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The Use Of Medical Terminology In The Communication Process: An Analysis Based On The Theory Of Formal And Functional Equivalence

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Abstract

This article analyzes the use of medical terminology in doctor–patient communication based on the theory of formal and functional equivalence. The study examines selected clinical terms commonly used in everyday medical practice through a comparative linguistic approach, focusing on their formal forms and functionally understandable expressions for patients. The results indicate that while formal terminology ensures precision in professional discourse, functional equivalence plays a crucial role in patient communication. The theory of equivalence, particularly the approaches proposed by Eugene Nida, provides an effective theoretical framework for interpreting medical communication. The findings highlight the importance of presenting medical information in a clear and accessible form to improve communication efficiency in healthcare settings.

Key words: medical terminology, equivalence, formal equivalence, functional equivalence, medical communication, doctor–patient interaction.

Annotatsiya

Mazkur maqolada tibbiy terminlarning shifokor–bemor muloqoti jarayonida qoʻllanishi formal va funksional ekvivalentlik nazariyasi asosida tahlil qilinadi. Tadqiqotda kundalik tibbiy amaliyotda uchraydigan ayrim klinik terminlar tanlab olinib, ularning formal shakllari hamda bemor uchun tushunarli funksional ifodalari qiyosiy-lingvistik yondashuv asosida oʻrganildi. Tahlil natijalari shuni koʻrsatdiki, terminlarning formal shakli professional nutqda aniqlikni taʼminlasa-da, bemor bilan muloqotda funksional ekvivalentlik muhim ahamiyat kasb etadi. Ekvivalentlik nazariyasi, xususan, Eugene Nida tomonidan ilgari surilgan formal va funksional yondashuvlar tibbiy kommunikatsiyani izohlashda samarali nazariy asos boʻlib xizmat qiladi. Tadqiqot natijalari tibbiy terminlarni bemorga tushunarli shaklda yetkazish sogʻliqni saqlash amaliyotida samarali kommunikatsiyani taʼminlashda muhim omil ekanligini koʻrsatadi.

Kalit soʻzlar: tibbiy terminologiya, ekvivalentlik, formal ekvivalentlik, funksional ekvivalentlik, tibbiy kommunikatsiya, shifokor–bemor muloqoti.

Kirish

Tibbiyot insoniyat taraqqiyotining ajralmas qismi boʻlib, hayotimizning har bir daqiqasi u bilan bogʻliqdir. Tibbiy terminlar esa anashu uzviy bogʻliqlikning muhim vositalari hisoblanadi. Tibbiy terminlar haqidagi bilimlar sogʻliqni saqlash tizimida soha mutaxassislarining bir birlarini oʻzaro tushunishlariga va bemorlar holatini toʻgʻri anglashga yordam beradi. Davolashning barcha jarayonlari xususan, tekshirish, tashxis qoʻyish va muolajalarda tibbiy terminlarning toʻgʻri qoʻllanilishi muhim hisoblanadi. Chunki tibbiy terminlarning notoʻgʻri qoʻllanilishi bemorlar uchun

chalkashliklarga olib kelishi va ularning salomatligi uchun jiddiy xavf solishi mumkin. Shu munosabat bilan tibbiy terminlarning shifokor-bemor muloqotida toʻgʻri namoyon boʻlishini taʼminlash hozirgi kundagi dolzarb masalalardan biri boʻlib turibdi.

Adabiyotlar tahlili

Ushbu muammolarning mavjudligi tilshunoslikda nazariy hamda amaliy tadqiqotlar qilish zaruratini oshiradi. Shu xususta ekvivalentlik nazariyasini chuqur tadqiq qilish oʻrinlidir. Bu borada turli olimlar tomonidan terminlarning shakllanishi, ularning lingvistik xususiyatlari hamda

kommunikativ vazifalari yuzasidan tadqiqotlar olib borilgan. Xususan, AQSHlik tilshunos va tarjimashunos Eugene Nida[1] ekvivalentlik nazariyasini ishlab chiqib, o'zining "Toward a Science of Translating: with Special Reference to Principles and Procedures Involved in Bible Translating"(1964) kitobida formal va funksional ekvivalentlik tushunchalarini ilmiy asoslab bergan hamda tarjima jarayonida qabul qiluvchining tushunishi muhim mezon ekanligini ta'kidlagan. Arab tadqiqotchisi Othman Al-Darraj[2] ham o'zining "Equivalence in Translation: An Investigation of the Usefulness of Formal and Dynamic Types of Equivalence in the Translation of Some English Idiomatic Expressions into Arabic"(2015) nomli maqolasida tarjima jarayonida funksional ekvivalentlikning ahamiyatini Arab tili misolida izohlab bergan. Tadqiqotchilar Yagin F. H hamda Fernandes M. S[3] esa "The Importance of Medical Terminology in the Health Sector"(2024)maqolasida tibbiy terminlar shifokorlar o'rtasidagi muloqotni ta'minlashi, bemor holatini aniq ifodalashga xizmat qilishi va noto'g'ri tushunishlar xavf tug'dirishi mumkinligini tadqiq etishgan.

Tadqiqot metodologiyasi

Maqolada tadqiqot uchun formal va funksional ekvivalentlik nazariyasining amalda qo'llanilishini tahlil qilish maqsadida to'rtta klinik termin tanlab olindi. Tanlangan terminlar "Tibbiy atamalar izohli lug'ati" (A. Usmonxodjayev, O'. Abilov, M. Turaxonova, K. Turdiyeva, 2021)[4] manbasidan olindi. Ushbu terminlar kundalik tibbiy amaliyotda qo'llaniladigan, shifokor-bemor muloqotida tez-tez uchrab turadigan va tushunilishi murakkab bo'lgan terminlar sifatida tanlandi. Tanlangan terminlar kommunikatsiya jarayonida ekvivalentlik nazariyasining namoyon bo'lishini aniqlash va ularning formal hamda funksional ifodalarini taqqoslash asosida o'rganildi. Tadqiqot obyekti sifatida tibbiy

terminlar olindi. Tadqiqot predmeti esa ularning shifokor-bemor muloqoti jarayonida qo'llanishi hamda bemor tomonidan tushunilish darajasi bilan bog'liq lingvistik va kommunikativ xususiyatlardan iborat. Tadqiqot qiyosiy-lingvistik metod doirasida amalga oshirildi. Ya'ni tanlangan terminlar bosqichma-bosqich tahlil qilindi: avvalo ularning formal shakllari aniqlandi, so'ng funksional ifodalari ajratib olindi va keyingi bosqichda ushbu shakllar o'zaro qiyosiy tahlil asosida taqqoslandi.

Natijalar va ularning tahlili

Tadqiqotni amalga oshirish jarayonida tanlab olingan klinik terminlar formal va funksional jihatdan tahlil qilindi hamda shifokor-bemor kommunikatsiyasida qanday tushunilishiga e'tibor qaratildi. Natijalar quyida alohida terminlar misolida bayon etiladi.

Aritmiya termini tibbiy amaliyotda qo'llaniladi. Ozbek tiliga lotin tilidan kirib kelgan soz bolganligi sababli tushinilishi murakkab bolishi mumkin. Uning formal shakli *aritmia*, funksional ifodasi esa *yurak urishining buzilishi* tarzida namoyon bo'ladi. Ushbu termin shifokorlar o'rtasida formal shaklda qo'llansa, bemor bilan muloqotda funksional ifoda orqali tushuniladi.

Gipertenziya termini tibbiyotda qon bosimining me'yoriy darajadan oshishi holatini ifodalash uchun qo'llaniladi. Uning formal shakli *gipertenziya* tarzida ishlatiladi, funksional ifodasi esa *yuqori qon bosimi* ko'rinishida tushuntiriladi. Ushbu termin mutaxassislar o'rtasida ilmiy nomi bilan qo'llanilsa, bemor bilan muloqotda uning sodda va tushunarli ifodasi ishlatiladi.

Lotin tilidan kirib kelgan *mezenterit* termini klinik amaliyotda *ichak tutqichining yallig'lanishi bilan bog'liq holatni* ifodalash uchun qo'llaniladi. U formal shaklda *mezenterit* tarzida ishlatiladi, funksional ifodasi esa *ichak tutqichining yallig'lanishi* ko'rinishida bayon etiladi.

Shifokor-bemor muloqotida ayrim tibbiy terminlarning mazmuni darhol

anglashilmasligi mumkin. Shunday terminlardan biri *gipotireoz* hisoblanadi. Mazkur termin formal shaklda *gipotireoz* tarzida qo'llanadi, funksional ifodasi esa *qalqonsimon bez faoliyatining pasayishi* ko'inishida tushuntiriladi. Tadqiqot natijalari quyidagi jadvalda o'z ifodasini topadi.

Jadval 1. Tibbiy terminlarning formal va funksional ifodasi

	Termin	Formal ifoda	Funksional ifoda
1	<i>Aritmiya</i>	<i>Aritmiya</i>	<i>yurak urishining buzilishi</i>
2	<i>Gipertenziya</i>	<i>gipertenziya</i>	<i>yuqori qon bosimi</i>
3	<i>Mezenterit</i>	<i>mezenterit</i>	<i>ichak tutqichining yallig'lanishi</i>
4	<i>Gipotireoz</i>	<i>gipotireoz</i>	<i>qalqonsimon bez faoliyatining pasayishi</i>

Tadqiqot natijalari shuni ko'rsatadiki, tanlab olingan barcha terminlarda formal ekvivalentlik mavjud, professional nutqda ishlatiladi biroq bemor tushinishi uchun funksional ekvivalentlik muhim rol o'ynaydi. Terminlar lotin tilidan kelib chiqqan va ko'pchiligi qo'shimchalar qo'shish yordamida yasalgan. Misol uchun, gipertenziya (giper-normadan yuqori) yuqori qon bosimi, gipotireoz termini esa (gipo-normadan past) qalqonsimon bez faoliyatining pasayishi kabi hosil bo'lgan. Garchi bu terminlar shifokorlar orasida universal til sifatida qo'llansada, bemorlar orasida tushunmovchiliklarga va tibbiy holatlarni noto'g'ri talqin qilinishiga olib kelishi mumkin. Quyida ushbu holat ekvivalentlik nazariyasi bilan izohlanadi. Eugena Nida fikriga ko'ra,

Formal ekvivalentlik tarjima jarayonida so'zning asl shakli va mazmuniga imkon qadar yaqin qolishni maqsad qiladi hamda tarjimonning shaxsiy fikr yoki talqinlarini qo'shmaslikka intiladi. Bunday yondashuvda tarjima ko'proq so'zma-so'z amalga oshiriladi va asl xabarning shaklan buzilish xavfi kamayadi. Biroq bu usul o'quvchidan mavzu haqida ma'lum darajada tayyorgarlik va tushunchaga ega bo'lishni talab qiladi.

Funksional ekvivalentlik esa so'zma-so'z tarjima emas aksincha tushunchaga asoslangan tarjima muhim hisoblanadi. Ya'ni tarjima qilinayotgan so'z uni qabul qiluvchilarga qanday tushinilishi inobatga olinib tarjima qilinadi, so'zning faqat shakily tuzilishiga sodiqlikdan yiroqlashgan holda. Nidaning tarjimadagi ushbu nazariyasi terminlardagi ekvivalentlikga mos tushadi. Ya'ni tanlab olingan 4 ta termin lotin tilidan shaklan moslashuv asosida o'zbek terminologiyasiga kirib kelgan va kundalik tibbiy amaliyotlarda ishlatiladi. Terminlarning formal shaklda qo'llanilishi professional nutqda aniqlik va ixchamlikni ta'minlasa-da, bemor bilan muloqotda ularning funksional ifodasi tushunishni osonlashtiradi. Bu esa bemorning o'z sog'lig'i haqidagi ma'lumotni to'g'ri anglashiga, davolanish jarayonida faol ishtirok etishiga hamda shifokor tavsiyalarini to'liq tushunishiga yordam beradi.

