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Content

Agricultural sciences

- Jalilova L.Z., Jafarova A.A., Manafova A.M., Guliyeva B.T.*
AMELIORATIVE STATE OF SOILS IN THE AZERBAIJAN REPUBLIC (SALYAN PLAIN) 3

Economic sciences

- Guan Pengpeng*
SMART SPECIALIZATION AND PROCESSING INDUSTRY CONVERGENCE: RUSSIAN-CHINESE BORDER (ALTAI KRAI & XINJIANG) 7

Historical sciences

- Aghayeva SevdA Aydin*
THE ORIGIN AND HISTORY OF THE NOWRUZ HOLIDAY. PART 1 11
- Omarkanova Asel Omarkanovna, Polkovnikova Valeriya Ivanovna, Galiaskarov Ilya Alexandrovich*
THE INQUISITION AS PART OF EVERYDAY LIFE IN LATE MEDIEVAL GERMANY 16

Medical sciences

- Arman Khozhayev, Tatyana Burkutbayeva, Aida Arkarbekova, Adilet Datkayev, Nurym Berikuly, Nadiya Zhumakadyr, Shynggys Kaimollayev, Baglan Kambarov, Eldor Mussakhanov*
LARYNGEAL CANCER: CONTEMPORARY DIAGNOSTIC AND CLINICAL PARADIGM 22
- Mehriniso Kasirova, Dzhamol Kholmatov*
A HEREDITARY FORM OF HEARING LOSS AS A RESULT OF CONSANGUINEOUS MARRIAGE 31

Pedagogical sciences

- Aitzhan Arailym Nalibaikyzy, Abishova Nazken Sabitkyzy, Abdrazak Nurai Muratkyzy, Isayev Sapar Auezbekovich*
THE IMPORTANCE OF USING TASK GENERATORS IN COMPUTER SCIENCE 36
- Aigerim Bekbosynova*
USE OF ARTIFICIAL INTELLIGENCE IN SPEECH THERAPY: CURRENT STATUS, POSSIBILITIES, AND DEVELOPMENT PROSPECTS 47
- Khojanazarova Nazira Omonjanovna*
THE ROLE OF VIRTUAL EXCHANGE PROGRAMS IN DEVELOPING STUDENTS' INTERCULTURAL COMPETENCE 50
- Orynbassar Aruzhan*
THE IMPACT OF ONLINE WRITING PLATFORMS ON STUDENTS' MOTIVATION TO WRITE IN ENGLISH 54
- Rozaliya Shafigulina*
USING ARTIFICIAL INTELLIGENCE IN DEVELOPING STUDENTS' ACADEMIC WRITING COMPETENCE 61

Philological sciences

- Anna Chikvaidze*
THE METAPHORIZATION OF THE MYTHOLOGICAL WORLDVIEW: COGNITIVE AND ANTHROPOLOGICAL PERSPECTIVES 64
- Fatma Aliyeva*
SEMANTIC MEANINGS AND BELIEF STATES 67
- Gunel Allahverdiyeva*
PHRASAL VERBS AS A PART OF THE ENGLISH LANGUAGE 70

Physical sciences

- Antonov Alexander Alexandrovich*
FROM THE CORRECTED VERSION OF THE SRT IT FOLLOWS THAT TIME TRAVELS IS NOW AVAILABLE TO PEOPLE ON EARTH 74

Psychological sciences

- Kateryna Tamrazova, Vira Syniakova*
SOCIAL AND PSYCHOLOGICAL CORRECTION OF INADEQUATE PARENTAL POSITIONS 92

Technical sciences

- Niyar Umarova*
THE TRANSFORMATIVE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN EDUCATION AND RESEARCH 94
- Mukhamadeyeva Railya Minibulatovna, Temerbulatov Nurbek Asylbekovich*
AN ANALYTICAL REVIEW OF MATERIALS FOR 3D FDM PRINTING 98

Agricultural sciences

AMELIORATIVE STATE OF SOILS IN THE AZERBAIJAN REPUBLIC (SALYAN PLAIN)

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Abstract

The problem of soil amelioration has been the center of people's attention in many countries. At present, large regions of the arid zones on earth have been subjected to swamping and salinization by the application of irrigation amelioration. The relief and climate play an important role in formation of soil cover. The soils in the republic are mainly located on vertical zones under the influence of these factors. The soil cover in Azerbaijan is various and a main reason is variety of the relief and climate condition. The Kur-Araz lowland is a main agricultural zone of the country. The soils Kur-Araz lowland in the Republic have favorable natural-climate conditions for growing of the agricultural plants. The soils of the Salyan plain are used for agricultural crops and they have been exposed to different degrees of salinization. The plain soils belong to the grey soil type and different types of soils – meadow-grey, grey-meadow, meadow-boggy and other soils are preferred. The long researches show that the soils of the Salyan plain belong to sulphate-chlorine type of salinization, but the chlorine type of salinized soils are found in some places. The soils are clayey, loamy for their granulometric composition. The presented article informed about the current ameliorative state of the soils in Salyan. An amount of physical clay in the experimental area is 46.46-52.32 % in soil layer of 0-20 cm, and it is 41.64-56.16 % towards low layers (at 0-100 cm of layer). It was determined that the soils of the plain were subjected to different degree of salinization and an amount of salts was 0.11-0.20 % in the soils of the selected research area. Its soils are sulfate-chlorine and sulfate for the salt type and pH is 7.6-7.7. The soils of the experimental area belongs to the non-salinized type for analysis results and mineralization is 3.5 g/l in the water sample taken from drain. It was determined preservation of the soil fertility under the agricultural crops and deep plowing of fields for improvement of the ameliorative state, application of the mineral fertilizers under plowing, conducting the winter showing, application of the irrigative waters with watering norm according to the crops need have been offered.

Keywords: irrigated, collector-drainage, salinization, salt amount, salt type, productivity

INTRODUCTION.

Recently, rapid population growth and solution of their food problems, the problems of soil improvement under the agricultural plants are among the most important and actual issues facing experts. The measures taken to preserve and restore the fertility of the soils thanks to the agrarian reforms carried out in the republic are a result of this. Though amelioration of the main irrigative soils in the Kur-Araz lowland belongs to the past, as a result of establishment of the collector-drainage systems, reclaiming saline soils thanks to the complex works carried out during the next period, the high and durable product was obtained from the agricultural crops [8, 10]. An aim of the research was to study the current ameliorative state of soils in Salyan.

RESEARCH OBJECT AND METHOD

Seyidsadakhli village in the Salyan plain was a research object, the experiments were carried out in the soils under cotton (the area was 2.0). The soil cuts were applied in the zone and the water sample was taken from the drain on the field edge. During the research a quantity and a type of salts, pH, granulometric composition, etc. were studied. All the chemical analyses were fulfilled according to the required method in the republic [4].

ANALYSIS AND DISCUSSION

It is known that, more than 40 % of soils in our country were subjected to erosion processes to one degree or another, these happens as a result of the men's spontaneous use of the soils and this process is observed with a decrease of humus substance which is an important indicator of soil fertility. Consequently, the repeat salinization of ameliorated soils carried out in incorrect condition becomes

inevitable. Preservation of this priceless wealth, fertility restoration are among the important problems that are in the spotlight of increasing anthropogenic impacts on soil cover [1].

It is known that amelioration of the agricultural soils depends on natural condition of the zone. The soil fund in Azerbaijan is 8641.5 000 hectares. 4227 000 hectares of the area is used in agriculture of the republic. The relief and climate play an important role in formation of soil cover. The soils in the republic are mainly located on vertical zones under the influence of these factors. The soil cover in Azerbaijan is various and a main reason is variety of the relief and climate condition. The Kur-Araz lowland is a main agricultural zone of the country. The salts in the soil rise to the upper layers and create salt-ridden soils because groundwater is close to the surface. Amelioration of such soils is an important issue facing us [15].

It is known that the soil salinization occurs more rapidly in areas with intensive irrigation. The salinization degree of soils is determined on the basis of total amount of water, taking into account its species composition. Many agricultural plants can't develop or productivity decreases when the amount of salts dissolved in soil rises. Therefore, assimilation of the salt-ridden and salinized soils is possible after complicated ameliorative measures [11].

Some researchers determined that the characters of soils change when they are used under the agricultural crops as a result of amelioration of salinized soils and after a short period the soils restore their structure and characters. The soils can reserve their peculiarities with the reclamation measures for along time [12].

It was known from the soil researches that the morphogenetic peculiarities of soils in this zone changed as a result of construction of collector-drainage, irrigation networks and intensive development of the irrigative agriculture [5].

The water-physical peculiarities of soils deteriorated and productivity obtained from the plants decreased because the soils in the Salyan plain were subjected to different degrees of salinization [2,13].

The Salyan plain is situated in the Kur-Araz lowland and occupies 149 000 hectares of the zone. Its 46 000 hectares are used under the agricultural crops. Geology of the Salyan plain is connected with the general history of the geotectonic zone of the Caspian sea. Though the zone is plain, there are little hollows in some places. The river vales, the irrigative canals caused fragmentation of the relief. The zone relief mainly consists of plains and is located below the level of the world's ocean. The relief rises slightly to the north and this is also more clearly noticeable in the debris cones of the rivers. An annual temperature of the air changes by 1.8 -2.5° C, but the relative humidity is 62-81 %. The vegetation of the zone is halophyte, xerophyte, ephemeral plants. The natural vegetation of the Salyan plain was minutely studied by A.Q.Qrosheym in 1929 [6]. Here, a level of the ground-water is located in different depths depending on relief. There is no ground-water in the north-west part of the plain. The ground-waters, found 3-5 m below the surface in the Kur region, extends in a narrow strip from the north of the village of Karimbeyli to Banka. The slope depth of groundwaters of 2-3 m are encountered along the Seyidsadikhli, Qushchu, Alchali, Arbatan Dayikand and Shorsulu villages. The carried out researches indicate that change of the location depth of the ground-water vibrates by 5-10.5 m [7].

The plain soils belong to the grey soil type and different types of soils – meadow-grey, grey-meadow, meadow-boggy and other soils are preferred. The long researches show that the soils of the Salyan plain belong to sulphate-chlorine type of salinization, but the chlorine type of salinized soils are found in some places. The soils are clayey, loamy for their granulometric composition. The plain soils have different water-leakage ability. The water of the Akkusha river is used in soils irrigation [3,14].

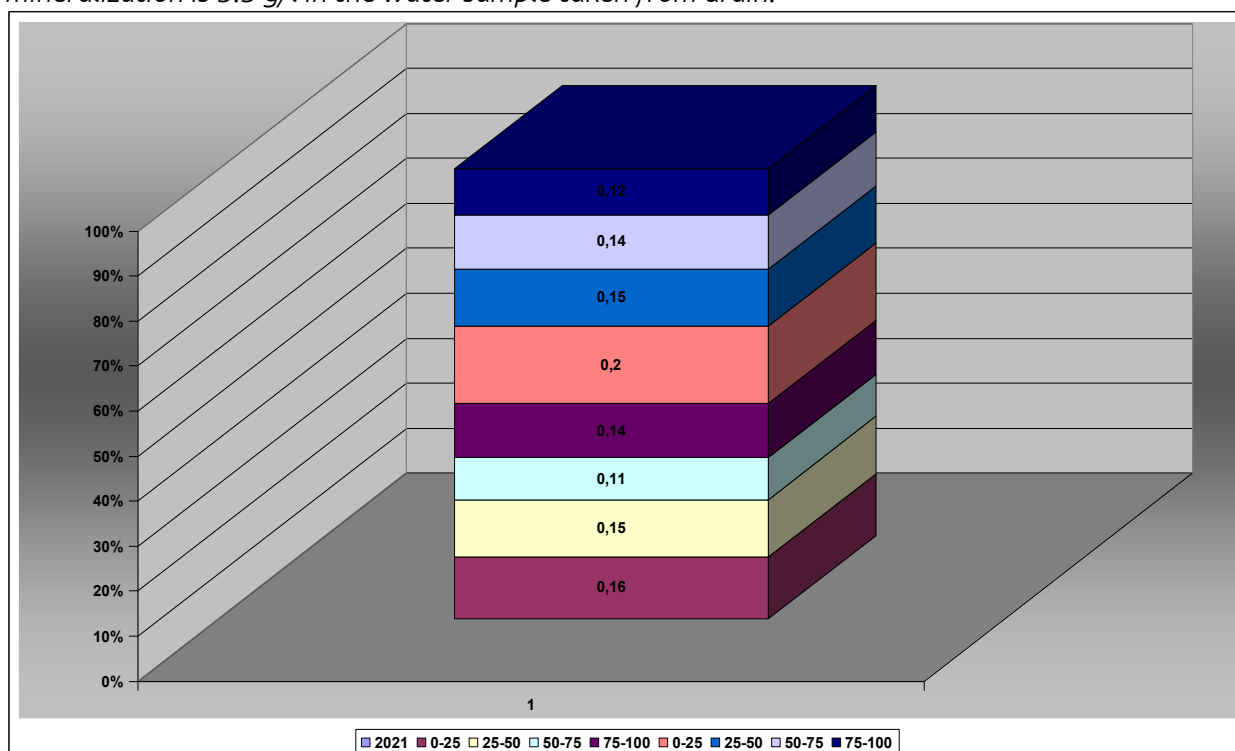
An amount of physical clay in the experimental area (from <0.01 mm small particles) is 46.46-52.32 % in soil layer of 0-20 cm, and it is 41.64-56.16 % towards low layers (at 0-100 cm of layer). A quantity of silt fractions is accordingly (from <0.01 mm small particles) 10.50 -23.54% and 10.04 -24.72 %.

The analyses of the short water weight have been performed in the samples taken from the experimental soils and the consequences were indicated on the table. CO₃ ion wasn't observed in soil sections and in water sample taken from the drain. An amount of HCO₃ was 0.012 -0.024 %, but it is 0.195 g/l in drain. A quantity of Cl is 0.007 -0.098%, but it is 3.668 g/l. Dry residue is 0.11 -0.20 % in soil sections, but it is 3.56 g/l in drain. pH is 7.6-7.7 in soil section and drain.

Table 1. Consequences of the analyses of the brief water weight in the experimental soils

N ^o of section	Depth, cm	Mg.ekv/%			Dry residue, %	pH
		CO ₃	HCO ₃	Cl		
1 N39°32'38,80 ¹¹ E48°55'30,60 ¹¹	0-25	no	0,40 0,024	2,80 0,098	0,16	7,6
	25-50		0,40 0,024	2,80 0,098	0,15	7,6
	50-75		0,40 0,024	1,40 0,049	0,11	7,7
	75-100		0,40 0,024	1,20 0,042	0,14	7,7
	0-25		0,20 0,012	2,40 0,084	0,20	7,6
	25-50		0,20 0,012	3,20 0,112	0,15	7,7
	50-75		0,20 0,012	0,20 0,007	0,14	7,7
	75-100		0,20 0,012	1,80 0,063	0,12	7,6
Drain water N39°32'40,01 ¹¹ E48°55'29,80 ¹¹		no	3,20 0,195	104,8 3,668	3,56	

The soils of the experimental area belongs to the non-salinized type for analysis results and mineralization is 3.5 g/l in the water sample taken from drain.

**Graphic 1. Change diagram of salts in the research area.**

Generally, conducting research in order to study ameliorative state of soils and reasons for the changes that occurred there and preparation of their prevention ways are main problems. So, recent climate conditions in the world is a main reason for this. On the other hand the soils are subjected to a definite change as a result of antropoghenic effects. At this time incorrect irrigation of soils causes their salinization and solonetzification and this negatively affects productivity of the plants grown in the same zone [9]. Generally, preservation of the soil fertility under the agricultural crops and deep plowing of fields for improvement of the ameliorative state, application of the mineral fertilizers under plowing, conducting the winter showing, application of the irrigative waters with watering norm according to the crops need have been offered.

1. It was determined that an amount of salts in the experimental soils of the Salyan plain was 0.11 - 0.20 %. The soils aren't salinized according to the obtained results in the experimental area. It is sulfate-chlorine and sulfate according to the salt type.

2. A value of pH is 7.6-7.7 in the soils under grain. The productivity is 28-30 c/h in grain plant.

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Economic sciences

SMART SPECIALIZATION AND PROCESSING INDUSTRY CONVERGENCE: RUSSIAN-CHINESE BORDER (ALTAI KRAI & XINJIANG)

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УМНАЯ СПЕЦИАЛИЗАЦИЯ И КОНВЕРГЕНЦИЯ ПЕРЕРАБАТЫВАЮЩЕЙ ПРОМЫШЛЕННОСТИ: РОССИЙСКО-КИТАЙСКАЯ ГРАНИЦА (АЛТАЙСКИЙ КРАЙ, СИНЬЦЗЯН)

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Abstract

In the face of global challenges, adjusting the structure of the manufacturing sector in the cross-border regions of Russia and China is becoming crucial for deepening cooperation. Drawing on data from 2015–2024 and employing comparative analysis, the location quotient and panel data, this article examines the convergence of the industrial structures of the Altai Krai of the Russian Federation and Xinjiang through the lens of smart specialisation. Results: the industrial structure shows marked signs of convergence (similarity coefficient ranging from 0.62 to 0.83), smart specialisation has a strong positive influence (coefficient 0.62, $p < 0.01$), and political support, resource potential and transport accessibility are also significant factors. This study complements the theory of smart specialisation in cross-border research and provides practical recommendations for coordinated development.

Аннотация

В условиях глобальных вызовов корректировка структуры перерабатывающей промышленности трансграничных регионов России и Китая становится ключевой для углубления сотрудничества. На основе данных за 2015–2024 гг. и методов сравнительного анализа, локационного коэффициента и панельных данных, статья исследует конвергенцию промышленной структуры Алтайского края Российской Федерации и Синьцзяна через призму умной специализации. Результаты: структура промышленности демонстрирует выраженные признаки конвергенции (коэффициент сходства с 0,62 до 0,83), умная специализация оказывает сильное положительное влияние (коэффициент 0,62, $p < 0,01$), а политическая поддержка, ресурсный потенциал и транспортный удобство также являются значимыми факторами. Работа дополняет теорию умной специализации в трансграничных исследованиях и дает практические рекомендации для согласованного развития.

Keywords: smart specialisation; the Russian-Chinese border; the processing industry; structural convergence; the Altai Krai of the Russian Federation; the Xinjiang Uyghur Autonomous Region of the People's Republic of China

Ключевые слова: умная специализация; российско-китайская граница; перерабатывающая промышленность; конвергенция структуры; Алтайский край Российской Федерации; Синьцзянский ицудурский автономный район КНР

1. Введение

Глобальные трансформации (санкции, реконструкция цепочек поставок) повлияли на развитие перерабатывающей промышленности на российско-китайской границе. Алтайский край Российской Федерации и Синьцзян, как ключевые трансграничные регионы двух стран, имеют взаимодополняющий ресурсный потенциал, но существующие исследования не охватывают системного анализа конвергенции их промышленной структуры через призму умной специализации В.В. Мищенко.

Научная значимость работы заключается в сочетании теории умной специализации с теорией конвергенции и оптимизации метода локационного коэффициента для трансграничных условий. Практическая значимость — в предоставлении рекомендаций для оптимизации промышленного сотрудничества между Алтайским краем России и Синьцзяном КНР. Исследовательская инновация: фокус на конкретных трансграничных регионах (Алтайский край РФ — Синьцзян КНР), использование актуальных данных и совершенная эмпирическая модель.

Методы исследования: сравнительный анализ, анализ локационного коэффициента, эмпирическое тестирование панельных данных (двусторонняя модель с фиксированными эффектами).

II. Основные теоретические основы

2.1 Теория умной специализации В.В. Мищенко

Ядро теории — развитие региональной промышленности на основе собственных преимуществ, фокус на перспективных отраслях, интеллектуальное обновление через инновации и политическую поддержку. В трансграничном сотрудничестве между Алтайским краем России и Синьцзяном КНР умная специализация выступает драйвером конвергенции структур.

2.2 Теория конвергенции промышленной структуры

Тенденция постепенного схождения отраслевого состава, долей отраслей и скорости развития регионов, обусловленная трансграничным взаимодействием и политическими факторами. Оценивается через коэффициент схождения структур и конвергенцию локационных коэффициентов.

2.3 Локационный коэффициент и его оптимизация

$$LQ_{ij} = \frac{q_{ij}/Q_i}{q_j/Q}$$

Где: LQ_{ij} — коэффициент j -отрасли в i -регионе; q_{ij} — стоимость производства j -отрасли в i -регионе; Q_i — общая стоимость производства перерабатывающей промышленности i -региона; q_j — общая стоимость производства j -отрасли в России и Китае; Q — общая стоимость производства перерабатывающей промышленности двух стран. Интерпретация: $LQ > 1$ — наличие преимуществ, $LQ = 1$ — средний уровень, $LQ < 1$ — отсутствие преимуществ.

2.4 Связь умной специализации и конвергенции

Формирование положительного цикла: умная специализация → схождение направлений обновления промышленности → конвергенция структур → повышение уровня умной специализации через трансграничное сотрудничество между Алтайским краем России и Синьцзяном КНР.

III. Текущее состояние и исследовательские гипотезы

3.1 Объекты исследования и их характеристики

Алтайский край Российской Федерации (опора на машиностроение, деревообработку, доля тяжелой промышленности >65%) и Синьцзян (согласованное развитие легкой и тяжелой промышленности, доля легкой >55%). За 2015–2024 гг. среднегодовой рост стоимости производства составил 8,9% (Алтайский край РФ) и 9,8% (Синьцзян) соответственно, объем трансграничного товарооборота между двумя регионами вырос с 520 до 1230 млн тонн.

3.2 Исследовательские гипотезы

H1: Структура промышленности Алтайского края Российской Федерации и Синьцзяня демонстрирует выраженные признаки конвергенции, тенденция усиливается;

H2: Уровень умной специализации оказывает положительное драйверное влияние на конвергенцию;

H3: Политическая поддержка, ресурсный потенциал и транспортный удобство способствуют конвергенции.

3.3 Источники данных

Официальные статистические ежегодники России (Федеральная служба государственной статистики, Статистическое ведомство Алтайского края) и Китая (Статистическое ведомство Синьцзянского и Цинхайского автономных районов), данные таможенных служб обеих стран (2015–2024 гг.). Данные проверены и скорректированы, валютные переводы выполнены по курсу ЦБ РФ на 31.12.2024 г.

IV. Эмпирический анализ

4.1 Определение переменных и модель

Зависимая переменная: Степень конвергенции (Convergence) — коэффициент схождения структур:

$$S_{ts} = \frac{\sum_{k=1}^n X_{tk} \times X_{sk}}{\sqrt{(\sum_{k=1}^n X_{tk}^2) \times (\sum_{k=1}^n X_{sk}^2)}}$$

Ключевая независимая переменная: Уровень умной специализации (Smart) — комплексный показатель (инвестиции в R&D, доля высококвалифицированных талантов, распространение интеллектуального оборудования);

Контрольные переменные: Политическая поддержка (Policy, 1–5 баллов), ресурсный потенциал (Resource), транспортный удобство (Traffic, млн тонн);

Модель: $Convergence_{it} = a_0 + a_1 Smart_{it} + a_2 Policy_{it} + a_3 Resource_{it} + a_4 Traffic_{it} + \mu_i + \lambda_t + \varepsilon_{it}$
(двусторонняя панельная модель с фиксированными эффектами, подтверждена тестами Ф и Хаусмана).

4.2 Результаты анализа

4.2.1 Локационные коэффициенты

Алтайский край Российской Федерации: машиностроение (1,32→1,58), деревообработка (1,25→1,41) — устойчивые преимущества; пищевая промышленность (0,98→1,12) — формирование преимуществ;

Синьцзян: легкая промышленность (1,45→1,62), переработка сельхозпродуктов (1,05→1,23) — ведущие преимущества; машиностроение (0,89→1,08) — постепенное формирование преимуществ.

Различия между коэффициентами сокращаются, указывая на конвергенцию специализации.

4.2.2 Степень конвергенции

Коэффициент сходства вырос с 0,62 (2015 г.) до 0,83 (2024 г.), ускорение после 2019 г. Конвергенция охватывает тяжелую (коэффициент сходства 0,58→0,81) и легкую (0,65→0,85) промышленность — H1 подтверждается.

4.2.3 Регрессионные результаты

Переменная	Коэффициент	Значимость
Smart	0,62	$p < 0,01$
Policy	0,21	$p < 0,05$
Resource	0,18	$p < 0,05$
Traffic	0,25	$p < 0,01$
R^2 / R^2_{adj}	0,89 / 0,87	—
F-статистика	68,52	$p < 0,01$

H2 подтверждается: умная специализация является ключевым драйвером конвергенции;

H3 подтверждается: все контрольные переменные имеют положительное влияние;

Проверка устойчивости (замена переменных, запаздывающие значения) подтверждает надежность результатов ($R^2 / R^2_{adj} > 0,83$).

V. Выводы и рекомендации

5.1 Основные выводы

1. Структура перерабатывающей промышленности Алтайского края Российской Федерации и Синьцзяня демонстрирует выраженную конвергенцию (коэффициент сходства 0,83 в 2024 г.), охватывающую все ключевые отрасли;

2. Умная специализация — ключевой драйвер конвергенции (коэффициент 0,62), формирующая положительный цикл развития;

3. Политическая поддержка, ресурсный потенциал и транспортный удобство являются значимыми факторами конвергенции между двумя регионами;

4. Конвергенция имеет характер дифференцированного взаимодополнения: Алтайский край Российской Федерации — преимущества в машиностроении и деревообработке, Синьцзян — в легкой промышленности и переработке сельхозпродуктов.

5.2 Практические рекомендации

1. Согласованное обновление на основе умной специализации: Алтайский край РФ — усилить инновации в машиностроении и деревообработке; Синьцзян — фокус на интеллектуализацию легкой промышленности и переработки сельхозпродуктов; создание трансграничного инновационного кластера между двумя регионами.

2. Оптимизация политики сотрудничества: Упрощение таможенных процедур между Алтайским краем РФ и Синьцзянем, создание совместного фонда поддержки трансграничных проектов, единственная информационная платформа.

3. Совершенствование транспортной инфраструктуры: Увеличение пропускной способности трансграничных пунктов пропуска между регионами, внедрение цифровых технологий в логистику, снижение транзакционных издержек.

5.3 Ограничения и перспективы

Исследование ограничено двумя регионами (Алтайский край РФ — Синьцзян КНР); в будущем стоит расширить объекты и обогатить систему переменных (технологическое распространение, рыночные спросы).

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Historical sciences

THE ORIGIN AND HISTORY OF THE NOWRUZ HOLIDAY PART 1

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Abstract

This article examines Nowruz as both a national cultural heritage of Azerbaijan and a transnational civilizational phenomenon observed across diverse regions of the world. The study explores the historical origins of Nowruz, its symbolic association with the vernal equinox, and its role as a ritualised representation of renewal, cosmological balance, and social cohesion. Drawing on a cultural-historical and comparative perspective, the article analyses how Nowruz has been preserved within Azerbaijani society while simultaneously functioning as a shared cultural practice among various peoples of the Northern Hemisphere. Particular attention is devoted to the transformation of Nowruz from a seasonal celebration into a marker of national identity and collective memory in Azerbaijan, as well as its broader recognition as part of the intangible cultural heritage of humanity. The findings indicate that Nowruz operates on multiple semiotic levels: as an agricultural calendar ritual, as a symbolic enactment of rebirth and moral purification, and as a sociocultural mechanism reinforcing intergenerational continuity. In the global context, the holiday demonstrates how ancient traditions can transcend ethnic and political boundaries, fostering intercultural dialogue and shared civilizational values. Thus, Nowruz emerges not merely as a spring festival but as a dynamic cultural institution sustaining identity, solidarity, and historical consciousness across societies.

Keywords: Nowruz, cultural heritage, vernal equinox, national identity, collective memory, ritual symbolism, intercultural dialogue.

*"Novruz is a holiday of national unity".
Great Leader Heydar Aliyev*

Introduction

Every nation has its traditions, customs and holidays, so do we. Azerbaijan is a country where national traditions are well preserved. Celebrating the holidays became part of the Azerbaijan traditions.

There is a holiday among holidays: the dearest, the dearest, the most beloved holiday - Nowruz holiday! This holiday, which has been painful for many years, but is not forgotten, is our national holiday.

Nowruz is one of the most joyful and beautiful holidays that have come to our days from the depths of centuries. Nowruz holiday is an ancient folk holiday that symbolises the arrival of spring in the northern hemisphere, in Azerbaijan, and has become a tradition among the people since ancient times.

Nowruz is held on the day of the equinox (March 20, 21, 22), the beginning of astronomical summer in the northern hemisphere. A number of nations connected the arrival of spring with the revival of nature, held festivities on this occasion, and celebrated it as the beginning of the New Year.



Nowruz means "new year", it is the first day of spring. The real new year in the life of all Muslims begins on that day. The arrival of Nowruz brings new happiness and joy to homes and families. Everyone tries to welcome this holiday with great solemnity, with joy in their hearts. In every house, every family is preparing for the Nowruz holiday in advance. Grandmothers, mothers and sisters cook shakerbura, paklava, shorgoghal and other goodies, and put samani, which is a symbol of abundance and blessing.

People gather around the bonfire, grudges are reconciled, relatives and friends go to each other's houses to congratulate each other. Young girls and boys light torches, jump over bonfires, throw hats at houses,

and perform fortune-telling. On the street, on the train, at school, in offices and institutions, the same words are heard in everyone's language: "Happy holiday!"

Nowruz holiday is a holiday of halal and purity. A month before Nowruz, people celebrate four Tuesdays. Each of these Tuesdays is dedicated to one of the four elements - fire, earth, water and air (wind) - which are essential for human existence and the existence of all life. This shows that Nowruz is one of the oldest and wisest holidays in the world. Among the Nowruz festivities, the last Tuesdays of the year is celebrated with great solemnity.

During Nowruz holiday, children and young people go from door to door in the neighbourhoods, especially in the rural areas, collect holiday shares and play various games. One of the decorations of Nowruz is a kosa (bowl) and kechal (bald head). They bring joy to children and entertain them with their games.

Those who passed away during the Nowruz holiday are also remembered, and the flow of people does not stop from the Alley of Martyrs, where those who sacrificed their lives for the Motherland. No one forgets to remember them on these dear days. Nowruz holiday is a holiday of our people's optimistic outlook on life, faith in the victory of nature and humanity. This traditional holiday, which has kept its strong influence until now, is the most massive public holiday. Nowruz is coming to our country, spring is coming, spring is coming. On the wings of swallows, in the air of the earth slowly waking up from winter sleep, in the buds of trees and flowers, Nowruz of our people, the spring of our country comes.

What is the Nowruz holiday, and in which countries is it celebrated?

On March 21, when day and night are equal, a number of people, including Azerbaijanis, have celebrated the coming of spring and the awakening of nature as the beginning of the New Year. These festivities are celebrated not only in Azerbaijan, but also in Iran, Afghanistan, Tajikistan and Uzbekistan and in a number of eastern countries. Even Iran and Afghanistan are not satisfied with only this; that day is considered the first day of the calendar, and the New Year begins on March 21.

On September 30, 2009, Nowruz was included in the list of intangible cultural heritage by UNESCO due to the people of the world celebrating this holiday at a high level and as a national holiday. On February 23, 2010, at the meeting of the 64th session of the United Nations General Assembly, March 21 was announced as "International Nowruz Day". Currently, this holiday is celebrated in the same way. Nowruz holiday is celebrated on a large scale in our country, the eve of the holiday (5 days) is declared non-working days.

"Nowruz holiday vividly demonstrates our commitment to historical and cultural heritage".

President Ilham Aliyev of Azerbaijan

Great leader Heydar Aliyev, who valued Nowruz's place in our national destiny, its status in the state building of the young Azerbaijan Republic that gained independence, and its role in our national revival as a people, nation and state, as a mechanism of ethnic self-organisation, immortalised this holiday as the main pillar of our national ideology. National Leader Heydar Aliyev appreciated the Nowruz holiday as a phenomenon that historically integrates our nation, nourishes its existence with unity, greatness and life force.

Although the Nowruz holiday was officially banned during the Soviet Union, national leader Heydar Aliyev's strong commitment to national traditions and values ensured that this holiday was loved and kept alive by the people, and its ideological and political importance was indirectly highlighted in the scientific research conducted in the field of folklore and philosophy.

In the 70s of the last century, the Nowruz holiday was officially celebrated and broadcast on television for the first time with the blessing of the great leader. Holding the national holiday at a high level raised the national spirit of the Azerbaijani people, created great love for the national heritage and history, and strengthened self-awareness. Nowruz traditions also found their place in films made at that time. Every time we watch the movie "Deli Kur" ("Crazy Kur"), we clearly see how Nowruz is promoted. Yes, the national and moral values preserved in those years, with the care of the wise leader, later played an exceptional role in the restoration of the state's independence of the Azerbaijani people. (1)

Nowruz holiday is one of the oldest holidays in Azerbaijan. For a very long time, clerics and representatives of various sects tried to dress Nowruz in a religious dress and did many things to distinguish it in their eyes. The impact of religious issues on Nowruz began with the arrival of the Arab caliphate in Azerbaijan. (2)

In our country, Nowruz holiday is celebrated in many Turkish and Muslim countries, including the Central Asian republics and Azerbaijan. Many researchers have investigated the history of Nowruz,

its connections with Zoroastrianism or Muslim culture, and found various facts that contradict or confirm each other in old sources. However, it is generally true that it is not correct to associate Nowruz with a specific religion or belief. Since ancient times, our people have considered Nowruz as the beginning of the new year and symbolised it as the beginning of abundance, blessing and prosperity. Celebrating Nowruz means welcoming the new year, the first day of spring.

According to scientists, the history of this holiday is very old. According to scientific research, the history of the Nowruz holiday goes back to ancient times, to the time of the prophet Zoroaster. Scientists estimate the age of this holiday to be at least 3,700 years and at most 5,000 years.

In ancient Babylon, this holiday was celebrated on the 21st day of Nisan (March, April) and lasted for 12 days. However, each of these 12 days had its own rituals (ceremony, ritual), its own entertainment. The first written source mentions that the Nowruz holiday dates back to B.C. It was founded in 505.

Islamic leaders always try to give a religious colour to this holiday. However, prominent scholars Firdowsi, Rudaki, Avicenna, Nizami, Sadi, Hafiz and others confirm that Nowruz was created even before Islam. Among the writings dedicated to the history of the Nowruz holiday, we can mention Nizami's "Siyasatnama" ("Policy Letter"), Omar Khayyam's "Nowruzname" and others. The origin of the Nowruz holiday, legends and myths related to it are ancient.

Researchers say that the Nowruz holiday originated among the ancient farming peoples of the Near East. They tried to connect the separate history of the Nowruz holiday with the names of legendary personalities (legendary Iranian kings Kayumars, "Gaye Mardan" in Avesta, Jamshid and others). After the spread of Islam in the countries of the Middle East and Central Asia, the Arab caliphate began to follow the traditions and holidays of the peoples of these countries.

Over the centuries, religious leaders and representatives of various sects have tried to separate this holiday from its natural and historical roots and have tried to dress it up in religious garb. Even some clerics have invented a hypothesis that the Nowruz holiday is related to the day when Caliph Ali IV came to power (656-661).

