

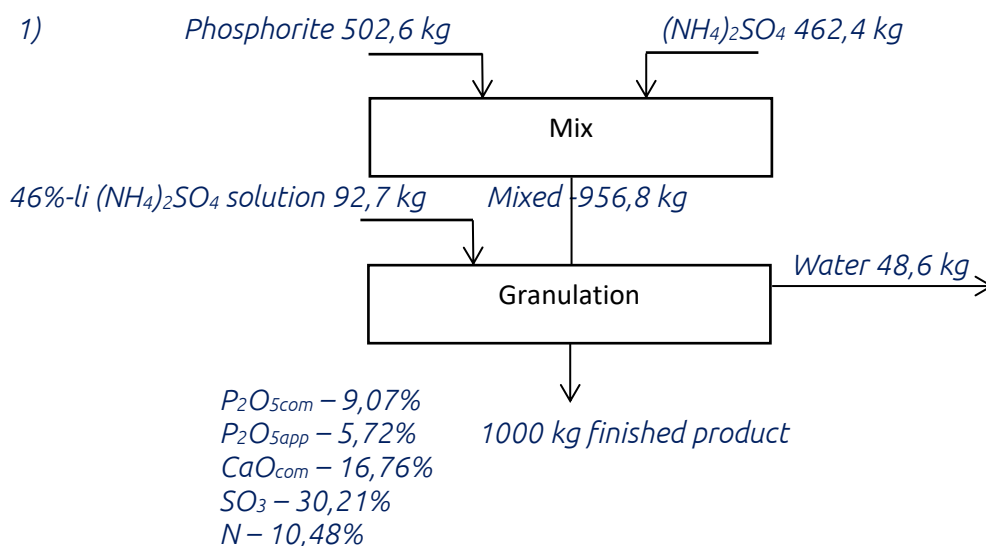
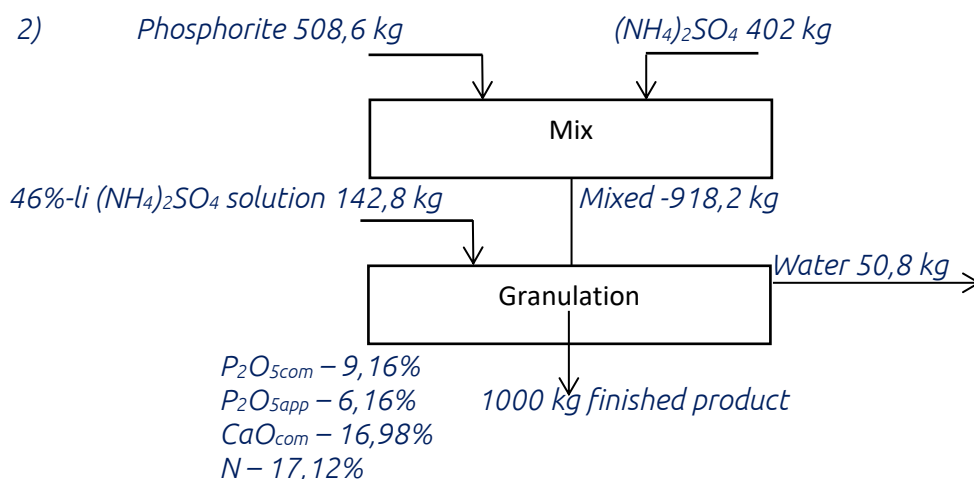


Figure 2: Material balance of complex fertilizer production in the ratio of phosphorite flour to ammonium salt (fertilizer) = 1:1.



Conclusion

Based on the conducted studies, a number of effectiveness of the application of mineral salts that contribute to the activation of phosphorites has been determined: ammonium sulfate > monoammonium phosphate > ammonium nitrate > ammonium chloride > potassium chloride > urea, that is, the lower the pH value of mineral salt solutions, the more effective the activation of phosphorite.

In this way, the production of complex mixed fertilizers does not require high costs and is economically feasible. New types of fertilizers produced on the basis of local raw materials can be considered effective in terms of application for increasing soil fertility.

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THE ROLE OF INFORMATION TECHNOLOGIES IN TOURISM SECTOR

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Abstract

The main aim of the article is to study the role of information technologies in the tourism sector. Information technology (IT) has brought about changes in the tourism sector, as in many other sectors, in recent years. These technologies play an important role in facilitating the organization of tourism, improving customer experience and increasing the efficiency of operations. It is very important to understand the impact of IT on the tourism sector, to monitor innovations in this field and to predict future developments.

Result: This article explains how information technology plays an important role in the tourism sector and how these technologies are applied in tourism business, supported by various sources. References to sources strengthen the scientific basis of the text.

Methods: analyzing method had been used while conducting the research.

Application importance: the material can be used in seminars and lectures in higher education institutions.

Keywords: technology, tourism, information technology, online reservation systems

Introduction. Information technology (IT) has brought about changes in the tourism sector, as in many other sectors, in recent years. These technologies play an important role in facilitating the organization of tourism, improving customer experience and increasing the efficiency of operations. It is very important to understand the impact of IT on the tourism sector, to monitor innovations in this field and to predict future developments.

The main part.

1. Online Reservation systems and E-Tourism

One of the biggest changes in the tourism sector in recent years has been the introduction of online reservation systems. These systems allow customers to make convenient and fast reservations for hotels, airlines, tours and other tourism services. E-tourism also helps tourism businesses collect customer data and provide more targeted services (Buhalis, 2003).

2. Technologies which improve the tourist experience

It provides various tools to provide a better experience to tourists. For example, through mobile applications and websites, tourists can get detailed information about their destinations, buy tickets, and read reviews about restaurants and activities. This increases customer satisfaction and also increases transparency and trust in the tourism business.

(Sigala, 2015).

3. Big Data and Analytics

The use of big data in tourism allows businesses to analyze customer behavior and offer more relevant products. Big data makes marketing strategies of tourism companies more effective, while also helping to predict demand and set optimal prices (Tussyadiah et al., 2017). For instance, travel agencies can use customer data to create personalized offers.

4. Social media and Tourism Marketing.

Social media platforms play an important role in the development of the tourism sector. Tourism businesses communicate with potential customers through social media and inform them about their offers and campaigns. Social media is also effective in collecting customer reviews and building an image (Xiang & Gretzel, 2010). For example, tourists can choose the services they want by reading the reviews of other travelers on social media. 5. Virtual and Augmented Reality Technologies Virtual reality (VR) and augmented reality (AR) technologies further improve the customer experience in the tourism sector. For example, through VR, tourists can virtually explore a certain place before traveling to that place. AR can provide tourists with real-time information, orient them and provide detailed information (Buhalis & Jun,

2011). 6. *Blockchain Technology and Payment System Innovations* Blockchain technology helps to increase the security of payments in the tourism sector. This technology also improves customer data protection and transparency. In the tourism sector, blockchain speeds up transactions such as tour bookings and hotel payments and eliminates bureaucratic obstacles (Zohari & Zhang, 2019).

Result.

Information technology has brought about large-scale changes in the tourism sector. E-tourism, mobile applications, social media, big data and other IT tools improve the tourist experience and facilitate the work of tourism enterprises. In the future, these technologies are expected to develop further and create new opportunities for the tourism sector.

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