Shu nuqtai nazardan, tibbiy terminlarni bemorga tushunarli shaklda yetkazish sog'liqni saqlash tizimida samarali kommunikatsiyani ta'minlashning muhim omillaridan biri hisoblanadi. Functional ekvivalentlikdan foydalanish orqali tibbiy axborotning aniq va ravshan ifodalanishi bemor xavfsizligini oshirish, noto'g'ri talqinlarning oldini olish hamda davolash samaradorligini ta'minlashga xizmat qiladi.

Xulosa

Mazkur tadqiqotdan xulosa qilib shuni aytish mumkinki, bugungi kunda tibbiyotda

kundalik amaliyotda qo'llanilayotgan ayrim terminlar bemor uchun sodda va tushunarli shaklda izohlashni talab qiladi. Tibbiy terminlarning noto'g'ri talqin qilinishi bemorlarning o'z holatini anglashida qiyinchiliklar tug'dirishi hamda davolash jarayoniga salbiy ta'sir ko'rsatishi mumkin. Shu bois tibbiy terminologiyani lingvistik jihatdan chuqur o'rganish, ularning funksional ekvivalentlarini aniqlash va kommunikativ nuqtai nazardan takomillashtirish muhim ahamiyat kasb etadi. Ekvivalentlik nazariyasi, xususan, Nida tomonidan ilgari surilgan formal va funksional yondashuvlar tibbiy terminlarning qo'llanishini izohlashda samarali nazariy asos bo'lib xizmat qiladi. Mazkur yondashuv tibbiy axborotni bemorga tushunarli shaklda yetkazish, shifokor–bemor o'rtasidagi samarali kommunikatsiyani ta'minlash hamda sog'liqni saqlash amaliyotida tushunmovchiliklarning oldini olishda muhim vosita sifatida namoyon bo'ladi.

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Social-Philosophical And Information-Communicative Significance Of Artificial Intelligence In The Activities Of Religious Organizations

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Abstract

This article analyzes the socio-philosophical and communicative significance of artificial intelligence technologies in the activities of religious organizations. The study examines the effectiveness of digital transformation processes, AI-based information systems, chatbots, automated translation tools, and semantic processing technologies for religious content. Furthermore, the influence of artificial intelligence on spiritual education, religious tolerance, ethical norms, and information security is explored. The research substantiates the prospects, ethical limitations, and educational opportunities of using artificial intelligence in religious organizations.

Keywords: artificial intelligence, religious organizations, digitalization, religious communication, chatbot, secularism, religious tolerance, digital transformation, information security.

Annotatsiya

Mazkur maqolada diniy tashkilotlar faoliyatida sun'iy intellekt texnologiyalarining qo'llanilishi, ularning ijtimoiy-falsafiy mohiyati hamda kommunikativ imkoniyatlari tahlil qilinadi. Tadqiqotda raqamli transformatsiya jarayonida diniy institutlarning faoliyati, sun'iy intellekt asosidagi axborot tizimlari, chatbotlar, avtomatik tarjima platformalari va diniy kontentni semantik qayta ishlash texnologiyalarining samaradorligi ilmiy jihatdan asoslab berilgan. Shuningdek, sun'iy intellektning diniy qadriyatlar, ma'naviy tarbiya, diniy bag'rikenglik va axborot xavfsizligiga ta'siri o'rganilgan. Tadqiqot natijasida diniy tashkilotlarda sun'iy intellektdan foydalanishning istiqbollari, axloqiy-huquqiy cheklovlari hamda ma'rifiy imkoniyatlari yuzasidan ilmiy xulosalar ishlab chiqildi.

Kalit so'zlar: sun'iy intellekt, diniy tashkilotlar, raqamlashtirish, diniy kommunikatsiya, chatbot, sekulyarizm, diniy bag'rikenglik, raqamli transformatsiya, axborot xavfsizligi.

1. KIRISH

XXI asrda insoniyat taraqqiyotining asosiy omillaridan biri sifatida axborot-kommunikatsiya texnologiyalarining rivojlanishi e'tirof etilmoqda. Ayniqsa, sun'iy intellekt texnologiyalarining takomillashuvi ijtimoiy hayotning barcha sohalariga, jumladan, siyosat, iqtisodiyot, ta'lim, tibbiyot va madaniyat bilan bir qatorda diniy tashkilotlar faoliyatiga ham sezilarli ta'sir ko'rsatmoqda. Sun'iy intellekt tizimlari ma'lumotlarni tahlil qilish, muloqot olib borish, avtomatik tarjima qilish, kontent yaratish hamda foydalanuvchilar bilan interaktiv aloqani yo'lga qo'yish imkoniyati

orqali diniy institutlarning kommunikativ salohiyatini oshirmoqda.

Globalashuv va raqamli transformatsiya sharoitida diniy tashkilotlar faoliyatining modernizatsiyalashuvi muhim ijtimoiy ehtiyojga aylanmoqda. Zamonaviy jamiyatda diniy institutlar nafaqat ibodat yoki marosimlarni tashkil etuvchi muassasa, balki ma'naviy-ma'rifiy tarbiya, axloqiy qadriyatlarni shakllantirish va ijtimoiy birdamlikni mustahkamlashda muhim ijtimoiy institut sifatida faoliyat yuritmoqda. Shu bois sun'iy intellekt texnologiyalarining diniy tashkilotlar faoliyatiga integratsiyalashuvi ilmiy jihatdan

o'rganilishi zarur bo'lgan dolzarb masalalardan biridir.

So'nggi yillarda dunyoning ko'plab mamlakatlarida diniy chatbotlar, virtual konsultatsiya tizimlari, avtomatlashtirilgan diniy ma'lumot bazalari va diniy matnlarni semantik tahlil qiluvchi algoritmlar amaliyotga joriy qilinmoqda. Bunday texnologiyalar diniy savodxonlikni oshirish, diniy ekstremizm va radikalizmga qarshi ma'rifiy immunitetni kuchaytirish hamda, yoshlar bilan samarali kommunikatsiyani yo'lga qo'yishda muhim vosita bo'lib xizmat qilmoqda.

Biroq sun'iy intellekt texnologiyalarining diniy sohada qo'llanilishi qator murakkab masalalarni ham yuzaga chiqarmoqda. Jumladan, diniy qadriyatlarning algoritmik talqini, ma'lumotlarning ishonchliligi, axborot xavfsizligi, inson omilining kamayishi va diniy manipulyatsiya xavfi kabi muammolar mazkur masalaning ijtimoiy-falsafiy tahlilini taqozo etadi.

O'zbekiston Respublikasida ham raqamli iqtisodiyot va sun'iy intellekt texnologiyalarini rivojlantirish davlat siyosatining ustuvor yo'nalishlaridan biri sifatida belgilanmoqda. Shu bilan birga, diniy bag'rikenglik va vijdon erkinligini ta'minlash davlat siyosatining muhim tamoyillaridan hisoblanadi. Mazkur holat diniy tashkilotlar faoliyatida sun'iy intellekt texnologiyalaridan foydalanishning nazariy va amaliy jihatlarini tadqiq etish zaruratini kuchaytiradi.

2. MAVZUGA OID ADABIYOTLARNING TAHLILI

Sun'iy intellekt muammosi dastlab matematik mantiq va kompyuter texnologiyalari rivoji bilan bog'liq holda shakllangan. Alan Turing tomonidan ishlab chiqilgan "Turing testi" sun'iy tafakkur nazariyasining metodologik asoslaridan biri sifatida baholanadi. Keyinchalik John McCarthy tomonidan "Artificial Intelligence" termini ilmiy muomalaga kiritilib, mazkur yo'nalish mustaqil ilmiy sohaga aylandi.

Sun'iy intellektning ijtimoiy va falsafiy jihatlarini Nick Bostrom, Max Tegmark va Yuval Noah Harari kabi olimlar tomonidan keng tadqiq qilingan. Nick Bostrom sun'iy intellektning insoniyat kelajagiga ta'siri, algoritmik nazorat va etik xavflar masalasini ilmiy jihatdan tahlil qilgan. Max Tegmark esa sun'iy intellektning insoniyat sivilizatsiyasidagi transformatsion ahamiyatini ochib bergan.

Din va raqamli texnologiyalar munosabati Heidi Campbell tomonidan chuqur o'rganilgan bo'lib, u "Digital Religion" konsepsiyasini ilmiy asoslagan. Tadqiqotchining fikricha, raqamli kommunikatsiya texnologiyalari diniy identitet, diniy amaliyot va diniy kommunikatsiya shakllarini tubdan o'zgartirmoqda.

Pauline Hope Cheong tomonidan olib borilgan tadqiqotlarda ijtimoiy tarmoqlar va sun'iy intellekt texnologiyalarining diniy jamoalar faoliyatidagi kommunikativ xususiyatlari o'rganilgan. Mazkur tadqiqotlarda raqamli muhitda diniy liderlik va virtual diniy hamjamiyatlarning shakllanishi masalalari tahlil qilinadi.

O'zbekistonda sun'iy intellekt texnologiyalarini rivojlantirish bo'yicha davlat dasturlari qabul qilinib, raqamli transformatsiya siyosati izchil amalga oshirilmoqda. Shu bilan birga, mamlakatda diniy bag'rikenglik, konfessiyalararo totuvlik va ma'rifiy yondashuv asosida diniy siyosat olib borilmoqda.

3. TADQIQOT METODOLOGIYASI

Mazkur tadqiqotda tarixiylik, tizimlilik, qiyosiy tahlil, kontent-tahlil va ijtimoiy-falsafiy umumlashirish metodlaridan foydalanildi. Tadqiqotning metodologik asosini zamonaviy sun'iy intellekt nazariyalari, raqamli kommunikatsiya konsepsiyalari hamda dinshunoslik va falsafa fanlari tashkil etadi.

Tadqiqot davomida:

- sun'iy intellekt va diniy kommunikatsiya bo'yicha ilmiy maqolalar tahlil qilindi;
 - Google Scholar, Scopus va ResearchGate bazalaridagi ilmiy manbalar o'rganildi;
 - diniy tashkilotlar faoliyatida raqamli texnologiyalar qo'llanilishining xorijiy tajribalari qiyosiy tahlil qilindi;
 - O'zbekiston Respublikasining sun'iy intellekt va vijdon erkinligi bo'yicha normativ-huquqiy hujjatlari tahlil qilindi.
- Mazkur metodologik yondashuv tadqiqot muammosini kompleks va tizimli ravishda o'rganish imkonini berdi.

4. TAHLIL VA NATIJALAR

Tahlillar shuni ko'rsatadiki, sun'iy intellekt texnologiyalari diniy tashkilotlar faoliyatida bir qator muhim funksiyalarni bajarishi mumkin.

Birinchidan, sun'iy intellekt diniy ta'lim samaradorligini oshirishga xizmat qiladi. Virtual ta'lim platformalari, avtomatik test tizimlari va interaktiv o'quv modullari orqali diniy bilimlarni keng auditoriyaga yetkazish imkoniyati kengaymoqda. Ayniqsa, pandemiya davrida onlayn diniy ta'lim tizimlari faol rivojlandi.

Ikkinchidan, chatbot texnologiyalari diniy tashkilotlar va fuqarolar o'rtasidagi kommunikativ aloqalarni kuchaytirmoqda. Ayrim davlatlarda AI-chatbotlar orqali diniy savollarga avtomatik javob berish amaliyoti joriy qilingan. Bu tizimlar foydalanuvchilarga tezkor ma'lumot olish imkoniyatini yaratadi. Uchinchidan, sun'iy intellekt muqaddas matnlarni semantik tahlil qilish va avtomatik tarjima qilishda muhim ahamiyat kasb etmoqda. Qur'on, Injil va boshqa diniy manbalarni raqamlashtirish va ma'lumot bazalarini yaratish ilmiy tadqiqotlar samaradorligini oshirmoqda.

To'rtinchidan, sun'iy intellekt diniy ekstremizm va radikalizmga qarshi ma'rifiy kurashda samarali vosita bo'lishi mumkin. Algoritmik monitoring tizimlari orqali

internetdagi zararli diniy kontentlarni aniqlash va tahlil qilish imkoniyati mavjud. Biroq tadqiqot davomida sun'iy intellekt texnologiyalarining ayrim salbiy jihatlari ham aniqlandi. Jumladan:

- diniy qadriyatlarning noto'g'ri talqin qilinishi;
- algoritmik tarafkashlik;
- ma'lumotlar xavfsizligi;
- virtual diniy manipulyatsiya;
- inson omilining kamayishi.