However, Imam Ali came to power in July, and Nowruz is celebrated in the spring. The ceremonies held by the people in connection with the holiday are not related to any religious doctrines. Most people have kept a number of traditions and games born from the true essence of the spring holiday until now. Medieval authors show that even after the spread of Islam in Eastern countries, spring traditions and agricultural calendar beliefs have a strong place in the Nowruz holiday. Most people have kept the customs from ancient times. It turns out that these holidays and customs are held without any connection with religious doctrines. (3)

Many talented personalities have also given their special views on the Nowruz Holiday. Abu Reyhan al-Biruni (11th century) talked about the Nowruz Holiday from various narrations, its reasons, the traditions spread among the people on the occasion of this holiday, and the real worldly holiday of Nowruz was celebrated in connection with the awakening of nature and the beginning of agriculture. Nizamul Mulk (11th century), in his work "Syasatnama," mentioned Nowruz holiday as a mass public holiday announced with the arrival of spring. The arrival of Nowruz is described and praised in the lyrical poem "Bahariyya", which is widespread in classical Eastern, including Azerbaijani poetry. (3)

Nowruz Holiday Wednesdays

Nowruz beliefs focus on the warming and "resurrection" of the fourth element – Su Charshabnasi (Water Tuesday), Od Charshabnasi (Fire Tuesday), Yel Charshabnasi (Wind Tuesday), and Ilakhir / Torpag Charshabnasi (Earth Tuesday) - in the place of nature's habitat. Therefore, Nowruz festivities cannot begin to be erased four weeks before the beginning of the New Year, i.e. March 21. This month is called Gray month. Each of his Tuesdays was obtained by an element of nature, and thus, gods were born in Tuesdays of people. According to old beliefs, one of the four elements of nature is "resurrected" on each of these Tuesdays. The last four Tuesdays of the year before Nowruz are considered holy. (4)

As we mentioned, the Nowruz holiday is celebrated on March 20-21, when day and night are equal. Before Nowruz, every Tuesday for four consecutive weeks is celebrated with a different name, which are listed below:



First Tuesday is called *Su Charshabnasi* (Water Tuesday). Water Tuesday usually coincides with the time when the weather starts to warm up slowly, and the ice in the rivers melts and mixes with the river.

The second Tuesday of the year is called *Od Charshanbasi* (Fire Tuesday). From this Tuesday, the sun starts to warm the earth even more, and spring wakes up. People leave bonfires



in their yards and light one candle for each family member in their homes. Fire is the symbol of purification and clarification. Fire is never put out by water; it burns down by itself. It is very important to light a bonfire in every yard on Fire Tuesday, because fire means the year will be warm and fertile. In ancient times, a newborn baby was laid on ashes to guarantee his health. It was also believed that those who covered their faces with ashes would have a beautiful sweetheart. *Khonchas* are made.

On Fire Tuesday people jump over the fire, because it is traditionally believed that all troubles and hardships will be left behind, and the new year will be happy and prosperous.

Azerbaijan, famous for its rich cuisine, has special dishes for each Tuesday of Nowruz. *Pilaf* is undoubtedly a signature dish of the Azerbaijani cuisine. There are about 200 kinds of pilaf: *dosheme-pilaf*, *milky-pilaf* and *borany-pilaf*, *arishta pilaf*, *sabzi pilav*, *shah pilav*, etc.

Our third Tuesday is *Yel Charshanbasi* (Wind Tuesday). From today, pollination starts in some trees. The wind almost causes this. Just as the wind moves the buds that have reached the time of pollination unite them for pollination.



The fourth and last Holy Tuesday of the year is called *Torpaq Charshanbasi* (Earth Tuesday). During all these four weeks, nature watered the earth on the first Water Tuesday, on Fire Tuesday it warmed the earth, on Wind Tuesday) it awakened nature, and now the work on the cultivated land begins on Earth Tuesday.



ated land begins on Earth Tuesday.

Nowruz Holiday in Azerbaijani Art

Nowruz holiday is a holiday celebrated by our people for centuries. Personalities of our people have written poems, songs and made films about the Nowruz holiday. Prominent composers such as *Uzeyir Hajibeyli*, *Fikret Amirov*, *Ogtay Zulfugarov*, and *Rahila Hasanova* wrote various songs. Also, Azerbaijani films about Nowruz, such as "*Novruzun Chalangi*" ("*Novruz's Wreath*") and "*Ocag*" ("*Ojak*") have been shot. (3)

<i>Bahar gəlir bizim azad ellərə,</i>	Spring is coming to our free lands,
<i>Mahnı qonur dodaqlara, dillərə.</i>	A song for brown lips and tongues.
<i>Parlaq günəş meydan açır güllərə,</i>	The bright sun gives way to the flowers,
<i>Qaranquşun müjdəsidir Novruzum!</i>	Nowruz is the good news of the swallow!

During the Soviet rule, the Nowruz holiday was celebrated unofficially, because the state authorities did not allow the celebration of the arrival of spring as a holiday. However, despite the prohibitions, every Azerbaijani family, which is loyal to the traditions of multiple captivity, celebrated this holiday. (5)

Even during the time of the Red Empire, i.e. the Soviets, the republics of this country - Azerbaijan, Kazakhstan, Uzbekistan, Tajikistan, Kyrgyzstan, Turkmenistan and other Turkic-speaking peoples - were forbidden to celebrate this holiday, but those peoples celebrated this holiday regardless of these prohibitions. In 1969, on the initiative of *Shikhali Gurbanov*, brave son of our nation, the second secretary of the Central Committee of Azerbaijan, the celebration of Nowruz holiday was held as an official holiday in Azerbaijan, and it aroused great interest among the people.

Nowruz is celebrated with great pomp in Iran, the Caucasus, and Central Asia. In Albania, Sultan Nowruz is celebrated as a religious holiday by followers of the *Bektashi* sect. Such places include Los Angeles, Toronto, and London. The city of Los Angeles has strict regulations on bonfires, and no one is

allowed to have bonfires on their property. Despite this, Iranians and Azerbaijanis living in Southern California who want to celebrate Nowruz go to California beaches and bonfires in places where bonfires are allowed. (5)

Even according to Chinese sources, ceremonies related to the arrival of spring were celebrated as a holiday during the Huns and Goyturks under the name "Yengi Kun". Simachen, a Chinese historian who lived in the second century before Christmas, noted in his work "Historical Memories" that the Hun rulers celebrated the New Year - Nowruz. (4)

In Kyrgyzstan, Kazakhstan, Tajikistan and Uzbekistan, fragrant branches are burned at home on the eve of the holiday in order to expel demons from the house.

Conclusion

The analysis demonstrates that Nowruz constitutes a multilayered cultural phenomenon that transcends the boundaries of a single nation while maintaining a particularly profound significance within Azerbaijani society. In the national context, the holiday functions as a symbolic axis of cultural continuity, reinforcing collective memory, ethical values, and social cohesion. Its rituals, seasonal symbolism, and performative practices sustain intergenerational transmission of identity and strengthen communal solidarity.

In the broader global framework, Nowruz illustrates how archaic cosmological beliefs associated with the renewal of nature have evolved into a shared cultural tradition recognised across diverse societies. The celebration of the vernal equinox in various regions reflects a universal human impulse to ritualise transition, regeneration, and temporal renewal. This universality does not diminish its national specificity; rather, it enhances its intercultural relevance.

Ultimately, Nowruz exemplifies the capacity of traditional festivals to function simultaneously as markers of national identity and as bridges between cultures. Its endurance across centuries confirms that intangible cultural practices remain vital instruments for sustaining historical consciousness, ethical continuity, and cross-cultural understanding in an increasingly globalised world.

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THE INQUISITION AS PART OF EVERYDAY LIFE IN LATE MEDIEVAL GERMANY

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DIE INQUISITION ALS BESTANDTEIL DES STÄDTISCHEN ALLTAGS IM SPÄTMITTELALTERLICHEN DEUTSCHLAND

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Abstract

This article examines the role of the Inquisition within the social and legal structure of German cities in the Late Middle Ages. The study focuses on the extent to which inquisitorial activity was integrated into everyday urban life and how its presence is reflected in judicial and normative sources. Particular attention is given to the functioning of the Inquisition within the political framework of the Holy Roman Empire, characterized by political fragmentation and a high degree of urban autonomy. The article analyzes the interaction between ecclesiastical inquisitors and urban judicial institutions, as well as the role of secular authorities in the investigation of heresy and the enforcement of sentences. Special emphasis is placed on everyday practices related to inquisitorial activity, including denunciations, public acts of penance, and the use of urban space for judicial procedures. The research is based on judicial protocols, municipal court records, and normative documents, including the papal bull Ad extirpanda. The analysis demonstrates that in the German cities of the Late Middle Ages the Inquisition functioned not only as an ecclesiastical institution combating heresy but also as an integral element of urban legal and social practices.

Zusammenfassung

Der Artikel widmet sich der Untersuchung der Rolle der Inquisition innerhalb der sozialen und rechtlichen Struktur deutscher Städte im Spätmittelalter. Im Mittelpunkt steht die Frage, in welchem Maße die Tätigkeit der Inquisition in den Alltag der städtischen Gesellschaft integriert war und auf welche Weise ihre Präsenz in gerichtlichen und normativen Quellen widergespiegelt wird. Die Studie betrachtet die Besonderheiten der Funktionsweise der Inquisition im politischen System des Heiligen Römischen Reiches, das durch einen hohen Grad an Dezentralisierung sowie durch eine bedeutende Autonomie der Städte gekennzeichnet war. Analysiert werden die Formen der Interaktion zwischen kirchlichen Inquisitoren und städtischen Gerichtsinstanzen sowie die Beteiligung weltlicher Behörden an Untersuchungen und an der Vollstreckung von Urteilen. Besonders berücksichtigt werden dabei Aspekte des städtischen Alltags, wie den Mechanismen der Denunziation, öffentlichen Bußakten sowie der Nutzung des städtischen Raums für die Durchführung gerichtlicher Verfahren. Die Quellenbasis der Untersuchung bilden Gerichtsprotokolle, städtische Gerichtsbücher sowie normative Rechtsakte, darunter auch die päpstliche Bulle „Ad extirpanda“. Die durchgeführte Analyse zeigt, dass die Inquisition in den deutschen Städten des Spätmittelalters nicht nur als kirchliche Institution zur Bekämpfung der Häresie fungierte, sondern auch als ein bedeutendes Element der städtischen rechtlichen und sozialen Praxis.

Keywords: *Inquisition; Late Middle Ages; urban everyday life; judicial sources; heresy; Holy Roman Empire; urban law.*

Schlüsselwörter: *Inquisition; Spätmittelalter; städtischer Alltag; Gerichtsquellen; Häresien; Heiliges Römisches Reich; Stadtrecht.*

Einleitung

Die Inquisition gehört zu den am häufigsten diskutierten Institutionen der religiösen und rechtlichen Geschichte des mittelalterlichen Europas. Sie entstand im 13. Jahrhundert als Mechanismus zur Bekämpfung der Häresie und stellte ein System kirchlicher Gerichtsverfahren dar, das auf die Aufdeckung und Verfolgung von Abweichungen von der orthodoxen christlichen Lehre ausgerichtet war. Die Herausbildung der päpstlichen Inquisition steht in engem Zusammenhang mit den Reformen des Papsttums im 13. Jahrhundert, insbesondere mit der Politik von Papst Gregor IX., der in den 1230er-Jahren das Institut der päpstlichen Inquisitoren einführte und ihre Tätigkeit vor allem Vertretern des Dominikaner- und des Franziskanerordens übertrug [1]. Die Hauptaufgabe dieser Vertreter bestand darin, Untersuchungen in Fällen von Häresie durchzuführen und ein kanonisch geregeltes Gerichtsverfahren zu gewährleisten, das die zuvor verbreiteten spontanen Formen der Verfolgung von Personen, die religiöser Abweichungen verdächtigt wurden, ersetzen sollte.

In der Historiographie wird die Inquisition traditionell vor allem im Kontext ihrer Tätigkeit in den Ländern Südeuropas – Frankreich, Italien und auf der Iberischen Halbinsel – betrachtet. Ihr Wirken in den deutschen Ländern stellte jedoch ebenfalls ein bedeutendes Phänomen des religiösen und sozialen Lebens des Spätmittelalters dar. Unter den Bedingungen der politischen Dezentralisierung des Heiligen Römischen Reiches und der weitgehenden Autonomie der Städte nahm die Tätigkeit der Inquisitoren spezifische Formen an, die sich von den stärker zentralisierten Modellen in anderen Regionen Europas unterschieden. Das Papsttum ernannte Inquisitoren für einzelne Gebiete der deutschen Länder, meist aus dem Kreis der Dominikanermönche, denen die Untersuchung von Fällen der Verbreitung von Häresien übertragen wurde, insbesondere im Zusammenhang mit den religiösen Bewegungen der Begarden und Beginen.

Im 14. und 15. Jahrhundert war die Tätigkeit der Inquisition in den deutschen Ländern eng mit dem städtischen Raum verbunden. Untersuchungen wurden vor allem in Städten durchgeführt, in denen sich religiöse Bewegungen, intellektuelle Zentren und ein aktives gesellschaftliches Leben konzentrierten. Die Inquisitoren standen in enger Verbindung mit lokalen kirchlichen Strukturen und den städtischen Behörden, da die Vollstreckung von Urteilen in der Regel die Beteiligung weltlicher Instanzen erforderte. Auf diese Weise wurde die Verfolgung der Häresie zu einem Bestandteil der städtischen Rechtspraxis und der sozialen Dynamik der mittelalterlichen Städte.

Trotz der vergleichsweise begrenzten Zahl erhaltener Dokumente, ermöglichen Gerichtsprotokolle, städtische Statuten und normative Rechtsakte, die Tätigkeit der Inquisition als ein Element des Alltags spätmittelalterlicher Städte zu betrachten. Diese Quellen spiegeln die Mechanismen der Identifizierung von Häresieverdächtigen, die Verfahren der Untersuchung sowie die Formen der Interaktion zwischen kirchlicher und städtischer Gerichtsbarkeit wider.

Die Inquisition in den deutschen Ländern des Spätmittelalters

Die Funktionsweise der Inquisition in den deutschen Ländern wies eine Reihe von Besonderheiten auf, die durch die politische Struktur des Heiligen Römischen Reiches bedingt waren. Im Unterschied zu Frankreich oder Italien, wo sich die päpstliche Autorität auf stabilere administrative Strukturen stützen konnte, war das politische System in den deutschen Ländern durch einen hohen Grad an Dezentralisierung gekennzeichnet. Das Reich stellte eine Gesamtheit zahlreicher Fürstentümer, Bistümer und freier Städte dar, die über eine beträchtliche Autonomie verfügten. Unter solchen Bedingungen war die Tätigkeit der Inquisitoren zwangsläufig von der Zusammenarbeit mit lokalen kirchlichen und weltlichen Behörden abhängig, insbesondere mit Bischöfen und städtischen Magistraten. Dieser Umstand bestimmte den begrenzten und episodischen Charakter inquisitorischer Untersuchungen im Vergleich zu den Regionen Südeuropas [1].

Das Institut der päpstlichen Inquisition wurde in der ersten Hälfte des 13. Jahrhunderts während des Pontifikats von Gregor IX. endgültig ausgebildet. Der Papst übertrug die Durchführung von Untersuchungen in Häresiefällen speziell ernannten päpstlichen Beauftragten. Eine bedeutende Rolle in diesem Prozess spielten die Bettelorden, vor allem der Dominikanerorden und der Franziskanerorden. Ihre Vertreter traten als Inquisitoren auf, was durch ihre theologische Ausbildung, ihre organisatorische Disziplin sowie ihre direkte Unterstellung unter die päpstliche Kurie begünstigt wurde. Die Dominikaner beteiligten sich besonders aktiv an inquisitorischen Untersuchungen, da ihr Orden ursprünglich als

Instrument der Predigt und der Bekämpfung der Häresie gegründet worden war. Auch die Franziskaner wurden zu dieser Tätigkeit herangezogen, wenngleich ihre Beteiligung weniger systematisch war und häufig von den jeweiligen regionalen Bedingungen abhing [2].

In den deutschen Ländern richteten sich inquisitorische Untersuchungen am häufigsten gegen verschiedene religiöse Bewegungen, die von den kirchlichen Behörden als potenziell häretisch angesehen wurden. Besondere Aufmerksamkeit galt dabei den Bewegungen der **Begarden** und **Beginen**, die vor allem in den Städten des Niederrheins und Süddeutschlands verbreitet waren. Diese Gemeinschaften stellten halb-religiöse Zusammenschlüsse von Laien dar, die sich frommen Praktiken außerhalb der strengen Regeln der monastischen Orden widmeten, was seitens der kirchlichen Hierarchie Misstrauen hervorrief. Im 14. und 15. Jahrhundert führten Inquisitoren wiederholt Untersuchungen gegen solche Gruppen durch, um die Grenzen zulässiger religiöser Praxis festzulegen [3].

Die rechtlichen Grundlagen inquisitorischer Verfahren wurden in einer Reihe päpstlicher Erlasse des 13. Jahrhunderts festgelegt. Als eines der bedeutendsten Dokumente gilt die päpstliche Bulle „Ad extirpanda“, die 1252 von Papst Innozenz IV. erlassen wurde. Dieses Dokument legte die prozessualen Normen für inquisitorische Untersuchungen fest, darunter die Ordnung der Verhöre, die Sammlung von Beweisen sowie die Zusammenarbeit zwischen kirchlichen und weltlichen Behörden. Die Bulle verpflichtete zudem weltliche Herrscher, die Inquisitoren im Kampf gegen die Häresie zu unterstützen, und sah vor, verurteilte Häretiker der weltlichen Gewalt zur Vollstreckung des Urteils zu übergeben [4].

In den deutschen Ländern erfolgte die Anwendung dieser Normen unter den Bedingungen eines komplexen Zusammenspiels zwischen dem kanonischen Recht und den lokalen Rechtstraditionen. Die städtischen Gerichte, die auf den Normen des lokalen Rechts und auf Rechtsbüchern wie dem Sachsenspiegel beruhten, beteiligten sich häufig an der Vollstreckung von Urteilen, die von kirchlichen Gerichten ausgesprochen worden waren. Auf diese Weise wurden inquisitorische Verfahren zu einem Bestandteil des umfassenderen Rechtssystems der spätmittelalterlichen Gesellschaft, in dem kirchliche und weltliche Gerichtsbarkeit eng miteinander verflochten waren.

Interaktion zwischen der Inquisition und den städtischen Gerichtsinstanzen

Eine Besonderheit der Funktionsweise der Inquisition in den deutschen Ländern des Spätmittelalters war ihre enge Zusammenarbeit mit den städtischen Behörden. Unter den Bedingungen der politischen Dezentralisierung des Heiligen Römischen Reiches verfügten kirchliche Inquisitoren nicht über einen eigenen administrativen Apparat, der in der Lage gewesen wäre, Untersuchungen selbstständig durchzuführen und gerichtliche Entscheidungen zu vollstrecken. Daher hing die Tätigkeit der inquisitorischen Tribunale in hohem Maße von der Kooperation mit lokalen Machtstrukturen ab, insbesondere mit städtischen Magistraten und weltlichen Gerichten [1].

Die städtischen Gerichte spielten eine wichtige Rolle bei der Gewährleistung der prozessualen Seite inquisitorischer Untersuchungen. Obwohl die Behandlung von Häresiefällen formal in den Zuständigkeitsbereich der kirchlichen Gerichtsbarkeit fiel, nutzten die Inquisitoren häufig die Infrastruktur der städtischen Verwaltung: Räumlichkeiten für Verhöre, die Unterstützung städtischer Beamter bei der Verhaftung von Verdächtigen sowie Hilfe bei der Vollstreckung von Urteilen. Eine solche Zusammenarbeit war sowohl durch die rechtlichen Normen des kanonischen Rechts als auch durch praktische Erwägungen bedingt, da die weltliche Gewalt über die notwendigen Zwangsmittel verfügte [5].

Ein Beispiel für eine solche Kooperation bietet die Praxis der Städte des Rheinlands, wo Inquisitoren regelmäßig mit den städtischen Räten zusammenarbeiteten. Insbesondere in der Stadt Köln wurden im 14. Jahrhundert kirchliche Untersuchungen gegen religiöse Bewegungen der Begarden unter Beteiligung der städtischen Behörden durchgeführt, die für die Umsetzung der gerichtlichen Entscheidungen sowie für die Kontrolle der der Häresie verdächtigten Personen sorgten [6]. Der städtische Magistrat fungierte dabei nicht selten als Vermittler zwischen dem Inquisitor und der lokalen Bevölkerung, organisierte öffentliche Bekanntmachungen über laufende Untersuchungen und gewährleistete die Ordnung während der gerichtlichen Verfahren.

Eine ähnliche Situation lässt sich auch in anderen großen Städten der deutschen Länder beobachten. In Straßburg zeigen die inquisitorischen Prozesse des 14. Jahrhunderts ebenfalls eine enge Zusammenarbeit zwischen kirchlicher und städtischer Gerichtsbarkeit. Die städtischen Behörden beteiligten sich an Verhaftungen und waren häufig bei den Verhören der Angeklagten anwesend. Nach der Verkündung des kirchlichen Urteils wurden die Verurteilten der weltlichen Gewalt übergeben, die die Vollstreckung der Strafe gemäß den geltenden rechtlichen Normen sicherzustellen hatte [7].

Die rechtlichen Grundlagen einer solchen Zusammenarbeit waren sowohl im kanonischen Recht als auch in lokalen Rechtstraditionen verankert. Päpstliche Erlasse des 13. Jahrhunderts sahen die

Verpflichtung weltlicher Behörden vor, bei der Bekämpfung der Häresie mitzuwirken, während städtische Rechtsnormen die Beteiligung der Magistrate an der Vollstreckung kirchlicher Urteile zuließen. In den deutschen Ländern standen solche Bestimmungen häufig im Zusammenhang mit Normen rechtlicher Sammlungen wie dem Sachsenspiegel, der die Beziehungen zwischen verschiedenen Gerichtsbarkeiten regelte und die Pflicht zur Aufrechterhaltung der öffentlichen Ordnung festschrieb [6].

Die Inquisition im Alltag der spätmittelalterlichen Stadt

Die Präsenz der Inquisition in den deutschen Städten des Spätmittelalters zeigte sich nicht nur im Bereich der Gerichtsbarkeit, sondern auch in der alltäglichen sozialen Praxis der städtischen Gemeinschaft. Entgegen der Vorstellung von der Inquisition als einer selten auftretenden und ausschließlich repressiven Institution belegen die Quellen, dass ihre Tätigkeit eng mit den Mechanismen sozialer Kontrolle verbunden war, die für das städtische Umfeld charakteristisch waren. Die Verfahren zur Untersuchung von Häresiefällen umfassten die Beteiligung der Bürger, öffentliche Formen religiöser Disziplinierung sowie eine regelmäßige Interaktion zwischen kirchlichen Behörden und der städtischen Bevölkerung [7].

Einer der wichtigsten Mechanismen zur Identifizierung von der Häresie verdächtigten Personen war das System von Denunziationen und Zeugenaussagen. Die Inquisitoren nutzten aktiv die Aussagen von Nachbarn, Mitgliedern religiöser Bruderschaften und anderen Bewohnern der Stadt. Unter den Bedingungen der dichten sozialen Struktur der mittelalterlichen Stadt verbreiteten sich Informationen über religiöse Praktiken oder verdächtige Äußerungen relativ schnell, was zur Einbeziehung breiter Bevölkerungsschichten in den Prozess der Aufdeckung religiöser Abweichungen beitrug. Eine solche Praxis spiegelt sich in zahlreichen Gerichtsprotokollen inquisitorischer Untersuchungen wider, in denen Zeugenaussagen einen bedeutenden Teil des Materials ausmachen [1].

Der öffentliche Charakter der inquisitorischen Verfahren machte sie ebenfalls zu einem sichtbaren Bestandteil des städtischen Lebens. Verhöre und die Verkündung von Urteilen fanden nicht selten in Anwesenheit von Vertretern der städtischen Gemeinschaft statt. In einigen Fällen wurden die Angeklagten zu öffentlichen Bußakten verpflichtet, die in städtischen Kirchen oder auf öffentlichen Plätzen durchgeführt wurden. Solche Zeremonien erfüllten nicht nur eine religiöse, sondern auch eine soziale Funktion, indem sie die Grenzen des zulässigen Verhaltens demonstrierten und die kollektiven Normen des Glaubens festigten [8].

Der städtische Raum spielte eine wichtige Rolle bei der Durchführung dieser Praktiken. Zentrale Plätze, Kirchengebäude und Rathäuser wurden zu Orten, an denen zentrale Etappen des inquisitorischen Verfahrens stattfanden – von öffentlichen Bekanntmachungen über laufende Untersuchungen bis hin zur Verkündung von Urteilen. So beteiligten sich beispielsweise in der Stadt Nürnberg die städtischen Behörden häufig an der Organisation solcher Verfahren, indem sie für Ordnung sorgten und die Anwesenheit von Amtsträgern gewährleisteten. Ähnliche Formen der Interaktion zwischen kirchlichen und städtischen Strukturen lassen sich auch in anderen Städten der deutschen Länder beobachten, darunter Augsburg, wo gerichtliche Untersuchungen religiöser Abweichungen ebenfalls von öffentlichen Maßnahmen begleitet wurden, die auf die Aufrechterhaltung religiöser Disziplin abzielten [9].

Ein wichtiger Aspekt der alltäglichen Präsenz der Inquisition war ihr Einfluss auf die sozialen Beziehungen innerhalb der städtischen Gemeinschaft. Anschuldigungen wegen Häresie konnten vor dem Hintergrund persönlicher Konflikte, wirtschaftlicher Streitigkeiten oder angespannter Beziehungen zwischen Nachbarn entstehen. Infolgedessen spiegelten inquisitorische Prozesse häufig nicht nur religiöse, sondern auch soziale Spannungen innerhalb der städtischen Gesellschaft wider. Untersuchungen gerichtlicher Quellen zeigen, dass solche Fälle Teil eines umfassenderen Systems der Regulierung von Verhalten und der Kontrolle religiöser Orthodoxie waren [2].

Die Darstellung der Inquisition in gerichtlichen und normativen Quellen

Die Erforschung der Tätigkeit der Inquisition in den deutschen Ländern des Spätmittelalters stützt sich in hohem Maße auf die Analyse verschiedener Arten schriftlicher Quellen. Dazu gehören in erster Linie Gerichtsprotokolle inquisitorischer Prozesse, städtische Gerichtsbücher, normative Akte der kirchlichen und weltlichen Gewalt sowie städtische Statuten. Obwohl ein erheblicher Teil der Dokumente nicht erhalten geblieben ist, ermöglichen die vorhandenen Materialien, die Besonderheiten der Funktionsweise inquisitorischer Untersuchungen sowie ihre Wechselwirkung mit dem städtischen Rechtssystem nachzuvollziehen [1].

Gerichtsprotokolle stellen einen der aufschlussreichsten Quellentypen dar. Sie enthalten Aufzeichnungen über die Verhöre der Angeklagten, Zeugenaussagen sowie die Formulierungen der verkündeten Urteile. Solche Dokumente hielten den Ablauf des gerichtlichen Verfahrens fest und verdeutlichten charakteristische Merkmale des inquisitorischen Prozesses: die Sammlung von

Zeugenaussagen, die Überprüfung der Orthodoxie der religiösen Überzeugungen des Angeklagten sowie die Entscheidungsfindung auf Grundlage des kanonischen Rechts. Die Analyse dieser Materialien zeigt, dass die Inquisitoren den mündlichen Zeugenaussagen und dem öffentlichen Schuldbekenntnis der Angeklagten besondere Bedeutung beimaßen, was den prozessualen Normen der kirchlichen Gerichtsbarkeit entsprach [5].

Eine beträchtliche Menge an Informationen über die Verfolgung der Häresie findet sich auch in städtischen Gerichtsbüchern, in denen die Entscheidungen der Stadtgerichte und die Handlungen der Magistrate verzeichnet wurden. In einigen Fällen spiegeln diese Einträge die Zusammenarbeit zwischen kirchlichen und weltlichen Behörden wider. So konnten Angeklagte nach der Verkündung eines kirchlichen Urteils dem städtischen Gericht zur Vollstreckung der Strafe übergeben werden. Solche Einträge finden sich in Gerichtsunterlagen von Städten des Rheinlands und Süddeutschlands, darunter Köln und Augsburg, wo die städtischen Behörden eine wichtige Rolle bei der praktischen Umsetzung der Entscheidungen kirchlicher Gerichte spielten [7].

Neben Gerichtsprotokollen stellen auch normative Dokumente eine wichtige Quellengruppe dar. Päpstliche Erlasse des 13. Jahrhunderts bestimmten die rechtlichen Grundlagen des inquisitorischen Verfahrens und legten die Pflichten weltlicher Behörden bei der Bekämpfung der Häresie fest. Eines der zentralen Dokumente war die Bulle „Ad extirpanda“, die von Papst Innozenz IV. erlassen wurde. Sie enthielt Bestimmungen über die prozessualen Normen der Untersuchung sowie Anweisungen zur Zusammenarbeit zwischen kirchlichen und weltlichen Autoritäten bei der Verfolgung von Häresie [4].

Neben den päpstlichen Akten stand die rechtliche Regulierung der inquisitorischen Tätigkeit in den deutschen Ländern auch in Beziehung zu den Normen des lokalen Rechts. Eine wichtige Rolle spielten dabei Rechtssammlungen wie der Sachsenspiegel, in denen grundlegende Prinzipien der Gerichtspraxis sowie die Verteilung der Zuständigkeiten zwischen verschiedenen Autoritäten festgelegt waren. Obwohl diese Rechtstexte die inquisitorischen Verfahren nicht unmittelbar regelten, bildeten sie eine juristische Grundlage für die Zusammenarbeit zwischen kirchlichen und städtischen Gerichten [6].

Schlussfolgerung

Die Analyse der Tätigkeit der Inquisition in den deutschen Ländern des Spätmittelalters zeigt, dass diese Institution eng mit der sozialen und rechtlichen Struktur der städtischen Gesellschaft verbunden war. Unter den Bedingungen der politischen Dezentralisierung des Heiligen Römischen Reiches konnten inquisitorische Untersuchungen nicht isoliert von den lokalen Autoritäten und den städtischen Gerichtsinstanzen funktionieren. Die praktische Durchführung inquisitorischer Verfahren erforderte eine enge Zusammenarbeit zwischen kirchlichen Inquisitoren und städtischen Magistraten, die für die Verhaftung der Verdächtigen, die Durchführung gerichtlicher Verfahren sowie für die Vollstreckung der verhängten Urteile verantwortlich waren.

Die Untersuchung von Gerichtsprotokollen, städtischen Gerichtsbüchern und normativen Dokumenten zeigt, dass die Verfolgung der Häresie in das bestehende System der Rechtsprechung und der Regulierung der öffentlichen Ordnung eingebettet war. Inquisitorische Prozesse spiegelten nicht nur die religiöse Politik der Kirche wider, sondern auch die Besonderheiten der sozialen Dynamik der Stadt, einschließlich der Beteiligung der Bürger an der Identifizierung von Verdächtigen, öffentlicher Formen der Buße sowie der Nutzung des städtischen Raums für die Durchführung gerichtlicher Verfahren.

Somit trat die Inquisition in den deutschen Städten des Spätmittelalters nicht nur als kirchliche Institution zur Bekämpfung der Häresie auf, sondern auch als ein Element des alltäglichen städtischen Lebens. Ihre Tätigkeit war in die Praxis der städtischen Verwaltung und Rechtsprechung integriert, was sowohl durch gerichtliche Materialien als auch durch normative Quellen bestätigt wird.

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Medical sciences

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LARYNGEAL CANCER: CONTEMPORARY DIAGNOSTIC AND CLINICAL PARADIGM

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Abstract

This scientific and analytical work presents modern world and local-regional data on incidence, mortality, lethality and five-year survival rate of such oncological pathology of head and neck tumors as laryngeal cancer. The issues of etiology and pathogenesis, features of distribution, modern approaches and principles of complex diagnostics, prospects for improving treatment results, as well as prognosis are covered in detail. The epidemiological characteristics of this pathology in our republic are given in the context of regions of the country.

Keywords: oncology, otorhinolaryngology, laryngeal cancer, human papillomavirus, biomarkers, RNA, immune-related genes, autophagy, epidemiology, incidence, mortality, lethality, five-year survival rate, prognosis.

Laryngeal cancer (LC) is a malignant tumor that develops from elements of the non-keratinizing epithelium of the larynx.

The etiologic factors remain unclear to date. In most cases, the patient's medical history includes untreated inflammatory and precancerous diseases of the larynx (laryngitis, papillomas, papillomatosis, dyskeratosis, leukoplakia, pachydermia, fibroma); a long period of smoking, alcohol consumption, work in dusty conditions (textile production), inhalation of harmful carcinogenic substances (oil, its distillation products, benzene, phenolic resins, asbestos); genetic predisposition (the presence of malignant diseases in relatives), as well as age and gender (males over 55 years of age) [1,2].

The diagnostic criteria are as follows. Complaints and medical history. Complaints: cough; hoarseness; sore throat radiating to the ear; difficulty breathing; choking when taking liquid food; enlarged

cervical, supraclavicular, subclavian, submandibular, and submental lymph nodes. History: early symptoms of the disease in LC are: hoarseness and cough, which appear already at stage I of the disease; when, at the initial visit of patients, hoarseness has been observed for six months with the addition of other symptoms, this may indicate later stages (III-IV) of the disease. In this case, complaints of shooting pain in the ear, difficulty breathing, choking when taking liquid food or water, and the appearance of enlarged nodes on the neck are also added [1].

Physical examination: indirect laryngoscopy (tumor, formation of one of the parts of the larynx, limited mobility of the true vocal cord or fixation of the affected half of the larynx, narrowing of the glottis); palpation examination of the lymph nodes of the neck on both sides (the presence of enlarged cervical lymph nodes of a dense consistency, immobile or stiff, slightly painful or possibly not painful, more than 1.0 cm in size).

Laboratory tests: cytological examination (increase in cell size up to giant, change in the shape and number of intracellular elements, increase in the size of the nucleus, its contours, different degrees of maturity of the nucleus and other cell elements, change in the number and shape of nucleoli); histological examination (large polygonal or spiky cells with well-defined cytoplasm, round nuclei with clear nucleoli, with the presence of mitoses, cells are located in the form of cells and cords with or without keratin formation, the presence of tumor emboli in the vessels, the severity of lymphocytic plasmacytic infiltration, mitotic activity of tumor cells).

Instrumental examinations: ultrasound examination of the cervical, submandibular, supraclavicular, subclavian lymph nodes (contours are clear, uneven, echogenicity is reduced, there may be areas of mixed echogenicity, the structure of the node is heterogeneous, increased vascularization is possible); computed tomography of the larynx (a tumor formation of the larynx, occupying the right or left half, spreading to the piriform sinus or the root of the tongue or soft tissues of the anterior surface of the neck, or to the trachea area, conglomerates of lymph nodes of various sizes are possible, compressing or displacing or growing into the vascular-nerve bundle of the neck); biopsy of a laryngeal tumor (cytological examination of the material reveals an increase in the size of the cell up to giant, a change in the shape and number of intracellular elements, an increase in the size of the nucleus, its contours, different degrees of maturity of the nucleus and other elements of the cell, a change in the number and shape of nucleoli; histological examination of the material reveals large polygonal or spiky cells with well-defined cytoplasm, round nuclei with clear nucleoli, with the presence of mitoses, the cells are arranged in the form of cells and cords with or without the formation of keratin, the presence of tumor emboli in the vessels, the severity of lymphocyte-plasmocyte infiltration, mitotic activity of tumor cells); fine-needle aspiration biopsy of enlarged lymph nodes of the neck (during cytological examination of the material - an increase in the size of the cell up to giant, a change in the shape and number of intracellular elements, an increase in the size of the nucleus, its contours, different degrees of maturity of the nucleus and other elements of the cell, a change in the number and shape of nucleoli) [1].

As noted by Huang J. et al. [3] though the LC only has 1% of the total cancer cases and related deaths, it is a type of head and neck cancers with the highest prevalence. Cigarette smoking and alcohol consumption was found to have the strongest relation with LC; other potential risk factors include age (≥ 65), sex (male), family history of cancer, chemical workplace exposure, gastro-esophageal reflux, and exposure to human papillomavirus (HPV).

In their work, the authors emphasize that the global incidence and mortality rates of LC in 2020 was extracted from the Global Cancer Observatory (GLOBOCAN) database, developed by the International Agency for Research on Cancer, World Health Organization (WHO) [4].

The Gross Domestic Products (GDP) and Human Development Index (HDI) for each country were retrieved from World Bank and United Nations. For the categorization of HDI rates, <0.550 , $0.550-0.699$, $0.700-0.799$, and ≥ 0.800 are considered low, medium, high, and very high. Data from 1980 to 2020 were obtained, and the data of the most recent 10 years were used for trend analysis. The WHO mortality database was used for cancer-related death data for each country and region. Cancer mortality data was collected from national civil cancer registries on a local and national level with the registering system logging verified cancer deaths and their causes, which is then reported to WHO annually. To ensure the quality of data, only figures with medium quality or above were published by the WHO mortality database based on the timeliness, completeness and coverage of registration and the proportion of deaths assigned to ill-defined causes. All incidence and mortality figures of LC were transformed - using the Segi-Doll world reference population for various nations - into an age-standardised rate (ASR) per 100 000 individuals. Weighting was allocated in accordance with proportions of people in the standard population's corresponding age groups. This enabled the current study to compare incidence and mortality rates

across different countries over time [3].

There were 184 615 newly reported cases of LC in 2020, with an ASR incidence of 2.0 per 100 000 persons. Incidence varied geographically, region with the highest incidence was Caribbean (ASR=4.0) followed by Central and Eastern Europe (ASR=3.6) and Southern Europe (ASR=2.9). Regions with the lowest incidence include Middle Africa (ASR=0.76), Western Africa (ASR=0.79), and Central America (ASR=0.86). There was a remarkable disparity among the two sexes in terms of incidence, as the global ASR of males (ASR=3.6) was more than seven times higher than that of females (ASR=0.49). The highest incidence was in countries with medium HDI (ASR=2.5), followed by very high HDI (ASR=2.3), high HDI (ASR=1.6), and low HDI (ASR=0.94). In 2020, 99 840 LC-related deaths were reported, which was slightly more than 1% of the total cancer-related deaths. Globally, LC has an ASR of 1.0 per 100 000 persons in mortality. In terms of the geographical distribution, the Caribbean region (ASR=2.1) had the highest mortality rate, doubling the global average, followed by Central and Eastern Europe (ASR=1.9), and South-Central Asia (ASR=1.7). Regions with the lowest mortality were Australia and New Zealand (ASR=0.34), Micronesia (ASR=0.45), and Middle Africa (ASR=0.54). Similar to incidence, the highest mortality was in countries with medium HDI (ASR=1.6), followed by high HDI (ASR=0.92), very high HDI (ASR=0.86), and low HDI (ASR=0.71). Among males LC incidence was associated with a higher HDI [$\beta=0.175$, 95% confidence interval (CI): 0.111-0.239, $P<0.001$], prevalence of smoking ($\beta=0.051$, 95% CI: 0.041-0.061, $P<0.001$), alcohol drinking ($\beta=0.040$, 95% CI: 0.028-0.052, $P<0.001$), unhealthy dietary ($\beta=0.012$, 95% CI: 0.006-0.018, $P<0.001$), obesity ($\beta=0.022$, 95% CI: 0.012-0.031, $P<0.001$), hypertension ($\beta=0.031$, 95% CI: 0.022-0.041, $P<0.001$), diabetes ($\beta=0.032$, 95% CI: 0.014-0.051, $P=0.001$), and lipid disorders ($\beta=0.021$, 95% CI: 0.013-0.029, $P<0.001$). Among females, incidence was associated with a higher HDI ($\beta=0.114$, 95% CI: 0.050-0.178, $P<0.001$), prevalence of smoking ($\beta=0.049$, 95% CI: 0.033-0.065, $P<0.001$), inactivity ($\beta=0.040$, 95% CI: 0.009-0.072, $P=0.011$), obesity ($\beta=0.013$, 95% CI: 0.004-0.022, $P=0.004$), hypertension ($\beta=0.012$, 95% CI: 0.002-0.023, $P=0.024$), diabetes ($\beta=0.051$, 95% CI: 0.031-0.071, $P<0.001$), and lipid disorders ($\beta=0.015$, 95% CI: 0.007-0.023, $P<0.001$). Among males LC mortality was associated with a higher HDI ($\beta=0.094$, 95% CI: 0.025-0.163, $P<0.001$), prevalence of smoking ($\beta=0.044$, 95% CI: 0.033-0.054, $P<0.001$), alcohol drinking ($\beta=0.025$, 95% CI: 0.013-0.038, $P<0.001$), unhealthy dietary ($\beta=0.009$, 95% CI: 0.003-0.015, $P=0.002$), obesity ($\beta=0.016$, 95% CI: 0.006-0.025, $P=0.001$), hypertension ($\beta=0.025$, 95% CI: 0.015-0.034, $P<0.001$), and lipid disorders ($\beta=0.013$, 95% CI: 0.004-0.021, $P=0.003$). Among females, mortality was associated with a lower GDP per capita ($\beta=-0.076$, 95% CI: -0.126-0.027, $P=0.003$), and prevalence of alcohol drinking ($\beta=-0.060$, 95% CI: -0.085-0.035, $P<0.001$) [3].

Overall, more countries were showing decreasing trends than increasing trends in LC while such trends were less evidence among female population, younger subjects, and countries from Europe. The overall incidence for males was decreasing while females reported mixed trends. For males, significant increases were found only in Cyprus [average annual percent change (AAPC)=5.88; 95% CI: 0.52-11.52; $P=0.035$], whilst decreasing trends were reported in 24 countries evenly distributed in different continents, Chile (AAPC=-11.5; 95% CI: -20.99-0.88; $P=0.038$) reported the largest decrease, followed by the Philippines (AAPC=-7.71; 95% CI: -12.15-3.05; $P=0.006$), and Norway (AAPC=-5; 95% CI: -8.71-1.14; $P=0.018$). For females, three countries showed significant increasing trends: Japan (AAPC=6.01; 95% CI: 1.51-10.71; $P=0.015$), Switzerland (AAPC=5.61; 95% CI: 0.05-11.49; $P=0.048$), and Czech Republic (AAPC=3.31; 95% CI: 1.28-5.39; $P=0.005$). Evident decreases were found in six countries, with India (AAPC=-8.35; 95% CI: -13.62-2.75; $P=0.009$), Korea (AAPC=-8.28; 95% CI: -11.68-4.74; $P=0.001$), and Turkey (AAPC=-6.05; 95% CI: -10.21-1.69; $P=0.013$) reporting the largest decreases. Similar to the incidence trends, there was a remarkable difference between the mortality trends of males and females. For males, only Thailand (AAPC=5.41; 95% CI: 3.56-7.30; $P<0.001$) reported significant increases. On the contrary, significant decreases were observed in 30 countries. The largest decreases were found in Korea (AAPC=-7.17; 95% CI: -8.65-5.66; $P<0.001$), Singapore (AAPC=-7.10; 95% CI: -13.59-0.11; $P=0.047$), and France (AAPC=-5.96; 95% CI: -6.76-5.15; $P<0.001$). For females, significant increasing trends were found in Israel (AAPC=12.49; 95% CI: 0.81-25.51; $P=0.038$); while significant decreases were reported in eight countries, with Korea (AAPC=-10.58; 95% CI: -15.61-5.24; $P=0.002$), Belarus (AAPC=-7.93; 95% CI: -13.55-1.95; $P=0.010$), and Colombia (AAPC=-5.68; 95% CI: -8.04-3.27; $P=0.001$) reported the most evident decreases. For the older males aged 50 or above two countries reported significant increases: Cyprus (AAPC=6.87; 95% CI: 1.16-12.91; $P=0.024$), and Belarus (AAPC=1.41; 95% CI: 0.28-2.55; $P=0.021$). In contrast, significant decreases were observed in 21 countries sporadically distributed worldwide. The largest decreases were found in Chile (AAPC=-10.31; 95% CI: -19.44-0.14; $P=0.048$), Philippines (AAPC=-7.57; 95% CI: -11.86-3.08; $P=0.005$), and Norway (AAPC=-5.69; 95% CI: -8.87-2.41;

$P=0.004$). For females aged 50 or above, three countries, all European countries, reported significant increases: Spain (AAPC=6.76; 95% CI: 2.03-11.72; $P=0.01$), Switzerland (AAPC=5.38; 95% CI: 0.25-10.78; $P=0.042$), and Czech Republic (AAPC=4.00; 95% CI: 1.73-6.32; $P=0.003$) reported the largest increases. On the other hand, four populations showed significant decreasing trends, Turkey (AAPC=-6.50; 95% CI: -11.64-1.07; $P=0.025$) reported the largest decline, followed by Canada (AAPC=-4.36; 95% CI: -6.94-1.70; $P=0.006$), and the white population in the USA (AAPC=-2.98; 95% CI: -5.13-0.78; $P=0.014$). Similar distribution but larger increase was found in males aged below 50 Norway (AAPC=18.77; 95% CI: 4.55-34.92; $P=0.014$) and Thailand (AAPC=10.24; 95% CI: 0.36-21.09; $P=0.044$) reported significant increasing trends, whereas evident decreasing trends were observed in 17 countries, predominately Asian and European countries, with Germany (AAPC=-17.17; 95% CI: -26.66-6.44; $P=0.007$), Denmark (AAPC=-9.88; 95% CI: -17.74-1.26; $P=0.030$), and France (AAPC=-9.66; 95% CI: -14.70-4.32; $P=0.004$) showing the greatest decreases. From the raw data, the highly significant increasing trend observed in the younger male population of Norway and Thailand was likely due to the statistical base effect as unusually low ASR was reported in the start of the 10-year interval 2010-2011 (Norway); 2003 (Thailand). For their younger females aged below 50, significant decreases were observed in two countries/regions: Hong Kong, SAR, China (AAPC=-12.44; 95% CI: -21.77-1.99; $P=0.026$) and Korea (AAPC=-11.79; 95% CI: -21.66-0.67; $P=0.041$), while no country reported significant increase [3].

In conclusion, our colleagues point out that the reported incidence for LC has been decreasing remarkably for the past decades, especially for the male population, potentially due to the reduced consumptions of cigarettes and alcohol. Its mortality has also been decreasing, possibly attributable to broader availability and applications of treatments. However, regional disparity in mortality remains due to difference in level of access to surgical care. On the contrary, it is alarming that some evident increases were observed in the female populations and younger subjects from some countries. If no mitigation interventions are implemented, such trends may continue. It is also recommended that governments should continue the implementation of smoking and alcohol reduction campaigns, to minimize further burden on healthcare system.

Nocini R. et al. in their work they say that [5] LC is a form of malignancy originating from the anatomic site called larynx (also commonly known as "voice box"), which is anatomically divided in three regions including the supraglottic larynx (encompassing the epiglottis, false vocal cords, ventricles, aryepiglottic folds and arytenoids), the glottis (encompassing the true vocal cords and the anterior and posterior commissures) and the subglottic region. Among squamous cell carcinomas, the well and moderately differentiated forms slightly prevail over poorly differentiated tumors; the larger number of LC cases originate from the glottic region (i.e., approximately two-third), followed by the supraglottic area (about 30%), whilst transglottic and purely subglottic tumors are generally less frequent. The more important risk factors for LC include tobacco use, excessive alcohol ingestion, gastro-esophageal reflux, Plummer-Vinson syndrome, anatomical malformations, exposure to heat, chemicals, asbestos, nickel or ionizing radiations, along with some viral infections (e.g., HPV). The most frequent symptoms of laryngeal malignancies include hoarseness, sore throat, dysphagia and/or painful swallowing, impairment in voice quality, otalgia, cough and hemoptysis. Despite hoarseness can develop early in patients with laryngeal malignancies, in many cases the cancer has already deeply involved the vocal cords and spreads to regional lymphatics at diagnosis. Primary tumor volume, composite nodal volumes, composite primary tumor and nodal volumes are significant predictors of unfavorable prognosis, along with advanced age, performance status, grade and depth of invasion.

In their work, the researchers note that LC is an important oncologic entity, whose prognosis depends on establishing appropriate preventive and diagnostic measures, especially in populations at higher risk. The current incidence, prevalence and mortality of LC are estimated at 2.76 cases/year per 100,000 inhabitants, 14.33 cases/year per 100,000 inhabitants and 1.66 deaths/year per 100,000 inhabitants, respectively, averaging 3.28 million Disability-Adjusted Life Years each year. Incidence and prevalence have increased by 12% and 24%, respectively during the past 3 decades, whilst mortality has declined by around 5%. The epidemiologic burden of this malignancy is approximately 5-fold higher in males and increases in parallel with ageing, peaking after 65 years of age. Both incidence and mortality rates are higher in Europe and lower in Africa, but the ratio between deaths and incidence is the highest in Africa. Incidence has gradually declined in Europe during the past 3 decades, whilst it has increased in South-East Asia and Western Pacific. Cigarette smoking and alcohol abuse contribute for about 90% of overall worldwide mortality for LC. At the same time, the conclusions state that LC still poses a high clinical and societal burden, with an escalating temporal trend not expected to reverse soon [5].

An interesting work was presented by Li C. et al. [6]. In this study, authors aimed to explore the

roles of cuproptosis-related genes in LC and their potential as prognostic markers and therapeutic targets. LC, characterized by high recurrence rates and a lack of effective biomarkers, has been associated with cuproptosis, a regulated cell death process linked to cancer progression. They collected comprehensive data from The Cancer Genome Atlas and Gene Expression Omnibus databases, including gene expression profiles and clinical data of LC patients. Using clustering and gene analysis, researchers identified cuproptosis-related genes with prognostic significance. A risk model was constructed based on these genes, categorizing patients into high- and low-risk groups for outcome comparison. Univariate and multivariate analyses were conducted to identify independent prognostic factors, which were then incorporated into a nomogram. Gene Set Enrichment Analysis was employed to explore pathways distinguishing high- and low-risk groups. This risk model, based on four genes, including transmembrane 2, dishevelled binding antagonist of β -catenin 1, stathmin 2, and G protein-coupled receptor 173, revealed significant differences in patient outcomes between high- and low-risk groups. Independent prognostic factors were identified and integrated into a nomogram, providing a valuable tool for prognostic prediction. Gene Set Enrichment Analysis uncovered up-regulated pathways specifically associated with high-risk patient samples. The authors point out that this study highlights the potential of cuproptosis-associated genes as valuable prognostic markers and promising therapeutic targets in the context of LC and sheds light on new avenues for understanding and treating this complex disease.

In a study by Ren L. et al. [7], immune signatures of LC were systematically analyzed and their role in tumor progression was assessed. Differentially expressed immune-related genes (IRGs) were screened between LC and normal tissues from The Cancer Genome Atlas (TCGA) dataset. Then, two prognosis-related IRGs aquaporin 9 (AQP9) and zeta chain of T cell receptor associated protein kinase 70 (ZAP70) were analyzed by a series of survival analysis. Based on them, molecular subtypes were constructed by unsupervised cluster analysis. Differences in survival outcomes, human leukocyte antigen (HLA) expression and immune cell infiltrations were assessed between subtypes. Expression of AQP9 and ZAP70 was validated in LC tissues and cells by reverse transcription-quantitative polymerase chain reaction (RT-qPCR) and immunohistochemistry. After silencing and overexpressing AQP9 and ZAP70, cholecystokinin-8 (CCK-8), 5-ethynyl-2'-deoxyuridine (EdU), wound healing and transwell assays were performed in TU212 and LCC cells. Totally, 315 IRGs were abnormally expressed in LC. Among them, AQP9 and ZAP70 were distinctly correlated to patients' prognosis. Two subtypes were developed with distinct survival outcomes, HLA expression and immune microenvironment. Low expression of AQP9 and ZAP70 was confirmed in LC. AQP9 and ZAP70 up-regulation distinctly suppressed proliferation, migration, and invasion of LC cells. The opposite results were investigated when their knockdown.

Our colleagues focus on the fact that the obtained findings revealed the roles of AQP9 and ZAP70 in progression of LC, and suggested that AQP9 and ZAP70 could potentially act as candidate immunotherapeutic targets for LC. Collectively, this study proposed two prognosis-related IRGs AQP9 and ZAP70. Two molecular subtypes based on AQP9 and ZAP70 may reflect immune microenvironment of LC. In vitro, their up-regulation inhibited proliferation, migration and invasion of LC cells. Results obtained demonstrated that AQP9 and ZAP70 might be candidate therapeutic targets and prognostic signatures for LC, which may assist guide clinical therapy in the future [7].

Liu W. et al. [8] in their work they say that LC is one of the most common malignant tumors among head and neck cancers. Accumulating studies have indicated that long noncoding RNAs (lncRNAs) play an important role in LC occurrence and progression, however, the functional roles and relative regulatory mechanisms of lncRNA growth arrest-specific transcript 5 (GAS5) in LC progression remain unclear. The expression of lncRNA GAS5 in both LC tissues and cell lines was evaluated using quantitative RT-qPCR assay.

The relationships between lncRNA GAS5 expression and clinical parameters were also analyzed. To determine the biological function of lncRNA GAS5, a lncRNA GAS5-specific plasmid was first transfected into LC cells using lentiviral technology. Cell counting kit-8 assay, flow cytometry, and Transwell assays were used to detect in vitro cell proliferation, apoptosis, cycle distribution, and metastasis abilities, respectively. Furthermore, in vivo cell growth experiments were also performed using nude mice. Additionally, western blotting was performed to identify the underlying regulatory mechanism. In the current study, lncRNA GAS5 was downregulated in LC tissues and its low expression was closely associated with poor tumor differentiation, advanced TNM stage, lymph node metastasis, and shorter overall survival time. In addition, lncRNA GAS5 upregulation significantly inhibited LC cell proliferation both in vitro and in vivo. Moreover, in response to lncRNA GAS5 overexpression, more LC cells were arrested at the G2/M stage, accompanied by increased cell apoptosis rates and suppressed migration and invasion capacities. Mechanistically, this data showed that the overexpression of lncRNA GAS5 significantly regulated the

PI3K/AKT/mTOR signaling pathway. LncRNA GAS5 might act as a suppressor gene during LC development, as it suppressed cell proliferation and metastasis by regulating the PI3K/AKT/mTOR signaling pathway; thus, lncRNA GAS5 is a promising therapeutic biomarker for the treatment of LC. Overall, lncRNA GAS5 could serve as a tumor suppressor gene in LC, which would be a promising therapeutic biomarker for LC treatment.

Liberale C. et al. [9] note that LC is one of the most frequent tumors of the upper aero-digestive tract. While certain factors such as alcohol consumption and tobacco smoking have been established as risk factors for LC, the correlation of many other risk factors with the mechanism of carcinogenesis remains unclear. The process of laryngeal carcinogenesis has been well described; however, there are still aspects that lack understanding, and the underlying biological mechanisms have not been fully elucidated. Indeed, the emerging role of lncRNAs, miRNAs, and mRNAs is becoming increasingly important in our understanding of cancer development and its clinical and therapeutic implications. These non-coding RNAs have been shown to play critical roles in various aspects of cancer biology, including tumor initiation, progression, metastasis, and response to treatment. Gaining insight into the molecular mechanisms involved in carcinogenesis could enable the prediction of tumor progression and facilitate targeted interventions at various stages of the disease. The ultimate goal is to develop precise and effective therapies through a precision medicine approach. Achieving this objective requires further comprehensive studies on the molecular biology of cancer and the role of different risk factors.

Özdaş T. et al. [10] point out that while LC does not show any obvious early symptoms, it tends to have a poor prognosis in advanced clinical stages. Chromosome region maintenance 1 (CRM1) mediates the nuclear export of some RNAs, major and tumor suppressor proteins and has been associated with the pathogenesis of many tumors. However, the clinicopathological significance of CRM1 gene expression in LC has not been clarified yet. CRM1 expression in matched tumor and normal tissues obtained from 43 LC patients were evaluated intracellular for protein and mRNA levels by immunohistochemical staining (IHC), western-blot, and quantitative real-time qRT-PCR, respectively. IHC, western-blot, and qRT-PCR analyses showed that CRM1 expression was significantly increased in LC tissue compared to normal tissue. Increased expression of CRM1 has been associated with poor prognostic clinicopathological features, including advanced tumor stage, increased tumor invasion, larger tumor size, positive lymph node metastasis, distant metastasis, and invasive histological type by IHC, western-blot, and qRT-PCR. Kaplan–Meier survival analysis showed that patients with high expression of CRM1 exhibited lower overall survival compared to those with low expression (Log-rank = 7.16, $p = 0.007$). According to the TCGA datasets, elevated CRM1 expression in head and neck cancer including cases of squamous cell laryngeal origin is associated with advanced tumor stage and histological grade ($p > 0.05$, for all). Consequently, CRM1 plays an important role in LC and may serve as an indicator and prognostic factor for poor overall survival in LC patients. In conclusion, this study revealed that CRM1 is a predictive biomarker for poor overall survival in LC patients, and that the evaluation of the clinical pTNM staging system of the tumor and CRM1 expression together may provide additional prognostic information. Moreover, inhibition of CRM1 expression may be a new therapeutic strategy for LC. Furthermore, prospective large-scale studies are needed to explore the true prognostic role of elevated CRM1 expression in laryngeal squamous cell carcinoma.

The aim of the study by Luo M.S. et al. [11] was to develop an autophagy-related model to predict the prognosis of patients with LC. Autophagy, a major cause of cancer-related death, is correlated with the pathogenesis of various diseases including cancers. Our colleagues analyzed the correlation between expression profiles of autophagy-related genes (ARGs) and clinical outcomes in 111 LC patients from TCGA. Afterward, gene functional enrichment analyses of gene ontology and Kyoto Encyclopedia of Genes and Genomes were performed to find the major biological attributes. Univariate Cox regression analyses and multivariate Cox regression analyses were performed to screen ARGs whose expression profiles were significantly associated with LC patients overall survival (OS). Furthermore, to provide the doctors and patients with a quantitative method to perform an individualized survival prediction, we constructed a prognostic nomogram. Thirty eight differentially expressed ARGs were screened out in LC patients through the TCGA database. Related functional enrichments may act as tumor-suppressive roles in the tumorigenesis of LC. Subsequently, 4 key prognostic ARGs (IKBKB, ST13, TSC2, and MAP2K7) were identified from all ARGs by the Cox regression model, which significantly correlated with OS in LC. Furthermore, the risk score was constructed, which significantly divided laryngeal cancer patients into high- and low-risk groups. Integrated with clinical characteristics, gender, N and the risk score are very likely associated with patients OS. A prognostic nomogram of ARGs was constructed using the Cox regression model. As the researchers note this study could provide a valuable prognostic model for predicting the

prognosis of LC patients and a new understanding of autophagy in LC. A novel autophagy-related model and a predictive nomogram were conducted to robustly estimate LC patients survival.

Now, regarding this pathology in our country at the republican level. The incidence of LC in the Republic of Kazakhstan in 2023 was 2.2 per 100 thousand population with an increase rate of 15.5% compared to the previous year (1.9 in 2022), which in absolute numbers amounted to 436 people (370 cases a year earlier), second only to prostate cancer (16.7%). The proportion of cases diagnosed for the first time in life, recorded by oncology organizations, was 1.2% (1.1% in 2022). At the same time, 384 men fell ill (the proportion is 2.4%, 13th rank place), women - 52 (the proportion is 0.2%, 22nd rank place), which clearly shows the gender difference in the incidence of this pathology with a pronounced predominance of the male population [12].

The LC level above the national average was established in 9 regions of the country: North Kazakhstan - 5.8 (the maximum indicator); Pavlodar - 3.8; Kostanay - 3.6; East Kazakhstan - 3.4; Abay - 3.3; Karaganda - 3.0; Akmola and Atyrau - 2.9; Mangistau - 2.6. This indicator is below the national average in 11 regions: Turkestan - 0.6 (the lowest level); the city of Astana - 1.0; Kyzylorda - 1.2; the city of Shymkent - 1.5; Ulytau and Almaty - 1.8; West Kazakhstan and Zhambyl - 1.9; Aktobe and Zhetysu regions and the city of Almaty - 2.1 per 100 thousand population. Mortality from this pathology was 0.8 per 100 thousand population, the same as a year earlier. The regions where the mortality rate from LC is above the average in the republic include: Abay - 2.5 (maximum level); North Kazakhstan - 1.9; Pavlodar - 1.6; Mangistau and Karaganda - 1.2; Zhetysu - 1.0; Aktobe - 0.9. Akmola, East Kazakhstan, Kostanay regions and the city of Almaty are on par with the national average. The lowest rates were noted in Ulytau - 0.0; Turkestan - 0.1; West Kazakhstan and the city of Shymkent - 0.3; Kyzylorda - 0.5; Atyrau and the city of Astana - 0.6; Zhambyl and Almaty - 0.7 regions per 100 thousand people [12].

One-year lethality was 19.2%, taking the 13th place among all nosological forms of malignant neoplasms. At the same time, the ratio between one-year lethality and neglect (stage IV) was 1.6. At the same time, we recall that the farthest from "1" is the worst ratio between the indicators of one-year lethality and neglect.

Next, regarding preventive examinations. It should be noted that during large-scale preventive examinations of the population in 2023, significantly more patients with malignant neoplasms were actively identified than in 2022. This is 25,193 patients versus 23,623 patients identified in 2022, i.e. +6.6%. This is due to the further abatement of the epidemiological trouble with coronavirus and the increased availability of preventive care for the population. The proportion of patients identified during routine examinations increased from 62.0% to 62.4% of the total number of patients identified per year. As for LC, the early detection of this pathology during preventive examinations increased significantly - from 50.6 to 60.9%. The number of newly identified patients with LC registered with oncology organizations amounted to 425 patients (365 patients in 2022). At the same time, the absolute number of patients with LC identified during medical examinations was 274 people (231 a year earlier), and the proportion was 64.5% and 63.3%, respectively. 167 people out of 274 are patients with stages I and II (in 2022 - 117 patients out of 231). The proportion of patients with LC detected at early stages, as indicated above, was 60.9% against 50.6% a year earlier.

Of course, when analyzing the epidemiological situation, early diagnosis indicators are very important issues.

The regions where the proportion of patients with early stage I of the pathology in question is above the national average (16.5% - 14th rank) include the following regions: the city of Almaty - 34.8% (the best indicator); Abay and Kyzylorda - 30.0%; West Kazakhstan and the city of Astana - 23.1%; North Kazakhstan - 22.6%; Karaganda - 18.8%; Akmola - 18.2%. The lowest rates of early diagnosis were recorded in the Ulytau region (not a single patient with stage I of the disease - 0.0%). Next come: Mangistau - 5.3%; the city of Shymkent - 5.6%; Kostanay - 6.7%; Pavlodar, Zhetysu and Almaty - 7.1%; Atyrau - 10.0%; Zhambyl - 13.0%; East Kazakhstan - 14.3%; Aktobe - 15.0% and Turkestan - 15.4% of the country's regions [12].

It should be noted that every second patient with LC is detected in the early (I-II) stages of this pathology (51.1%). However, the situation with this indicator is deplorable in the Ulytau region - there is not a single patient detected in the early stages of the disease. The regions where the proportion of patients with LC detected at stages I-II is above the national average include the following regions. The best indicator is in the city of Astana - 76.9%. Then follow: Pavlodar - 75.0%; West Kazakhstan - 69.2%; North Kazakhstan - 67.7%; Zhambyl - 65.2%; Aktobe - 65.0% regions and the city of Almaty - 63.0%. Low rates of early diagnosis were recorded in Ulytau - 0.0% (the worst result in the country); Turkestan - 15.4%; Almaty - 21.4%; the city of Shymkent - 22.2%; Zhetysu - 35.7%; Mangistau - 42.1%; East Kazakhstan -

42.9%; Atyrau - 45.0%; Kostanay - 46.7%; Abay, Akmola, Karaganda and Kyzylorda - 50.0% regions [12].

As is clearly seen from the above data, there is a very large spread in early diagnostics rates across the country, from very good to dismal. Of course, it is necessary to take into account migration processes and other factors that affect early diagnostics rates, but nevertheless, the results obtained give reason not to stop there, both for oncologists and otolaryngologists, general practitioners, since improving early diagnostics rates of malignant tumors, as one of the main postulates and one of the main tasks of medicine in general, continues to be relevant today. The proportion of stage IV LC was 9.4%. At the same time, as mentioned above, the proportion of patients with this nosological form of malignant neoplasms detected at stages I-II was 51.1% (stage I - 16.5%, stage II - 34.6%), which indicates that the largest number of patients with LC was detected at locally advanced with loco-regional damage - stage III of the disease. This stage was 39.5%, i.e. almost two patients out of every five, and we know what aggressive, often complex treatment is used with such a spread of the oncological process and what a disappointing prognosis is for these patients. As for the average national indicator of the proportion of stage IV (9.4%), against this background, West Kazakhstan, Mangistau, Turkestan regions and three megalopolises - the cities of Astana, Almaty, Shymkent stand out, where not a single patient was detected in the terminal stage - 0.0%. Then come: Almaty - 3.6%; Aktope - 5.0%; North Kazakhstan - 6.5%; Zhetysu and Pavlodar - 7.1%; Zhambyl - 8.7%; Kyzylorda - 10.0%; Kostanay - 13.3%; East Kazakhstan - 14.3%; Atyrau - 20.0%; Akmola - 22.7% regions. This list is closed by three regions, where every fourth patient was detected in the incurable stage of the disease with the worst indicator of 25.0% - Abay, Karaganda and Ulytau regions [12].

The morphological verification rate of LC in the country was 98.8%, second only to non-melanoma skin cancer (99.6%), breast cancer (99.4%) and lip cancer (99.1%) in the first three positions. At the same time, in the Pavlodar region, the morphological verification rate was 92.9%, in Akmola - 95.5%, in Almaty - 96.4%. In other regions, the disease verification rate was 100%.

The total number of patients with malignant neoplasms registered with specialized oncology organizations of the republic continued to increase and by the end of 2023 amounted to 218,186 people, with an increase of 6.0% compared to the previous year (2022 - 205,822, +5.8%). The overall incidence rate of malignant neoplasms increased by 3.9%, from 1055.3 to 1096.4 per 100 thousand people. The growth of this indicator is due to both the increase in the incidence and detection of pathology, and the increase in the survival of cancer patients. In addition, statistical data on patients diagnosed with malignant neoplasms, who have been under observation for 5 years or more, and continue to be observed in 2023, showed that the number of patients under the observation of oncological organizations in Kazakhstan for over five years continued to grow and at the end of the reporting year amounted to 117,616 people, with an increase of 6.2% (2022 - 110,790 people, + 6.6%) (form No. 7).

It is impossible to ignore such an important clinical aspect as the coverage of patients with a first-time diagnosis of LC in the Republic of Kazakhstan with special treatment.

In 2023, the number of hospitalizations for all nosological forms of malignant tumors in the country's oncology organizations amounted to 108,252 cases (2022 - 101,095), with an increase of 7.1% compared to the previous year, which is associated with a constant increase in the number of cancer patients, improved standardization of oncological care, and the development of palliative and restorative services.

At the end of 2023, the absolute number of LC patients who completed specialized treatment was 247 people, continuing treatment - 135 patients. The following results were obtained in percentage terms by methods and types of treatment. Only 12.6% of patients received surgical treatment, only radiation - 19.4%, only drug treatment - 8.9%, combined - 26.7%, complex - 21.5% and chemo-radiation - 10.1%.

Further, regarding the five-year survival of patients. As for LC, at the end of 2023, 2032 people were registered for dispensary care, or 10.2 per 100 thousand of the population. At the end of 2022 - 1899 patients or 9.7 per 100 thousand of the population, respectively.

At the same time, the mortality rate of the observed contingents in 2023 decreased compared to the previous year and amounted to 7.6% in 2023 (8.6% in 2022).

The five-year survival rate of patients with LC was 52.2% in 2023 and 53.2% in 2022 [12].

Summarizing the above, we can conclude that LC, despite not having the highest place in terms of incidence among all existing malignant tumors of other localizations, deserves close attention from specialized specialists. At the same time, taking into account a number of factors, the indicators of early diagnostics do not allow oncologists to "sleep peacefully", since the locally advanced stage III, which prevails over all stages, in addition to being widespread, gives a large number of complications due to the

location of vital centers and tissue structures near the primary focus and locoregional metastases. The veiled and variable symptoms, its similarity with various non-core processes, leads to the neglect of the disease. All this requires both oncologists and, first of all, primary health care workers and, of course, otolaryngologists to increase the level of cancer alertness, inform the population about early symptoms that may indicate this pathology or the onset of proliferative changes and conduct high-tech diagnostic measures, including for the purpose of differential diagnosis and, as a result, timely treatment. People from the risk group are recommended to visit specialized specialists annually and, if necessary, undergo an examination.

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

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A HEREDITARY FORM OF HEARING LOSS AS A RESULT OF CONSANGUINEOUS MARRIAGE

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НАСЛЕДСТВЕННАЯ ФОРМА ПОТЕРИ СЛУХА НА ПОЧВЕ РОДСТВЕННЫХ БРАКОВ

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Abstract

This review provides comprehensive coverage of the issues of consanguineous marriage as a factor of congenital deafness and hearing loss. The authors set out the direction of research and the population geography of hereditary diseases, the population with specific characteristics; in particular, the factor of insolent-stipulated inbreeding. The analysis of clinical audiological and vestibulometric aspects of hearing loss results from consanguineous marriages. The analysis of the published materials proves that there really exists a heredofamilial form of hearing loss among the local population. The investigation results are of interest due to the fact that mono-national marriages, mountain insolents and high frequency of consanguineous marriages are peculiar to Tajikistan.

Аннотация

В данном обзоре представлен всесторонний анализ вопросов родственных браков как фактора врожденной глухоты и потери слуха. Авторы определяют направление исследований и популяционную географию наследственных заболеваний, популяции со специфическими характеристиками; в частности, фактор инбридинга с выраженными признаками. Проведен анализ клинических, аудиологических и вестибулометрических аспектов потери слуха в результате родственных браков. Анализ опубликованных материалов доказывает наличие действительно наследственной формы потери слуха среди местного населения. Результаты исследования представляют интерес в связи с тем, что мононациональные браки, горные инбридинги и высокая частота родственных браков характерны именно для Таджикистана.

Keywords: hereditary diseases, inbreeding, consanguineous marriages, audiological.

Ключевые слова: наследственные заболевания, инбридинг, родственные браки, аудиологический.

Введение. Наследственные факторы, вызывающие изменения в структурах слухового анализатора, играют существенную роль среди причин нарушения слуха. Хотя о генетической природе глухоты и тугоухости известно давно, идентифицировать конкретные формы наследственных дефектов удалось лишь в последние десятилетия. [1–13].

Наиболее сложной и малоизученной проблемой в области наследственных патологий остаются заболевания, вызванные близкородственными браками. Риск их возникновения напрямую зависит от степени родства супругов: чем она ближе, тем более выражены неблагоприятные последствия для потомства. Статистически подтверждено, что у детей от таких союзов наследственные заболевания встречаются значительно чаще, чем в браках между неродственными лицами. [4, 6–8].