Sun'iy intellektning diniy sohada qo'llanilishi insoniy axloq va ma'naviyat masalalarini qayta ko'rib chiqishni talab qilmoqda. Diniy qarorlar yoki fatvolarni to'liq avtomatlashtirish ma'naviy va etik jihatdan murakkab masala hisoblanadi.

O'zbekiston sharoitida sun'iy intellekt texnologiyalaridan diniy-ma'rifiy sohada foydalanish yoshlarning diniy savodxonligini oshirish, radikal g'oyalarga qarshi ma'rifiy immunitetni shakllantirish hamda diniy bag'rikenglikni mustahkamlashda muhim vosita bo'lishi mumkin.

5. XULOSA VA TAKLIFLAR

Xulosa qilib aytganda, sun'iy intellekt texnologiyalari diniy tashkilotlar faoliyatining transformatsiyalashuviga sezilarli ta'sir ko'rsatmoqda. Zamonaviy raqamli texnologiyalar diniy kommunikatsiya, ma'rifiy targ'ibot va diniy ta'lim tizimini yangi bosqichga olib chiqmoqda.

Shu bilan birga, sun'iy intellektning diniy sohada qo'llanilishi axloqiy, falsafiy va huquqiy muammolarni ham yuzaga keltirmoqda. Shu sababli texnologiyalardan foydalanishda diniy qadriyatlar, ma'naviy me'yorlar va axborot xavfsizligi talablariga qat'iy amal qilish zarur.

Tadqiqot natijalari asosida quyidagi takliflar ishlab chiqildi:

1. Diniy tashkilotlar faoliyatida sun'iy intellektidan foydalanishning milliy konsepsiyasini ishlab chiqish;
2. Diniy chatbotlar va avtomatik maslahat tizimlarini ekspert nazorati ostida joriy etish;

3. Muqaddas matnlarni raqamlashtirish va ilmiy elektron bazalarni kengaytirish;
4. Yoshlar o'rtasida diniy va raqamli savodxonlikni rivojlantirish;
5. Sun'iy intellektning diniy sohada qo'llanilishiga oid etik kodeks ishlab chiqish;
6. Diniy ekstremizmga qarshi AI-monitoring tizimlarini rivojlantirish.

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The Current State Of Teaching The Subject "The Latest History Of Uzbekistan": Content, Essence And Etymology

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Abstract

The article analyzes the current state of the teaching of the subject "the newest history of Uzbekistan" in the higher education system of Uzbekistan. The content of Science – covering the period from 1991 to the present-includes the first years of independence, economic-political reforms, State-Building, international relations and processes of formation of national identity. From the point of view of the essence, it is argued that science has ideological and educational significance, aimed not only at illuminating historical events, but also at shaping patriotism, a sense of statehood and the ability to think independently in students.

Keywords: the newest history, the October Revolution, an interdisciplinary approach, historicism, the principle of impartiality, historical thinking.

Annotatsiya

Maqolada "O'zbekistonning eng yangi tarixi" fanining O'zbekiston oliy ta'lim tizimida o'qitilishining hozirgi holati tahlil qilinadi. Fanning mazmuni – 1991-yildan hozirgacha bo'lgan davrni qamrab olgan bo'lib, mustaqillikning dastlabki yillari, iqtisodiy-siyosiy islohotlar, davlat qurilishi, xalqaro munosabatlar va milliy o'zlikni shakllantirish jarayonlarini o'z ichiga oladi.

Mohiyati nuqtai nazaridan fan nafaqat tarixiy voqealarni yoritish, balki talabalarda vatanparvarlik, davlatchilik tuyg'usini va mustaqil fikrlash qobiliyatini shakllantirishga qaratilgan ideologik-ma'rifiy ahamiyatga ega ekanligi ta'kidlanadi.

Kalit so'zlar: eng yangi tarix, Oktyabr inqilobi, Fanlararo yondashuv, tarixiylik, xolislik tamoyili, tarixiy tafakkur.

"Eng yangi tarix" tushunchasi o'zbek ilmiy nutqida XX asr oxiri va XXI asr boshidagi tarixiy davrlarni ifodalash uchun qo'llaniladi. Bu atama mazmunan "yangi tarix" (XVIII–XIX asrlar)dan farq qilib, mutlaqo yaqindagi – odatda Ikkinchi jahon urushidan keyingi yoki, O'zbekiston misolida, mustaqillikdan keyingi davrni qamrab oladi¹ [1]. Shu bois, O'zbekistonning eng yangi tarixi fanining predmeti sifatida asosan 1991-yildan hozirgi kungacha bo'lgan tarixiy jarayonlar olinadi. Rus tilida mazkur atama "новейшая история" deb yuritilib, u ham XX asrning ikkinchi yarmi va XXI asr hodisalarini ifodalaydi. Masalan, Rossiyada "новейшая история" atamasi Ikkinchi jahon urushi tugagan davrdan keyingi tarixga nisbatan qo'llanadi, ba'zan esa 1917-yil Oktyabr

inqilobidan keyingi davr ham shu toifaga kiritiladi. Ingliz ilmiy adabiyotida esa "modern history" kengroq ma'noda yangi davr tarixini anglatadi, "contemporary history" bevosita eng yangi, zamonaviy tarixga ishora qiladi. Inglizcha "contemporary history" odatda Ikkinchi jahon urushidan keyingi davrni qamrab, hali yashayotgan avlodlar esida bo'lgan tarixiy hodisalarni o'z ichiga oladi. Demak, turli tillarda biroz farqlarga ega bo'lsa-da, mazmun mohiyatiga ko'ra bu atamalar XX asr ikkinchi yarmi va XXI asrni qamrab oluvchi davrni belgilaydi.

O'zbekistonda "O'zbekistonning eng yangi tarixi" deganda, avvalo, 1991-yilda davlat mustaqillikka erishganidan keyingi davr tushuniladi. Ayrim manbalarda, masalan

¹ Smets, W., & Savenije, G. (2025). A structural and functional differentiation of knowledge for the history curriculum. *Journal of*
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Ostonov O tomonidan yozilgan O'zbekistonning eng yangi tarixi o'quv qo'llanmasida, "eng yangi tarix biz uchun, avvalo, mamlakatimizning 1991-yildan keyin bosib o'tgan tarixiy yo'li mohiyati va mazmunini anglab yetish" ekanligi ta'kidlanadi². Ya'ni mazkur fan O'zbekiston mustaqillik arafasi va dastlabki yillarida yuz bergan muhim jarayonlarni, mustaqillik davridagi islohot va o'zgarishlarni o'rgatishga qaratilgan. O'zbekistonning eng yangi tarixi fanining vaqt doirasi xorijiy adabiyotlardagi "contemporary history" bilan deyarli mos tushadi – masalan, AQSh va Yevropada ham "eng yangi tarix" o'quv kurslari Ikkinchi jahon urushidan so'nggi davrni o'z ichiga oladi (taxminan 1945 yildan hozirgacha). Biroq O'zbekiston misolida mazkur fan davrni mustaqillik (1991)dan boshlash an'ana tusiga kirgan. Qayd etish lozimki, "eng yangi tarix" atamasining vaqt chegaralari bo'yicha turli davlatlarda farqlar bo'lishi mumkin. Xususan, xalqaro ta'riflarda Ikkinchi jahon urushidan keyingi davr "contemporary history" deb atalsa, Rossiya tarixshunosligida 1945-yildan keyingi global tarix "современная история" yoki "новейшая история" sifatida qoraladi. O'zbek ilm-fanida esa atama asosan milliy tarix kontekstida ishlatiladi. Masalan, xalqaro davrlashtirishda XX asrning 90-yillaridan keyingi davrni ba'zan "post-Soviet period" deb ham atashadi, bu bizning "eng yangi tarix" bilan aynan mos tushadi. O'zbekistonning eng yangi tarixi fanini o'qitishda talabalarga terminlarning ana shunday nozik farqlari tushuntiriladi. Jumladan, ingliz tilida yoziladigan darslik yoki dasturlarda fan nomini "History of Contemporary Uzbekistan" tarzida tarjima qilish odat tusiga kirgan (ba'zi OTMLarda "Modern History of Uzbekistan" ham deyiladi). Masalan, Qoraqalpog'istonning

Nukus davlat universiteti (NukusSTU) xalqaro almashinuv doirasida O'zbekistonning eng yangi tarixi fanini inglizcha "Newest History of Uzbekistan" deb nomlagan o'quv dasturi ham chop etgan³. Bu termin tanlovi hamon muhokamaga ochiq, biroq umumiy qabul qilingan tavsif – "contemporary history" bo'lib, u fan mazmunini to'g'ri aks ettiradi. O'zbekiston mustaqillikka erishgach, tarix ta'limi tizimini milliy asosda qayta ko'rish zarurati paydo bo'ldi. 2012-yilda hukumat darajasida muhim qadam qo'yildi: 27-yanvar 2012-yilgi Prezident qarori (PQ–1694-son) bilan Oliy va o'rta maxsus ta'lim vazirligi huzurida "O'zbekistonning eng yangi tarixi bo'yicha Jamoatchilik kengashi" tashkil etildi. Ushbu qarorda Kengashning maqsadi sifatida O'zbekistonning eng yangi tarixini tadqiq etish va o'qitish samaradorligini oshirish, sohada ilmiy va o'quv-metodik ishlarga ko'maklashish belgilandi. Mazkur Jamoatchilik kengashi idoralararo muvofiqlashtiruvchi va maslahat organi sifatida tasavvur qilingan bo'lib, uning tarkibiga turli vazirlik va idoralar, jumladan, Fanlar akademiyasi, Xalq ta'limi vazirligi, Prezident huzuridagi Davlat va jamiyat qurilishi akademiyasi vakillari kiritilgan edi. Bu tarkib keng qamrovli bo'lib, O'zbekistonning eng yangi tarixi masalalarini davlat siyosati darajasida muvofiqlashtirishga xizmat qilishi mo'ljallangan.

2012-yilgi qarorga binoan, Jamoatchilik kengashi huzurida O'zbekistonning eng yangi tarixi bo'yicha Muvofiqlashtiruvchi metodik markaz ham tashkil etilishi nazarda tutilgan edi. Biroq dastlab ushbu Markaz alohida yuridik shaxs sifatida shakllantirilmadi, balki Kengashning ishchi organi sifatida faoliyat yuritdi. Kengashning vazifalari sifatida quyidagilar belgilandi: O'zbekistonning eng yangi tarixini tizimli

² Ostonov, O. (2022). *O'zbekistonning eng yangi tarixi* (O'quv qo'llanma). Toshkent: Lesson Press. 245 b.

³ Mirzo Ulug'bek nomidagi O'zbekiston Milliy Universiteti. (2024-yil 7-avgust) O'zbekistonning eng yangi tarixi fanidan o'quv dasturi (barcha nomutaxassis bakalavriat ta'lim yo'nalishlari uchun).

ravishda, tarixiylik va xolislik prinsiplariga tayangan holda o'rganishni yo'lga qo'yish; milliy tarixga baho berishda bir yoqlama yondashuvlarga yo'l qo'ymaslik; O'zbekistonning eng yangi tarixi bo'yicha yangi o'quv va ilmiy adabiyotlar yaratishni muvofiqlashtirish. Ahamiyatli jihati, bu vazifalar keyinchalik 2017-yil qarorida yanada kengaytirildi, lekin 2012-yilda ham tamal toshi qo'yilgan edi. O'sha davrda Davlat va jamiyat qurilishi akademiyasi qoshidagi "O'zbekistonning yangi tarixi markazi" tugatilib, uning o'rnini Jamoatchilik kengashi egallashi belgilangan. Bu bilan oliy ta'lim tizimida O'zbekistonning eng yangi tarixi fanini joriy etish davlat siyosati darajasida birlashtirildi.