В зависимости от родства, родственные браки делятся на следующие степени: I степень – родство, связывающее родителей с детьми или родных братьев и сестер; II степень – родство между дядей, тетей и племянниками; III степень – родство двоюродных братьев и сестер; IV степень – родство троюродных братьев и сестер [7, 8, 17].

Обычаи и законы многих стран прямо или косвенно запрещают заключение браков между родственниками I степени. Но самое удивительное это существование замкнутых религиозных общин в многомиллионном Лондоне, а также в США. К ним относится, например, секта менонитов (8000 человек), ведущая свое происхождение от немногочисленных эмигрантов, прибывших в Северную Америку еще в XVIII веке [22, 24].

Исторически замкнутые общины формировались в изолированных районах, таких как труднодоступные горные местности и отдалённые острова. Благодаря низкой миграционной активности и стабильности состава населения на протяжении многих лет, родственные браки в таких популяциях становились практически неизбежными. Подобные формы изоляции сохранились до наших дней, например, в высокогорных районах Памира и Заравшанской долине Таджикистана. Данный феномен обусловлен оторванностью этих сообществ от густонаселённых центров, что приводит к замкнутому образу жизни, ограниченным контактам с внешним миром и высокой частоте близкородственных браков [7, 19–20].

Исследователи, изучавшие заболеваемость в подобных изолированных общинах с высоким процентом родственных браков, неизменно отмечали там и более высокий уровень тугоухости. Чаще регистрировались задержка умственного развития, дефекты речи, наследственно-семейная глухота, болезни обмена веществ [4, 7, 13–18].

Наследственная предрасположенность является установленным фактором развития тугоухости, причем ключевую роль часто играют близкородственные браки, ведущие к реализации рецессивной наследственности. Генетические и аудиологические исследования, проведенные среди жителей Таджикистана, идентифицировали семейную форму тугоухости с глубокими кохлеарными нарушениями [4, 7, 18]. Работы И. Б. Холматова и соавт. (1997, 2003) на примере пациентов из таких семей продемонстрировали, что тугоухость может возникать у детей фенотипически здоровых родителей, состоявших в родственном браке, причем поражаются не все дети в семье [7, 17]. Сравнительный кариологический анализ не выявил закономерных различий в кариотипах между больными с семейной тугоухостью, их здоровыми родственниками и пациентами с кохлеарным невритом [19].

Изучены состояние звуковоспринимающего аппарата и эффективность лечения семейной тугоухости на почве родственных браков [29]. К. А. Авазов (1984), впервые используя комплекс клинико-аудиологических исследований, изучил распространенность семейной тугоухости на почве родственных браков среди жителей этнически замкнутых групп населения Таджикистана, и выявил 22% тугоухих детей из общего числа обследованных. Среди жителей, где не имеется этническая замкнутость населения, родственные браки попадают реже, и соответственно тугоухость встречается реже (2,4%) [19–24].

Влияние комплекса природно-климатических факторов, экономических условий, генетической и территориальной принадлежности жителей разных областей, лежащих в основе формирования своеобразных функций различных систем организма, в том числе иммунного ответа, изучено М. Д. Вялушкиной и соавт. [25].

В развитии тугоухости на почве родственных браков важную роль играет иммунная система организма. Изменение иммунологического статуса у больных на почве родственных браков изучены Х. Х. Нурматовым и соавт., (1995).

М. М. Рахимовой и соавт. (1989) изучена эффективность сурдопедагогических занятий при ушном протезировании у взрослых больных с тугоухостью на почве родственного брака и выявлена 100%-ная разборчивость речи при ушном протезировании.

А. А. Очилзода (1999), используя комплекс клинико-аудиологических исследований игровой тональной и игровой речевой аудиометрии у детей младшего возраста при семейной тугоухости на почве родственных браков, разработал критерий дифференциальной диагностики тугоухости на почве родственного брака и нейросенсорной тугоухости у детей младшего возраста. Автор выявил типичную картину нейросенсорной тугоухости, однако результаты игровой речевой аудиометрии свидетельствовали о нарушении слуховой функции по кондуктивному типу внутриулиткового характера.

Для реабилитации детей с тугоухостью на почве родственного брака совместно с сурдопедагогами разработал таблицу таджикских слов для сурдопедагогических занятий с применением звукоусиливающей аппаратуры «Аудиофильтр МТ» [6, 7, 19].

А. А. Очилзода и соавт. (2015) изучили частоту и структуру кровнородственных браков в Согдийской области Таджикистана. Из 7205 детей-инвалидов с различными патологиями органов и систем организма в возрасте от 3 до 18 лет у 1515 (21,0%) выявили кровнородственный брак у родителей.

В целях профилактики наследственных заболеваний, связанных с родственными браками, авторы рекомендуют вести агитацию о вреде родственных браков среди населения Республики Таджикистан [19]. З. Р. Мавлянова (2003), используя комплекс клинико-вестибулометрических исследований, выявила особенности состояния вестибулярного анализатора при тугоухости на

почве родственного брака. Установлено, что нарушение вестибулярного анализатора выявляется не только у лиц с тугоухостью на почве родственного брака, но и у лиц с нормальной слуховой функцией, родители которых имеют родственный брак. При нарушении слуховой функции гипорефлексия вестибулярного анализатора более выражена, о чем свидетельствуют данные теста «спонтанной» вестибулометрии, калорической и вращательной стимуляции [4, 6].

А. М. Пулатов (1989), Р. А. Рахмонов (2004), Ф. А. Ходжаев и соавт. (2012) сообщили об анализе клинических особенностей некоторых наследственных заболеваний нервной системы в Таджикистане, показали, что груз наследственной патологии нервной системы формируется в значительной степени аутосомно-рецессивными заболеваниями и установили высокий коэффициент инбридинга (0,0094–0,0148 по разным районам республики) [20–23].

В. М. Панахиан (2005) изучал частоту и структуру кровнородственных браков в семьях больных с врожденной формой глухоты в Азербайджане. Проведено аудиологическое и генеалогическое обследование 658 пациентов. В роду 236 (35,8%) пробандов отмечались кровнородственные браки с высоким коэффициентом инбридинга (0,0105). Анализ структуры кровнородственных браков показал преобладание брака между двоюродными сибсами по параллельному типу. Установлено влияние кровнородственных браков на увеличение гомозиготации патологического рецессивного гена, увеличивающего риск рождения неполноценного потомства [8].

Н. Ж. Хушвакова (2010) в результате проведенных аудиологических и генетических исследований детей, находящихся в специализированных школах-интернатах Самарканда, установила, что у 552 (97,7%) детей родители явились родственниками, а тугоухость и глухота носили наследственный характер, преимущественно по аутосомно-рецессивному типу. Наследственный фактор установлен у 48,2% пробандов, причем среди них 78% имели в роду кровнородственные и эндогамные браки [21].

В. П. Божкова и соавт. (2011) в результате проведенных генетических исследований детей, находящихся в специализированных школах-интернатах 1-го вида (для глухих детей) г. Махачкалы, установили, что родители этих детей являлись между собой родственниками. Проведен анализ мутаций в кодирующей области и донорском сайте сплайсинга GJB2-гена (гена коннексина 26), которые являются наиболее частой причиной доречевых врожденных и ранних детских наследственных нарушений слуха. С использованием метода секвенирования показано, что в Республике Дагестан наследственные нарушения слуха более гетерогенны, чем в центрально-европейской части РФ. Мутации в GJB2-гене составляют только 34% от общего числа аллелей детей с не синдромальными аутосомно-рецессивными нарушениями слуха в отличие от центрально-европейской части РФ, где они составляют более 90% [2].

И. Б. Холматов и соавт. (2015) провели полное аудиологическое обследование тугоухих детей, родившихся от родственного брака родителей [7, 18].

Выводы. Несмотря на противоречивость и неполноту существующих литературных данных, их анализ подтверждает наличие семейной наследственной формы тугоухости среди коренного населения Таджикистана.

Изучение этих материалов позволяет оценить влияние инбридинга, географической изоляции и других факторов на формирование популяционной структуры. Данные исследования в свою очередь, углубляют понимание наследственной тугоухости, связанной с родственными браками, и способствует совершенствованию планирования и организации профильных мероприятий в системе здравоохранения республики.

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Pedagogical sciences

THE IMPORTANCE OF USING TASK GENERATORS IN COMPUTER SCIENCE

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Abstract

The article explores the theoretical and methodological foundations of using task generators in the teaching process of computer science. The purpose of the study is to determine the pedagogical effectiveness of task generators in the context of digital education and analyze their impact on the quality of learning. The paper reviews domestic and international scientific works, and examines the capabilities of automated assessment systems and adaptive learning technologies.

The analysis results show that task generators allow for the flexible organization of learning content, provide tasks adapted to the individual characteristics of learners, and ensure the objectivity of the assessment process. Additionally, this technology reduces the teacher's routine workload and enables a focus on creative and research activities. The article also discusses the future prospects of integrating task generators with artificial intelligence technologies and the creation of data-driven adaptive learning environments.

The research concludes that task generators have a strategic importance in the methodology of teaching computer science and that their scientifically grounded use is an effective tool for improving the quality of education.

Аннотация

Мақалада информатика пәнін оқыту үдерісінде тапсырмалар генераторларын қолданудың теориялық және әдістемелік негіздері қарастырылады. Зерттеудің мақсаты – цифрлық білім беру жағдайында тапсырмалар генераторларының педагогикалық тиімділігін анықтау және олардың оқу сапасына ықпалын талдау. Жұмыста отандық және шетелдік ғылыми еңбектерге шолу жасалып, автоматтандырылған бағалау жүйелері мен адаптивті оқыту технологияларының мүмкіндіктері сараланады.

Талдау нәтижелері тапсырмалар генераторларының оқу мазмұнын вариативті ұйымдастыруға, білім алушылардың жеке ерекшеліктеріне сәйкес бейімделген тапсырмалар ұсынуға және бағалау үдерісінің объективтілігін қамтамасыз етуге мүмкіндік беретінін

көрсетеді. Сонымен қатар, бұл технология мұғалімнің рутиндік жүктемесін азайтып, шығармашылық және зерттеушілік әрекеттерге бағытталуына жағдай жасайды. Мақалада генераторларды жасанды интеллект технологияларымен ықпалдастырудың болашағы және деректерге негізделген адаптивті білім беру ортасын қалыптастыру мәселелері де қарастырылады.

Зерттеу қорытындысы тапсырмалар генераторларының информатика пәнін оқыту әдістемесіндегі стратегиялық маңызын айқындап, оларды ғылыми негізде қолдану білім сапасын арттырудың тиімді тәсілі екенін дәлелдейді.

Keywords: computer science, task generator, digital education, automated assessment, adaptive learning, artificial intelligence, personalized learning trajectories, education quality, digital pedagogy.

Кілт сөздер: информатика, тапсырмалар генераторы, цифрлық білім беру, автоматтандырылған бағалау, адаптивті оқыту, жасанды интеллект, жеке оқыту траекториясы, білім сапасы, цифрлық педагогика.

Кіріспе

Қазіргі таңда жаһандық білім беру кеңістігі «Индустрия 4.0» концепциясы аясында түбегейлі парадигмалық өзгерістерді бастан кешіруде. Бұл үдеріс тек қана техникалық құралдармен жабдықтауды емес, сонымен қатар оқытудың дидактикалық негіздерін қайта қарастыруды талап етеді [1]. Цифрландыру жағдайындағы білім беру үдерісі білім алушының ақпаратты пассивті тұтынушысынан оны белсенді түрде өңдеуші және жаңа цифрлық өнімдерді жасаушы деңгейіне көтерілуіне бағытталған [2]. Осы тұрғыда информатика пәнінің рөлі ерекше маңызға ие болып отыр.

Информатика пәні өзінің табиғаты бойынша өте динамикалық және жоғары дәрежедегі практикалық бағыттылығымен сипатталады. Мұндағы білімнің ескіру жылдамдығы басқа ғылым салаларымен салыстырғанда әлдеқайда жоғары болғандықтан, оқу материалдарының мазмұны мен оны тексеру механизмдері икемді әрі заманауи болуы тиіс [3]. Пәннің күрделілігі алгоритмдік ойлауды, бағдарламалау дағдыларын және деректерді талдау қабілетін синтездеуді талап етеді, бұл өз кезегінде оқыту әдістемесіне жаңа талаптар қояды.

Қазіргі білім беру жүйесіндегі басты қайшылықтардың бірі стандартталған статикалық тапсырмалар мен білім алушылардың әртүрлі когнитивті қабілеттері арасындағы алшақтық болып табылады. Дәстүрлі тапсырмалардың шектеулілігі олардың бірыңғай шаблондарға негізделуінен және жауаптарының алдын ала белгілі болуынан көрінеді, бұл көбінесе академиялық адалдықтың бұзылуына, яғни дайын жауаптарды көшіруге әкеп соғады [4]. Оқулықтардағы шектеулі есептер саны студенттердің материалды терең меңгеруіне емес, тек алгоритмді механикалық түрде жаттауына ықпал етеді.

Бұл мәселені шешудің жалғыз жолы жеке дара оқыту қажеттілігін қанағаттандыру. Әрбір білім алушының жеке қарқынына, базалық деңгейіне және қызығушылығына бейімделген білім беру траекториясын құру заман талабы [5]. Алайда, оқытушының әр студентке жеке бірегей тапсырма дайындауы уақыт пен ресурстық тұрғыдан өте ауыр жүктеме тудырады. Дәл осы жерде тапсырмаларды автоматты түрде генерациялайтын жүйелерді енгізудің маңыздылығы туындайды.

Осы ғылыми жұмыстың негізгі мақсаты информатика пәнінде тапсырмалар генераторын қолданудың әдістемелік тиімділігін кешенді түрде талдау және оның білім сапасын арттырудағы рөлін негіздеу болып табылады. Зерттеу барысында біз тапсырмалар генераторының мазмұны мен құрылымын ғылыми тұрғыдан анықтаймыз. Сондай-ақ, мұндай жүйелердің білім алушылардың пәндік құзыреттіліктеріне тигізетін нақты әсерін бағалау маңызды орын алады.

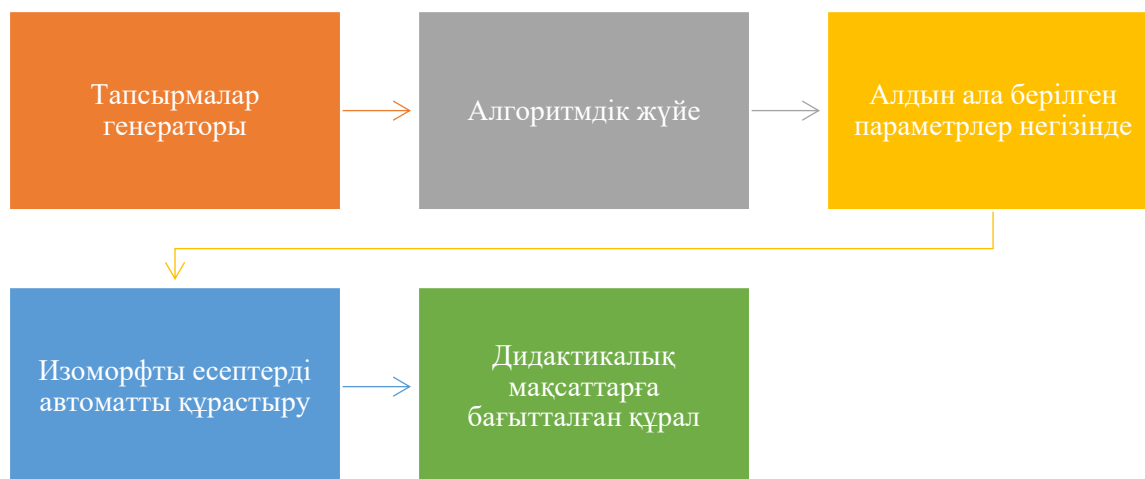
Зерттеудің теориялық негізін қалау үшін бірнеше негізгі сұрақтарға жауап ізделеді. Біріншіден, тапсырмалар генераторының заманауи дидактикадағы концептуалды анықтамасын нақтылау қажет. Екіншіден, бұл технологиялық шешімнің білім сапасына, соның ішінде бағалаудың объективтілігіне және мотивацияға әсерін зерттеу көзделеді. Үшіншіден, бүгінгі таңда осы салада қолданылатын платформалар мен технологиялық стектердің, соның ішінде жасанды интеллект пен алгоритмдік тәсілдердің мүмкіндіктерін саралау басты назарда болады [6].

Тапсырмалар генераторы дегеніміз белгілі бір дидактикалық ережелер мен параметрлер жиынтығы негізінде бірегей оқу мәселелерін автоматты түрде құрастыратын

интеллектуалды бағдарламалық кешен. Оның тиімділігі тек нұсқалардың көптігінде емес, сонымен қатар әрбір тапсырманың оқу мақсаттарына сәйкестігі мен қиындық деңгейінің бақылануында [7]. Қазіргі таңда Moodle, Stepik сияқты платформалар және Python тіліндегі арнайы кітапханалар осы бағыттағы негізгі технологиялық құралдар болып табылады [8].

Әдебиеттерге шолу

Ғылыми әдебиеттерде «тапсырмалар генераторы» ұғымы дидактикалық мақсаттарды жүзеге асыруға бағытталған, алдын ала анықталған параметрлер жиынтығы негізінде изоморфты, яғни құрылымдық тұрғыдан ұқсас, бірақ деректік мазмұны әртүрлі есептерді автоматты түрде құрастыратын алгоритмдік жүйе ретінде анықталады [11]. Қазіргі зерттеулерде бұл құрал тек техникалық қосымша ретінде емес, білім алушының танымдық белсенділігін арттыратын және оқу әрекетін ұйымдастырудың когнитивтік архитектурасына ықпал ететін кешенді педагогикалық механизм ретінде қарастырылады. Цифрлық білім беру құралдарына арналған іргелі зерттеулерде тапсырмалар генераторлары білім мазмұнын статикалық күйден динамикалық, икемді және вариативті форматқа көшіруге мүмкіндік беретін технологиялық шешім ретінде сипатталады [12]. Сонымен қатар педагогикалық дизайнның заманауи тұжырымдамалары аясында бұл жүйелер оқытушының бірқатар рутиндік функцияларын автоматтандыру арқылы оның шығармашылық және консультациялық қызметіне басымдық беруіне жағдай жасайтын тиімді құрал ретінде бағаланады [13] (Сурет 1).



Сурет 1. Тапсырмалар генераторының ғылыми анықтамасы

Автоматтандырылған бағалау жүйелерінің қалыптасуы мен дамуы білім беру үдерісіндегі кері байланыстың жеделдігін арттыру мәселесімен тығыз байланысты. Шетелдік зерттеулерде мұндай жүйелердің тек жауаптың дұрыстығын тіркеумен шектелмей, қателердің құрылымын, логикалық негізін және туындау себептерін талдайтын диагностикалық әлеуеті кеңінен қарастырылады [14]. Осы тұрғыдан алғанда, адаптивті оқыту технологиялары тапсырмалар генераторларының эволюциялық дамуының заңды жалғасы болып табылады. Аталған технологиялар білім алушының оқу әрекетін үздіксіз мониторинг жасап, оның нәтижелілік деңгейіне сәйкес келесі тапсырмалардың күрделілік параметрлерін автоматты түрде өзгертіп отырады [15]. Мұндай тәсіл білім алушының «жақын даму аймағында» (Zone of Proximal Development) тиімді жұмыс істеуін қамтамасыз етіп, оқу мотивациясының тұрақтылығын сақтауға ықпал етеді [16].

Информатика пәнінің практикалық бағыттылығы алгоритмдеу, бағдарламалау және деректерді өңдеу салаларында тапсырмалардың кең ауқымды вариативтілігін талап етеді. Отандық және шетелдік тәжірибелер көрсеткендей, бағдарламалау есептерін генерациялау барысында кодтық шаблондар мен мета-бағдарламалау элементтерін қолдану жоғары нәтижелілікке жеткізеді [17]. Әсіресе студенттердің код жазу стилін талдау, алгоритмдік және синтаксистік қателерді автоматты түрде анықтау бағытындағы зерттеулер тапсырмалар генераторларының функционалдық мүмкіндіктерін едәуір кеңейтті. Соңғы

жылдары аталған салада жасанды интеллект пен машиналық оқыту әдістерін қолдану арқылы білім алушының жеке ерекшеліктері мен бағдарламалау стиліне бейімделген жаттығулар құрастыру мәселесі ғылыми қауымдастықтың ерекше қызығушылығын тудырып отыр [18].

Зерттеу тақырыбына қатысты ғылыми мектептерді саралау барысында шетелдік әдебиеттерде (мысалы, Дж. Андерсон, Р. Майер еңбектерінде) мультимедиялық оқыту теориясы мен когнитивтік жүктеме тұжырымдамасы аясындағы талдаулардың басым екендігі байқалады [19]. Бұл еңбектерде цифрлық ортадағы оқу материалын құрылымдау мен визуализациялаудың білім алушының танымдық ресурстарына әсері жан-жақты қарастырылады. Ал отандық ғылыми кеңістікте (Г.К. Нұрбекова, Ж.А. Қараев және басқа зерттеушілердің еңбектерінде) білім беруді цифрландырудың әдістемелік жүйесін қалыптастыру, сондай-ақ қазақстандық мектептер мен жоғары оқу орындарының ерекшеліктерін ескере отырып, оқытуды деңгейлеп және саралап ұйымдастыру мәселелеріне басымдық беріледі [20]. Отандық зерттеулерде компьютерлік оқыту бағдарламаларының дидактикалық әлеуеті, олардың ұлттық білім беру стандарттарына сәйкестігі және оқу нәтижелеріне ықпалы кешенді түрде талданған (Сурет 2).



Сурет 2. Педагогикалық мәні

Зерттеу әдістемесі

Осы ғылыми жұмыстың әдістемелік негізі ақпараттық технологияларды білім беру үдерісіне интеграциялаудың тиімділігін зерделеуге бағытталған кешенді тәсілдерден тұрады. Зерттеу сипаттамалық-талдамалық сипатқа ие болғандықтан, негізгі әдіс ретінде заманауи ғылыми мақалаларды жүйелі талдау таңдап алынды. Бұл тәсіл тапсырмалар генераторларының даму динамикасын бақылауға және олардың дидактикалық әлеуетін теориялық тұрғыдан негіздеуге мүмкіндік береді. Талдау барысында зерттеудің өзектілігі мен ғылыми жаңалығын айқындау үшін әлемдік деңгейдегі озық тәжірибелер мен академиялық басылымдардағы соңғы тұжырымдар назарға алынды.

Зерттеудің логикалық құрылымын қалыптастыруда салыстырмалы әдіс шешуші рөл атқарды. Бұл әдіс арқылы дәстүрлі тапсырмалар беру форматы мен автоматтандырылған генерациялау жүйелерінің артықшылықтары мен кемшіліктері сараланды. Сонымен қатар, нарықтағы түрлі платформалар мен технологиялық шешімдердің (мысалы, статикалық тест жүйелері мен адаптивті AI-генераторлардың) функционалдық мүмкіндіктеріне детерминистік салыстыру жүргізілді. Мұндай компаративті талдау информатика пәнінің ерекшелігіне практикалық кодтау мен алгоритмдеуге ең қолайлы технологиялық стектерді анықтауға жол ашты.

Ақпаратты өңдеу мен негізгі тенденцияларды айқындау мақсатында сапалық контент-талдау әдісі қолданылды. Оқу бағдарламаларының мазмұны, оқытушылардың цифрлық құралдарға қатысты пікірлері және студенттердің автоматтандырылған кері байланысқа

реакциясы туралы деректер осы әдіс арқылы өңделді. Контент-талдау нәтижесінде тапсырмалар генераторларына қойылатын негізгі дидактикалық талаптар тізімі қалыптасты. Бұл кезеңде білім берудегі инновациялық тәжірибелерді жинақтау мен жалпылау процесі жүзеге асты, бұл теориялық зерттеуді практикалық қолданыспен ұштастыруға мүмкіндік берді.

Зерттеудің ақпараттық базасын құрайтын дереккөздер ретінде соңғы 5–10 жыл ішіндегі Scopus, Web of Science және Google Scholar халықаралық базаларында жарық көрген жоғары рейтингті ғылыми мақалалар таңдалды. Бұл уақыт аралығы цифрлық технологиялардың, соның ішінде жасанды интеллект пен бұлттық есептеулердің қарқынды даму кезеңімен сәйкес келетіндіктен, деректердің өзектілігі толық қамтамасыз етілді. Сонымен қатар, халықаралық білім беру платформалары мен жетекші электронды оқыту жүйелерінің (LMS) техникалық құжаттамалары мен практикалық кейстері зерттеудің эмпирикалық негізін құрады. Осы дереккөздер жиынтығы тақырыпты жан-жақты, әрі объективті тұрғыдан ашуға жағдай жасады.

Зерттеу нәтижелері

Зерттеу нәтижелері көрсеткендей, тапсырмалар генераторын енгізудің ең айқын басымдығы оқытушының уақыт ресурсын айтарлықтай үнемдеуі. Педагогикалық қызметтің мониторингі көрсеткендей, мұғалімдер өз уақытының шамамен 40%-ын тапсырмаларды дайындау мен тексеру сияқты рутиндік жұмыстарға жұмсайды [3]. Автоматтандырылған жүйелер бұл процесті секундтық деңгейге дейін қысқартып, оқытушыға босаған уақытты білім алушылармен жеке консультация өткізуге немесе шығармашылық жобаларды дамытуға бағыттауға мүмкіндік береді. Бұл нәтижелер әсіресе үлкен ағындық аудиториялармен жұмыс істейтін жоғары оқу орындарының цифрлық платформаларынан алынған деректермен расталады [6] (Сурет 3).



Сурет 3. Тапсырмалар генераторының педагогикалық тиімділігі

Информатика пәніндегі білім деңгейінің әртүрлілігі мәселесін шешуде тапсырмалар генераторы жеке дара оқыту (personalized learning) мүмкіндігін қамтамасыз етеді. Адаптивті оқыту жүйелерінің жұмыс нәтижелерін талдау барысында, әрбір білім алушының когнитивті профиліне сәйкес келетін бірегей тапсырмалар жиынтығын құру оқу үлгерімін орта есеппен 15–20%-ға арттыратыны анықталды [5]. Бұл әдіс студенттің «жақын даму аймағын» дәл анықтауға және оған тым жеңіл емес, бірақ еңсеруге болатын күрделіліктегі есептерді ұсынуға негізделген. Мұндай нәтижелер халықаралық адаптивті білім беру платформаларының (мысалы, Khan Academy немесе ALEKS) қолданушылық тәжірибесін зерделеу арқылы тұжырымдалды (Сурет 4).



Сурет 4. Адаптивтілік және жеке оқыту

Автоматтандырылған бағалау жүйелері білімді тексеру үдерісіндегі субъективті факторларды толығымен жояды. Ғылыми мақалаларды талдау барысында анықталғандай, алгоритмдік тексеру жүйелері қателіктерді диагностикалауда жоғары дәлдік танытып, білім алушыға жедел әрі бейтарап кері байланыс береді [5]. Бұл оқу үдерісінің транспаренттілігін (айқындылығын) арттырып, студент пен оқытушы арасындағы бағалауға қатысты келіспеушіліктерді азайтады. Әсіресе, бағдарламалау кодын автоматты тексеру жүйелері (Online Judges) арқылы алынған нәтижелер бағалаудың бұл форматы оқушыларды өз бетінше қатемен жұмыс істеуге ынталандыратынын көрсетеді [9].

Тапсырмалар генераторының маңызды артықшылығы оның шексіз вариативтілігі. Практикалық педагогикалық тәжірибелерді жинақтау көрсеткендей, бір типті, бірақ параметрлері әртүрлі мыңдаған нұсқаны жасау мүмкіндігі білім алушылар арасындағы көшіру (plagiarism) деңгейін нөлге дейін төмендетеді [15]. Есептердің мазмұндық әртүрлілігі студентті дайын шаблонды қолдануға емес, есептің шешілу алгоритмін түсінуге мәжбүрлейді. Бұл нәтижелер бақылау жұмыстарын дәстүрлі форматта және генератор арқылы өткізген топтардың көрсеткіштерін салыстырмалы талдау негізінде алынды. Осылайша, вариативтілік тек білімді тексеру құралы ғана емес, сонымен қатар академиялық мәдениетті қалыптастырудың пәрменді механизмі болып табылады [11](Сурет 5).



Сурет 5. Бағалау және вариативтілік

Информатика курсына бағдарламалауды оқыту барысында тапсырмалар генераторлары кодтың синтаксистік және логикалық құрылымын тереңірек меңгеруге жағдай жасайды. Генераторлар әрбір студентке бірегей кіріс деректерін (input data) және соған сәйкес күтілетін шығыс нәтижелерін (output) автоматты түрде жасап береді, бұл өз кезегінде "дайын кодты

көшіру" мәселесін түбегейлі шешеді [12]. Сонымен қатар, қазіргі жүйелер тек айнымалыларды өзгертіп қана қоймай, тапсырманың мазмұндық мәнін (мысалы, массивтермен жұмыс немесе циклдік операторлар) сақтай отырып, есептің контекстін түрлендіруге қабілетті [5]. Бұл тәсіл білім алушының бағдарламалау тілінің құрылымдарын механикалық емес, мағыналық деңгейде түсінуіне ықпал етеді.

Алгоритмдеу бөлімінде генераторлар сұрыптау, іздеу және графтар теориясы сияқты күрделі тақырыптарды игеруде таптырмас құрал болып табылады. Мұндай жүйелер алгоритмнің орындалу қадамдарын (trace table) көрсететін немесе нақты деректер жиыны үшін алгоритмнің күрделілігін есептейтін бірегей сценарийлерді тудырады [6]. Мәселен, графтар теориясын өткенде генератор әр студентке түйіндері мен қабырғаларының саны әртүрлі бірегей графтарды ұсына алады, бұл алгоритмдік ойлауды жан-жақты дамытуға мүмкіндік береді [9]. Деректерді визуалды түрде генерациялау арқылы оқушылар абстрактілі алгоритмдерді нақты нысандармен байланыстырып, олардың жұмыс істеу принципін тереңірек сезінеді.

Информатиканың іргелі бөлімі болып табылатын математикалық логика мен ақпарат теориясы саласында генераторлар ақиқаттық кестелерін құру, логикалық өрнектерді ықшамдау және логикалық схемаларды синтездеу бойынша вариативті жаттығулар жиынтығын жасайды [8]. Логикалық функциялардың параметрлерін автоматты түрде өзгерту арқылы жүйе білім алушының Буль алгебрасы заңдарын қаншалықты меңгергенін объективті бағалауға мүмкіндік береді [7]. Бұл бағыттағы генерациялау үдерісі тапсырманың күрделілік деңгейін біртіндеп арттыруға негізделеді, бұл білім алушының логикалық пайымдау қабілетін жүйелі түрде шыңдайды.

Теориялық білімді тексерудегі тест тапсырмаларының генерациясы дәстүрлі тестілеуден сұрақтар мен нұсқалардың динамикалық түрде өзгеруімен ерекшеленеді. Генераторлар дистракторларды (қате жауап нұсқаларын) мағыналық жақындық принципі бойынша іріктеп, тесттің сенімділігі мен валидтілігін арттырады [19]. Сонымен қатар, информатика пәніне тән сәйкестендіру, дұрыс тізбекті құру немесе код фрагментіндегі қатені табу сияқты интерактивті тест форматтарын автоматты түрде құрастыру оқу сапасын бағалаудың пәрменді механизміне айналды [20]. Бұл жүйелер тест нәтижелерін статистикалық талдау арқылы оқушының қай тақырыптан ақсап тұрғанын анықтап, соған сәйкес түзету тапсырмаларын ұсынуға қабілетті.

Талқылау

Информатиканы оқытудың дәстүрлі әдістемесі мен автоматтандырылған генерация жүйелерін салыстыру барысында айтарлықтай дидактикалық айырмашылықтар байқалады. Дәстүрлі әдістер көбінесе статикалық мазмұнға сүйенеді, бұл оқушылардың білімді репродуктивті деңгейде ғана меңгеруіне (жаттанды білім) әкеп соғады. Ал тапсырмалар генераторлары оқу үдерісін динамикалық сипатқа ие ете отырып, білім алушыны әр жолы жаңа жағдаяттарға бейімделуге мәжбүрлейді. Бұл тек ақпаратты сақтау емес, оны сыни тұрғыдан өңдеу және логикалық операцияларды орындау қабілетін дамытады. Дегенмен, дәстүрлі әдістің мұғалім мен оқушы арасындағы тікелей эмоционалды-интеллектуалды байланысты сақтауы оның басты артықшылығы болып қала беретінін ұмытпаған жөн.

Технологияның жоғары әлеуетіне қарамастан, оны жаппай тәжірибеге енгізуде бірқатар техникалық және субъективті шектеулер кездеседі. Біріншіден, техникалық шектеулер мәселесі туындайды: күрделі алгоритмдік тапсырмаларды генерациялау үшін жоғары есептеу қуаттары мен тұрақты интернет байланысы қажет, бұл барлық білім беру мекемелерінде бірдей деңгейде қолжетімді емес. Екіншіден, мұғалімдердің цифрлық құзыреттілігі шешуші фактор болып табылады. Көптеген педагогтар дайын генераторларды қолдануға немесе жаңаларын құрастыруға психологиялық және кәсіби тұрғыдан дайын емес.

Сонымен қатар, нарықтағы дайын генератор сапасының әртүрлілігі де өзекті мәселе. Кейбір жүйелер тек қарапайым параметрлерді ауыстырумен шектелсе, басқалары тым күрделі интерфейске ие. Сапасыз жасалған генераторлар қате нәтижелер беруі немесе дидактикалық мақсаттан ауытқып, оқушының шатасуына әкеп соғуы мүмкін. Сондықтан, бағдарламалық өнімнің педагогикалық экспертизадан өтуі аса маңызды.

Тапсырмалар генераторларының эволюциясы жақын болашақта білім беруді толықтай жекешелендіруге бағытталады. Бұл бағыттағы ең перспективалы жол Жасанды интеллект (AI) негізіндегі генераторлар. LLM (Large Language Models) модельдері оқушының сұранысына

қарай тек есепті құрастырып қана қоймай, оның шешілу жолын түсіндіретін және қателерді талдайтын интеллектуалды ассистентке айналуға.

Адаптивті жүйелердің дамуы оқу процесін "ойын" форматына жақындатады, мұнда тапсырманың қиындығы оқушының әрбір сәтті қадамына байланысты нақты уақыт режимінде өзгеріп отырады. Бұл білім алушының зерігуіне немесе шамадан тыс шаршауына жол бермейді. Соңғы маңызды тренд онлайн платформалармен (LMS) терең интеграция. Генераторлар оқшауланған бағдарлама емес, білім беру экожүйесінің ажырамас бөлігіне айналып, студенттің цифрлық ізін (digital footprint) талдау арқылы оның болашақ дамуын болжайтын болады.

Қорытынды

Болашақ зерттеулердің перспективалық бағыттары тапсырмалар генераторларының педагогикалық, технологиялық және әдіснамалық әлеуетін одан әрі жетілдіруге бағытталуы тиіс. Ең алдымен, тапсырмалар генераторларын жасанды интеллектінің ірі тілдік модельдерімен (LLM) интеграциялау мәселесі ерекше маңызға ие. Мұндай біріктіру тапсырмалардың тек мазмұндық вариативтілігін арттырып қана қоймай, олардың күрделілік деңгейін білім алушының оқу жетістіктеріне сәйкес автоматты түрде бейімдеуге мүмкіндік береді. Нәтижесінде оқу үдерісі динамикалық, интерактивті және дербестендірілген сипатқа ие болады. Сонымен қатар, LLM негізіндегі жүйелер оқушылардың қателерін талдап, түсіндірмелі кері байланыс беруге қабілетті, бұл формативті бағалаудың сапасын жаңа деңгейге көтереді.

Екінші маңызды бағыт – деректерге негізделген адаптивті алгоритмдер әзірлеу. Оқу барысында жинақталатын сандық деректер (тапсырмаларды орындау уақыты, қателер жиілігі, қайталану саны, жетістік динамикасы) білім алушының танымдық ерекшеліктерін модельдеуге мүмкіндік береді. Осындай талдау негізінде тапсырмалар генераторы оқыту мазмұнын жекелеңдіріп, әлсіз тұстарды күшейтуге бағытталған тапсырмалар ұсына алады. Бұл тәсіл білім беру үдерісін тек мазмұн жеткізу жүйесі емес, деректерге сүйенген интеллектуалды ортаға айналдырады.

Үшінші перспективалық бағыт – виртуалды және толықтырылған шындық технологияларымен ықпалдастыру. Информатика пәні алгоритмдік модельдеу, деректер құрылымы, желілік процестер секілді абстрактілі ұғымдарға негізделгендіктен, оларды визуалды әрі интерактивті ортада ұсыну білім алушының түсіну деңгейін айтарлықтай арттыра алады. Мысалы, алгоритмдердің жұмысын үшөлшемді ортада көрсету немесе деректер ағынын виртуалды модель арқылы бейнелеу күрделі теориялық материалды интуитивті деңгейде меңгеруге мүмкіндік береді. Мұндай интеграция тапсырмалар генераторын тек мәтіндік жүйе емес, көпформатты цифрлық білім беру платформасына айналдырады.

Сонымен қатар, педагогтердің цифрлық құзыреттілігін арттыру мәселесі де болашақ зерттеулердің өзекті бағыты болып табылады. Тапсырмалар генераторларының тиімділігі оларды әдіснамалық тұрғыдан сауатты қолдануға тікелей байланысты. Осыған орай арнайы біліктілікті арттыру курстарын ұйымдастыру, әдістемелік ұсынымдар әзірлеу және цифрлық педагогика бойынша кешенді бағдарламалар енгізу қажеттілігі туындайды. Мұғалім тек технологияны қолданушы емес, оны оқу мақсатына бейімдей алатын стратег ретінде қалыптасуы тиіс.

Тағы бір маңызды зерттеу бағыты – тапсырмалар генераторларының оқу нәтижелеріне ұзақ мерзімді әсерін эмпирикалық тұрғыда бағалау. Қысқа мерзімді тиімділік көрсеткіштерімен қатар, оқушылардың алгоритмдік ойлау қабілетінің дамуы, бағдарламалау дағдыларының тұрақтылығы, сыни және жүйелі ойлау деңгейінің қалыптасуы сияқты параметрлерді кешенді талдау қажет. Бұл технологияның білім сапасына шынайы ықпалын ғылыми негізде айқындауға мүмкіндік береді.

Түйіндей келе, тапсырмалар генераторы заманауи информатиканы оқыту әдістемесінің стратегиялық компонентіне айналып отыр. Ол оқу мазмұнын вариативті ұйымдастыруға, бағалау жүйесін объективтендіруге, білім алушының жеке траекториясын қалыптастыруға және цифрлық трансформация талаптарына сай икемді білім беру ортасын құруға мүмкіндік береді. Ғылыми негізделген тәсілмен енгізілген жағдайда бұл технология ұлттық білім беру жүйесінің бәсекеге қабілеттілігін арттырып, цифрлық қоғам талаптарына жауап беретін құзыретті мамандар даярлаудың тиімді тетігі бола алады.

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USE OF ARTIFICIAL INTELLIGENCE IN SPEECH THERAPY: CURRENT STATUS, POSSIBILITIES, AND DEVELOPMENT PROSPECTS

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ИСПОЛЬЗОВАНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ЛОГОПЕДИИ: СОВРЕМЕННОЕ СОСТОЯНИЕ, ВОЗМОЖНОСТИ И ПЕРСПЕКТИВЫ РАЗВИТИЯ

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Abstract

This article examines current applications of artificial intelligence technologies in speech therapy.

It analyzes the potential of machine learning algorithms, speech recognition systems, and intelligent learning platforms in the diagnosis and treatment of speech disorders. Particular attention is paid to the personalization of speech therapy, automated speech data analysis, and monitoring of patients' speech development dynamics.

The advantages and limitations of implementing digital technologies in speech therapy practice are discussed. It is noted that artificial intelligence can significantly expand a speech therapist's toolkit and improve the effectiveness of correctional work, but cannot completely replace a specialist.

Аннотация

В статье рассматриваются современные направления применения технологий искусственного интеллекта в логопедии. Анализируются возможности использования алгоритмов машинного обучения, систем распознавания речи и интеллектуальных обучающих платформ в диагностике и коррекции речевых нарушений. Особое внимание уделяется вопросам персонализации логопедической терапии, автоматизированного анализа речевых данных и мониторинга динамики речевого развития пациентов. Рассматриваются преимущества и ограничения внедрения цифровых технологий в логопедическую практику. Отмечается, что искусственный интеллект способен существенно расширить инструментарий логопеда и повысить эффективность коррекционной работы, однако не может полностью заменить специалиста.

Keywords: *artificial intelligence, speech therapy, speech disorders, digital technologies, speech recognition, speech correction*

Ключевые слова: *искусственный интеллект, логопедия, речевые нарушения, цифровые технологии, распознавание речи, коррекция речи*

Развитие цифровых технологий и систем искусственного интеллекта в XXI веке оказывает значительное влияние на различные области науки, образования и медицины. Одной из сфер, в которой данные технологии начинают активно внедряться, является логопедия — область коррекционной педагогики, занимающаяся изучением нарушений речи, их диагностикой и разработкой методов коррекции.

В последние годы наблюдается устойчивый рост интереса исследователей к использованию технологий искусственного интеллекта для анализа речевых данных. Это связано с развитием систем автоматического распознавания речи, нейронных сетей и методов машинного обучения, которые позволяют обрабатывать большие массивы аудиоданных и выявлять закономерности в речевом поведении человека.

Современная логопедическая практика требует высокой точности диагностики, индивидуального подхода к каждому пациенту и постоянного мониторинга результатов коррекционной работы. Использование интеллектуальных систем способно существенно облегчить решение данных задач.

Целью настоящего исследования является анализ возможностей применения технологий искусственного интеллекта в логопедической практике, а также определение перспектив их дальнейшего развития.

Одним из ключевых направлений применения искусственного интеллекта в логопедии является использование технологий распознавания речи. Современные системы автоматического анализа речи основаны на алгоритмах глубокого обучения и способны распознавать фонетические, акустические и интонационные характеристики речи.

Технологии автоматического распознавания речи позволяют анализировать произношение отдельных звуков, темп речи, интонацию и ритмическую структуру высказывания. На основе полученных данных система может выявлять отклонения от нормативного произношения и фиксировать типичные речевые ошибки. Использование таких технологий имеет большое значение при диагностике различных видов речевых нарушений, включая дислалию, дизартрию, заикание и задержку речевого развития. Автоматизированный анализ речи позволяет получить объективные количественные показатели, которые могут использоваться логопедом при постановке диагноза и планировании коррекционной работы.

Одной из наиболее перспективных областей применения искусственного интеллекта является автоматизация диагностики речевых нарушений. Системы машинного обучения способны анализировать большие объемы речевых данных и выявлять характерные особенности речи пациентов.

Например, нейронные сети могут обучаться на базе аудиозаписей речи с различными типами речевых нарушений и использовать полученные модели для автоматического выявления сходных паттернов в речи новых пользователей.

Такие системы могут использоваться как вспомогательный инструмент для логопедов, позволяющий ускорить процесс диагностики и повысить его объективность. Кроме того, автоматизированные системы диагностики могут применяться в условиях массового скрининга речевого развития детей.

Одним из ключевых преимуществ использования искусственного интеллекта является возможность персонализации образовательного и коррекционного процесса. Интеллектуальные обучающие системы способны адаптировать содержание занятий в зависимости от индивидуальных особенностей пациента.

На основе анализа речевых ошибок система может автоматически подбирать упражнения, направленные на коррекцию конкретных нарушений. Например, если у ребенка наблюдаются трудности в произношении определенных фонем, программа может предложить серию упражнений, направленных на развитие артикуляционных навыков.

Использование игровых элементов и интерактивных заданий позволяет повысить мотивацию детей к занятиям и сделать процесс коррекции речи более эффективным.

Еще одним важным направлением применения искусственного интеллекта является мониторинг прогресса пациентов. Цифровые платформы позволяют автоматически фиксировать результаты занятий и формировать аналитические отчеты.

Такие системы могут отслеживать частоту речевых ошибок, точность произношения звуков, темп речи и другие параметры. Полученные данные позволяют логопеду объективно оценивать эффективность проводимой коррекционной работы и своевременно корректировать программу занятий.

Несмотря на значительные преимущества, использование искусственного интеллекта в логопедии имеет определенные ограничения. Речевые нарушения часто имеют сложную природу и могут быть связаны с психологическими, неврологическими и социальными факторами.

Кроме того, важную роль в логопедической работе играет эмоциональное взаимодействие между специалистом и пациентом. Использование цифровых технологий не может полностью заменить профессиональную поддержку и педагогическое сопровождение.

Также необходимо учитывать вопросы конфиденциальности и защиты персональных данных, поскольку системы искусственного интеллекта работают с аудиозаписями и другой чувствительной информацией.

Таким образом, технологии искусственного интеллекта открывают новые возможности для развития современной логопедии. Использование систем автоматического анализа речи, интеллектуальных обучающих платформ и цифровых инструментов мониторинга позволяет повысить эффективность диагностики и коррекции речевых нарушений.

В то же время искусственный интеллект следует рассматривать как вспомогательный инструмент, расширяющий профессиональные возможности логопеда. Дальнейшие исследования в данной области должны быть направлены на совершенствование алгоритмов анализа речи и разработку специализированных программ для логопедической практики.

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THE ROLE OF VIRTUAL EXCHANGE PROGRAMS IN DEVELOPING STUDENTS' INTERCULTURAL COMPETENCE

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Abstract

In the context of globalization, intercultural competence has become an essential skill for university students, particularly in countries such as Uzbekistan that are actively integrating into the international educational space. Virtual exchange programs, which connect learners from different countries through digital communication technologies, offer new opportunities for intercultural learning without physical mobility—an important factor for many students who have limited access to study abroad programs. This article examines the role of virtual exchange initiatives in developing students' intercultural competence at higher education institutions, with special reference to the experience of the Namangan State Institute of Foreign Languages. The study focuses on the development of communication skills, cultural awareness, and attitudes toward diversity through online collaboration with international peers. It also discusses the pedagogical benefits, existing challenges in the Uzbek educational context, and the practical implications of integrating virtual exchange into university curricula to prepare students for participation in a globalized world.

Аннотация

В условиях глобализации межкультурная компетентность стала одним из ключевых навыков для студентов университетов, особенно в странах, таких как Узбекистан, которые активно интегрируются в международное образовательное пространство. Программы виртуального обмена, объединяющие обучающихся из разных стран с помощью цифровых коммуникационных технологий, открывают новые возможности для межкультурного обучения без физической мобильности, что особенно важно для студентов, имеющих ограниченный доступ к программам обучения за рубежом. В данной статье рассматривается роль инициатив виртуального обмена в развитии межкультурной компетентности студентов высших учебных заведений на примере опыта Наманганского государственного института иностранных языков. Основное внимание уделяется развитию коммуникативных навыков, культурной осведомлённости и толерантного отношения к культурному разнообразию в процессе онлайн-взаимодействия с зарубежными партнёрами. Также анализируются педагогические преимущества, существующие трудности в условиях узбекской системы образования и практические аспекты интеграции виртуального обмена в учебные программы вузов для подготовки студентов к участию в глобализированном мире.

Keywords: *virtual exchange, intercultural competence, digital learning, cross-cultural communication, higher education, Uzbekistan, Namangan State Institute of Foreign Languages.*

Ключевые слова: *виртуальный обмен, межкультурная компетентность, цифровое обучение, межкультурная коммуникация, высшее образование, Узбекистан, Наманганский государственный институт иностранных языков.*

INTRODUCTION

Interconnectedness has increased the need for individuals who can communicate effectively across cultural boundaries, particularly in countries such as Uzbekistan that are strengthening international cooperation in education, science, and economic development. Traditional study abroad programs have long been considered the primary means of developing intercultural competence; however, financial constraints, visa issues, and geographical distance often limit participation for many Uzbek students. In this context, virtual exchange programs offer an accessible and cost-effective alternative by enabling students from different cultural backgrounds to collaborate online without leaving their home institutions. At the Namangan State Institute of Foreign Languages, where preparing globally competent language professionals is a key priority, such programs can play a crucial role in providing authentic intercultural interaction with international peers.

Intercultural competence refers to the ability to communicate appropriately and effectively with people from other cultures. It includes knowledge, skills, attitudes, and behaviors that facilitate mutual understanding, tolerance, and cooperation. For students in Uzbekistan, developing these competencies

is especially important as the country expands its participation in global academic and professional networks. This article explores how virtual exchange programs contribute to the development of these components among university students, with particular attention to the opportunities and challenges faced in the Uzbek higher education context and at the Namangan State Institute of Foreign Languages.

CONCEPT OF INTERCULTURAL COMPETENCE

Intercultural competence is a multidimensional construct involving cultural knowledge, communication skills, empathy, tolerance, and adaptability. According to contemporary educational theories, effective intercultural interaction requires not only linguistic proficiency but also awareness of cultural norms, values, and perspectives.

Higher education institutions increasingly recognize intercultural competence as a key graduate attribute. Students must be prepared to work in multicultural environments, participate in global networks, and address complex international challenges. Therefore, innovative educational approaches are required to cultivate these abilities.

VIRTUAL EXCHANGE PROGRAMS

Virtual exchange programs are structured online collaborations between students in different countries, facilitated by educators. These programs use tools such as video conferencing, discussion forums, collaborative platforms, and social media to support interaction.

Unlike informal online communication, virtual exchanges are guided by pedagogical objectives and often integrated into coursework. Activities may include joint projects, cultural discussions, problem-solving tasks, and peer feedback sessions. Such structured interaction promotes meaningful engagement rather than superficial contact.

Virtual exchange also democratizes international education by providing opportunities for students who cannot participate in physical mobility programs. It reduces costs, eliminates travel barriers, and allows sustained interaction over time.

IMPACT ON COMMUNICATION SKILLS

One of the primary benefits of virtual exchange is the improvement of communication skills. Students practice using a foreign language in authentic contexts, negotiate meaning, and adapt their speech to intercultural situations. Regular interaction increases confidence and reduces anxiety associated with cross-cultural communication.

Moreover, digital communication requires additional competencies, such as interpreting nonverbal cues in online environments, managing time zone differences, and using appropriate online etiquette. These skills are increasingly relevant in global workplaces.

CULTURAL AWARENESS DEVELOPMENT

Virtual exchange programs expose students to diverse perspectives, traditions, and social norms. Through dialogue and collaboration, participants gain deeper insights into both foreign cultures and their own cultural assumptions. This reflective process helps reduce stereotypes and ethnocentric attitudes.



Cultural and intercultural competencies:

Introspection:
Hofstede Dimension
Cultural shock
Study abroad
Collaborate with foreigners



Digital competencies:

Work on LMS: collaborative forum and chat
Use synchronous messaging for collaboration: WhatsApp
Emailing:
Sharing with a group with Padlet
Using ZOOM for synchronous meeting (Video, voice, text and sharing screen).



Language competencies:

Read
Write
Listen
Speak

Students often report increased openness, curiosity, and respect for cultural diversity after participating in virtual exchanges. By discussing real-life issues and personal experiences, they develop empathy and intercultural sensitivity.

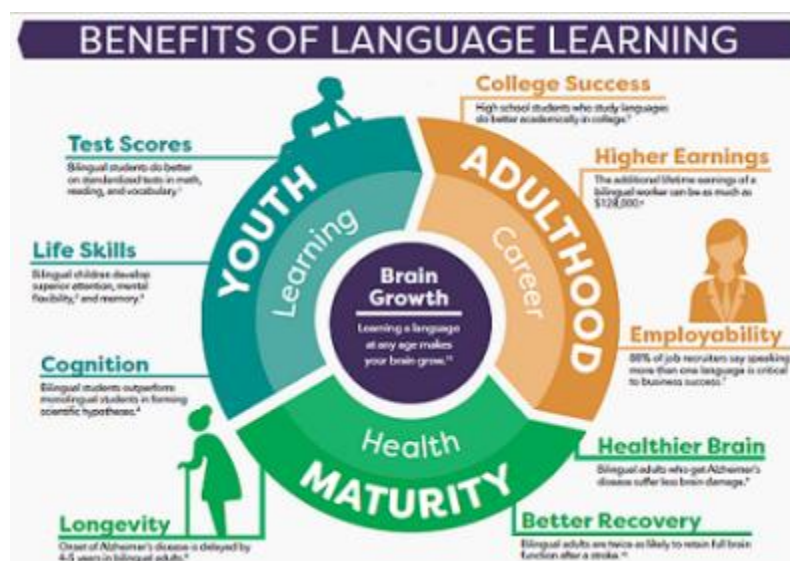
CHALLENGES AND LIMITATIONS

Despite their advantages, virtual exchange programs also face several challenges. Technical issues, unequal access to digital resources, and language barriers may hinder effective participation. Differences in academic calendars, institutional expectations, and teaching methods can complicate coordination.

Additionally, meaningful intercultural learning requires careful facilitation. Without structured guidance, interactions may remain superficial or reinforce stereotypes. Therefore, instructors play a crucial role in designing tasks, moderating discussions, and supporting reflection.

PEDAGOGICAL IMPLICATIONS

To maximize the effectiveness of virtual exchange, educators should integrate it systematically into the curriculum. Clear learning objectives, intercultural training, and assessment strategies are essential. Collaborative tasks should encourage critical thinking, mutual problem-solving, and sustained interaction.



Teacher preparation is equally important. Educators need digital literacy, intercultural awareness, and facilitation skills to manage online collaboration effectively. Institutional support and technological infrastructure also determine program success.

CONCLUSION

Virtual exchange programs represent a powerful tool for developing students' intercultural competence in the digital age. They provide authentic communication opportunities, enhance cultural awareness, and promote attitudes of openness and tolerance. Although challenges exist, thoughtful pedagogical design and institutional support can ensure meaningful outcomes. As globalization continues to reshape education and employment, virtual exchange will likely play an increasingly significant role in preparing students for participation in multicultural societies. In summary, while AI tools such as chatbots and Metaverse platforms greatly enhance the Korean language learning experience by providing interactive, accessible, and engaging environments, they are not without limitations. These technologies should be viewed as **supplements** to, rather than **replacements for**, authentic human interaction and well-rounded educational practices.

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THE IMPACT OF ONLINE WRITING PLATFORMS ON STUDENTS' MOTIVATION TO WRITE IN ENGLISH

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Abstract

This study explores the impact of online writing platforms on students' motivation to write in English. Writing is often considered one of the most difficult skills for EFL learners, frequently associated with low motivation, lack of confidence, and anxiety. In many traditional classrooms, writing activities are limited to individual, paper-based tasks, which may reduce students' engagement. Therefore, this study investigates whether online writing platforms can enhance students' motivation and participation. The research employed a quantitative pre-test/post-test design and involved 22 second-year students from Abai Kazakh National Pedagogical University. Data were collected using a Likert-scale questionnaire administered before and after a 4 week intervention. During this period, students completed writing tasks through online platforms such as blogs and Google Docs, focusing on collaboration and feedback. The results showed a significant improvement in students' motivation levels. There was a noticeable decrease in low-motivation students and an increase in highly motivated learners. In addition, students demonstrated greater confidence, reduced anxiety, and higher engagement in writing activities. Overall, the findings suggest that online writing platforms create a more interactive and supportive learning environment, which positively influences students' motivation. The study highlights the importance of integrating digital tools into English language teaching to improve writing instruction and student engagement.

Keywords: *online writing platforms, writing motivation, EFL learners, digital learning, collaborative writing, pre-test post-test, student engagement, English writing skills*

Introduction

In modern education, digital technologies play an increasingly important role in language learning, particularly in the development of writing skills. The rapid growth of information and communication technologies (ICT) has transformed traditional teaching approaches, making learning more interactive, flexible, and student-centered [1]. In this context, writing is no longer limited to paper-based tasks but extends to digital platforms where students can write, edit, and share their work instantly. Online writing platforms, such as blogs, Google Docs, and discussion forums, have become valuable tools in second language education. These platforms allow students to collaborate with peers, receive immediate feedback, and revise their work more effectively. Writing is considered a social and interactive process, and digital tools support this by enabling communication beyond the classroom [2]. For example, when students use Google Docs for collaborative writing, they can comment on each other's work, suggest improvements, and co-construct texts in real time. Similarly, blog writing encourages students to express their ideas to a wider audience, which increases their sense of responsibility and motivation. Research also shows that the use of online platforms positively affects students' motivation. Digital writing environments promote learner autonomy and engagement, as students feel more comfortable expressing their ideas online compared to traditional classroom settings [1, 3]. In addition, the availability of instant feedback and interactive features makes writing tasks more enjoyable and less stressful. For instance, students who participate in online discussions or maintain personal blogs often demonstrate greater interest in writing and improved language performance.

Globally, many educational systems actively integrate online tools into language teaching. In countries with advanced digital infrastructure, such as the United States and European nations, online writing platforms are widely used to enhance students' writing skills and motivation. However, in Kazakhstan, although digitalization in education is developing rapidly, the integration of online writing platforms into English language teaching is still at an early stage. Many classrooms continue to rely on traditional methods, such as writing essays in notebooks, with limited opportunities for interaction, collaboration, and feedback [4]. As a result, students in Kazakhstan may experience lower motivation to write in English due to the lack of engaging and interactive learning environments. This highlights the importance of exploring innovative teaching approaches, such as the use of online writing platforms. Therefore, this study aims to investigate the impact of online writing platforms on students' motivation to write in English, focusing on second-year students at Abai Kazakh National Pedagogical University. In

spite of the increasing importance of English as an international language, many students continue to demonstrate low motivation to write in English, which remains one of the most challenging language skills to master. Writing requires not only knowledge of grammar and vocabulary but also the ability to organize ideas, think critically, and express thoughts clearly. For this reason, students often experience difficulties such as lack of confidence, fear of making mistakes, and limited interest in writing tasks. One of the key factors contributing to this problem is the continued use of traditional writing methods in many educational contexts. These methods typically involve individual, paper-based tasks such as essays, grammar exercises, and written assignments that provide little opportunity for interaction, creativity, or immediate feedback. As a result, students frequently perceive writing as a monotonous and obligatory activity rather than an engaging and meaningful process of communication. This issue is particularly relevant in the context of Kazakhstan, where, despite ongoing educational reforms and the growing emphasis on trilingual education, writing instruction often remains traditional and teacher-centered. Students are rarely exposed to modern digital tools that reflect real-life communication practices, such as online collaboration, peer feedback, and interactive writing environments [5]. Consequently, their motivation to write in English may decrease, which can negatively affect their overall language development and academic performance.

In response to this problem, it is essential to explore innovative approaches that can enhance students' motivation and engagement in writing. One such approach is the use of online writing platforms, which provide opportunities for collaborative learning, instant feedback, and authentic communication. Therefore, the purpose of this study is to investigate the impact of online writing platforms on students' motivation to write in English. In order to achieve this aim, the study seeks to answer the following research questions: whether online writing platforms increase students' motivation to write in English, and whether there is a significant difference between students' motivation levels before and after the implementation of these platforms, as measured through pre-test and post-test results. Based on these considerations, the study is guided by the hypothesis that the use of online writing platforms significantly increases students' motivation to write in English.

Methods

This study employed a quantitative research method in order to examine the impact of online writing platforms on students' motivation to write in English. Specifically, a pre-test/post-test design was used to measure changes in students' motivation levels before and after the intervention. This design allowed for a clear comparison of participants' motivation and helped to determine the effectiveness of the implemented approach.

The participants of the study were 22 second-year students from Abai Kazakh National Pedagogical University. All participants were English language learners with a similar educational background. They were selected as a convenient sample and participated in the study voluntarily.

Several instruments were used to collect data. First, a motivation questionnaire based on a Likert scale was administered to assess students' attitudes toward writing in English. The questionnaire included statements related to interest, confidence, and engagement in writing activities. In addition, students were given online writing tasks designed to encourage active participation and interaction. Pre-test and post-test surveys were used to measure changes in motivation over the course of the study.

The research procedure consisted of three main stages. During the pre-test stage, students completed the initial questionnaire in order to measure their baseline level of motivation toward writing in English. This provided a starting point for comparison. In the intervention stage, which lasted for 4 weeks, students were engaged in writing activities using online platforms. These activities included blog writing and collaborative writing through tools such as Google Docs, where students could share ideas, comment on each other's work, and receive feedback. This stage aimed to create a more interactive and engaging writing environment. Finally, in the post-test stage, the same questionnaire was administered again to evaluate any changes in students' motivation. The results of the post-test were then compared with the pre-test data.

The collected data were analyzed using basic statistical methods. Mean scores and percentages were calculated to identify overall trends in students' motivation levels. In addition, a comparison between pre-test and post-test results was conducted to determine whether there was a significant improvement after the use of online writing platforms.

Results

The pre-test was conducted to determine students' initial level of motivation to write in English before the use of online writing platforms. A Likert-scale questionnaire (1 = strongly disagree, 5 = strongly agree) consisting of multiple statements was used to assess different aspects of motivation,

including interest, confidence, anxiety, and engagement. The results showed that the overall level of motivation among students was relatively low, with several weak areas identified, particularly in confidence and fear of making mistakes.

Table 1. Pre-test Results on Students' Motivation

Statement	Mean Score	Percentage (%)	Interpretation
<i>I enjoy writing in English</i>	2.6	52%	Low motivation
<i>I feel confident when writing in English</i>	2.4	48%	Low confidence
<i>Writing in English is interesting for me</i>	2.7	54%	Moderate
<i>I like expressing my ideas in written form</i>	2.9	58%	Moderate
<i>I feel motivated to complete writing tasks</i>	2.5	50%	Low motivation
<i>I am not afraid of making mistakes when writing</i>	2.3	46%	High anxiety
<i>I write in English outside the classroom</i>	2.1	42%	Very low engagement
<i>I prefer writing tasks to other language activities</i>	2.2	44%	Low preference
<i>I find writing tasks easy to complete</i>	2.4	48%	Low perceived ability
<i>I actively participate in writing activities</i>	2.5	50%	Low engagement
<i>I like receiving feedback on my writing</i>	3.0	60%	Moderate (strong point)
<i>I am interested in improving my writing skills</i>	3.2	64%	Relatively high (strength)

The findings indicate that students' motivation to write in English before the intervention was generally low to moderate, with several clear weaknesses identified. The lowest scores were observed in writing outside the classroom (2.1) and preference for writing tasks (2.2), suggesting that students rarely engage in writing voluntarily and do not perceive it as an enjoyable activity. In addition, students demonstrated low confidence (2.4) and a high level of anxiety (2.3), particularly related to making mistakes, which indicates that emotional barriers play a significant role in reducing their motivation. Low scores in perceived ability (2.4) and participation (2.5) further confirm that students are not fully comfortable with writing tasks and tend to avoid active involvement.

Despite these challenges, some relatively stronger aspects were also identified. Students showed a moderate to high interest in improving their writing skills (3.2) and a positive attitude toward receiving feedback (3.0). These findings suggest that although students initially lack motivation, they still demonstrate a willingness to develop their writing abilities when appropriate support, guidance, and engaging learning methods are provided.

Table 2. Post-test Results on Students' Motivation

Statement	Mean Score	Percentage (%)	Interpretation
<i>I enjoy writing in English</i>	3.8	76%	High motivation
<i>I feel confident when writing in English</i>	3.6	72%	Increased confidence
<i>Writing in English is interesting for me</i>	3.9	78%	High interest
<i>I like expressing my ideas in written form</i>	4.0	80%	Strong motivation
<i>I feel motivated to complete writing tasks</i>	3.7	74%	High motivation
<i>I am not afraid of making mistakes when writing</i>	3.5	70%	Reduced anxiety
<i>I write in English outside the classroom</i>	3.3	66%	Increased engagement
<i>I prefer writing tasks to other language activities</i>	3.4	68%	Improved preference
<i>I find writing tasks easy to complete</i>	3.5	70%	Improved ability
<i>I actively participate in writing activities</i>	3.8	76%	High engagement
<i>I like receiving feedback on my writing</i>	4.2	84%	Very strong point
<i>I am interested in improving my writing skills</i>	4.4	88%	Highest motivation

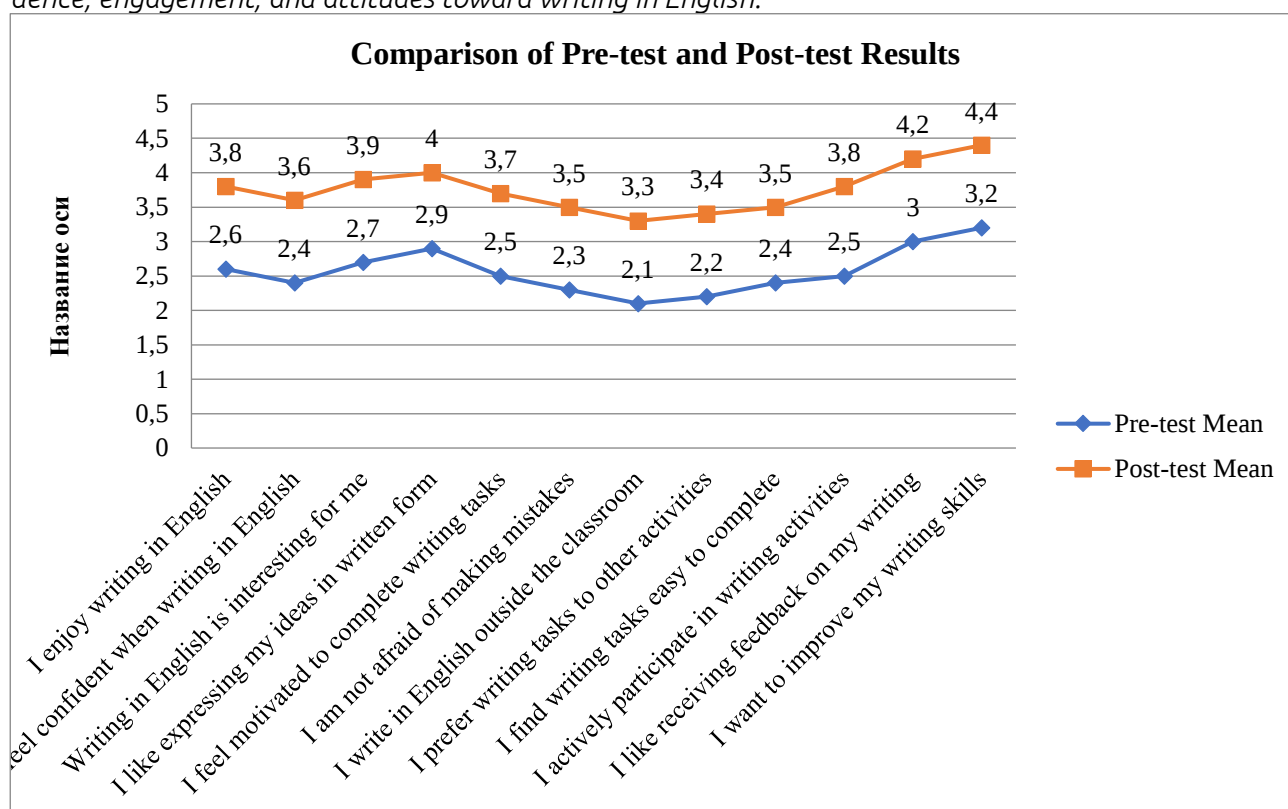
The post-test results demonstrate a significant improvement in students' motivation to write in English after the use of online writing platforms. All indicators show higher mean scores compared to the pre-test results, suggesting that the intervention had a positive effect on students' attitudes and engagement.

One of the most notable improvements can be seen in students' enjoyment of writing (from 2.6 to 3.8) and interest in writing (from 2.7 to 3.9), indicating that writing activities became more engaging and enjoyable. Similarly, students' confidence increased considerably (from 2.4 to 3.6), while their fear of making mistakes decreased (from 2.3 to 3.5), showing that online platforms helped create a more supportive and less stressful learning environment.

In addition, students became more actively involved in writing activities, as reflected in higher scores for participation (3.8) and writing outside the classroom (3.3). This suggests that online platforms encouraged autonomous learning and extended writing practice beyond the classroom setting.

The strongest results were observed in students' interest in improving their writing skills (4.4) and their positive attitude toward receiving feedback (4.2). These findings highlight the importance of interactive features, such as peer feedback and collaboration, which are commonly available in online writing environments.

To evaluate the effectiveness of online writing platforms, a comparison was made between the pre-test and post-test results. The analysis focused on identifying changes in students' motivation, confidence, engagement, and attitudes toward writing in English.

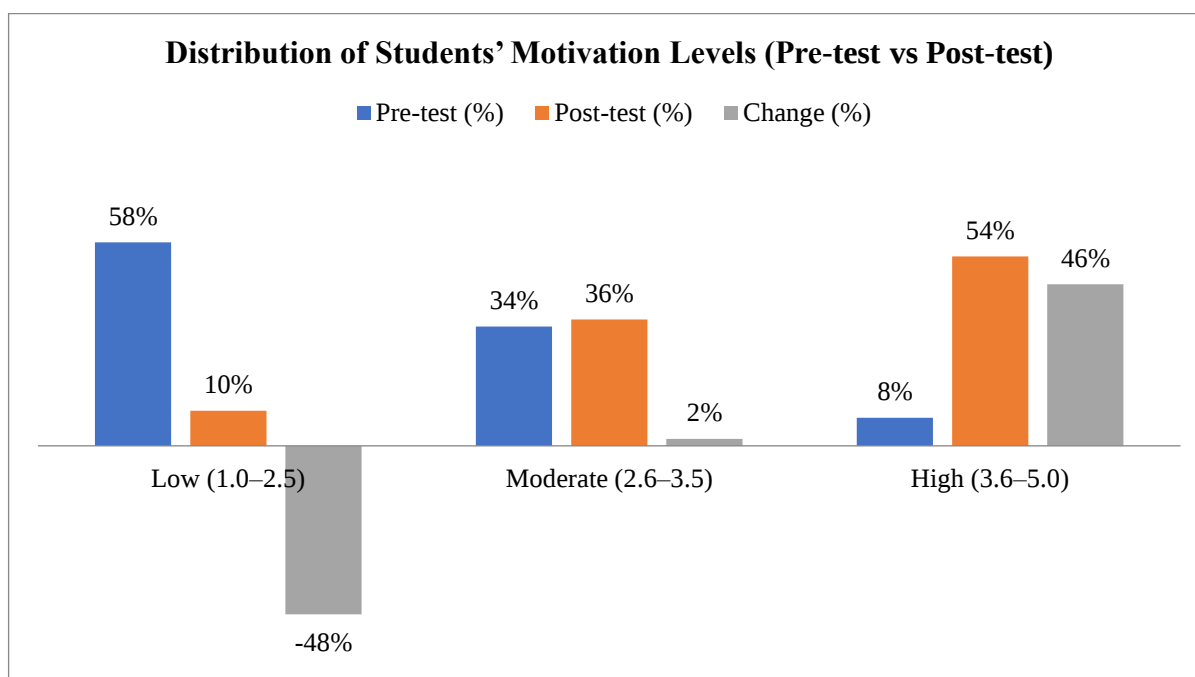


Picture 1. Comparison of Pre-test and Post-test Results

The comparative analysis clearly shows a positive shift across all measured indicators, with all statements demonstrating an increase of more than +1.0 point. This indicates a significant improvement in students' motivation and engagement after the intervention. The most notable improvement was observed in students' participation in writing activities (+1.3), suggesting that online platforms encouraged more active involvement in the learning process. Similarly, students' enjoyment, motivation, and interest in writing increased considerably (+1.2), indicating that writing became a more engaging and meaningful activity rather than a routine task.