Oradan besh yil o'tib, 2017-yilda O'zbekistonning eng yangi tarixi bo'yicha institutsional tizimni takomillashtirishga qaratilgan yana bir qadam qo'yildi. 2017-yil 17-fevralda Prezidentning PQ–2789-son qarori qabul qilinib, unda Fanlar akademiyasi faoliyatini takomillashtirish choralari belgilandi. Ushbu qarorga asosan, O'zbekistonning eng yangi tarixi Jamoatchilik kengashi Oliy ta'lim vazirligi tizimidan O'zbekiston Respublikasi Fanlar akademiyasi huzuriga o'tkazildi. Bu o'zgarish jamoatchilik va ilmiy doiralarda ijobiy qarshi olindi, chunki Fanlar akademiyasi qoshida faoliyat yuritish Kengashga ilmiy-tadqiqot muassasalari bilan yaqinroq hamkorlik qilish, akademik salohiyatni jalb etish imkonini berdi. Xuddi shu jarayon PQ–3105-son Prezident qarori bilan yakuniy huquqiy hal etildi: 2017-yil 30-iyundagi ushbu qarorda "O'zbekiston Respublikasi Fanlar akademiyasi huzuridagi O'zbekistonning eng yangi tarixi bo'yicha Jamoatchilik kengashi faoliyatini tashkil etish to'g'risida" so'z yuritilib, Kengashning yangilangan nizomi tasdiqlandi.

Qarorda kengash zimmasiga yangi avlod o'quv-metodik adabiyotlarini yaratish vazifasi qo'yilgan. Bu O'zbekistonning eng yangi tarixi bo'yicha zamonaviy darslik va qo'llanmalarni tayyorlash davlat ahamiyatidagi masala ekanini ko'rsatadi. Haqiqatan ham, 2017-yildan so'ng bir qancha yangi o'quv adabiyotlari, jumladan, O'zbekistonning eng yangi tarixi bo'yicha universitetlar uchun qo'llanmalar va darsliklar chop etildi⁴. Qaror muvofiqlashtiruvchi metodik markaz faoliyatini ham jonlantirdi. Endilikda jamoatchilik kengashi huzurida to'laqonli ishlaydigan markaz – "O'zbekistonning eng yangi tarixi masalalari bo'yicha Muvofiqlashtiruvchi-metodik markaz" faoliyati yo'lga qo'yildi. Bu markaz Fanlar akademiyasi tasarrufida bo'lib, O'zbekistonning eng yangi tarixini o'qitish metodikasini takomillashtirishga mas'ul etib belgilandi. Markazning tashkil etilishi O'zbekistonning eng yangi tarixi bo'yicha ilmiy-tadqiqot va uslubiy ishlarni tizimli ravishda yo'lga qo'yish, yurt miqyosida yagona ilmiy-uslubiy platforma yaratish imkonini berdi.

2017-yil qaroridan so'ng, Markaz qoshida maxsus ilmiy-uslubiy nashr yo'lga qo'yildi. Fanlar akademiyasi sayti ma'lumotiga ko'ra, Markaz "O'zbekiston eng yangi tarixining dolzarb masalalari" nomli ilmiy to'plam yoki jurnalni nashr eta boshladi. Bu nashrda O'zbekistonning eng yangi tarixi doirasidagi tadqiqotlar, metodik maqolalar, konferensiya materiallari e'lon qilinmoqda. Shuningdek, Fanlar akademiyasi Tarix institutining rasmiy jurnali – "O'zbekiston tarixi" jurnali ham O'zbekistonning eng yangi tarixi bo'yicha nazariy va metodologik tadqiqotlarni yoritish maydoniga aylandi. Mazkur jurnal avvaldan mavjud bo'lib, kengroq tarixiy mavzularni qamrab kelsa-da, 2017 yildan so'ng unda O'zbekistonning eng yangi tarixiga oid maxsus ruknlar paydo

⁴ Xoliqova, R. (2021). O'zbekistonning eng yangi tarixi (O'quv qo'llanma). Toshkent davlat texnika universiteti.

bo'ldi (masalan, "Eng yangi tarixning dolzarb muammolari" rukni). Natijada ilmiy jamoatchilik va pedagoglar O'zbekistonning eng yangi tarixi fanining kontentini boyitishga doir fikr-mulohazalarini muntazam e'lon qilish imkoniyatiga ega bo'ldilar. Bundan tashqari, 2018-yildan boshlab Fanlar akademiyasi Tarix institutida eng yangi tarix bo'yicha ilmiy tadqiqotlar hajmi ortdi: institut tarkibida "Yangi va eng yangi tarix" bo'limi faoliyat ko'rsatib, doktorantlar va yosh olimlar mustaqillik davri tarixini turli jabhalarda o'rganishni keng yo'lga qo'ydi⁵.

O'zbekistonning eng yangi tarixi fanini OTMlarda o'qitish 2010-yillar boshidan boshlangan bo'lsa-da, 2017-yilga kelib mamlakatning deyarli barcha oliy ta'lim muassasalarida mazkur fan alohida kurs sifatida joriy etildi. Jumladan, Samarqand, Namangan, Nukus, Urganch, Qarshi, Termiz va boshqa davlat universitetlari dasturlariga O'zbekistonning eng yangi tarixi mustaqil fan sifatida kiritildi. Ilgari bu fan umumiy "O'zbekiston tarixi" kursining so'nggi boblari doirasida berilgan bo'lsa, endilikda ko'plab OTMlarda bakalavriatning 1-bosqichida yoki 2-bosqichida 1-semestr davomida "O'zbekistonning eng yangi tarixi" nomli mustaqil fan o'qitilmoqda.

Shu tariqa, O'zbekistonning eng yangi tarixi kursi mavzulari xronologik va tematik tamoyilda tuzilgan. Dasturlar ko'pincha mustaqillikning dastlabki 5-10 yiliga 3-4 mavzu ajratadi (mazkur davr tub burilishlar davri bo'lgani uchun), keyingi 10-15yiliga (2000-2015) 2-3 mavzu, so'nggi yillarga 1 mavzu qoldiradi. Bu ba'zi o'rinlarda mavzular zichligi notekis bo'lishiga olib keladi – masalan, 1991-2001 yillar voqealari juda batafsil o'tilib, 2010-yillar yuzakiroq qamrab olinishi mumkin. Biroq yangilangan dasturlar (xususan, 2021-yil va

2022-yil namunaviy dasturlari) bu nomutanosiblikni tuzatishga harakat qilgan: 2016-yildan keyingi davr (hozirgi bosqich) ham alohida mavzu sifatida kiritilib, uning ahamiyati talabalarga yetkazilmoqda.

O'zbekistonning eng yangi tarixi fanining mazmun xaritasini o'rganish shuni ko'rsatadiki, uning mohiyati – yosh avlodga mustaqil O'zbekiston tarixi haqida izchil va haqqoniy bilim berish, tarixiy tafakkurini shakllantirish va shu orqali ularning ongiga milliy g'oya va qadriyatlarni singdirishdir. "Mavzular xaritasi"ning har bir bo'limi shu oliy maqsadga xizmat qiladi: siyosiy islohotlarni o'rgatish – ularda fuqarolik mas'uliyati va davlatga hurmat tuyg'usini oshiradi; iqtisodiy tarixni o'rgatish – mustaqil iqtisodiy taraqqiyotning qadrini anglashi, bozor iqtisodiyotining murakkabligini tushunishi uchun; madaniy-ma'rifiy siyosatni o'rgatish – milliy meros va qadriyatlarni egasi bo'lishga undaydi va hokazo. Ta'kidlash joizki, xalqaro ilmiy doiralarda ham tarix ta'limidan kutiladigan natijalarning biri – tarixiy bilimlarni bugungi kundagi fuqarolik ongini yuksaltirishga xizmat qildirishdir⁶. O'zbekistonning eng yangi tarixi fani ham aynan shunday vazifani bajarishi mo'ljallangan milliy fan sifatida qaraladi.

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⁵ Abdullayev, R. (2017, August 14). O'zbekistonning eng yangi tarixini o'rganish – dolzarb masala. *Uza.uz*. <https://uza.uz/posts/98861>

⁶ Thorp, R., & Persson, A. (2020). On historical thinking and the history educational challenge. *Educational Philosophy and Theory*, 52(8), 891–901. <https://doi.org/10.1080/00131857.2019.1686940>

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AI Adoption in Small and Medium Enterprises: Data Infrastructure, Customer Engagement, and Organizational Capabilities

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Abstract

Artificial intelligence presents opportunities for small and medium-sized enterprises to improve operational processes, sharpen marketing decisions, and enhance customer interactions, yet adoption is uneven due to resource limits, limited technical expertise, and infrastructure gaps. This work synthesizes definitional debates and empirical findings on technological enablers, data practices, applications, and organizational capabilities required for effective adoption in smaller firms. Evidence highlights the need for systematic data architectures, governance, and analytics pipelines as precursors to scalable AI services; staged implementation trajectories often reconfigure platform design and data capture before deploying machine learning and automation. Demonstrated applications include automated customer support and predictive analytics that reduce resolution times, optimize resource allocation, and enable personalized recommendations and continuous service. Organizational antecedents include top management commitment combined with dynamic capabilities for sensing, seizing, and transforming opportunities, plus workforce adaptability supported by targeted reskilling and external technical assistance. Measurement models report reliable constructs for readiness and adaptability, while contextual barriers such as regulatory constraints, investment shortfalls, and consumer data concerns moderate outcomes. Recommendations emphasize aligning AI efforts with strategic goals, investing in data management and people, and leveraging partnerships to convert technological potential into measurable performance improvements.

1. Introduction

Across diverse organizational contexts, artificial intelligence (AI) has been associated with gains in operational efficiency, enhanced decision quality, and improved customer interactions. AI marketing solutions that integrate machine learning, predictive analytics, natural language processing, and automated customer service systems have been used to streamline operations, support decision making, and modernize business-to-consumer communication patterns. In domains such as retail, banking services, and online sales, these technologies have been applied to reduce expenses while enhancing customer service and access to behavioral data, enabling more individualized marketing approaches. Customer-facing applications constitute a

central strand of this development. Chatbots, virtual assistants, and call center conversational interfaces provide continuous availability and can deliver personalized support that strengthens customer relationships and satisfaction. E-commerce platforms that employ AI-based recommendation systems generate tailored product suggestions from historical user behavior and stated preferences, contributing to more engaging user experiences. In financial services, AI assists with risk evaluation, fraud detection, and financial consultation, thereby supporting more responsive and data-driven service provision (1). These examples illustrate how AI can embed automation and data analytics into core customer and operational processes. At the same time, research on small and medium-

sized enterprises (SMEs) underscores that AI adoption is uneven and shaped by specific constraints. In several contexts, SMEs lag behind larger organizations in technology uptake and AI integration, largely due to limited resources, insufficient understanding of AI capabilities, and challenges in adapting existing systems. Studies focusing on SME environments identify competitive pressure, top management commitment, employee adaptability, external support, and organizational readiness as key determinants of AI adoption decisions (2,3). Competitive pressure can push firms to incorporate AI into marketing and operational strategies to remain viable in dynamic markets, while top management commitment supports strategic recognition of AI's potential and mobilizes resources for implementation. Employee adaptability and organizational readiness emerge as particularly salient internal conditions. Employee adaptability, understood as the capacity to adjust to new technologies, roles, and processes, is closely linked to the effective utilization of AI tools in everyday work. Organizational readiness, which spans leadership support, culture, infrastructure, and processes, shapes whether AI can be aligned with business strategy, supported by adequate technical and data capabilities, and embedded through appropriate change management. External support, including expertise, technical assistance, customization, training, and ongoing services, can help SMEs overcome capability gaps and leverage AI for improved efficiency, decision making, competitive advantage, and customer service (2). Despite these developments, several research gaps remain. Existing work often aggregates different forms of AI and concentrates on large, resource-rich firms, providing limited insight into how generative and other AI technologies are used by SMEs, especially

for sustainability-oriented functions. Evidence indicates that SMEs in technologically constrained environments confront additional barriers related to infrastructure and context-specific limitations, which further complicate AI adoption (4). In some regions, such as Jordan and Sabah, empirical studies report insufficient knowledge about AI's practical influence on small business performance and a lack of detailed understanding of sector-specific adoption drivers (1,2). As a result, the literature on AI and SMEs calls for contextually grounded research designs that can clarify how perceived usefulness, ease of use, organizational conditions, and external support jointly shape AI uptake and its operational consequences for smaller enterprises (1–4).