Another important finding is the reduction in writing anxiety. The increase in the statement "I am not afraid of making mistakes" (+1.2) shows that students became more confident and less fearful, likely due to the supportive and interactive nature of online platforms. In addition, students began to write more frequently outside the classroom (+1.2), which reflects increased autonomy and a greater willingness to practice writing independently. This is a key indicator of intrinsic motivation, as students are no longer limited to classroom requirements but engage in writing voluntarily.

In order to provide a clearer overview of the changes in students' motivation, the results of the pre-test and post-test were categorized into three levels: low (1.0–2.5), moderate (2.6–3.5), and high (3.6–5.0). This categorization allows for a more visual and comprehensive comparison of students' motivation before and after the intervention.



Picture 2. Distribution of Students' Motivation Levels (Pre-test vs Post-test)

The results presented in Picture 2 demonstrate a substantial shift in students' motivation levels following the use of online writing platforms. In the pre-test, the majority of students (58%) were categorized as having low motivation, while only a small proportion (8%) demonstrated a high level of motivation, indicating that most students were not actively engaged in writing activities and lacked both interest and confidence prior to the intervention. However, the post-test results reveal a significant improvement in all categories. The percentage of students with low motivation decreased dramatically from 58% to 10%, suggesting that a large number of students moved out of the lowest motivation level. At the same time, the proportion of highly motivated students increased sharply from 8% to 54%, showing that more than half of the participants developed a strong interest in writing in English.

Meanwhile, the moderate category remained relatively stable, with a slight increase from 34% to 36%, which suggests that some students demonstrated gradual progress but did not reach the highest level of motivation. Overall, these findings clearly indicate that the use of online writing platforms had a strong positive impact on students' motivation. The noticeable shift from low to high motivation levels highlights the effectiveness of interactive, technology-based learning environments in enhancing students' engagement and interest in writing.

Discussion

The findings of this study indicate that online writing platforms had a clear positive effect on students' motivation to write in English. The comparison of the pre-test and post-test results showed that students became more interested in writing, more confident in expressing their ideas, and more willing to participate in writing activities after the intervention [3, 5]. One of the most important changes was the sharp decrease in the proportion of students with low motivation and the substantial increase in the number of students who reached a high level of motivation. This suggests that the online writing environment helped transform writing from a stressful and routine classroom task into a more interactive and meaningful activity. A possible explanation for this improvement is the interactive nature of online platforms. Tools such as blogs and Google Docs allow students not only to write but also to share, edit, comment, and collaborate in real time [6]. These features may increase motivation because students feel that writing has a real audience and a more authentic purpose. In addition, such platforms make the writing process more dynamic than traditional paper-based tasks. The opportunity to revise texts easily, exchange ideas with classmates, and observe others' contributions may have supported greater engagement and a stronger sense of participation. This interpretation is consistent with previous research showing that Google Docs can create a supportive and motivating learning environment through collaboration and interaction with peers and teachers [7].

Another important explanation is accessibility. Online writing platforms can usually be accessed outside the classroom, which may help students continue writing practice beyond lesson time. In the present study, one of the improvements was related to writing outside the classroom, suggesting that students became more willing to engage in autonomous writing. This matters because motivation often

grows when learners feel they have more control over when and how they write. Previous research on blog-based writing has similarly shown that blogging increases students' motivation, encourages autonomy, and supports collaboration [8]. Immediate feedback also appears to be a major factor behind the positive change in motivation. Traditional writing tasks often involve delayed teacher correction, which can reduce students' sense of progress and engagement. By contrast, online platforms allow faster responses from peers and teachers, making writing more interactive and less isolated. In the present study, students' attitudes toward feedback were among the strongest in the post-test results. This supports earlier findings that peer feedback can improve students' motivation and confidence in writing [9]. The results of this study are consistent with previous research on digital writing tools. Studies have shown that blog-mediated instruction enhances students' writing motivation compared to traditional methods [10]. In the current study, improvements were observed not only in interest and enjoyment but also in confidence, suggesting a broader positive impact. However, the findings should be interpreted with caution. Some students remained at a moderate level of motivation, indicating that online tools may not be equally effective for all learners. Factors such as digital skills, language proficiency, and task design can influence outcomes. Previous studies have also identified challenges such as technical difficulties and limited peer interaction in some cases [8, 11]. In the context of Kazakhstan, these findings are particularly relevant. Although digital education is developing, challenges such as limited resources and lack of teacher training still exist. Research shows that while digital tools can increase engagement, their successful implementation requires proper support and methodology [12].

Conclusion

To conclude, the findings of this study provide strong and convincing evidence that online writing platforms play a significant role in enhancing students' motivation to write in English. The integration of digital tools into the educational process has fundamentally transformed the nature of writing instruction by shifting it from a traditional, teacher-centered model to a more interactive, flexible, and learner-centered approach. This transformation is particularly important given that writing is often perceived by students as one of the most challenging and anxiety-inducing language skills. By incorporating online platforms into the learning environment, writing activities become more meaningful, communicative, and engaging, allowing students to view writing not merely as an academic obligation but as a valuable tool for self-expression and interaction. The comparative analysis of pre-test and post-test results clearly demonstrates a substantial and measurable improvement in students' motivation levels. Prior to the intervention, the majority of students displayed low motivation, limited confidence, and a considerable degree of anxiety when engaging in writing tasks. These factors significantly restricted their participation and reduced their willingness to practice writing independently. However, following the implementation of online writing activities, a marked shift was observed in students' attitudes and behaviors. Students became more confident in expressing their ideas, more actively involved in writing tasks, and more willing to engage in writing both within and beyond the classroom context. The notable increase in the proportion of highly motivated students, along with the sharp decline in low-motivation learners, provides clear empirical support for the effectiveness of online writing platforms as a pedagogical tool.

The positive outcomes observed in this study can be attributed to several key features of online writing environments. Firstly, the interactive nature of digital platforms encourages collaboration and peer interaction, enabling students to exchange ideas, provide feedback, and engage in joint knowledge construction. This collaborative dimension not only enhances students' engagement but also fosters a sense of belonging and shared responsibility within the learning community. Secondly, the accessibility and flexibility of online tools allow students to continue their writing practice outside the classroom, thereby promoting learner autonomy and encouraging continuous language development. This extended engagement is particularly valuable, as it helps students develop intrinsic motivation and a habit of independent learning.

Furthermore, the immediate feedback mechanisms available on online platforms play a crucial role in improving students' confidence and reducing anxiety. Unlike traditional writing tasks, where feedback is often delayed and limited, digital environments provide timely and ongoing responses from both peers and instructors. This continuous feedback loop allows students to identify and correct their mistakes more effectively, while also reinforcing their progress. As a result, students become less afraid of making errors and more willing to experiment with language, which is essential for developing writing proficiency. Additionally, the possibility of revising and editing their work multiple times in a supportive and low-pressure environment contributes to a more positive emotional experience, further enhancing motivation.

From a pedagogical perspective, the findings of this study highlight the broader potential of online writing platforms to improve not only students' motivation but also the overall quality of writing instruction. By supporting active learning, fostering collaboration, and encouraging independent practice, these tools align closely with contemporary educational principles and contribute to more effective and meaningful learning outcomes. In particular, their use can be highly beneficial in contexts such as Kazakhstan, where traditional teaching methods still play a dominant role and where there is a growing need to integrate digital technologies into education.

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USING ARTIFICIAL INTELLIGENCE IN DEVELOPING STUDENTS' ACADEMIC WRITING COMPETENCE

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ИСПОЛЬЗОВАНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ФОРМИРОВАНИИ АКАДЕМИЧЕСКОЙ ПИСЬМЕННОЙ КОМПЕТЕНЦИИ СТУДЕНТОВ

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Abstract

This article examines the use of artificial intelligence technologies in developing students' academic writing competence in foreign language learning. The relevance of using intelligent digital tools in higher education is substantiated [1, p. 45]. The potential of artificial intelligence as a means of improving the quality of academic writing, developing critical thinking, and fostering student independence is explored [2, p. 72]. The advantages and limitations of using artificial intelligence technologies in the educational process are described. The results of the study demonstrate the effectiveness of using intelligent systems in developing students' academic writing skills.

Аннотация

В статье рассматривается использование технологий искусственного интеллекта в формировании академической письменной компетенции студентов в процессе обучения иностранному языку. Обоснована актуальность применения интеллектуальных цифровых инструментов в образовательной среде высшей школы [1, с. 45]. Исследуются возможности искусственного интеллекта как средства повышения качества академического письма, развития критического мышления и формирования самостоятельности обучающихся [2, с. 72]. Описаны преимущества и ограничения использования технологий искусственного интеллекта в образовательном процессе. Результаты исследования демонстрируют эффективность применения интеллектуальных систем в развитии навыков академического письма студентов.

Keywords: *artificial intelligence, academic writing, writing competence, digital pedagogy, English language teaching, higher education, educational technologies.*

Ключевые слова: *искусственный интеллект, академическое письмо, письменная компетенция, цифровая педагогика, обучение английскому языку, высшее образование, образовательные технологии.*

Введение

Современное высшее образование характеризуется активным внедрением цифровых технологий в образовательный процесс, что обусловлено глобальной цифровизацией общества и развитием информационных технологий [1, с. 38]. Особое место в системе инновационных образовательных инструментов занимает искусственный интеллект, который оказывает значительное влияние на трансформацию методов обучения иностранным языкам [2, с. 80].

Одной из ключевых задач обучения иностранному языку в высшей школе является формирование академической письменной компетенции студентов, включающей способность создавать научные тексты, аргументировать позицию, соблюдать нормы академического дискурса и применять языковые средства в соответствии с жанровыми требованиями [3, р. 15].

В условиях цифровой образовательной среды использование искусственного интеллекта открывает новые возможности для развития письменных навыков обучающихся. Интеллектуальные системы обеспечивают автоматическую проверку текстов, генерацию языковых моделей, анализ ошибок и предоставление обратной связи, что способствует повышению эффективности обучения [4, р. 112].

Актуальность исследования определяется необходимостью изучения возможностей искусственного интеллекта в формировании академической письменной компетенции студентов, а также выявления педагогических условий его эффективного использования.

Цель исследования — определить особенности и эффективность применения технологий искусственного интеллекта в формировании академической письменной компетенции студентов.

Задачи исследования:

- рассмотреть теоретические основы академической письменной компетенции;
- проанализировать возможности искусственного интеллекта в обучении письму;
- выявить преимущества и ограничения использования искусственного интеллекта;
- определить педагогические условия эффективного применения технологий искусственного интеллекта.

Теоретические основы исследования

Академическая письменная компетенция рассматривается как комплекс знаний, умений и навыков, обеспечивающих создание научных текстов в соответствии с нормами академического дискурса [3, р. 27]. Она включает владение лексико-грамматическими средствами, логической организацией текста, аргументацией и соблюдением норм академической этики.

В современной педагогике большое внимание уделяется цифровым технологиям обучения, способствующим индивидуализации образовательного процесса [1, с. 52]. Искусственный интеллект представляет собой совокупность технологий, способных имитировать когнитивные функции человека, включая анализ информации, обработку данных и генерацию текста [2, с. 94].

Использование искусственного интеллекта в обучении иностранным языкам способствует развитию автономности обучающихся, повышению мотивации и формированию навыков самообучения [4, р. 125].

Методология исследования

В ходе исследования использовались методы анализа научной литературы, наблюдения, педагогического эксперимента и сравнительного анализа результатов обучения. В эксперименте приняли участие студенты высшего учебного заведения, изучающие английский язык.

Обучающиеся выполняли письменные задания с использованием инструментов искусственного интеллекта и без их применения. Оценивались уровень аргументации, логичность текста, грамматическая правильность и структура письменных работ.

Результаты исследования

Результаты исследования показали, что использование технологий искусственного интеллекта способствует улучшению качества письменных работ студентов. Было отмечено снижение количества грамматических ошибок, повышение логической последовательности текста и улучшение структуры письменных работ, что согласуется с результатами современных исследований [4, р. 130].

Студенты продемонстрировали более высокий уровень мотивации и заинтересованности в выполнении письменных заданий. Использование интеллектуальных систем позволило обучающимся получать оперативную обратную связь и корректировать ошибки.

Обсуждение

Несмотря на положительные результаты, использование искусственного интеллекта имеет ряд ограничений. Существует риск снижения самостоятельности студентов и формирования зависимости от цифровых инструментов. Кроме того, возникают вопросы академической честности и этического использования технологий.

Эффективное применение искусственного интеллекта требует педагогического сопровождения и разработки методических рекомендаций по его использованию в образовательном процессе.

Заключение

Таким образом, использование искусственного интеллекта в формировании академической письменной компетенции студентов является перспективным направлением развития современной педагогики. Применение интеллектуальных технологий способствует повышению качества письменных навыков, развитию критического мышления и формированию самостоятельности обучающихся [2, с. 101].

Для эффективного использования искусственного интеллекта необходимо разработать педагогические стратегии, обеспечивающие баланс между применением цифровых технологий и развитием самостоятельности студентов.

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Philological sciences

THE METAPHORIZATION OF THE MYTHOLOGICAL WORLDVIEW: COGNITIVE AND ANTHROPOLOGICAL PERSPECTIVES

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Abstract

This article examines the metaphorical mode of perception and cognition as a universal mechanism of human thought, focusing on its role in shaping the mythological worldview. Metaphor is analyzed not merely as a stylistic device but as a fundamental cognitive principle that structures, conceptualizes, and interprets reality. The study aims to identify the cognitive and cultural-anthropological prerequisites of metaphorization and to explore the genetic connection between metaphor and myth. Myth is considered the earliest syncretic form of human consciousness, providing provisional frameworks for understanding the world under conditions of limited rational knowledge. Through anthropomorphism, animism, magical representations, and the principle of participation, myth transforms chaotic experience into an ordered cosmos. Early mythological models establish systematic correspondences between human, natural, and cosmic elements, exemplified by macrocosm–microcosm analogies and anthropocentric projections. These mechanisms create metaphorical mappings that underpin conceptualization and guide human cognition. The research employs an interdisciplinary framework, with the cognitive-discursive approach as the primary perspective. Complementary methods include theoretical analysis and synthesis of scholarly literature, comparative-analytical and interpretative techniques, and conceptual analysis aimed at identifying basic cognitive models. This methodology allows metaphor to be understood as a cognitive tool that precedes and supports logical-discursive thinking. The study concludes that metaphorization is a universal and primordial feature of human cognition. In mythological consciousness, metaphor functions as a mode of perception in which objects, events, and phenomena are experienced as interconnected and meaningful. The emergence of metaphor in language reflects both phylogenetic and ontogenetic development, marking the transition to more complex forms of linguistic and conceptual thought. Thus, metaphor is not only a linguistic phenomenon but also a foundational mechanism for structuring human experience and worldview.

Keywords: *metaphor, myth, mythological worldview, cognitive linguistics, anthropomorphism, syncretism, conceptualization, metaphorization.*

The metaphorical mode of perceiving and understanding the world is universal in nature. Since metaphor constitutes a fundamental cognitive mechanism of human thought, it acquires particular significance in addressing key issues within cognitive linguistics.

The aim of this study is to identify the cognitive and cultural-anthropological prerequisites of the metaphorization of the mythological worldview, as well as to determine the role of metaphor as a universal mechanism for the formation and structuring of human thought. The relevance of this research is determined by the growing interest in contemporary cognitive linguistics and philosophy of language in the problem of the relationship between thought, language, and the perception of reality. Within the anthropocentric scientific paradigm, the study of metaphor gains special importance not only as a stylistic device but also as a fundamental cognitive mechanism that ensures the conceptualization and interpretation of the surrounding world.

Despite the considerable body of research devoted to metaphor, the questions concerning its genetic connection with mythological thinking and the prerequisites for the metaphorization of the mythological worldview remain insufficiently explored, which necessitates further investigation.

The study employs an integrated methodological framework determined by its interdisciplinary nature. The primary approach is the cognitive-discursive approach, which allows metaphor to be considered as a mechanism of knowledge conceptualization. The research also applies methods of theoretical analysis and synthesis of scholarly literature, the comparative-analytical method, the interpretative method, and elements of conceptual analysis aimed at identifying basic cognitive models and metaphorical mappings.

Turning to the origins of the phenomenon, one inevitably arrives at the idea of a genetic connection between metaphor and myth. As noted by Ernst Cassirer: "The origin of metaphor is sought either in the creation of language or in mythological imagination; sometimes the word itself, due to its inherent metaphorical nature, is believed to generate and continuously nourish myth, while in other cases metaphoricality is seen merely as a legacy that language has received from myth and, as it were, lends back to it" (Cassirer, 1990: 33–34).

Myth represents the earliest syncretic form of human spiritual culture. It constitutes humanity's first attempts to define its place in the world. Endowed with reason and imagination, human beings possess not only a sense of identity but also a need for intellectual orientation in their environment. Emphasizing the subjective-objective nature of the human worldview, Erich Fromm wrote that a person encounters many puzzling phenomena and, possessing reason, must assign them meaning and integrate them into a comprehensible context. As reason develops, the system of orientation becomes more adequate, and the individual's worldview depends on both reason and knowledge. The need for orientation is inherent to human nature, and the system of orientation constitutes one's worldview. A lack of knowledge compels reliance on imagination, which temporarily substitutes for logical-discursive thinking. Intuition and creative imagination fill in missing links, organizing facts into a system that functions as provisional "scaffolding" until real connections are established through thought and experience. Myth serves precisely as such scaffolding for primitive consciousness. The term "primitive" here does not imply "pre-logical" or "illogical"; rather, it corresponds to Lévy-Bruhl's notion of the "prelogical." Primitive thinking differs from modern thinking not by the absence of logic, but by its distinct orientation. For such consciousness, there is only one reality, inherently mystical in nature. As Lévy-Bruhl observed, what modern individuals perceive as separate realms—physical and spiritual - constitute a unified reality in primitive thought. The essence of myth lies in its nature as fiction accepted as truth. For the primitive human, myth is neither poetic creation nor scientific construct, but an intensely real and concrete form of experience. As Aleksei Losev emphasized, myth represents the highest degree of concrete and lived reality within mythological consciousness.

Under conditions of limited rational knowledge, humans replaced empirical understanding with imagined constructs. Animistic, fetishistic, magical, and totemistic beliefs largely structured the mythological worldview. The function of myth is to transform chaos into an ordered cosmos. It provides not only a model of the universe but also a model of human behavior within it. Thus, myth can be understood as an adaptive mechanism that serves not so much to explain objective causal relationships as to systematize subjective impressions of reality and human existence within it. While science operates with abstract concepts and logical reasoning, myth relies on vivid imagery and sensory associations.

A key feature of primitive culture is syncretism. This syncretic worldview is grounded in analogical thinking. Humans did not distinguish themselves from nature but perceived themselves as part of it. In the mythological worldview, there are no clear boundaries between subject and object, emotion and cognition, or reality and the supernatural. Instead, these domains are organically intertwined. Anthropomorphism plays a central role: the cosmos and nature are humanized, and objects are personified through metaphorical associations. In their attempt to understand the world and their place within it, humans inevitably drew parallels between themselves and natural phenomena. Having identified similarities, they transferred additional qualities onto observed objects. For instance, early myths often describe the origin of the cosmos by analogy with biological birth. Myths of the "First Man" (such as Purusha, Ymir, and Adam) establish a connection between the macrocosm and the microcosm. These narratives describe either the emergence of the universe from parts of the primordial human body or, conversely, the creation of the human from elements of the cosmos. Such myths reveal structured systems of correspondences, through which elements of space acquire mythopoetic meaning. In many traditions, these correspondences tend toward formulaic expressions: flesh corresponds to earth, blood to water, bones to stone, breath to wind, eyes to the sun or fire, and so on. As V. N. Toporov notes, these correlations reflect an ancient mythopoetic concept of the unity of macrocosm and microcosm and anticipate later philosophical theories of the fundamental elements of the universe.

The mythological worldview also reflects the principle of anthropomorphism, according to which all things are conceived "in the image and likeness" of the human being. This is grounded in the basic animistic metaphor: "the world is a human." Traces of anthropomorphism persist in fossilized metaphors such as "the sun rises," "the rain falls," and "the stream runs."

Another important prerequisite for the emergence of metaphor is magic, based on the attribution of natural phenomena to supernatural forces. According to Werner, who studied the evolutionary-psychological origins of metaphor, its emergence is closely connected with motives rooted in magical

thinking, particularly taboos on words and names. The "law of participation" (Lévy-Bruhl) constitutes another principle of mythological thinking: similarity implies a form of mystical connection. For primitive consciousness, representation and reality are inseparable; an image of a being is perceived as its second self, and influencing the image equates to influencing the being itself. «An analysis of the earliest forms of human culture - myth and language - leads to the conclusion that the function of "metaphorical thinking" (a term used by Cassirer himself) is more fundamental and, in metaphysical terms, takes precedence over the function of logical-discursive thinking (i.e. over the function of reason). For the formation of concepts presupposes their fixation in language, but language itself arises on the basis of the original, metaphysical metaphorical nature of consciousness, which breaks down the original chaos of the 'matter' of sensory experience, identifies independent centres of meaning within this chaos, and concentrates the 'light' of meaning in these centres. It is precisely because of this priority that emerging language, like myth, is based on the fundamental oppositions of 'sacred–profane', '(absolutely) valuable–worthless', rather than on the oppositions traditional to logical-discursive thinking: 'true–false', 'particular–universal', 'meaningful–meaningless'. Only the gradual development of the logical-discursive function of consciousness and its (entirely natural and fruitful) integration into language leads to the transformation of the latter. Ultimately, the emphasis shifts to the opposite, and in the structure of the languages of modern European cultures, it is precisely the second function that has clear priority, whilst the first is revealed only through the creative effort of linguistic ('secondary') metaphors» [Evlampiev, 1997: 150–151].

Thus, metaphor is a universal and primordial feature of human cognition. It is as inherent as language and thought themselves. In conditions of limited knowledge, metaphor enables thought to take shape. The metaphorization of the mythological worldview was therefore inevitable. It was conditioned by syncretism, anthropomorphism, animistic representations, magical thinking, and the principle of participation. At the same time, metaphor in its modern sense - as a conscious transfer of meaning from one domain to another - could not have existed at the stage of myth formation. The awareness of such transfer emerged later. As O. M. Freidenberg argued, for primitive consciousness one object is another; there is no distinction that would allow for metaphorical transfer in the modern sense. The emergence of metaphor, riddles, and proverbs within linguistic consciousness thus signals both phylogenetic and ontogenetic maturity. It marks the formation of a new type of linguistic consciousness capable of operating with metaphor as a cognitive and expressive tool.

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SEMANTIC MEANINGS AND BELIEF STATES

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<https://orcid.org/0000-0002-6650-5330>**Abstract**

The natural intuition of human beings is very complex. The Information Retrieval and understanding of the semantic meaning requires a clear reasoning of the knowledge of discourse.

The research is concerned with explicit representations of the meanings of utterances. By “explicit representations of meaning” we mean structured variables with a pre-defined interpretation—the kind of thing that semanticists are concerned with. The word is one of the fundamental units of language. It is a dialectal unity of form and content. Its content or meaning is not identical to notion, but it may reflect human notion, but it may reflect human notion and is considered as the form of their existence. So, the definition of a word is one of the most difficult in linguistics, because the simplest word has many different aspects. The term semantics is often defined as the study of meaning. It might be more accurate to define it as the study of the relationship between linguistic form and meaning. This relationship is clearly rule-governed, just as other aspects of linguistic structure are. When we study semantics, we are trying to understand this shared system of rules that allows hearers to correctly interpret what speakers intend to communicate. The study of meaning in human language is often partitioned into two major divisions, and in this context the term semantics is used to refer to one of these divisions. In this narrower sense, semantics is concerned with the inherent meaning of words and sentences as linguistic expressions.

Keywords: Semantic meaning, belief states, logical form, structure, approach

For a long time, meaning representations were central to successful efforts aimed at linking language to other tasks involving reasoning, perception, and action (a line of work that runs in modern semantic problems. Structured meaning representations were also central to unsuccessful work on translation, syntax, etc. This work uses lots of different representation formalisms—proper logical forms, combinatory logics, other non-logical structures—but if you squint, they’re all basically predicate-argument structures implementing a model-theoretic semantics, with perhaps a few free parameters in the bodies of the predicates.

These kinds of approaches seem to be disappearing. Now that everything is end-to-end all the time, it’s rare to see models with explicit latent variables taking values in hand-designed logical languages. Utterances come into our models, behaviors come out, and we don’t worry too much about the structure of the computation that gets performed in the middle. Besides, there are hyponymy, homonymy, polysemy, synonymy, antonymy and metonymy are different types of lexical relations. [3,30]

There are still certain kinds of generalization and inductive bias we used to get for free with the old models that we haven’t totally figured out how to recreate. The success of hybrid approaches like structured regularizes and our work suggests we’ll get there eventually. This is, with some qualifications, a good thing: in more formal approaches, tight coupling between the machine learning and the representation means that there’s always a risk that some new semantic phenomenon shows up in the data and suddenly your model is useless. Sufficiently generic machinery for learning (non-logical) representations makes this a little less scary.

But the attitude of the end-to-end world seems to be that since we’re no longer doing logical inference, there is no need to think about meaning at all. Suddenly everyone loves to cite Wittgenstein to argue that we should be evaluating “language understanding” in terms of success on downstream tasks rather than predicting the right logical forms—which is great! - but underlying this seems to be a philosophy that “meaning is use, so if we can predict use with high accuracy, we’ve understood everything we need to about meaning”. In this post I want to motivate the use of explicit representations of belief states of the form world state utterance as representations of meaning suitable for “unstructured” machine learning models. These kinds of representations arise naturally in the sorts of decision-making tasks the community is excited about these days, but they also look a lot like classical representational theories in linguistics. The synthesis suggests ways of both training and interpreting language processing models.

Consider the problem of trying to act in a partially observed world where people talk to you in order to help reduce your uncertainty. How should you choose the best possible action to take? Given a single utterance as; very happy can be replaced by thrilled, very tasty-delicious, very fast-quick, very pretty-gorgeous, very calm-tranquil as they can reveal all possible true states of the meanings of words.

Any listener who hopes to succeed in the world needs to do a good job of at least approximately solving this optimization problem, and in practice the listener will probably need to represent the distribution at least implicitly. In a belief state; for it's a function that maps from possible worlds to scalar plausibility judgments—how likely is it that is the true world given that we observed someone saying about it.

Compare this to the notion of an intension in Montague semantics: “a function from possible worlds and moments of time to truth values”. Most (model theoretic) semantics programs represent intensions using logical expressions (rather than e.g., tabular). But a logical form is just one way of expressing a function of the right type; at the end of the day, an “explicit representation of meaning” to the Montagovian tradition is precisely an intension—that is, something that looks like a discretized version.

A belief state is an intension with probabilities. Intentional representations of meaning are useful not just because they help us solve linguistic problems, but also because they approximate a quantity that we know helps language users do useful things with the information they've acquired from language. From the other side, what the POMDP tells us we have to understand the meaning upon hearing an utterance is approximately the thing linguists have been telling us to compute all along. Or almost the thing linguists have been telling us about—what would be even better than a black box for answering the queries would be something with a little structure, maybe some kind of factorized representation that let us find the MBR action efficiently by making it possible to inspect the set of properties that all plausible worlds have in common. Perhaps a product of assertions about individuals, their properties, and their relations, etc. If logical semantics didn't exist, we would have had to invent it. [5, 103]

The semantic “meaning” should be precisely understood as a listener meaning: an accurate belief state already accounts for Gricean speaker-meaning-type effects (e.g., implicatures) and also further inferences the speaker may not have wanted the listener to draw (e.g. the possibility that is a lie). Our story here doesn't care where meaning comes from, so it might be vague via something like RSA with a distinct notion of sentence meaning embedded inside.

One last adjustment: real-world listeners don't start with a tabula rasa: every utterance is interpreted in the context of an existing belief state $p(x)p(x)$, and we really want to think of the meaning of a sentence as an update function;

Practical implications All very nice, but we led by noting that explicit denotational meaning representations (logical, probabilistic, or otherwise) don't actually show up in the kinds of models that work well in practice. So why does any of this matter?

For language understanding systems to work well, they must be choosing something close to the min Bayes risk action. Hand-wavingly: a suffix of a deep network is a function from input representations to output actions via a fixed circuit; if this suffix can pick a good action for every input representation it's implementing something like an MBR decoding algorithm (though perhaps approximate and specialized to the empirical distribution over representations); whatever representation of language-in-context is presented to this part of the network must then be sufficient to solve the optimization problem.

This is not a great argument: there may in fact be no clear distinction between the “sentence representation” and “optimization” parts of the model. But in practice we do see meaning-like sentence representations emerge (especially in models where the sentence representation is computed independent of whatever initial information the listener has about the state of the world. When using specialized optimization modules within larger networks we can be sure of the distinction. In any case, the knowledge that some intermediate representation in our model is (or should be) decodable into a distribution over world states gives us two tools: Interpretability: test whether representations are capturing the right semantics (or identify. Determine whether this corresponds to the real (i.e., human listener's) denotation. We got a bunch of mileage out of this technique in our neutralize papers and other students in the group have been using it recently to analyze pretraining schemes for instruction-following models. But in some ways it's even more natural to apply it to the learning of representations of natural language itself rather than a learned space of messages / abstract actions.

In my view, while dynamic semantics has produced highly informative and unique insights about language, of great relevance to any program for linguistic semantics, it is still properly Platonic. This is so for two reasons. The first reason is conceptual in nature, and the less philosophically inclined reader

is welcome to skip it: most dynamic semantics are still ultimately concerned with truth in a classical sense.

Conclusion Thinking about POMDP-style solutions to language games results in an account of meaning that looks suspiciously like model-theoretic semantics. This analogy provides tools for interpreting learned models and suggests auxiliary objectives for improving their accuracy.

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PHRASAL VERBS AS A PART OF THE ENGLISH LANGUAGE

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<https://orcid.org/0000-0001-8013-7741>**Abstract**

Phrasal verbs form one of the most common types of multi-word verbs. They consist of a lexical verb and a spatial adverb, and since this combination often brings a new meaning different from those of the verb and the particle, it is usually the hardest part of the English language to be learned by foreign students. These verbs should not be confused with free combinations of verb plus adverb, where the meanings of both their components are maintained. In order to avoid this misunderstanding, a series of characteristics that may help to distinguish phrasal verbs from free syntactic combinations are presented, but these are exposed below because they change according to whether the phrasal verb is intransitive or transitive.

It is important to learn phrasal verbs because they mark the difference between average and advanced speakers of English, whose language sounds more natural. Phrasal verbs have a bad reputation among students because they are asked to learn long lists containing these verbs without there being any apparent logical connection between them. In order to that, students need to be conscious of how English speakers usually talk about abstract things (e.g. intentions, feelings, attitudes), which is by expressing them as concrete objects (through conceptual metaphor), and then they will be able to apply these abstract notions to the spatial adverbs in phrasal verbs.

Keywords: phrasal verbs, combination, English, particle, separable, non-separable, transitive, intransitive

English phrasal verbs consist of a verb paired with a particle that is homophonous with an English preposition. The verb and its particle are written as separate words in the orthography, and the phrasal verb shares similarities, such as transitivity and irregularity, with the single-word verb which the 'verb' part of the phrasal verb resembles and from which it presumably originates. The particle used in the phrasal verb is not a preposition, although it resembles one in appearance. Instead, it is semantically fused to the verb, and the meaning of the verb with its particle may be significantly different from the verb when it does not have a particle attached to it. The particle may be considered adverbial by some authors. Prosodically, the phrasal verb construction results in stress being placed on both the verb and the particle, rather than solely on the verb, specifically in its nonseparated state. However, the English phrasal verb is not merely the fusing of the root verb and the particle into a single word. While the phrasal verb can be used in the same manner as a single word English verb, an additional syntactic option exists for this construction. The particle may be placed after the verb's object, separate from the verb to which it is semantically connected. This alternation naturally only occurs in transitive sentences. There are also some phrasal verbs which do not occur with this construction, and for which this construction is considered ungrammatical. For the verbs which allow this construction, the alternative word order is obligatory when the object of the sentence is a pronoun (1 Curzan & Adams, 2006, p. 148). This is demonstrated in the examples below, where we see that, in examples (1), (2), (5), (6), (9), and (10), the object consists of a noun phrase with either a noun or a proper noun. In these examples, the alternative word order, with the particle following the noun phrase, is possible, but it is not the only available grammatical option. In examples (3) and (7), the noun phrase consists of a pronoun, and the particle occurs after the pronoun. Examples (4) and (8) show that the 'standard' word order, where the particle occurs after the verb and prior to the noun phrase, is ungrammatical when the noun phrase is a pronoun. (1) Mark asked out Jane; (2) Mark asked Jane out; (3) Mark asked her out; (4) Mark asked out her; (5) Jeremy put the lightbulbs in; (6) I put the kettle on; (7) Bring it on!; (8) Bring on it!; (9) Bring on the turkey!; (10) Bring the turkey on!.

Phrasal verbs have been present for much of the history of the English language; they are easily traceable back to early Middle English (2 McArthur, 1992, p. 773). There are similar constructions in other Germanic languages, such as Dutch, but such constructions are less common in other language families and can therefore be considered typologically unusual. Like the phenomenon of preposition-stranding, phrasal verbs appear to occur only in the Germanic languages (3 Newmeyer, 2005, p. 113).

Many phrasal verbs occur within semantic frames which are typically considered idiomatic. While often, certainly initially, analyzed as additional variations in the meaning of the root verb, the combination of the verb and the particle can result in a meaning drastically different from that of the root verb. These are called more idiomatic phrasal verbs "frozen verbs," relegating them to the realm of the lexicon. "Compositional" verbs, on the other hand, are seen as a verb plus a particle which adds aspect to the verb, while retaining the core meaning of the original verb (4 Machonis, 2009, p. 253). For example, Machonis identifies the aspect added by the particle up as completion, intensity, direction, or a combination of those three. Machonis argues that because certain phrasal verbs are "frozen" they are different from "compositional" verbs; however, once a phrasal verb is in usage, its compositionality changes and the meaning moves, sometimes quite swiftly, towards the metaphoric, rather than the literal. A compositional verb can eventually become a 'frozen' verb, or it can remain productive. Jackendoff comments on this: "Some combinations of verb + particles are productive, some are semi-productive, and some are purely idiosyncratic". However, Jackendoff does not elaborate on whether or not productivity in a phrasal verb depends on its being what Machonis calls "compositional." While the historical development of phrasal verbs is important to understanding the phenomenon, the end result is, of course, how the phrasal verbs are used at this point in time. Their current usage is better explained if we address their semantics. Turning to the semantics of the phrasal verbs, this section contains some description and discussion of the semantics involved in both the verbs and the particles. Many of the root verbs for phrasal verbs are monosyllabic, and are frequently verbs of motion, affect, giving, being, or doing (5 Dixon, 1992; McArthur, 1992). One root verb can be used with more than one particle, forming many phrasal verbs (e.g., get up, get out, get off, get on). While the type of verb root which phrasal verbs are drawn from is typically limited to a few semantic classes, the phrasal verbs themselves are not nearly so limited. Dixon writes that "the resulting phrasal verbs are distributed over a wider range of types; some of them have quite abstract and specialized meanings, for which there is no monomorphemic synonym.

A few examples listed below show that there are a number of common phrasal verbs whose parent verbs are Germanic in origin. Examples (16), (17), and (18), however, show that parent verbs for phrasal verbs are not limited to Germanic roots. The etymologies shown come from Pearsall (2002).

(11) bring about, bring along, bring back (Germanic root, Old English bringan)

(12) draw back, draw out (Germanic root, Old English dragan)

(13) break off (Germanic root, Old English brecan)

(14) go out, go up (Germanic root, Old English gan)

(15) take on, take out, take in (Germanic root, Old English tacan, from Old Norse taka)

(16) point out, point to (non-Germanic root, Old French pointer)

(17) carry on (non-Germanic root, Anglo-Norman French and Old North French carier, from Latin carrus).

(18) attend to (non-Germanic root, Old French attendre from Latin attendere)

The particles which form phrasal verbs are homophonous with the English class of prepositions (although not all English prepositions double as particles). Usually the particles are based on prepositions of location and direction. According to the Corpus of Contemporary American English [COCA], as of September 2012, the ten most frequently used particles were up, out, back, down, on, in, off, over, around, and about, with up having occurrences in the corpus, and about having occurrences. The corpus lists a total of English particles, while Machonis, citing Fraser, states that there are a total of fifteen particles in English. These drastically different numbers, fifteen versus ninety-seven, occur partly because Davies does not limit his definition of 'particle' to those which only occur with phrasal verbs, and partly because Fraser was working with a smaller set of data than Davies. In addition to this, phrasal verbs are currently very productive constructions, particularly in American English, as stated earlier, and there were simply more phrasal verbs in use in 2008 than there would have been in 1976.

Examples of the use of the ten particles listed above would include hold up, back out, draw back, put down, carry on, turn in, take off, carry over, go around, and bring about. Some of these include both so-called idiomatic meanings (they held up the bank) and meanings in keeping with the root verb (she held up the card).

Phrasal verbs are treated morphologically in much the same way as singleword verbs in English, with suffixes inflecting the verb for third person singular, past tense, or for progressive or perfective participles. The 'verb' part of the phrasal verb—the first word, which was 18 originally a separate verb—is the part which receives any inflection. If the original verb was irregular, it follows the same pattern of inflection as that irregular verb. For other instances of tense or aspect, the verbs are used in the same way as other English verbs, with tense and aspect indicated through auxiliary words. In examples (19) to

(28), the verbs, phrasal and nonphrasal, are marked in bold, so as to highlight the changes in morphology for the reader.

(19) You **try on** the shoes.

(20) He **tries on** the shoes.

(21) I am **trying on** the shoes.

(22) He **tried on** the shoes.

(23) He **tries** the whiskey.

(24) I **will try** the whiskey.

(25) I **crossed** the street.

(26) I **crossed out** the misspelled word.

(27) While **chewing** gum, I **blew** a bubble.

(28) The construction worker **blew up** the condemned building.

As can be seen in (19), the phrasal verb is zero-marked, which is typical of the second-person singular simple present in English, but in (20), *try on* is inflected to 'tries on' in keeping with the norm for the third-person singular simple present of *to try*. In the above examples, the parent verb for the phrasal verb is the same as the single-word verb; in each set, the verbs share the same inflection. The "verb" portion of phrasal verbs follows the same morphological patterns as other English verbs; it is homophonous with the parent verb, but due to the presence of its particle, it no longer has the same meaning.

While the case for phrasal verb status may at times be murkier with intransitive verbs, this problem of phrasal verb status is also a question which affects the assignment of transitivity to some phrasal verbs. Because the particles within the constructions are largely homophonous with the class of English prepositions, a following noun phrase can potentially be assigned the role of the object of a prepositional phrase, or the role of the object of the verb. This ambiguity means that some phrasal verbs are of indeterminate status regarding transitivity.

Intransitive phrasal verbs, despite their orthographic treatment as two separate words, essentially function as single-word verbs, as shown below, and are therefore of less interest in this study. In examples (29) to (33), intransitive phrasal verbs are marked in bold to show that the verb can occur followed by either a prepositional phrase or no complement at all.

(29) I **went over** to the other side of the street.

(30) She **lay down** on the couch.

(31) The noise **let up**.

(32) **Don't wait up!**

(33) **It'll work out**. The above examples follow the pattern established in the discussion of the morphology of phrasal verbs: the verb of the Verb-Particle construction is, like nonphrasal verbs, inflected for tense, number, person, or aspect. Auxiliary verbs are also used to convey tense and aspect. If the parent verb was irregular, the phrasal verb is also irregular. However, these phrasal verbs exhibit the same syntactic behaviour as single-word verbs:

(34) **Don't wait up!**

(35) **Don't steal!**

(36) I **went over** to Joe's place.

(37) I **walked** to Joe's place.

(38) The noise **let up**.

(39) The noise **abated**. The only syntactic difference shown here is the orthographic multi-word status of the phrasal verbs. Interestingly, intransitive phrasal verbs are quite similar to those phrasal verbs with multiple particles; there is no 'movement' of the particle, and the words are used as a unit, semantically and syntactically, despite being depicted as separate entities in the orthography. However, the particle is not so integrated into the verbal unit that it can receive morphological inflections: those markers appear only on the verb. Those phrasal verbs which are considered transitive non-separable verbs are significant because they are referred to as transitive (Master, 1996), despite the evidence for questioning whether or not they are actually transitive. In appearance, transitive non-separable phrasal verbs could simply be intransitive verbs followed by a prepositional phrase. However, they are often interpreted as phrasal verbs because the verb and particle are more semantically connected than the particle and the following noun phrase. For example, in (40), 'in' does not refer solely to the location of 'in the car' but also to the action of 'getting in.' In (41), the particle 'across' adds an additional semantic nuance to the verb 'run.' In both cases, the verb means something quite different when it does not occur with the particle.

(40) *He got in the car.*

(41) *I ran across an old friend at the store.*

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Physical sciences

FROM THE CORRECTED VERSION OF THE SRT IT FOLLOWS THAT TIME TRAVELS IS NOW AVAILABLE TO PEOPLE ON EARTH¹

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Abstract

Time travel, which until very recently was relegated to the genre of science fiction, is likely to soon become physically possible and technically feasible for people on Earth. And such a possibility is created by the corrected version of the special theory of relativity (SRT). But the version of SRT studied in all physics textbooks states that time travel on Earth will never be available to people. Nevertheless, ignoring this statement of the generally recognized SRT, currently millions of airplane passengers, daily traveling in space, also already make their unconscious and unnecessary time travel, which is confirmed by the translation of their watches to local time after landing the plane. And the article explains how to make such time travel conscious and necessary. And what needs to be done for this.

Keywords: *special relativity theory, anti-universe, anti-time, time zones of Earth, time travels*

1. Preface

The author published his three "top secret" articles in which the physical reality of imaginary numbers was proved, during the existence of the USSR. And after this, the Library of the US Congress contacted the author's place of work with a request to send an unclassified his publications. And at this time the author, having learned about the secret resolution² of the Presidium of the USSR Academy of Sciences 1964 prohibiting any criticism of the works of Albert Einstein, not wanting to be repressed, stopped his research and left the Moscow region for Ukraine. And he resumed his research only after the collapse of the USSR, as a result of which Ukraine became independent.

Later, already living in Ukraine, the author in 2008-2010. published five articles in English in which he again proved the physical reality of imaginary numbers. And thus, with his publications, he made the unsuccessful ORERA experiment in 2011 unnecessary. However, participants in the ORERA experiment ignored these publications. And the incorrect version of the SRT still continues to be studied in all physics textbooks. And these textbooks are used in the educational process of universities, even the most prestigious ones.

2. Introduction

The article explains that the special theory of relativity (SRT), studied in all physics textbooks, rightly recognized as an outstanding scientific achievement due to the principle of relativism proposed in it, nevertheless, due to the lack of necessary experimental knowledge in the 20th century, turned out to be largely incorrect³. Therefore, she could not explain the phenomena of dark matter and dark energy, the problem of baryon asymmetry, denied the existence of tachyons and antimatter, and incorrectly solved other problems of astrophysics. And due to the inability to explain the relativistic formulas obtained by the creators of this theory in the hyperluminal speed range, an incorrect postulate was introduced into this SRT, called the principle of not exceeding the speed of light, from which incorrect conclusions were drawn about the existence in nature of our only visible universe and about the physical unreality of imaginary numbers. But by denying the physical reality of imaginary numbers, the incorrect SRT unprovenly denied, although it did not admit it, the existence of radio engineering. But by denying the physical reality of imaginary numbers, this incorrect SRT denied the existence of radio technology and computer technology, resonance and bell ringing, tsunamis, piano music, swaying children's swings and much more. Therefore, due to the complete lack of experimental proof of its truth of this version of SRT, Albert Einstein for its creation, even despite the fact that he was nominated for the Nobel Prize 66 times, never received it.

¹ This is reprint of the article "Antonov A. A. 2026. How to call yourself to yesterday? Norwegian Journal of Development of the International Science No 172".

² which has not yet been canceled

³ For a new theory, this is forgivable. But then it still needs to be corrected.

This incorrect version of the theory of relativity also denies the possibility of time travel for humans. But every day, millions of airplane passengers on Earth make such time travel that they don't need. And this article explains how to make time travel necessary and beneficial for people on Earth.

3. The version of SRT taught in all physics textbooks is incorrect

However, while being brilliant in its concept, the version of SRT taught in all physics textbooks is nevertheless largely incorrect, since::

- *the relativistic formulas obtained in this SRT are incorrect, because it is ignored the fact that the argument 'velocity' in them, in accordance with Newton's first law, is the fourth spatial dimension⁴ [1]-[5];*
- *the formula for the relativistic mass $m(v)$ in the hyperluminal $v > c$ speed range corresponds to a physically unstable process that cannot exist in nature;*
- *being unable to explain the physical meaning of the imaginary values of the quantities $m(v)$, (v) , $l(v)$ in the hyperluminal $v > c$ speed range, the authors of the SRT, in order not to explain their relativistic formulas in this range, introduced an incorrect postulate into it, called the principle of not exceeding the speed of light, which is incompatible with the fourth spatial dimension.*
- *in the 21st century, despite the fact that the attempt to refute SRT with the OPERA experiment [6] at the Large Hadron Collider was unsuccessful, it was still experimentally proven that imaginary numbers are physically real [7]-[24]. And, therefore, the principle of not exceeding the speed of light in the generally accepted SRT and this version of SRT itself, which is studied in textbooks, are incorrect [25]-[57].*

In addition, the conclusions drawn from incorrect relativistic formulas using the incorrect principle of not exceeding the speed of light are also incorrect:

- *about the existence in nature of our only visible universe;*
- *about the physical unreality of imaginary numbers.*

4. Proof of the physical reality of imaginary numbers

But by now, numerous [7]-[24] experimental evidence of the physical reality of imaginary numbers have already been published. All of them are quite simple and can be completed by one radio engineer in less than one day. They can therefore always be repeated and checked in any other radio engineering laboratory. In contrast to these simple radio engineering experiments, the unsuccessful OPERA physics experiment at the Large Hadron Collider was carried out for a total of almost 15 years (2003-2018).

And so that the reader can convince himself of the truth of the mentioned radio engineering experiments, let us consider one of them as an example. The rest are also quite simple experiments mentioned in the list of references.

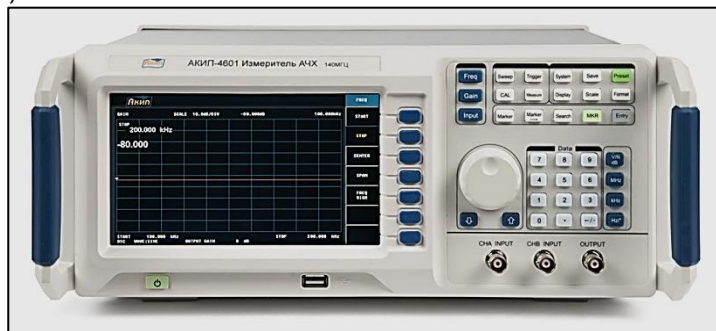


Fig. 1. Every radio engineering laboratory has devices called frequency response meters, which, by their very existence, prove the physical reality of imaginary and complex numbers. And thus, they made the OPERA experiment at the Large Hadron Collider unnecessary.

From the well-known Ohm's law in the interpretation of Steinmetz [58], the validity of which is daily confirmed by millions of radio engineers throughout the world through their practical activities, it follows that in addition to the electrical resistance R of resistors, measured by real numbers, there are also electrical resistances $-j/\omega C$ of capacitors and $+j\omega L$ of inductors, which are measured by imaginary numbers.

Consequently, if these imaginary numbers $-j/\omega C$ and $+j\omega L$, in accordance with the generally accepted version of SRT are physically unreal, then the electrical resistance of any electrical LCR-circuit will always be measured in real numbers and will not depend on frequency. Therefore, when the

⁴ Not to be confused with the fourth dimension in four-dimensional space-time (Minkowski space).

frequency ω of the applied voltage changes, the amount of current flowing through such an electrical circuit will not change.

And vice versa, if the imaginary resistances $-j/\omega C$ and $+j\omega L$ are physically real, then the electrical resistance of any electrical LCR-circuit will be measured in complex numbers and when the frequency ω of the applied voltage changes, its resistance will change. Therefore, in accordance with Ohm's law, the magnitude of the current flowing through this electrical LCR-circuit will also change.

Consequently, an experiment proving the physical reality of imaginary numbers is extremely simple. You just need to change the frequency ω of the voltage applied to any electrical LCR-circuit and measure the value of electric current flowing through it. And all radio engineers know that in this case its value will change. Thus proving the physical reality of imaginary numbers.

For over half a century, devices called frequency response meters (Fig. 1) have existed and been mass-produced. They measure the transfer functions of electrical LCR circuits described by complex numbers. But only something physically existing can be measured. Therefore, the very existence of frequency response meters proves the physical reality of imaginary numbers.

However physicists did not do such an experiment, since in fact, as shown below, on the contrary, they need evidence of the physical unreality of imaginary numbers. Which do not exist in nature.

4. Corrected version of SRT

And since the physical reality of imaginary numbers has just been proven in the most indisputable way, it remains to fully and correctly explain (which no one has done over the past hundred years) the relativistic formulas of SRT [59]-[67].

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

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

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

in which m_0 is the rest mass of a moving body;

m is the relativistic mass of a moving body;

Δt_0 is the rest time of a moving body;

Δt is the relativistic time of a moving body;

l_0 is the rest length of a moving body;

l is the relativistic length of a moving body.

And it turned out to be elementarily simple. These formulas correspond to the graphs in Fig. 2a,b,c. And they show that these graphs in the subluminal $v < c$ and superluminal $v > c$ ranges of the argument v have different appearances. Therefore, the same processes cannot occur in these ranges. And in order for the same processes to occur in these ranges, the graphs of the corrected relativistic formulas should look the same, as shown in Fig. 2d,e,f. And for this, in formulas (1)-(3), since the speed v in them is the fourth spatial dimension, the factor i^q must be introduced

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

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

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

where $q(v) = [v_q/c]$ is the "floor" function of discrete mathematics from the argument v_q/c (its graph shown in Fig. 3a), which is the fourth spatial dimension;

$w = v - qc$ is the local speed in all universes (its graph is shown in Fig. 3b).

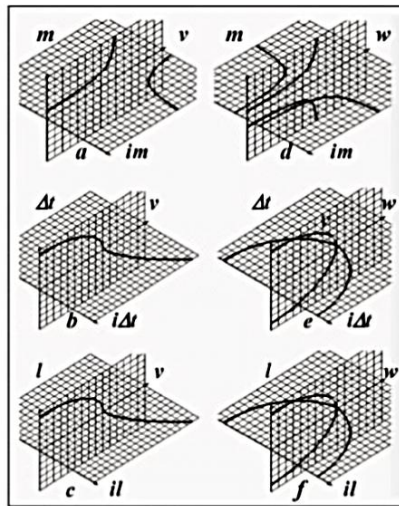


Fig 2. Graphs of functions $m(v)$, $\Delta t(v)$, $l(v)$, corresponding to the existing and revised versions of SRT in the subluminal $v < c$ and hyperluminal $v > c$ ranges

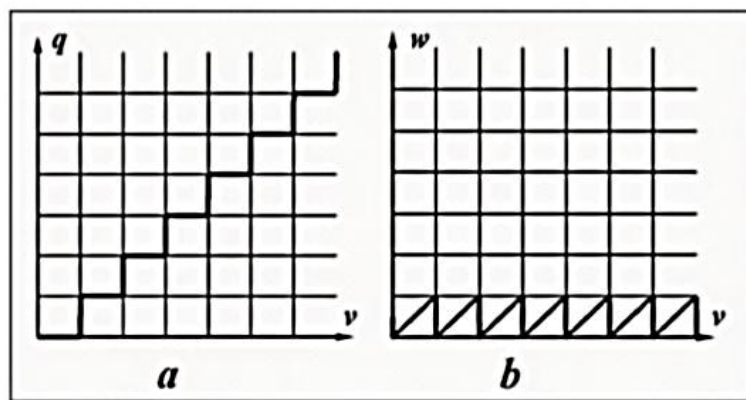


Fig. 3. Graphs of functions $q(v)$ and $w(v)$, illustrating the meaning of the "floor" function of discrete mathematics

At that, this function iq in formulas (4)-(6), which determines the essence of each universe, for integer values of the argument $q(v)$ equal to ... 0, 1, 2, 3, 4, 5, ..., takes the values +1, +i, -1, -i, +1, +i, ... etc. And the value $q(v) = 0^5$ in formulas (4)-(6) for the range of sublight speeds $v < c$ corresponds (since $i^0 = 1$) to our visible universe, which for definiteness we will call the tardyon universe⁶ (see Fig. 3). The value $q(v) = 1$ in the hyperluminal speed range $2c > v > c$ corresponds (since $i^1 = i$) to some other invisible universe, since it is located beyond the event horizon. For definiteness, we will therefore call it the tachyon universe⁷. Then the value $q(v) = 2$ in the speed range $3c > v > 2c$ will correspond (since $i^2 = -1$) to an invisible tardion antiverse. The value $q(v) = 3$, in the speed range $4c > v > 3c$ will correspond (since $i^3 = -i$) to an invisible tachyon antiuniverse. The value $q(v) = 4$ in the speed range $5c > v > 4c$ will correspond (since $i^4 = +1$) to another (and therefore also invisible) tardyon universe. The value $q(v) = 5$ in the speed range $6c > v > 5c$ will correspond (since $i^5 = +i$) to another tachyon universe. Etc.

⁵ Those, if we take our visible universe as the origin of coordinates q .

⁶ Tardyon universe is a term used by Isaak Asimov in his short story 'Take a Match'.

⁷ Tachyon universe is a term used by Isaak Asimov in his short story 'Take a Match'.

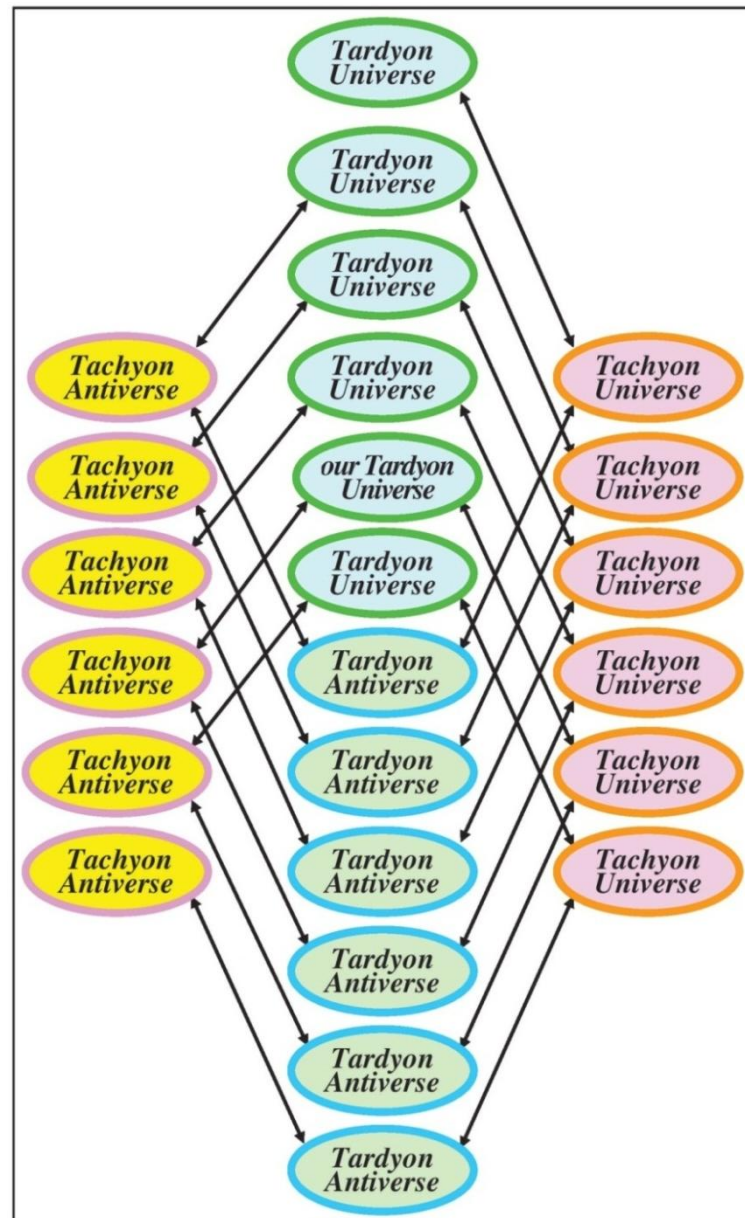


Fig. 4. Structure of the hidden Multiverse corresponding to the principle of physical reality of complex numbers

Consequently, in nature there is not only, as stated in the generally accepted version of SRT, our visible universe corresponding to formulas (1)-(3), but also many other mutually invisible⁸ universes and antiuniverses corresponding to formulas (4)-(6). And these mutually invisible universes and antiuniverses, together with our visible universe, form the Multiverse, which we therefore called hidden. Such a hidden Multiverse, the structure of which is helical, is shown in Fig. 3.

6. The invisible universes and anti-universes of the hidden Multiverse are dark matter and dark energy

However, in this structure it is still necessary to take into account and explain the phenomena of dark matter and dark energy, so named because of their incomprehensibility, since not a single chemical element has been found in them, and also because they do not emit, absorb, reflect or refract electromagnetic radiation and, therefore, are invisible. Finally, it is not clear why dark matter and dark energy, which accounts for more than 95% of all mass-energy contained in nature, are being persistently searched for at the Large Hadron Collider in the microcosm of our only visible universe. In fact, it is impossible to explain it this way.

Therefore, let us assume that dark matter and dark energy are all other mutually invisible universes and antiuniverses of the hidden Multiverse. Then the phenomena of dark matter and dark energy will be a gravitational shadow on our visible universe from the remaining mutually invisible universes and

⁸ Since they are all beyond the event horizon

antiuniverses included in the hidden Multiverse. That is why these phenomena do not contain, like our shadow on a sunny day, a single chemical element, and dark matter and dark energy contain more than 95%⁹ of all mass-energy contained in nature. This assumption explains all the incomprehensibility of phenomena simply and clearly. That's why we will use it.

Then, assuming that over the billions of years of its existence, the mass-energy of all universes and antiuniverses of the hidden Multiverse, due to the presence of a huge number of portals between them according to the law of communicating vessels, has been largely averaged, it becomes possible, using the data obtained by the WMAP and Planck spacecraft, to determine the structure of the hidden Multiverse. And according to data obtained by the WMAP spacecraft [68], the mass-energy of our visible universe (in fact, our hidden Multiverse) consists of 4.6% baryonic matter, 22.4% dark matter and 73.0% dark energy. And according to more recent data obtained by the Planck spacecraft [69], the mass-energy of our visible universe (again, actually our hidden Multiverse) consists of 4.9% baryonic matter, 26.8% dark matter and 68.3% dark energy. As you can see, these data differ little from each other, which proves their truth. Therefore:

- the entire hidden Multiverse, according to experimental data obtained by the WMAP spacecraft, consists of $100\% / 4.6\% = 21.8$ parallel universes, and according to data obtained by the Planck spacecraft, it consists of $100\% / 4.9\% = 20.4$ parallel universes;
- dark matter, according to experimental data obtained by the WMAP spacecraft, consists of $22.4\% / 4.6\% = 4.9$ parallel universes, and according to data obtained by the Planck spacecraft, it consists of $26.8\% / 4.9\% = 5.5$ parallel universes;
- dark energy, according to experimental data obtained by the WMAP spacecraft, consists of $73.0\% / 4.6\% = 15.9$ parallel universes, and according to data obtained by the Planck spacecraft, it consists of $68.3\% / 4.9\% = 13.9$ parallel universes;
- and our visible universe, naturally, is only one.

7. Corrected version of SRT (continued)

As can be seen, received by the WMAP and Planck spacecraft experimental data did not confirm the above conclusions about the structure of the hidden Multiverse, since our visible universe actually has not two neighboring invisible parallel universes - one tachyon universe and one tachyon antiuniverse - but five or six¹⁰.

Consequently, there was some error in the previous reasoning. And we, it turns out, were wrong in assuming that in the hidden Multiverse there is only one additional dimension q . And therefore, when describing it, they used complex numbers containing only one imaginary unit. And now, in order for six other parallel universes to coexist with our visible universe in the really existing hidden Multiverse - three tachyon universes and three tachyon antiuniverses - it is necessary to have three additional dimensions q, r, s . At the same time relativistic formulas must be corrected again as follows [70]-[77]

$$m(q, r, s) = \frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1 - [v/c - (q + r + s)]^2}} \quad (7)$$

$$\Delta t(q, r, s) = \Delta t_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (8)$$

$$l(q, r, s) = l_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (9)$$

where $q(v) = [v_q/c]$ is the "floor" function of discrete mathematics from the argu-

ment v_q/c which is one of the orthogonal coordinates q of the fourth spatial dimension v ;

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

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

v_q, v_r, v_s is projections of the velocity vector v onto the orthogonal coordinates q, r, s (see Fig. 4).

The space of such a hidden Multiverse will already be six-dimensional (see Fig. 4). And its structure will correspond to the quaternions $\sigma + i_1\omega_1 + i_2\omega_2 + i_3\omega_3$, i.e. hypercomplex numbers [78] containing exactly three imaginary units i_1, i_2, i_3 , which are related to each other by the relations

⁹ That is, about 20 times more than in our entire visible universe.

¹⁰ According to WMAP data 4.9 universes and Planck data 5.5 universes

$$i_1^2 = i_2^2 = i_3^2 = -1 \quad (10)$$

$$i_1 i_2 i_3 = i_2 i_3 i_1 = i_3 i_1 i_2 = -1 \quad (11)$$

$$i_1 i_3 i_2 = i_2 i_1 i_3 = i_3 i_2 i_1 = 1 \quad (12)$$

In such a quaternion structure of the hidden Multiverse [79], in contrast to its structure considered earlier (in Fig. 3), the distribution of material content in each three-dimensional parallel universe will be determined by a certain function $f_{q,r,s}(x, y, z)$, and the coordinates of these universes will be determined by the values $i_1 q, i_2 r, i_3 s$. Those. the hidden Multiverse (see Fig. 4) will be described by the formula $f_{q,r,s}(x, y, z) + i_1 q + i_2 r + i_3 s$. This is exactly what Lisa Randall predicted: "Perhaps we live in a three-dimensional pocket of higher dimensional space".

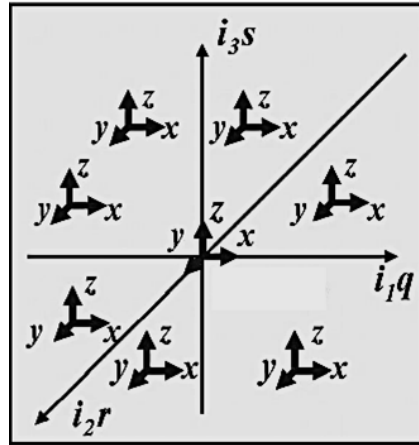


Fig. 4. Six-dimensional space of the hidden Multiverse, where q, r, s are the coordinates of invisible parallel universes, and x, y, z are the coordinates of the matter content in each parallel universe

From formulas (7)-(9) it follows that such a hidden Multiverse still has a helical structure, and its mutually invisible universes and antiuniverses (in addition to our visible universe) form dark matter and dark energy. In this case, it is possible to move into the tardion antiuniverse from the tardion universe and into the tardion universe from the tardion antiuniverse in various, but not arbitrary, ways, but only in such a way (see Fig. 5), in which the value of i^q will successively take on the values $+1, +i_1 \oplus i_2 \oplus i_3, -1, -i_1 \oplus i_2 \oplus i_3, +1, \dots$ and etc., where $\oplus$ is the symbol of the logical operation of discrete mathematics 'exclusive OR'. In this case, different trajectories of movement from one universe (or antiuniverse) to another can differ only due to the replacement of some tachyon universes from i_1, i_2, i_3 with others and some tachyon anti-universes from i_1, i_2, i_3 with others. Consequently, tachyon universes i_1, i_2, i_3 in the hidden Multiverse are located parallel to each other. Tachyon antiuniverses i_1, i_2, i_3 are also located parallel to each other for the same reasons. And therefore, in the hidden Multiverse, when transitioning from any tardion universe to a tardion anti-universe and then to another tardion universe, parallel universes and antiverses must alternate in the following sequence - 'tardion universe', 'one of the tachyon universes', 'tardion anti-universe', 'one of the tachyon anti-universes', 'tardion universe', 'one of tachyon universes', etc.

One of the easiest to explain such possible quaternion structures of the hidden Multiverse is shown in Fig. 6. Its difference from the structure shown in Fig. 4 is the presence in it of several different tachyon universes and antiuniverses located in

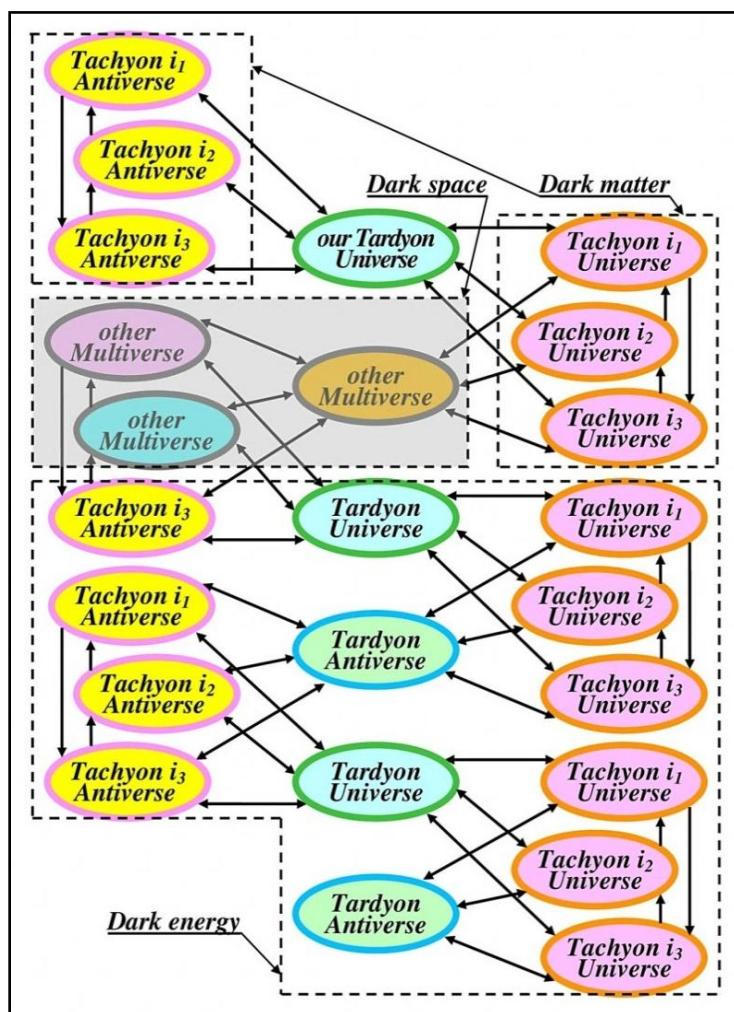


Fig. 6. Structure of the hidden Multiverse corresponding to the principle of physical reality of hypercomplex numbers

parallel, corresponding to three imaginary units i_1, i_2, i_3 . Another difference is the presence in such a structure of the Multiverse of not only bidirectional portals corresponding to formula (7) and indicated by two-way arrows, but also unidirectional portals corresponding to formulas (8), (9) and indicated by one-way arrows.

In Fig. 6 all these transitions are shown. Moreover, since the data obtained by the WMAP and Planck spacecraft correspond to the not closed screw structures of our hidden Multiverse, united through the corresponding portals with other Multiverses, then all together they form the Hyperuniverse.

8. How to see invisible universes and anti-universes?

But in order to believe in the existence of the Multiverse mentioned in the article instead of the Monoverse mentioned in the textbooks, experimental confirmation of the above is necessary [80]-[97]. Those. it is necessary to prove that in addition to our visible universe, there are other universes and anti-universes in nature.

And it is possible to do this.

Eventually, the invisible universes and anti-universes in outer space, drifting in their different dimensions, touch each other in many places and even slightly immerse themselves in each other, forming transitions called portals between the touching universes and anti-universes. And since the constellations in the starry sky in neighboring universes and antiuniverses are always different¹¹, when moving through portals, the map of the starry sky in them will change, which will prove the existence of invisible universes neighboring the Earth. On Earth there are more than two hundred thousand anomalous zones¹² [98]-[101], which are entrances to portals. Moreover, in some of them observatories are already located. For example, the Main Astronomical Observatory of the Academy of Sciences of Ukraine is 12 km away from the center of the capital of Ukraine, Kyiv, in the Goloseevsky forest. Therefore, by comparing maps of the

¹¹ Like all people, everything that is in their apartments

¹² Which in itself confidently – more than two hundred thousand times – also confirms the existence of neighboring universes and anti-universes.

starry sky on a computer in portals (or even in anomalous zones) and outside portals, universes neighboring the Earth can be discovered. And as a result of astro-geophysical studies of portals, it will be possible to determine the main parameters of neighboring tachyon universes and antiuniverses. Which will ultimately allow us to determine the structure of our hidden Multiverse.

9. Where are antimatter and anti-time located?

And this structure of the hidden Multiverse allows us to explain another problem that is currently inexplicable within the framework of all physics textbooks - where antimatter is located [102]-[112]. It is clear that it cannot be in our visible universe¹³, since due to its annihilation with matter, our universe would then cease to exist. But the fact that antimatter exists has been proven experimentally. In 1995, a sensational result was obtained at CERN - scientists managed to obtain nine antihydrogen atoms, which lasted for about forty billionths of a second. And just one gram of such antihydrogen would cost 662.5 trillion dollars.