2. Foundations of Artificial Intelligence in Small Business Contexts

2.1 Definition and Scope of AI

Definitions of artificial intelligence vary across fields, yet several sources converge on key elements that clarify its scope for organizational applications. One account describes AI as a field of computer science dedicated to creating intelligent machines capable of performing tasks that typically require human intelligence, emphasizing abilities such as data analysis, learning from experience, decision making, and problem solving through algorithms, machine learning techniques, and large datasets (2). A complementary definition characterizes AI as the study of algorithms that enable machines to reason and carry out cognitive functions including problem solving, object and word recognition, and decision making (3). Taken together, these descriptions frame AI as a collective term for applications that reproduce or augment human cognitive functions in computational systems (2,3). Historical contextualization further refines this scope. The phrase "Artificial Intelligence" was coined by John McCarthy

in 1956 at the Dartmouth Conference, which is widely regarded as the starting point of AI research. Substantial progress in AI techniques did not emerge until the 1970s, in part because early efforts were constrained by limited data availability and immature computing technologies. Subsequent developments associated with Industry 4.0 and the proliferation of data generating devices accelerated AI by supplying large volumes of data and the networking infrastructure required for large scale data sharing, enabling more advanced applications across domains (3). Current descriptions emphasize the breadth of AI's application areas. AI systems encompass subfields such as natural language processing, computer vision, robotics, expert systems, and neural networks, and are applied in healthcare, finance, transportation, gaming, small and medium sized enterprises, and marketing strategy (2). Everyday manifestations include chatbot interactions, web searches, and voice assistants, alongside deployment in education, industry, and health services. Despite this diversity, research still reports the absence of a universally accepted single definition of AI, reinforcing the value of treating AI as an umbrella term for a wide range of algorithmic approaches. Within small business and SME contexts, AI is often conceptualized through its functional roles and the specific tools it activates. One synthesis highlights AI powered tools that automate routine activities such as data entry, scheduling, and basic customer service inquiries, as well as algorithms that analyze customer data to personalize marketing campaigns, product recommendations, and chatbot interactions (3). Another review characterizes AI in SMEs as a general purpose technology that can streamline internal processes, support strategic and operational decision making, and enhance productivity across marketing, sales, and performance management.

These accounts position AI not as a single technology but as a configurable ensemble of analytic and automation capabilities that organizations can embed into diverse business processes (2,3). Public understanding and acceptance form part of AI's practical scope. Analyses of media coverage show that AI is increasingly visible in public discourse, with both optimistic narratives and concerns about issues such as job displacement, ethics, and safety risks. Negative news is reported to exert a stronger influence on perceptions, which can generate resistance to AI powered products and services and potentially affect organizational attempts to derive competitive advantage from AI deployments (3). In parallel, domain specific studies in regions such as Jordan and Sabah describe AI in terms of concrete applications including digital marketing, personalization, predictive analytics, and decision support for SMEs, while also noting gaps in understanding of AI capabilities among managers and resource constraints that limit effective adoption (1,2). Through these combined perspectives, AI in small business environments can be delineated as a multifaceted technological domain spanning algorithmic intelligence, data driven analytics, and automated interaction systems that are shaped by both technical possibilities and contextual adoption conditions (1–3).

2.2 Relevance of AI to SMEs

Across small and medium sized enterprises, AI is positioned as a strategic tool for enhancing decision processes, marketing effectiveness, and overall business performance. Studies on SMEs in diverse contexts report that AI supported applications can streamline operations, improve strategic decisions, and optimize performance, but they also underline that realizing these benefits requires deliberate

planning, investment, and expertise for successful integration with existing systems (2,3). Within this framing, AI is treated as a powerful enabler of growth, innovation, and competitiveness in digital markets, particularly when organizations can match technological solutions to clearly identified business needs and ensure accurate, unbiased data for model training (3). Marketing and customer related functions constitute a central area of relevance. By using machine learning and data analytics, SME marketers can derive detailed insights into customer behavior and preferences and employ these insights to design more personalized, effective, and efficient campaigns. Such applications span personalized recommendations, targeted communication, and improved segmentation, and they are regarded as important for decision making regardless of SME size, sector, or product and service portfolio (2). In consumer facing industries in Jordan, AI marketing solutions integrate machine learning, predictive analytics, natural language processing, and automated customer service systems to streamline operations and provide access to rich behavioral data, which firms can use to develop individualized marketing approaches and updated business to consumer communication patterns. Customer engagement and service delivery form another major domain in which AI is operationally salient for SMEs. AI powered chatbots, virtual assistants, and call center conversational interfaces offer continuous availability and can strengthen customer relationships by enabling more responsive and personalized support. In Jordanian retail, banking, and online sales, these tools contribute to enhanced customer experiences while simultaneously simplifying work processes and reducing expenses. Financial sector examples show that AI applications support risk evaluation, fraud detection, and financial consultation,

indicating how data driven systems can extend SME capabilities in domains that traditionally required substantial human expertise (1). Beyond front end interactions, AI contributes to operational efficiency and internal value creation. Empirical syntheses on AI and SMEs describe AI as enabling automation, predictive analytics, and data driven decision making that can improve productivity and reduce manual labor in a range of business functions. Automation can reduce errors and simplify administrative processes, while predictive systems help firms forecast demand, monitor environments, and adjust strategies under conditions of technological turbulence and market volatility. These capabilities are particularly salient where SMEs face competitive pressure and must do more with fewer resources to remain viable, as AI supported tools can help them adapt business models, monitor regulatory compliance, and expand into wider markets via digital channels such as e commerce and online marketplaces (3). At the same time, research focused on specific SME ecosystems reveals that AI's relevance is conditioned by context specific constraints. In Sabah, Malaysia, local SMEs significantly lag in AI adoption due to a lack of fundamental understanding of AI capabilities and inadequate resources for adaptation and integration, despite their recognized importance for the regional economy (2). Similar gaps are documented for Jordan, where there is insufficient empirical evidence on AI's practical influence on business performance, customer attitudes, and engagement tactics, and firms often lack awareness that user perceptions and trust in AI services directly affect adoption rates and outcomes (1). These findings underline that AI's potential to enhance operations, customer experience, and competitiveness in SMEs is substantial but not automatic, depending critically on organizational readiness,

external support, and local infrastructural and knowledge conditions (1–3).

3. Technological Enablers for AI Adoption in SMEs

3.1. Infrastructure and Tools

Empirical work on AI in consumer industries and SME contexts foregrounds data infrastructure as a central enabler of advanced applications. In the case of the PrestaShop platform, a dedicated Data Strategy Team was created in 2021 specifically to build systematic data collection capabilities, complemented by external ecosystem intelligence tools that enrich merchant and partner profiles. This restructuring included platform level changes to support data capture and analytics, positioning the organization for later AI integration. A subsequent phase, explicitly labeled as data readiness for AI integration, involved configuring the platform for large scale data collection and analysis, followed by pilot AI services and internal capacity development. These steps underline that robust data architectures and analytics pipelines are treated as prerequisites for AI deployment rather than incidental by products of digitalization. In PrestaShop's ongoing AI enabled transition, capabilities and infrastructure remain under development, indicating that the underlying tooling and data systems must evolve alongside business model transformation. Operational tools built on this infrastructure support concrete performance gains. At PrestaShop, machine learning has been integrated into the customer support system, contributing to a measurable reduction in average ticket resolution time and an increase in automated content delivery tailored to user history and behavior. Customer care managers describe these changes as generating rapid improvements through dynamic content provision and AI generated resources in a learning

academy, reflecting how AI tools are embedded into support workflows. Data driven dashboards, such as those implemented with Looker, enable strategic reallocation of resources and identification of profitable merchant clusters, illustrating how analytics interfaces become part of the operational toolset for decision makers. Over time, these tools have supported a broader shift from reactive to proactive business development, including the design of new revenue generating services informed by ecosystem level data analysis (5). Survey based research in Jordanian consumer industries provides complementary evidence on how specific AI functionalities depend on adequate technological and data infrastructures. Measurement models include items capturing the capacity of firms to use AI to predict behavior, offer relevant solutions, and personalize customer experiences, while simultaneously acknowledging capital, cost, and knowledge constraints in personalization and the early stage of AI use in local e commerce. Additional indicators frame operational efficiency around AI enabled error minimization, process simplification, cost and delivery time reduction, and sectoral patterns such as slow AI adoption in finance due to regulatory concerns and investment needs. These constructs implicitly assume the presence of data networks and secure infrastructures, as other items in the same model highlight data security issues as major constraints and stress the importance of quality data networks for maximizing AI benefits (1). Together, these findings connect AI applications, operational efficiency, consumer engagement, and business performance to the availability of reliable technical infrastructures and data management capabilities. Within SME focused adoption models, organizational readiness and external support function as infrastructural enablers at the

organizational level. Organizational readiness is defined to encompass leadership, employees, culture, infrastructure, and processes that together determine whether a firm can effectively adopt and leverage AI technologies. High readiness ensures alignment with business strategy, robust data management, and suitable technical infrastructure, all of which support improved efficiency and decision making. External support packages expertize, technical assistance, customization, data management, training, and continuous services into a complementary resource base that allows SMEs to access and operate AI tools they could not build alone. These forms of support compensate for internal resource and capability gaps, enabling SMEs to develop the infrastructural conditions required for AI adoption and to convert abstract technological potential into operational tools that enhance performance (2).

3.2. Data Management

Data practices underpin many of the AI functionalities documented in SME and platform contexts, linking data collection, storage, and analysis directly to operational and customer facing outcomes. At PrestaShop, the creation of a Data Strategy Team and subsequent restructuring of the platform explicitly targeted systematic data capture and analytics, which later supported AI based automation in ecosystem monitoring and decision making. Machine learning integration in the customer support system relied on historical user data to reduce average ticket resolution time and deliver content dynamically based on user profiles and behavior. These same data resources fed Looker dashboards that allowed managers to identify profitable merchant clusters and reallocate resources strategically, illustrating how curated datasets become

central to AI enabled decision support and market segmentation (5). Measurement models in Jordanian consumer industries operationalize data related constructs that implicitly assume robust data management capabilities. Items describing AI applications emphasize enhanced and personalized customer experiences, prediction of consumer behavior, and the provision of relevant solutions, all of which depend on access to reliable behavioral data. Constructs for business performance refer to AI tools that build customer profiles, personalize experiences, and improve efficiency, again presupposing systematic data collection and processing. Additional indicators highlight that Jordanian organizations use AI to analyze customer data for market insights and to monitor buying behaviors and supply chains, while simultaneously underscoring that data security issues are a major constraint and that quality data networks are essential for realizing AI benefits. These scales position data security and network quality as integral components of the broader data management environment required for AI driven personalization, operational efficiency, and performance improvements (1). Organizational level enablers of AI adoption in SMEs incorporate data management within wider readiness constructs. In Sabah, organizational readiness is defined through leadership, employees, culture, infrastructure, and processes, a configuration that includes the technical and procedural arrangements needed to manage data effectively. High levels of readiness are described as ensuring alignment between AI technologies and business strategy and as providing the necessary technical infrastructure for data handling. External support captures complementary resources such as data management expertize, technical assistance, and training, which help SMEs that lack internal capacity to

build and operate appropriate data systems. Construct validity assessments for these factors report high average variance extracted and composite reliability for organizational readiness and AI adoption measures, suggesting that data related capabilities are statistically coherent elements of the readiness construct (2). Open source platform research offers a detailed view of how governance and architecture shape data management for AI. For PrestaShop, decentralised user controlled infrastructures initially limited data access, compelling a redesign of business model architecture to enable data collection and harmonisation before AI could be scaled. Studies on this case describe a staged trajectory in which data readiness for AI integration involved restructuring the platform for analytics, followed by a phase where AI acted as a trigger for ecosystem mapping, market segmentation, and merchant expert matchmaking. Subsequent phases treated AI as a driver and enabler, with data informed market intelligence guiding strategic focus on particular merchant segments and supporting development of new offerings such as subscription based enterprise distributions. Across these stages, data architecture, governance mechanisms, and tools like CloudSync and analytics specialists are identified as essential for transforming fragmented, decentralised data into a managed resource base that supports AI enabled personalisation, targeting, and scalable value creation (3,5).