Consequently, this experiment can be considered proof that, in accordance with formulas (7)-(9), antimatter can exist in nature in the invisible tardyon and tachyon antiuniverses of the hidden Multiverse and Hyperuniverse. (see Fig. 5). Moreover, in these invisible tardyon and tachyon anti-universes, anti-time and anti-space also exist.

10. Time travels

And the discovery of anti-time already allows us to assert that due to the choice of one or another route of travel in space, time travel also becomes possible [113]-[123], since from formulas (8), (9) it follows that time Δt in universes and antiuniverses during such travel will always change simultaneously with the change in distance l . But since neither the portals, much less the universes and anti-universes of the hidden Multiverse, are still unexplored, time travel in space is now inaccessible to us. And that's why we're interested in time travel on Earth now.

However, although official modern science admits the possibility of time travel in some exotic situations in the special¹⁴ and general¹⁵ theories of relativity, as well as in quantum physics¹⁶, it still claims that time travel of people on Earth, neither now nor in the distant future, will never be possible.

Nevertheless, these time travels on Earth are now already carried out by airplane flights. And millions of people take part in these flights every day, since upon landing at any airport, air passengers always change their watches to a local time other than at the airport of departure. Thus, they confirm their time travel. Indeed, due to the rotation of the Earth and the presence of time zones on it, movement in space on Earth, as in space, is always accompanied by movement in time.

And when explaining this situation, we must take into account the existence in nature of two different types of time that we will use - internal human time, which we have always used until now, and external time, which, on the contrary, we have never used before. These two times are generated by different processes that exist independently of each other and have different features. Internal time is determined by processes occurring in human bodies. One second is one contraction of the human heart. Therefore, internal time is the biological time of people. External time is determined by processes occurring in the external environment. Namely, by the rotation of the Earth and the existence of time zones. These features of it are reflected in formula, absent from physics textbooks, derived from the relativistic SRT formulas (5), (6) and (8), (9)

$$\Delta t = \Delta t_0 \, l / l_0 \quad (13)$$

in which Δt is external time in hours;

Δt_0 – 24 hours;

l – path length in the direction perpendicular to time zones;

l_0 – the length of a circle that intersects 24 time zones at a given latitude.

These two different times also have different properties. Human biological time cannot flow backwards. A person cannot return to his youth or childhood. And external time, when changing the direction of movement, can change its sign - the plane can fly across time zones both to the west and to the east. When the speed of movement of the aircraft changes, the value of external time will also change. Therefore, in the external environment it is possible to move both into the past and into the future. Moreover, even short-term movements in external time can sometimes be very useful¹⁷. This is known to everyone,

¹³ But the textbooks state that there are no other universes in nature besides it. And this, naturally, gives reason to doubt the truth of this version of SRT.

¹⁴ For example, in the 'twin paradox'

¹⁵ For example, in a region of ultra-high gravity near the event horizon of a black hole

¹⁶ For example, as a result of teleportation not of information, but of physical objects

¹⁷ For example, by traveling time first to the past and then to the future, it would probably be possible to save President John Fitzgerald Kennedy after the assassination attempt [124]-[134].

although it has not yet been used in any way in human activity. But this is a free resource given to us by nature for solving the problem of people traveling through time, which would even seem easy to use (you just need to fly on an airplane).

The only difficulty with this is that such time travel on Earth necessarily involves unnecessary travel over long distances, which is why they are not used. However, this problem can be solved. Airplane flights must be carried out in compliance with one mandatory condition. The flight of the aircraft must be around the world, that is, all the time from takeoff to landing at the same airfield from which the aircraft took off, it must be carried out in the same direction - to the West or to the East, as a result of which, ultimately, the movement of the aircraft in space can be ignored.

Table 1. Examples of business jet performance flight performance characteristics that could be used for time travels

Aircrafts	Maximum range	Cruising speed	Hourly rates	Seats
Citation Latitude	5 300 km	815 km/h	3 500 €/hour	8
Citation Longitude	7 400 km	910 km/h	5 000 €/hour	12
Challenger 300	5 700 km	850 km/h	4 900 €/hour	8
Challenger 350	5 926 km	850 km/h	4 000 €/hour	9
Challenger 600	5 500 km	850 km/h	4 600 €/hour	12
Challenger 3500	6 297 km	985 km/h	5 500 €/hour	10
Falcon 20	4 200 km	987 km/h	3 900 €/hour	8
Falcon 50/50EX	5 600 km	850 km/h	4 900 €/hour	8-10
Global 5500	10 927 km	900 km/h	8 000 €/hour	16
Gulfstream G150	5 200 km	850 km/h	3 900 €/hour	6-8
Gulfstream G200	5 000 km	870 km/h	6 200 €/hour	8
Hawker 850 XP	4 800 km	750 km/h	3 400 €/hour	6-8
Hawker 900XP	5 400 km	865 km/h	3 700 €/hour	6-8
Hawker 4000	5 280 km	890 km/h	5 400 €/hour	10
Learjet 70	3 815 km	967 km/h	3 500 €/hour	7
Legacy 450	5 370 km	860 km/h	3 300 €/hour	8
Praetor 600	7 400 km	850 km/h	6 000 €/hour	12

Table 2. The value of external time at different latitudes

Location of departure and arrival airfields	Geographic coordinates of the airfield	Size of 24 time zones for a round-the-world flight	Size of one time zone.
Santiago de Chile	33,45° S.	33422 km	1393 km
Buenos Aires	34,60° S.	33021 km	1375 km
Melbourne	37,82° S.	31339 km	1306 km
New York City	40,72° N.	30456 km	1269 km
Reykjavík	64,15° N.	17616 km	734 km
Murmansk	69,58° N.	14424 km	601 km
Kirkenes	69,73° N.	14376 km	599 km
Longyearbyen (Spitsbergen, Norway)	78,13° N.	8184 km	341 km
Alert, (Canada)	82,5° N.	5230 km	218 km

There are many aircraft models suitable for use in time travel. They are called business jets. And Table 1 shows, as an illustration, the flight performance characteristics of some of these business jets. And Table 2 lists airfields close enough to the North Pole that can provide the shortest routes for round-the-world flights.

Therefore, time travels to the present is already physically and technically feasible.

12. Conclusion

From the above it follows that for Albert Einstein in his version of SRT, it turns out that the most important thing was to prove not physical reality, but, on the contrary, the physical unreality of imaginary numbers. Because otherwise it became clear to everyone that his theory was frankly incorrect.

But the physical reality of imaginary numbers in radio engineering was factually proven by Charles Proteus Steinmetz in his proposed interpretation of Ohm's law back in 1893. That is, before the creation by Albert Einstein and Jules Henri Poincaré in 1905 of the version of SRT that is now studied in all physics textbooks. And since then, radio engineers have never had the slightest reason to doubt this, since always when the frequency of the sinusoidal voltage applied to any electrical LCR-circuit changes, the amount of current flowing through it changes. This well-known fact, which occurs in the practical activities of radio engineers literally at every step, is an extremely simple, absolutely understandable and irrefutable proof of the physical reality of imaginary numbers.

And Albert Einstein, in his proposed version of SRT, needed to obligatorily object to this¹⁸. For this reason, a postulate¹⁹ was introduced into the SRT, called the principle of not exceeding the speed of light, from which a conclusion was made about the physical unreality of imaginary numbers²⁰, which was not confirmed by any experiments. And only the Nobel Committee - and this causes the greatest respect for it - remained faithful to common sense and scientific integrity. Due to the lack of any experimental evidence of the truth of the proposed version of SRT, despite the fact that Albert Einstein was nominated for the Nobel Prize 66 times, he never received it for this theory.

And in order to preserve the denial of the physical reality of imaginary numbers in SRT, relativistic physicists had to make great sacrifices. In particular, in order to create the impression that it is impossible to refute the statement of SRT about the physical unreality of imaginary numbers, at the Large Hadron Collider (worth ten billion dollars), the OPERA collaboration, which includes more than one hundred of the most authoritative physics professors, carried out the unsuccessful OPERA experiment for almost 15 years²¹ (2003-2018), which allegedly had as its goal proving the physical reality of imaginary numbers, but not managed to do it. And thereby allegedly proving the impossibility of refuting the statement about the physical unreality of imaginary numbers. In 2011, its sensationally successful completion was even announced, but six months later in 2012 it was announced that it had been refuted at the same Large Hadron Collider by the ICARUS experiment.

For this reason, numerous publications were ignored, citing simple and easily understood radio engineering experiments that successfully demonstrated the physical reality of imaginary numbers and explained that if imaginary numbers were truly, as claimed in the SRT, physically unreal, then all radio engineering devices and computers would not exist, tsunamis, bell ringing, piano music would not exist, children's swings would not swing after a parent's push, and much more.

Furthermore, because of the assertion of the physical unreality of imaginary numbers and, therefore, the existence of our only visible universe in nature, it turned out that antimatter and tachyons had no place in single visible universe. The corrected version of the SRT, however, explains where they are located.

It also turned out that due to the statement about the physical unreality of imaginary numbers and therefore about the existence in nature of our only visible universe, the phenomena of dark matter and dark energy have not been and will never be explained, since dark matter and dark energy are actually, according to the corrected version of SRT, mutually invisible universes and antiuniverses of the really existing hidden Multiverse.

More than two hundred thousand anomalous zones have also been discovered on Earth, which are entrances to portals to the invisible universes and antiuniverses neighboring our visible universe. And even this alone already proves their existence. Moreover, these universes and antiuniverses, invisible outside the portals, can also be seen by astronomical observations of the starry sky in portals. But these low-cost astronomical observations, which would allow sensational scientific discoveries of other universes, are still not carried out due to fears that these invisible neighboring universes and antiuniverses can actually be seen. And then the version of SRT studied in textbooks will undoubtedly have to be recognized as incorrect.

In the version of SRT studied in physics textbooks, it was also concluded that time travel is impossible for people. Although in fact, millions of air passengers on Earth already make such time travel every day, which is confirmed by the translation of their watches to local time after the planes land. But since such time travel by airline passengers occurs simultaneously with travel on Earth, they are not used. And the article explains how it is still physically and technically possible to travel through time on airplanes without ultimately traveling through space.

Less expensive telephone time travel is also possible, which, when needed, can be implemented quickly and inexpensively. Then telephone conversations with people located in the past or future tense will become publicly available. However, probably the most promising is the joint use of aviation and telephone options for time travel: aviation when crossing time zones over the ocean, and telephone when crossing them over land.

¹⁸ Unable to explain in any other way the incorrect relativistic formulas of SRT in the hyperlight range of speeds

¹⁹ As it turned out later, it turned out to be incorrect and refuted by all published experimental evidence of the physical reality of imaginary numbers.

²⁰ At the beginning of the 20th century, this assumption saved special relativity, as it allowed it to be explained somehow. Otherwise, a theory that its creators couldn't explain would have been of no use to anyone. Therefore, back then, such an assumption, as a temporary measure, was acceptable. But now, in the process of knowledge, it's time to move on.

²¹ Let's remember - one day is more than enough for a radio engineering experiment proving the physical reality of imaginary numbers.

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Psychological sciences

SOCIAL AND PSYCHOLOGICAL CORRECTION OF INADEQUATE PARENTAL POSITIONS

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СОЦІАЛЬНО-ПСИХОЛОГІЧНА КОРЕКЦІЯ НЕАДЕКВАТНИХ БАТЬКІВСЬКИХ ПОЗИЦІЙ

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Abstract

Parent-child relationships play a crucial role in the psychological development of children and adolescents. Modern social changes and psychological stress factors significantly influence family dynamics and parental attitudes. Inadequate parental positions may lead to emotional instability, low self-esteem, and difficulties in social adaptation among adolescents.

The purpose of this research is to identify the main factors influencing the formation of inadequate parental positions and to determine effective methods of their social and psychological correction.

The empirical study involved adolescents aged 14–16 and their parents. The sample consisted of 100 respondents. The research methods included the Span-Fisher Attachment Scale, the Dembo–Rubinstein self-esteem method (modified by A. Parafiyani), the Family Adaptability and Cohesion Evaluation Scales (FACES-III), the ADOR questionnaire “Adolescents about Parents,” and the method of scaled self-assessment of psychophysiological state by O. Kokun.

The results demonstrated a predominance of ambivalent and avoidant attachment styles, indicating emotional tension in family relationships. Based on the obtained results, a social and psychological correction program aimed at improving parental competence and developing effective communication strategies was proposed.

Keywords: parental position, parenting styles, parent-child relationships, family psychology, psychological correction, adolescents

Основна частина

Вступ. Проблема дитячо-батьківських відносин є однією з ключових у сучасній психологічній науці. Умови соціальних трансформацій, економічних змін та підвищеного рівня психологічного стресу значною мірою впливають на структуру та характер сімейних взаємин. У результаті цього можуть формуватися неадекватні батьківські позиції, які негативно впливають на психологічний розвиток дитини.

Батьківська позиція розглядається як комплекс установок, емоційних реакцій, поведінкових стратегій і ціннісних орієнтацій, які визначають характер взаємодії батьків із дитиною. Вона формується під впливом особистісних характеристик батьків, їхнього життєвого досвіду, соціокультурних умов та особливостей розвитку дитини.

Наукові дослідження показують, що стиль батьківської поведінки відіграє важливу роль у формуванні самооцінки, емоційної стабільності та соціальної компетентності дитини. Однією з найбільш відомих класифікацій стилів виховання є типологія Д. Баумрінда, яка виділяє авторитетний, авторитарний, ліберальний та байдужий стилі виховання.

У сучасних умовах багато батьків стикаються з труднощами у побудові ефективної взаємодії з дітьми. Це може призводити до надмірного контролю, емоційної дистанції або недостатньої уваги до потреб дитини. Тому дослідження чинників формування неадекватних батьківських позицій та розроблення ефективних програм їх корекції є актуальним завданням сучасної психології.

Метою дослідження є визначення чинників формування неадекватних батьківських позицій та розроблення шляхів їх соціально-психологічної корекції.

Методи дослідження

Емпіричне дослідження проводилося серед підлітків віком 14–16 років та їхніх батьків. Загальна вибірка становила 100 осіб: 50 підлітків і 50 батьків.

Для дослідження були використані такі психодіагностичні методики: методика визначення прив'язаності «Шкала Спана-Фішера»; методика діагностики самооцінки Дембо–Рубінштейн (модифікація А. М. Парафіян); опитувальник «Шкала сімейної адаптації та згуртованості» (FACES-III) Д. Олсона; опитувальник «Підлітки про батьків» (ADOR) Е. Шафера; методика шкалової самооцінки психофізіологічного стану О. М. Кокуна.

Обробка результатів здійснювалася за допомогою методів описової статистики та аналізу відсоткових показників.

Результати дослідження

Результати дослідження показали, що серед респондентів переважають амбівалентний та уникаючий стилі прив'язаності. Зокрема, безпечний стиль прив'язаності було виявлено лише у 20% учасників дослідження, тоді як 30% респондентів продемонстрували амбівалентний стиль прив'язаності і ще 30% — уникаючий.

Підлітки з амбівалентним стилем прив'язаності характеризуються підвищеним рівнем тривожності, емоційною залежністю та страхом втрати близьких взаємин. Водночас підлітки з уникаючим стилем прив'язаності схильні до емоційної дистанції та труднощів у вираженні почуттів.

Отримані результати свідчать про наявність певних труднощів у формуванні гармонійних дитячо-батьківських взаємин та недостатній рівень емоційної взаємодії між батьками і дітьми.

На основі результатів дослідження було розроблено програму соціально-психологічної корекції, спрямовану на формування адекватної батьківської позиції. Програма включає психологічні тренінги, консультації та практичні вправи для батьків, які сприяють розвитку емоційної компетентності, формуванню ефективних комунікативних навичок та підвищенню усвідомленості батьківської ролі.

Висновки

Результати дослідження підтверджують значну роль батьківських позицій у психологічному розвитку підлітків. Неадекватні батьківські позиції можуть призводити до виникнення емоційної нестабільності, зниження самооцінки та труднощів у соціальній адаптації дітей.

Розроблена програма соціально-психологічної корекції спрямована на підвищення батьківської компетентності, покращення комунікації у сім'ї та формування конструктивних моделей взаємодії між батьками і дітьми.

Подальші дослідження можуть бути спрямовані на оцінку ефективності таких програм у різних соціальних та культурних умовах.

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Technical sciences

THE TRANSFORMATIVE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN EDUCATION AND RESEARCH

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Abstract

The rapid development of Information and Communication Technologies (ICT) has profoundly transformed educational systems and research practices across the globe. Digital technologies facilitate new forms of knowledge production, collaboration, and dissemination. This study examines the role of ICT in contemporary education and research, focusing on its impact on learning processes, academic productivity, and global knowledge exchange. Drawing on a qualitative review of relevant scholarly literature, the research highlights the opportunities and challenges associated with ICT integration. The findings suggest that ICT enhances access to information, promotes collaborative research, and supports innovative teaching practices. However, issues such as digital inequality, technological dependence, and data security continue to present significant challenges for educational institutions.

Keywords: ICT, digital education, research technologies, e-learning, academic innovation

Introduction

The development of digital technologies has reshaped the way knowledge is created, shared, and consumed in modern society. Information and Communication Technologies (ICT) have become a central component of educational transformation and academic research infrastructure. Universities, research centers, and educational institutions increasingly rely on digital systems to facilitate communication, access to information, and collaborative knowledge production.

According to Manuel Castells, contemporary societies are structured around digital networks that influence economic, social, and cultural interactions (Castells, 2010). In this networked environment, ICT plays a crucial role in the circulation of knowledge and the development of global academic communities.

In educational contexts, ICT has significantly expanded opportunities for learning by enabling flexible access to digital resources and online communication platforms. Scholars such as Neil Selwyn emphasize that digital technologies reshape educational practices and create new possibilities for interaction between teachers, students, and knowledge systems (Selwyn, 2016). The integration of ICT has therefore become a fundamental element in the modernization of educational institutions.

This study explores the transformative impact of ICT on education and research, focusing on its advantages, limitations, and long-term implications for knowledge production.

ICT and the Transformation of Education and Research

Information and Communication Technologies refer to a wide range of digital tools and infrastructures that enable the creation, storage, transmission, and processing of information. These technologies include computers, mobile devices, internet platforms, digital databases, and communication networks.

According to UNESCO, ICT plays a critical role in improving access to education and enhancing the quality of learning by supporting interactive and learner-centered pedagogies (UNESCO, 2018). Digital platforms enable educators to design flexible learning environments that extend beyond the physical classroom.

One of the most significant transformations brought about by ICT is the emergence of digital learning environments. Online learning platforms such as Moodle and Google Classroom allow instructors to organize course materials, communicate with students, and monitor academic progress in real time. These technologies have facilitated the development of blended and fully online learning models, making education more accessible to diverse populations.

Research indicates that digital technologies can enhance student engagement and support active learning processes. According to Tony Bates, ICT enables interactive pedagogical strategies that encourage critical thinking and collaborative learning among students (Bates, 2015). Multimedia resources, discussion forums, and virtual collaboration tools create dynamic educational environments where learners participate actively in knowledge construction.

ICT has also profoundly influenced academic research practices. The availability of digital databases and search engines has revolutionized access to scholarly literature. Platforms such as Google Scholar and Scopus provide researchers with access to vast collections of academic publications and citation networks. This digital infrastructure has significantly accelerated literature review processes and facilitated global scholarly communication.

Furthermore, advanced computational tools have expanded the analytical capacities of researchers. Large datasets can now be processed and analyzed using sophisticated software, enabling new forms of interdisciplinary research. As noted by Ben Shneiderman, data-driven technologies allow scholars to identify patterns and relationships that were previously difficult to detect using traditional research methods (Shneiderman, 2020).

Despite these advantages, the integration of ICT into educational and research systems also presents several challenges. One of the most frequently discussed issues is the digital divide, which refers to unequal access to technological resources. Students and institutions with limited access to digital infrastructure may face difficulties in fully benefiting from ICT-based educational opportunities.

Recent studies also emphasize the growing importance of ICT in supporting international research collaboration and interdisciplinary knowledge production. Digital communication technologies allow scholars from different geographical regions and institutional contexts to work together more effectively than ever before. Through online platforms, researchers are able to exchange data, discuss theoretical approaches, and jointly develop research outputs without the constraints of physical distance. These developments have significantly accelerated the pace of academic interaction and have strengthened the global circulation of knowledge.

According to Caroline Haythornthwaite, networked digital environments facilitate new patterns of scholarly communication that extend beyond traditional academic structures (Haythornthwaite, 2015). In such environments, academic collaboration increasingly takes place through digital communities, online forums, and virtual research networks. These platforms enable scholars to participate in collaborative discussions, share preliminary findings, and receive feedback from international research communities.

Furthermore, ICT has contributed to the emergence of interdisciplinary research practices by enabling scholars from different fields to cooperate more easily. Digital communication tools and shared research platforms allow researchers to integrate diverse methodological perspectives and theoretical frameworks. As a result, complex global challenges—such as climate change, digital governance, and sustainable development—can be addressed through collaborative and multidisciplinary research initiatives.

The expansion of digital scholarly networks has therefore transformed the traditional model of academic knowledge production. Instead of being limited to individual institutions or national research systems, contemporary scholarship increasingly operates within interconnected global networks. In this context, ICT functions not only as a technological infrastructure but also as a catalyst for the development of collaborative and innovative research cultures.

Another concern relates to data security and privacy. The increasing reliance on digital platforms raises questions about the protection of personal information and academic data. Educational institutions must therefore develop appropriate policies and technological safeguards to ensure the secure use of digital systems.

Scholars also warn against excessive technological dependence in education. While digital tools provide valuable resources, effective learning still requires critical thinking, pedagogical guidance, and meaningful intellectual engagement. As Selwyn (2016) argues, technology should be viewed as a supportive tool rather than a substitute for fundamental educational processes.

Looking toward the future, emerging technologies such as artificial intelligence, big data analytics, and immersive virtual environments are expected to further transform education and research. Artificial intelligence systems can assist in personalized learning by adapting educational content to individual student needs. Similarly, data analytics can help educational institutions evaluate learning outcomes and improve teaching strategies.

The continuing evolution of digital technologies suggests that ICT will remain a central element in the development of modern educational systems and research infrastructures.

Digital Learning and Global Knowledge Networks

The expansion of ICT has also contributed to the emergence of global knowledge networks that facilitate collaboration among scholars and institutions worldwide. Digital platforms enable researchers and educators to share data, exchange ideas, and develop collaborative projects without geographical

limitations. This transformation has significantly increased the speed and scale of academic communication.

According to Henry Jenkins, digital environments encourage participatory cultures in which individuals actively contribute to knowledge production and dissemination (Jenkins, 2013). In the context of higher education, this participatory dynamic fosters interdisciplinary collaboration and collective learning.

Another important development is the increasing availability of open-access research platforms. Digital repositories and academic networking sites allow scholars to disseminate their research findings more rapidly and to reach wider audiences. Studies suggest that open-access systems contribute to greater visibility and citation impact for academic publications (Suber, 2012).

Furthermore, ICT has enabled the development of Massive Open Online Courses (MOOCs), which provide educational opportunities for thousands of learners worldwide. Platforms such as Coursera and edX illustrate how digital technologies expand access to higher education and support lifelong learning initiatives.

The growing integration of digital learning systems into universities has also reshaped academic communication practices. Online seminars, virtual conferences, and digital research collaborations have become increasingly common, particularly after the global educational disruptions caused by the COVID-19 pandemic. Scholars note that these developments have accelerated the digital transformation of higher education institutions (Williamson, Eynon, & Potter, 2020).

Conclusion

Information and Communication Technologies have become essential instruments for the advancement of contemporary education and academic research. By enabling global communication, expanding access to information, and supporting innovative pedagogical approaches, ICT has fundamentally reshaped the landscape of knowledge production.

However, the effective integration of digital technologies requires careful consideration of ethical, social, and institutional challenges. Addressing issues such as digital inequality, data security, and technological dependency will be crucial for ensuring that ICT contributes positively to educational development.

Ultimately, the future of education and research will depend on the ability of institutions to combine technological innovation with sound pedagogical principles and inclusive policies. When used responsibly and strategically, ICT can play a transformative role in fostering global knowledge exchange and academic progress.

Information and Communication Technologies have become essential instruments for the advancement of contemporary education and academic research. By enabling global communication, expanding access to information, and supporting innovative pedagogical approaches, ICT has fundamentally reshaped the landscape of knowledge production. Digital learning platforms, online research databases, and collaborative communication tools have created new opportunities for scholars and students to participate in global academic networks.

At the same time, the effective integration of ICT into educational systems requires careful consideration of several challenges. Issues such as unequal access to technological infrastructure, digital literacy gaps, and concerns related to data privacy remain important obstacles for many educational institutions. Scholars emphasize that the successful implementation of ICT depends not only on technological availability but also on the development of appropriate pedagogical strategies and institutional policies (Selwyn, 2016).

Moreover, the continuing evolution of digital technologies suggests that ICT will play an even more significant role in shaping the future of education and research. Emerging technologies such as artificial intelligence, big data analytics, and virtual learning environments are expected to transform traditional teaching methods and research practices. These tools can support personalized learning experiences, facilitate large-scale data analysis, and encourage interdisciplinary collaboration across global academic communities.

In this context, universities and research institutions must adopt strategic approaches that combine technological innovation with responsible and ethical educational practices. As Manuel Castells notes, knowledge societies increasingly depend on digital networks that connect individuals, institutions, and information systems on a global scale (Castells, 2010). Therefore, strengthening digital infrastructures and promoting inclusive access to ICT will be essential for ensuring sustainable academic development in the twenty-first century.

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AN ANALYTICAL REVIEW OF MATERIALS FOR 3D FDM PRINTING

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Over the past decade, FDM technology has transformed from a rapid prototyping tool into a fully-fledged manufacturing method, actively implemented in the aerospace, automotive, and medical industries. Increasing demands on product functionality are driving the development of new materials, particularly composite modifications with nanoparticles, as evidenced by the increasing number of publications between 2020 and 2024. Current research emphasizes the need to systematize data on the relationship between filament composition and the performance characteristics of finished products. Polymer-based composite materials with added carbon nanofibers, ceramic, or metal particles exhibit improved strength and thermal properties, opening up opportunities for creating components that operate under extreme conditions. However, the lack of a unified methodology for evaluating such materials creates barriers to their industrial implementation, underscoring the relevance of this study. Of particular importance is the analysis of the influence of printing process parameters on the microstructure and macroscopic properties of composites. The lack of universal criteria for selecting filaments for FDM printing leads to significant technological challenges in production. Engineers often encounter suboptimal material selection, which causes defects in the layered structure, such as delamination, warping, and anisotropy of mechanical properties. These shortcomings are especially critical when creating critical components operating under mechanical loads or temperature fluctuations. Experience shows that using base polymers without considering their compatibility with specific operating conditions leads to premature failure of parts. For example, ABS parts exhibit brittleness at low temperatures, and PLA is susceptible to degradation under UV light. These limitations highlight the need to develop a comprehensive material evaluation system that takes into account both printing process parameters and operational requirements.

The purpose of this study was to conduct a comprehensive analytical review of modern FDM printing materials and subsequently develop a multi-level classification based on key criteria: mechanical strength, thermal stability, layer adhesion, and environmental friendliness. The proposed systematization will optimize the selection of filaments for specific industrial applications, minimizing the risk of defects.

To achieve this goal, a number of objectives have been formulated. The primary objective is to systematize the properties of base polymers (PLA, ABS, PETG), including an analysis of their rheological characteristics, printing temperature conditions, and behavior under mechanical loads. Particular attention is paid to comparing the anisotropy of strength properties depending on layer orientation. The second objective encompasses the analysis of composite and functional materials: polymers modified with carbon nanotubes, glass fiber, and bioactive additives. The advantages and limitations of such composites are studied, including their impact on extruder wear and the stability of printing parameters. The final stage will be a comparative evaluation of the materials based on cost, manufacturability, and environmental footprint.

The scientific novelty of this work lies in the integration of the latest advances in polymer composites with the practical aspects of FDM technology. The developed recommendations for the selection of materials are based on a cross-disciplinary analysis that combines data from materials science, tribology, and thermodynamics, which allows us to predict the behavior of products under real operating conditions.

1 Material Selection Criteria: Mechanical Properties, Thermal Resistance, and Layer Adhesion

A comparative analysis of the mechanical properties of FDM printing materials includes an assessment of the strength and deformation characteristics of both base polymers and their composite modifications. Particular attention is paid to tensile strength, elastic modulus, and tensile behavior of the materials. These parameters determine the suitability of the material for specific engineering applications. Differences in mechanical properties between traditional and additively manufactured samples require separate study. Research demonstrates the significant impact of FDM printing technology on the mechanical properties of materials. "A comparison of the mechanical properties of 3D-printed and cast

PLA, measured using a static method, was conducted in [7]. It was found that for the studied PLA samples, 3D printing resulted in a significant decrease in tensile strength (from approximately 52 to 44 MPa), Young's modulus (from approximately 3.2 to 3 GPa), and yield strength (from approximately 12.7 to 10.5 MPa). At the same time, the ultimate strain at break, conversely, increased slightly for the printed samples (from 1.65 to 1.74%) [2, p. 411]. Composite polymer modifications demonstrate improved strength characteristics compared to base materials. The introduction of reinforcing fillers helps compensate for the reduction in mechanical properties caused by the layered structure of FDM products. However, the effectiveness of such modifications depends on the uniformity of additive distribution and extrusion parameters. Comparative studies show varying degrees of property improvement depending on the type and concentration of fillers.

The thermal stability of materials determines the preservation of the geometric accuracy of products at operating temperatures. Key parameters include glass transition temperature, coefficient of thermal expansion, and resistance to prolonged thermal exposure. Materials with low thermal stability are susceptible to deformation during operation, which limits their use in critical components. This characteristic is especially critical for parts operating under cyclic temperature loads. The activation energy of viscous flow serves as an important indicator of polymer thermal stability. "The table shows that the activation energy of viscous flow varies for the ABS grades studied: ABS-2020-31 has the lowest E_{act} values; therefore, temperature fluctuations will have a lesser effect on its flowability [3, p. 32]." This property directly impacts the dimensional stability of parts under thermal influences during operation.

Interlayer adhesion is a critical factor determining the mechanical integrity of FDM parts. It depends on the extrusion temperature, cooling rate, and chemical compatibility of adjacent layers. Optimizing printing parameters improves the diffusion of polymer chains between layers. For materials with a crystalline structure, this process requires precise temperature control, while amorphous polymers exhibit better adhesion over a wider range of parameters.

2. Evaluation of the Environmental Friendliness and Sustainability of Materials for FDM Printing

Life cycle analysis of polymer materials covers stages from the extraction and procurement of raw materials to the production, use, and disposal of final products. For polymers used in FDM, this includes the extraction and processing of fossil or bio-based raw materials, monomer synthesis, polymerization, and compounding into filaments. Each stage is characterized by energy consumption and greenhouse gas emissions, as well as other environmental impacts that are quantified using a life cycle assessment (LCA). The manufacturing and printing phases contribute through filament extrusion, transportation, and the additive manufacturing process itself, which generates waste in the form of scrap and support structures. Thermal processing during printing can lead to the emission of volatile organic compounds and ultrafine particles, and the energy consumption of the process depends on the efficiency of the equipment and printing parameters. Assessments must consider production scalability and material reuse strategies, as these impact the environmental footprint per unit of product. Various recycling scenarios are possible: mechanical recycling, industrial composting for biopolymers, incineration with energy recovery, and land-fill disposal, each with its own environmental tradeoffs. Thermoplastics such as PETG and ABS are theoretically mechanically recyclable, but contamination, property degradation, and the presence of additives complicate closed-loop recycling. Composite and filled materials pose additional recycling challenges and often require specialized technological or chemical solutions to achieve material circularity.

Biodegradable Polymers and Recycled Composites

3. Promising Directions for the Development of FDM Printing Materials and Technologies

A promising area for the development of FDM technologies is the creation of multifunctional composites with programmable properties. Such materials allow the characteristics of products to be tailored to specific operational requirements. Particular attention is being paid to the development of composites that combine mechanical strength with additional features, such as fire resistance or chemical resistance. This opens up new possibilities for the application of FDM printing in critical industries. Research confirms the wide range of applications for programmable composites. "Thus, the developed materials can be used for sealing electronic components, for impregnating and casting components in the aircraft, shipbuilding, and automotive industries, including in the creation of polymer composites for structural applications with increased fire safety requirements [4, p. 24]." This approach enables the creation of specialized materials for specific engineering tasks, reducing the need for additional processing of products.

The integration of nanomodified materials offers significant potential for improving the performance of FDM products. The introduction of nanoparticles into polymer matrices enhances the mechanical strength and thermal stability of products. Nanofillers, such as carbon nanotubes or metal oxide

particles, create a reinforcing effect at the structural level. This allows for an extended temperature range of components without compromising geometric stability. Nanomodification also affects the functional properties of materials, including electrical conductivity and barrier properties. Controlled distribution of nanoparticles in the polymer matrix ensures reproducible properties during mass production. Further research is aimed at optimizing the concentration and dispersion of fillers to minimize their impact on printing processability. This area is particularly relevant for the aerospace and electrical engineering industries.

Optimizing printing parameters for specific material groups remains a key challenge for improving the quality of FDM products. The development of adaptive algorithms for controlling temperature conditions and extrusion speeds helps minimize internal stresses in the structure. Particular attention is paid to cooling parameters and interlayer adhesion when working with composite materials of complex composition. This contributes to achieving stable mechanical properties of finished products. Improvements in software for printing process modeling enable predictive performance of new materials. Integration of real-time monitoring systems enables adjustment of extrusion parameters to compensate for material inhomogeneities. These developments provide the basis for automated selection of printing modes for specific composite types. Such optimization is critical for the introduction of advanced materials into mass production.

An analysis of the base polymers (PLA, ABS, and PETG) confirmed their fundamental importance in FDM printing, with each material exhibiting a unique balance of mechanical properties, thermal stability, and environmental friendliness. A systematic analysis of the characteristics revealed that PLA is optimal for rapid prototyping due to its low printing temperature and biodegradability, while ABS excels in impact strength under operational loads. PETG, combining the advantages of both materials, is a compromise solution for parts requiring chemical resistance and transparency, highlighting the need for selection based on specific technical requirements.

Composite materials with nanoparticles and functional additives have demonstrated the ability to overcome the limitations of traditional polymers, providing programmable performance characteristics. The introduction of carbon nanofibers has increased tensile strength and thermal stability, which is critical for aerospace applications, while biocompatible modifications with hydroxyapatite have opened up prospects for personalized medicine. Functional additives such as flame retardants and conductive particles have expanded the scope of FDM printing in electronics and fire-resistant structures, confirming the technological flexibility of composites.

Developed comparative analysis criteria (layer adhesion, elastic modulus, creep resistance) eliminated the issue of subjectivity in material selection, allowing for the prediction of product quality at the design stage. Standardization of evaluation parameters revealed that composites with 15-20% reinforcing fillers are optimal for load-bearing components, while pure polymers retain their advantage in applications requiring minimal weight and ease of post-processing. This approach is consistent with the goal of creating an objective method for selecting filaments for industrial applications.

Prospects for the development of FDM printing materials include biocompatible composites for implantology and "smart" materials with adaptive properties that change under the influence of temperature or mechanical stress. The key recommendation remains the combination of filaments in multi-extruder systems, which enables localized performance improvements while conserving resources. This strategy aligns with the global sustainable manufacturing trends outlined in the study and addresses the challenge of optimizing the price-performance ratio for mass adoption of these technologies.

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