4. AI Applications for Small Business Solutions

4.1. Operational Efficiency

Operational outcomes linked to AI applications are described in terms of automation, error reduction, and process streamlining, particularly in consumer industries that resemble many small

business environments. AI technologies are reported to perform automated processes within technical and administrative domains, enhancing business processes and reducing human errors. Organizations using AI have documented improvements in inventory management, fraud identification, marketing process automation, and risk evaluation. AI driven analytics are described as operating on real time processing of large data volumes, which supports faster and more precise business decisions and contributes to productivity gains in manufacturing and service functions. In administrative departments, AI assists in reducing mistakes and simplifying operations, which can raise manufacturing productivity and decrease implementation time and cost for services. Empirical models that measure operational efficiency in Jordanian consumer industries further specify how AI functions are associated with efficiency indicators. One construct defines operational efficiency through items such as AI minimizing errors and simplifying processes in administrative work, enhancing production, and improving efficiency by reducing costs and delivery times. Additional items reference global financial sector experiences, where AI contributes to efficient loan processing and fraud detection, while noting that adoption in Jordan's finance sector remains slow because of regulatory concerns and investment requirements. These measurement items collectively embed AI supported error reduction, cost savings, and time compression within a broader efficiency framework that links automation and analytics to improved operational performance. Global assessments of AI's efficiency effects extend beyond single sectors. Drawing on resource based view arguments, one account reports that about 30% of AI based efficiency improvements are reflected directly in improved business results, connecting process optimization to

financial performance outcomes. Operational efficiency is framed as producing high quality outputs at lower production costs relative to competitors, with AI enabled automation, refined resource distribution, and coordinated partnerships contributing to process improvement. Infrastructure upgrades that remove bottlenecks and other inefficient behaviors are highlighted as complementary interventions that, together with AI, streamline operations. Within this perspective, process improvement, automatization of services, and optimized resource allocation are treated as central mechanisms through which AI supported efficiency underpins marketplace performance and sustainability goals. Findings from Jordanian consumer industries also reveal contextual constraints that shape whether such efficiency gains materialize locally. Regulatory barriers and limited technical infrastructure are identified as obstacles for firms seeking to translate globally observed efficiency benefits into domestic results. Operational efficiency did not exhibit a direct, statistically strong influence on business performance in one structural model, despite being conceptually important for organizational success. This pattern is interpreted as implying that efficiency improvements alone may be insufficient without additional strategies related to consumer trust and engagement. Nonetheless, companies that deploy AI systems to make predictions about markets, prices, and supply chains are described as experiencing increased operational efficiency and more informed decision making, suggesting that predictive analytics can still yield meaningful process gains even in constrained environments. Overall, research on Jordanian and international settings situates AI enabled operational efficiency at the intersection of automation, predictive analytics, infrastructural conditions, and

complementary customer focused strategies (1).

4.2.Customer Engagement

AI driven customer interfaces such as chatbots, virtual assistants, and call center conversational systems are positioned as central mechanisms for strengthening ongoing relationships between firms and consumers. These tools provide continuous, 24 / 7 availability, deliver personalized responses, and support rapid resolution of inquiries, which together cultivate higher levels of satisfaction and a more robust relational base. In consumer industries worldwide, such applications enable real time interaction and tailored experiences that shape service quality perceptions and deepen engagement. However, empirical work focused on Jordan reports that current implementations in local firms and banks do not yet reach international standards of consumer engagement, pointing to a gap between technological possibilities and realized practice in this context. Measurement constructs for customer engagement in Jordanian consumer industries operationalize these ideas in more detail. Items in the structural model capture beliefs that AI strengthens customer relations through chatbots, virtual assistants, and call center interfaces, that AI chatbots provide 24 / 7 support and improve customer service, and that such tools are increasingly adopted by Jordanian banks and firms. At the same time, other items acknowledge that chatbot adoption lags behind global benchmarks and is slowed by regulatory and investment challenges. This configuration of indicators reflects both the perceived engagement benefits of AI mediated interaction and the structural frictions that temper diffusion and limit the intensity of customer engagement gains at present. Conceptual sections in the same study frame customer engagement as a key

determinant of business performance. Engaged customers are more likely to repurchase, remain loyal to a brand, and disseminate positive word of mouth, thereby providing behavioral information that helps firms optimize marketing strategies and increase satisfaction. Within a resource-based view perspective, such engagement is characterized as an intangible strategic asset that can sustain high levels of performance results, while technology acceptance arguments imply that consumers will use engagement tools when they perceive them as useful and easy to use. Findings also caution that negative experiences with AI personalization, particularly when recommendations are perceived as inappropriate or overly invasive, can produce adverse engagement outcomes, underscoring the need to balance personalization intensity with ethical and contextual sensitivity. Research on AI marketing in Jordan broadens this picture by situating customer engagement within a wider digital communication environment. AI marketing solutions integrating machine learning, predictive analytics, natural language processing, and automated customer service systems are described as streamlining operations and reshaping business to consumer communication patterns. These systems enable access to behavioral data that supports individualized marketing approaches, while recommendation engines in e commerce contexts generate personalized suggestions from historical behavior and stated preferences. Continuous chatbot availability combined with customer service functions is associated with improved satisfaction and contributes to enhanced loyalty and communication quality, although overall empirical coverage of engagement tactics in Jordan remains limited and context specific constraints such as data privacy concerns and cultural sensitivity

issues are identified as barriers to broader acceptance. Within this evidence base, customer engagement appears as a multi dimensional construct shaped by interaction frequency, perceived service quality, personalization experiences, and underlying trust in AI applications. AI powered interfaces can provide meaningful relational benefits when they deliver convenient, responsive, and culturally appropriate services, yet their impact depends on local regulatory environments, investment capacities, and consumer attitudes toward data security and automation. Consequently, firms in contexts such as Jordan face the dual task of deploying AI tools that technically enable rich engagement while simultaneously addressing the attitudinal and institutional factors that condition whether consumers will embrace these modes of interaction (1).

5. Organizational Capabilities for AI Integration

5.1. Leadership and Vision

Strategic support from owners and top managers plays a decisive role in whether AI initiatives are legitimized, resourced, and sustained in smaller organizations. In SME contexts, top management commitment is defined as the degree of support and dedication that senior decision makers provide to initiatives such as AI adoption, shaping long term direction, market choices, and technology investments. Empirical work associates this commitment with recognition of AI's potential, overcoming resistance to change, and ensuring that AI is leveraged as a strategic tool to enhance decision making, competitiveness, and overall performance. Without explicit endorsement and resource allocation from senior leaders, AI initiatives are unlikely to progress beyond exploratory stages or to be integrated into core business processes (2,3). Leadership support has been examined in more depth

in family business settings, where governance structures and socioemotional priorities intensify its importance for AI driven innovation. In these firms, leaders often occupy dual roles as family members and business professionals, and their stance toward AI is central to reconciling technological change with family values and long term goals. Leadership support legitimizes AI projects, aligns them with concerns about control and legacy, and guides decisions about investing in technological infrastructure and human capital. Conceptual analyses identify leadership support as one of five critical antecedents of AI adoption in family businesses, alongside technological readiness, cultural openness, organizational agility, and knowledge management, all of which form the premises for innovation when combined with appropriate capabilities. Dynamic Capabilities Theory offers a structured lens to explain how leadership and vision translate into innovation outcomes in such contexts. Dynamic capabilities are conceptualized as higher order processes of sensing, seizing, and transforming that allow firms to integrate, build, and reconfigure internal and external competencies under environmental uncertainty. For family firms pursuing AI initiatives, dynamic capabilities mediate the connection between leadership support and innovation capabilities, ensuring that strategic intent is operationalized through resource reallocation, experimentation, and continuous adjustment. A specific proposition advances that dynamic capabilities make leadership support actionable, linking leaders' vision, strategic decisions, and resource commitments to concrete innovation capabilities rather than static technology acquisition. This capability perspective implies that vision alone is insufficient. Leaders need to foster sensing activities that monitor technological trends

and customer needs, seizing behaviors that mobilize resources into pilot AI projects, and transforming actions that reconfigure routines and roles to embed AI in everyday operations. Conceptual frameworks developed for family firms argue that, in the absence of these dynamic processes, AI is likely to be implemented in a generic manner that fails to unlock its full potential, resulting in underutilized technologies and limited innovation outcomes. Conversely, when leadership vision is combined with systematic efforts to cultivate dynamic capabilities, AI related antecedents such as technological infrastructure, cultural openness, and knowledge management can be converted into sustained innovation capabilities over time (6). Parallel work on SMEs more broadly reinforces the centrality of leadership vision by framing digital leadership as an internal antecedent of AI adoption and business model adaptation. Digital leaders with a strong belief in technology's potential and a clear vision for its role in strategy are described as enabling SMEs to adjust their business models, coordinate resources, and engage with complementary technologies such as big data analytics, particularly under conditions of technological turbulence and post crisis adjustment. In this stream, leadership oriented toward digital transformation is linked to the ability to detect and seize AI related opportunities, rearrange capabilities via digital platforms, and orchestrate gradual but continuous changes in business models that sustain competitiveness in an AI influenced environment (3). Across these strands, research shows that effective leadership and a forward looking vision function as integrating mechanisms that connect AI adoption decisions with organizational capabilities and long term competitive positioning. Leaders who articulate clear AI related goals, align them with broader strategic and socioemotional objectives, and invest in the development of

dynamic capabilities create conditions under which AI can move from isolated tools to drivers of innovation and performance in small and family owned enterprises (2,3,6).

5.2. Workforce Skills

Developing appropriate workforce capabilities is repeatedly identified as a decisive condition for effective AI adoption in small and medium sized enterprises. Employee adaptability is defined as an individual's ability to adjust and thrive in changing work environments, encompassing flexibility, open mindedness, and a willingness to learn new technologies, processes, and roles. In SME settings, such adaptability is considered crucial because these firms often operate in dynamic and competitive markets that demand continuous adjustment. AI technologies in areas such as automation, machine learning, and data analytics can streamline processes, improve productivity, and enhance decision making, but their benefits depend on employees being able to integrate these tools into their work. Staff who possess strong adaptability skills can quickly learn how to use AI tools, reconfigure their job roles to collaborate with AI systems, and acquire new skills as needed. They are described as embracing the changes and opportunities introduced by AI and contributing directly to the successful implementation and utilization of AI technologies within their organizations. This focus on adaptability is formalized in SME adoption models that articulate a specific hypothesis: employee adaptability significantly influences the adoption of AI technologies. Within these models, the relationship between adaptability and AI integration is treated as mutually dependent, with adaptable staff facilitating implementation and AI driven changes in turn requiring further adaptation. Empirical constructs for employee adaptability are operationalized through reflective

measurement models that capture dimensions such as flexibility and readiness to learn. Reported factor loadings for adaptability items range from 0.696 to 0.872, with an average variance extracted of 0.641 and composite reliability of 0.877, indicating that the underlying construct is reliably measured and conceptually coherent in the context of AI adoption. Discriminant validity assessments using the Heterotrait Monotrait ratio of correlations show that adaptability is distinct from, yet related to, other antecedents such as competitive pressure, external support, organizational readiness, and top management commitment. These psychometric results substantiate the argument that adaptability represents a specific workforce capability that meaningfully shapes AI uptake in SMEs (2). Alongside adaptability, broader workforce skills in technological and managerial domains emerge as central levers for AI integration. Analyses of organizational readiness for AI stress that changes in work processes, roles, and responsibilities accompany adoption, requiring clear communication, training, and support so that employees understand benefits and feel prepared to adjust to new ways of working. Practical guidance includes evaluating existing skill gaps and investing in training initiatives that enhance proficiencies in programming, machine learning, and data analysis. These recommendations position technical skills as part of a wider readiness package that also involves cultivating a culture of continuous improvement and collaboration. Research on top management commitment complements this view by arguing that senior leaders should prioritize the development and training of employees in relevant technological and managerial competencies to ensure the workforce can effectively utilize AI technologies. Upskilling and reskilling opportunities are framed as

necessary conditions for realizing AI's potential, with workforce capabilities explicitly linked to improved decision making, efficiency, and performance outcomes. In this perspective, organizational readiness, leadership commitment, and employee skills are intertwined: readiness initiatives must include structured capacity building, and leadership support is critical for allocating resources to systematic workforce development that aligns with AI related strategic objectives (2,3).

6. Conclusion

The synthesis highlights a consistent pattern: artificial intelligence can enhance small and medium sized enterprises by improving operational processes, enriching customer interactions, and supporting more data driven decision making, but realizing these benefits depends on a combination of technical, organizational, and institutional conditions.

On the technical side, systematic data collection, harmonized architectures, and analytics pipelines are prerequisites for advanced AI functions. Platform level actions such as creating a dedicated data strategy team, redesigning decentralized data governance, and implementing analytics tools enable progressive stages of adoption, from data readiness and pilot services to scaled AI offerings and market intelligence. Practical examples show that machine learning embedded in customer support and dashboarding tools can shorten ticket resolution times and reveal profitable merchant segments when underlying data flows are mature and coherent.

Data management practices are central. Curated historical data, secure networks, and governance mechanisms permit personalization, prediction, and automation. Where data architectures remain fragmented, firms face barriers to model

training, monitoring, and scaling. External assistance that supplies data engineering expertise, cloud syncing tools, and analytics specialists can bridge capacity gaps for smaller firms that lack inhouse resources. Operational impacts arise through automation, error reduction, and predictive analytics. Use cases include inventory optimization, fraud detection, and streamlined administrative workflows. Yet process improvements do not automatically translate into superior business outcomes without complementary strategies that address consumer trust and engagement. Evidence shows that predictive systems can raise efficiency and informed decision making, but contextual constraints such as regulation and infrastructural limits can mute direct performance gains.

Customer engagement benefits from AI mediated interfaces like chatbots and virtual assistants, which provide round the clock response and personalized interactions that can boost satisfaction and loyalty. Adoption levels and service quality vary by setting; in some markets implementations lag behind international standards due to investment, regulatory, and cultural factors. Careful balancing of personalization intensity with privacy sensitivity and ethical design remains necessary to avoid adverse reactions to intrusive or inappropriate recommendations.

Organizational capabilities determine whether technology delivers value. Leadership commitment and a clear strategic vision are necessary to legitimize AI initiatives, allocate resources, and guide integration into business models. In family owned and small firms, leaders must combine strategic intent with dynamic capabilities that sense opportunities, mobilize resources into pilots, and transform routines and roles so AI is embedded rather than isolated. Workforce skills complement leadership: employee adaptability, continuous training, and

targeted upskilling in data and analytics correlate with higher adoption. Measurement evidence indicates that adaptability is a reliable construct within adoption models (item loadings in the 0.696–0.872 range, average variance extracted around 0.641, and composite reliability near 0.877), and it is distinct from other antecedents such as competitive pressure and external support.

External support emerges repeatedly as a compensatory mechanism for resource constrained SMEs. Consulting services, technical assistance, customization, and ongoing training enable firms to access capabilities they cannot build alone and to progress through staged adoption trajectories. Policy and ecosystem actors can amplify these effects by improving digital infrastructure, clarifying regulatory expectations, and subsidizing capacity building where appropriate.

Regional evidence underscores heterogeneity in adoption. Some settings exhibit proactive platform led transformations that reconfigure data architectures and produce measurable operational improvements, while others exhibit slow uptake caused by low awareness, limited resources, and regulatory caution. Research gaps remain, particularly regarding the role of generative AI and sustainability oriented applications in smaller firms, and more context sensitive empirical work is required to map sectoral differences and long term performance impacts.

Practical implications follow from these findings: prioritize data readiness before large scale AI investments; sequence adoption through pilot projects tied to measurable outcomes; align senior leadership, workforce development, and IT governance; and leverage external partners to compensate for capability shortfalls. Attention to privacy, ethical design, and culturally appropriate engagement

practices will support customer acceptance and long-term value realization.

Future investigations should emphasize longitudinal case studies, comparative analysis across sectors and regions, and evaluation of newer AI modalities in small firm settings. By combining technological investments with organizational development and supportive external ecosystems, small and medium sized enterprises can move from isolated experiments to sustained, measurable improvements in efficiency, customer relations, and strategic agility.

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Green Technologies, Human Psychology, and Education: Evidence from Uzbekistan's National Sustainability Transition

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Abstract

Uzbekistan is undergoing a rapid and ambitious green technology transition, committing to derive 54% of its electricity from renewable sources by 2030 and investing approximately USD 2.90 billion in clean energy in 2024 alone. While the technical and macroeconomic dimensions of this transformation have been extensively documented, its psychological and educational implications remain underexplored. This paper examines how green technology adoption influences human psychological well-being, pro-environmental attitudes, and motivational orientations among Uzbek citizens, students, and business professionals. Drawing on Attention Restoration Theory, Stress Recovery Theory, and Self-Determination Theory, and integrating empirical evidence from national education programmes, business sector case studies, and international development initiatives, the paper demonstrates that Uzbekistan's green transition is simultaneously an environmental, psychological, and pedagogical phenomenon. Findings indicate that green technology environments positively affect cognitive performance and psychological resilience, while targeted sustainability education programmes are cultivating ecological literacy and green entrepreneurial identity across the country. Implications for national education policy, corporate sustainability strategy, and future cross-cultural research are discussed.

Keywords: green technologies, psychological well-being, sustainability education, Uzbekistan, green economy, pro-environmental behaviour, business sustainability, ecological literacy.

1. Introduction

Uzbekistan stands at a pivotal juncture in its developmental trajectory. Since the adoption of the Green Economy Transition Strategy in 2019, the country has pursued an accelerating programme of renewable energy deployment, smart infrastructure development, and environmental modernisation. By 2024, Uzbekistan had attracted approximately EUR 30 billion in energy sector investment since 2017, increasing total electricity generation from 60 billion kWh to 85 billion kWh, and achieving a renewable energy share of 23% of total power generation [1, 2]. In December 2025, the government launched 42 new green energy projects valued at EUR 9.46 billion, targeting a 54% renewable share by 2030 [1].

This remarkable physical transformation is reshaping not only the country's energy infrastructure but also the psychological

and educational environments in which Uzbek citizens live, study, and conduct business. Environmental psychology has long established that the built environment, energy systems, and natural elements present in everyday settings exert substantial influence on human behaviour, mood, cognitive performance, and social attitudes [3]. However, the psychological and educational dimensions of large-scale national green transitions — particularly in Central Asian contexts — remain inadequately studied.

This paper addresses this gap by examining three interrelated dimensions of Uzbekistan's green technology transition: (1) its effects on the psychological well-being and motivational orientations of the population; (2) its integration into formal and non-formal educational systems; and (3) its influence on business culture and entrepreneurial identity. By situating this

analysis within an internationally recognised theoretical framework and grounding it in Uzbekistan-specific empirical evidence, the paper aims to contribute both to global environmental psychology scholarship and to policy dialogue on sustainable development in Central Asia.

2. Uzbekistan's Green Technology Transition: National Context

Uzbekistan's green economy transition is guided by the National Strategy for Transition to a Green Economy 2019–2030, whose targets were substantially revised

upward in 2024 to reflect accelerated progress [4]. The country's renewable energy market reached 3.15 GW of installed capacity in 2024, with projections indicating growth to 6.95 GW by 2030 at a compound annual growth rate of 13.73% [5]. Clean energy investment reached USD 2.90 billion in 2024, representing a 43% increase from USD 2.03 billion in 2023 [6].

Table 1 summarises key statistical indicators of Uzbekistan's green energy transition, providing the empirical baseline for the psychological and educational analyses presented in subsequent sections.

Table 1. Key Indicators of Uzbekistan's Green Technology Transition (2018–2030)

Indicator	2018	2022	2024/2025	Target 2030
Renewable energy share (%)	10–12%	14%	23%	54%
Total electricity generation (bn kWh)	60	67	85	~120
Clean energy investment (USD bn)	—	~1.2	2.90	>9.46*
Renewable capacity (GW)	1.84	~2.5	3.15	21+
Green-trained teachers	—	—	50,000†	100,000+
Students in climate education	—	—	1.3 mln†	—

Sources: [1, 2, 4, 5, 6, 7, 8]. *2025 announced investment figure. †UNDP-MoPSE joint programme data.

Key investment partners include ACWA Power (Saudi Arabia), Masdar (UAE), TotalEnergies (France), and Voltalia (France), reflecting Uzbekistan's growing integration into global green technology value chains [5]. In July 2024, a USD 350 million, 500 MW photovoltaic solar plant was launched in the Besharyk region, with projected annual generation of 1.6 billion kWh [5]. Over 20 universities now offer degrees in electrical engineering, power systems, and renewable energy technologies, with institutions such as Tashkent State Technical University and

Fergana State Technical University playing leading roles [9].

3. Theoretical Framework

Three complementary psychological theories frame this analysis. Attention Restoration Theory (ART), developed by Kaplan and Kaplan [10], holds that natural and green environments restore directed attentional capacity depleted by urban and cognitive demands. As Uzbekistan's urban areas increasingly incorporate green infrastructure — including smart parks, biophilic building designs, and solar-powered public spaces — ART predicts

measurable improvements in the attentional functioning and cognitive performance of urban residents.

Stress Recovery Theory (SRT), proposed by Ulrich [11], posits that exposure to natural elements triggers involuntary affective responses that facilitate rapid physiological and psychological recovery from stress. IoT-enabled smart buildings and green-certified workplaces, which maintain optimal indoor air quality and thermal comfort through renewable energy systems, create environments that approximate the restorative conditions described by SRT.

Self-Determination Theory (SDT), developed by Deci and Ryan [12], identifies three universal psychological needs — autonomy, competence, and relatedness — whose satisfaction supports intrinsic motivation and sustained behaviour change. Sustainability education programmes that involve students in authentic green technology projects, such as those being implemented under Uzbekistan's national climate education initiative, satisfy these needs and thereby cultivate durable pro-environmental motivation and ecological identity.

4. Psychological Effects of Green Technologies on Uzbek Citizens

4.1 Environmental Quality, Stress, and Psychological Well-Being

Uzbekistan's historical environmental challenges — including desertification, air pollution from fossil fuel dependence, and the ecological legacy of the Aral Sea disaster — have imposed significant psychological burdens on the population, including elevated rates of environmental anxiety and eco-grief, particularly in Karakalpakstan and western regions [13]. The government's green transition strategy explicitly addresses environmental remediation as a component of improved quality of life, recognising the psychological

as well as physical health benefits of cleaner energy and urban greening.

Smart building technologies powered by renewable energy are being deployed in new urban developments in Tashkent and other major cities, incorporating natural ventilation systems, biophilic design elements, and real-time environmental monitoring. Consistent with SRT, research in comparable transition economies indicates that residents of green-certified residential environments report significantly lower perceived stress, improved sleep quality, and higher life satisfaction compared to residents of conventional buildings [14]. As Uzbekistan's 300 mahalla neighbourhoods receive rooftop solar installations under the government's micro-solar programme — targeting 30,000 low-income families — these psychological benefits are being extended to previously disadvantaged populations [1].

4.2 Pro-Environmental Identity and Behaviour Change

The visible installation of renewable energy infrastructure in Uzbek communities — solar panels on schools, wind turbines on urban peripheries, and smart energy meters in residences — creates environmental cues that influence psychological self-perception and normative behaviour. Research in environmental psychology demonstrates that when community members can observe and interact with green technologies in their immediate environment, they are more likely to develop pro-environmental identities and engage in conservation behaviours [15].

Uzbekistan's introduction of a national carbon credit trading system, reported at COP-30 in 2025 and accounting for 23 million tons of verified greenhouse gas reductions, represents a structural mechanism that reinforces pro-environmental behaviour at the individual and corporate level through economic incentives aligned with psychological

principles of behaviour modification [1]. The government's real-time energy consumption monitoring software, developed with UNDP support and deployed in residential buildings, further enables citizens to receive corrective feedback that enhances environmental self-efficacy [7].

5. Educational Implications: Green Technology in Uzbek Schools and Universities

5.1 National Climate Education Initiative

The most significant educational intervention in Uzbekistan's green transition is the joint UNDP–Ministry of Preschool and School Education (MoPSE) programme targeting 1.3 million school students aged 15–18 across seven regions of the country, including the Republic of Karakalpakstan, Bukhara, Navoiy, Khorezm, Samarkand, Kashkadarya, and Surkhandarya [8]. The programme integrates climate change knowledge, green skills, and sustainability competencies into the formal upper secondary school curriculum through the 'Climate Box' toolkit, representing one of the largest climate education initiatives in Central Asia.

A total of 50,000 teachers have received training in climate pedagogy, participatory instructional methods, and AI-assisted teaching tools under this initiative [8]. Furthermore, 800 Young Green Ambassadors have been established as a network of youth environmental leaders who co-design and implement community sustainability projects, providing authentic leadership experiences that develop environmental agency consistent with SDT's emphasis on autonomy and relatedness [8].

5.2 Vocational and Higher Education

At the vocational level, 12 training centres offer two specialised courses — one on renewable energy technologies and one on climate-smart agriculture — to approximately 4,000 young people

annually, directly linking green technology skills to employment outcomes and career identity [8]. This aligns with Uzbekistan's 'Uzbekistan 2030' Strategy, which explicitly targets the alignment of educational outputs with green economy labour market demands [7].

At the higher education level, over 20 universities now offer programmes in renewable energy, electrical engineering, and sustainable systems [9]. In 2025, a historic MoU signed at Power Uzbekistan 2024 between the National Research Institute for Renewable Energy Sources (NIREs), EUROSOLAR Uzbekistan Energy, and the Academy of Sciences of the Republic of Uzbekistan established a dedicated centre for innovative renewable energy education, workforce training, and applied research [5]. This institutional architecture creates a pipeline through which ecological literacy and green technical competence are developed systematically across educational levels.

5.3 Digital Education and Psychological Outcomes

Uzbekistan's 'One Million Uzbek Programmers' initiative — which has produced over one million certified IT graduates and launched a 'Five Million AI' phase in late 2025 — demonstrates the country's capacity for large-scale technology education mobilisation [16]. The integration of AI tools and digital platforms into sustainability education creates the conditions for adaptive, personalised learning experiences that can make abstract climate and energy concepts concretely relevant to individual learners, enhancing intrinsic motivation as predicted by SDT [12].

The InfoTeach-2025 forum provided online AI training to more than 5,000 teachers and 700 regional administrators, illustrating how digital education infrastructure is being deployed to build sustainability competence across the educational workforce [16].

Research in comparable contexts indicates that students who engage with digital simulations of renewable energy systems demonstrate significantly higher ecological literacy scores and stronger environmental identity compared to peers in conventional curriculum environments [17].

6. Business Dimension: Green Technologies and Organisational Psychology

6.1 Corporate Sustainability and Employee Well-Being

Uzbekistan's green transition is not confined to the public sector. The country's revised investment climate, including the 2024 Law on Energy Saving and Energy Efficiency, mandates energy audits for large enterprises and establishes efficiency standards that incentivise private sector adoption of green technologies [9]. As Uzbek businesses respond to these regulatory drivers and to growing international ESG (Environmental, Social, and Governance) investor expectations, the psychological dimensions of workplace sustainability are becoming strategically significant.

Research in organisational psychology consistently demonstrates that employees in green-certified and sustainable workplaces report higher levels of job satisfaction, organisational commitment, and psychological well-being, driven by perceptions of value alignment and meaning at work [18]. For Uzbek enterprises competing for international investment and export market access, the psychological benefits of green workplace transformation represent not merely a welfare consideration but a competitive advantage in talent attraction and retention.

6.2 Green Entrepreneurship and Ecological Identity

The emergence of green entrepreneurship as a distinctive business identity is a significant psychological development in Uzbekistan's private sector. The

government's support for small-scale renewable energy initiatives — including the 40 micro-hydro plants with 40 MW collective capacity that generated 120 million kWh in 2025, and the programme targeting 65 additional MW of micro-hydropower — creates economic opportunities that simultaneously reinforce entrepreneurial identity and pro-environmental self-concept [1].

Psychological research on green entrepreneurship identifies ecological identity — the degree to which individuals perceive environmental stewardship as central to their professional self-concept — as a key predictor of sustainable business innovation and resilience [19]. As Uzbekistan's business community increasingly operates within a policy environment that links commercial success to environmental performance, the cultivation of ecological entrepreneurial identity through business education and mentorship programmes becomes a strategic priority for sustainable economic development.

6.3 Psychological Barriers to Green Technology Adoption in Business

Despite the positive trends documented above, psychological barriers to green technology adoption persist in Uzbekistan's business sector. Research in the Central Asian context highlights limited environmental awareness, risk aversion towards new technology investments, and scepticism regarding the long-term reliability of renewable energy systems as significant psychological impediments to private sector green transition [20]. Uzbekistan's energy intensity remains approximately 50% above the global average — and roughly three times higher than in advanced economies — reflecting deeply embedded industrial practices and technological path dependencies that are resistant to rapid change [9].

Addressing these psychological barriers requires targeted interventions at the organisational level, including sustainability leadership development programmes, green technology demonstration projects that build managerial confidence and competence, and industry networks that provide social proof and peer normative pressure consistent with social cognitive theory [15]. Several international partners — including GIZ, UNDP, and USAID — are currently supporting curriculum development and pilot projects in this domain, providing models that Uzbek educational and business institutions can adapt and scale [9].

7. Discussion

The evidence synthesised in this paper reveals that Uzbekistan's green technology transition is unfolding simultaneously across environmental, psychological, educational, and business dimensions in ways that are deeply interconnected. The country's ambitious renewable energy targets — backed by USD 2.90 billion in clean energy investment in 2024 and a national goal of 54% renewable electricity by 2030 — create the physical conditions for the psychological and educational transformations documented in this review [1, 6].

Three principal findings merit emphasis. First, green technologies are reshaping the psychological environments of Uzbek citizens through improved environmental quality, reduced ecological anxiety, and enhanced opportunities for pro-environmental agency. Second, Uzbekistan's national climate education initiative — reaching 1.3 million students and 50,000 teachers — represents one of the most comprehensive attempts in Central Asia to institutionalise ecological literacy as a core educational outcome, with measurable implications for the development of environmental identity and intrinsic sustainability motivation. Third, the

business sector is emerging as a critical arena in which green technology adoption, organisational psychology, and entrepreneurial identity intersect in ways that have significant implications for both individual well-being and national economic development.

Important limitations of this analysis must be acknowledged. The review draws primarily on programme-level data and international reports; longitudinal empirical studies measuring psychological outcomes directly in Uzbek green technology contexts remain scarce. Regional disparities within Uzbekistan — particularly between urban centres such as Tashkent and rural or remote communities — mean that the psychological and educational impacts of green transition are likely to be unevenly distributed. Future research should employ mixed-methods designs, including surveys, physiological stress measures, and ethnographic approaches, to capture the heterogeneity of psychological responses to Uzbekistan's green transformation.

8. Conclusion

This paper has examined the psychological and educational dimensions of green technology adoption in Uzbekistan, situating the country's remarkable national sustainability transition within an evidence-based theoretical framework drawn from environmental psychology and motivational science. The analysis demonstrates that Uzbekistan's green technology investments are not merely infrastructure projects: they constitute psychological environments, educational contexts, and business ecosystems that shape how citizens think, feel, learn, and work.

The convergence of large-scale renewable energy deployment, a national climate education initiative reaching over one million young people, and a business regulatory environment that increasingly links commercial performance to environmental responsibility creates a

uniquely fertile context for the emergence of psychologically resilient, ecologically literate, and sustainably oriented citizens and professionals. Realising this potential, however, requires deliberate attention to the psychological dimensions of green transition — including the reduction of eco-anxiety, the development of ecological identity, and the removal of psychological barriers to green business adoption.

As Uzbekistan positions itself as a regional leader in the green economy transition, its experience offers valuable lessons for other Central Asian and developing nations navigating the intersection of environmental, psychological, and educational transformation. Future empirical research comparing psychological outcomes across Uzbekistan's regions and demographic groups will be essential for refining policy and educational interventions in this rapidly evolving context.

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Current Trends In The Development Of The Problem Of Linguistic Picture Of The World

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Abstract

The article studies the problem of linguistic picture of the world in different languages. It is well known that the concepts “world picture” and “world model” are frequently used interchangeably in linguistic study. However, we believe that these ideas differ significantly from one another. In reality, language, thought, and culture are all part of one system made up of these three interrelated components. Without the other two, nothing of these elements can exist on its own. Together, they interact with the outside world, mirror it, and take part in its creation. Consequently, “world pictures” are created. The authors of this article seek to elucidate the essence of concepts like “world”, “world picture,” “real picture,” “cultural picture,” “linguistic picture,” and “national picture.”

Keywords: The picture of the world, world model, linguistic reality, extralinguistic objectivity, alternative worlds, the cultural picture of the world, subjective perception, the national picture of the world, linguocultural isoglosses, dialect.

Introduction

Currently, in studies dedicated to this topic, two terms are used in parallel: “the picture of the world” and “world model,” which are used interchangeably. However, it seems to us that there is a significant difference in their meaning. The word “model” is presented as “something” logically organized and planned, while the concept of “picture” carries a slightly different property—it contains elements of creativity. In this regard, we will henceforth prefer the term “picture of the world”.

Languages “died” not under the influence of a foreign culture, but under the influence of new means of accumulation, consolidation, transmission, and consumption of the natural language. Thus, while noticeably losing their language, these cultures imperceptibly lost their symbolism. The death of any culture, as far as it can be understood, is always carried out by the

same path—by isolating the elements of culture; that is, when symbolism disappeared as a result of changed living conditions, language, as an isolated element of culture, was thereby already doomed. Thus, language, thinking, and culture are so closely interconnected that they practically constitute a single whole consisting of three components, none of which can function (and consequently exist) without the other two. Together, they correlate with the surrounding world, reflect it, and simultaneously form it. At the same time, they form so-called pictures of the world.

Literature analysis

Many linguists and researchers have worked on the role and significance of the worldview in linguistic and cultural studies. For example, Yu.D. Apresyan, V.I. Karasik, P.S. Gurevich, Yu.N. Karaulov, N. Korneyev, G.D. Gachev, A.I. Gelyayeva, M. Heidegger,

I.Trier, S.G.Ter-Minasova, Sh.Safarov, M.Hakimov and others. All of them interpreted the concept of “worldview” differently and gave different definitions to this concept.

V.I.Karasik writes about the need to clearly differentiate between two principles of researching the linguistic picture of the world [4]:

- 1) the reflection in language of a world picture existing outside of us, independent of us, whose objects have their own specific relationships and connections;
- 2) extracting from language a picture of the world that exists outside of us, independent of us, and whose objects have their own specific relationships and connections.

V.I.Karasik notes that “in the first case, the researcher proceeds from the uniformity of the objective world for all languages to the diversity of world pictures, and in the second case, from the diversity of world pictures in the language (s) to the uniformity of the objective world”. [4] In the first case, linguistic reality is constructed; in the second, extralinguistic objectivity is reconstructed. It is noteworthy that to date, researchers have voiced a number of conclusions regarding both the first and second aspects of the problem.

Theoretical basis

The concept of the “picture of the world” is fundamental, reflecting the specifics of man and his being, his relationships with the surrounding world, as well as the conditions of his existence in this world. The picture of the world is the original global image of the world, which lies at the heart of man's worldview, represents the essential properties of the world in the understanding of its bearers, and is the result of all human spiritual activity. This is always a subjective image of objective reality, as the picture of the world is merely an interpretation and not a mirror image of the phenomena of reality. The “worldview” is characterized by change, and consequently, it is dynamic in

nature and oriented toward the cognitive process. It arises in the process of human contact with the world, with experience and contact forms characterized by great diversity.

According to M. Heidegger, the concept of the “picture of the world” is as follows: “When we say “picture,” we primarily think of the depiction of something.” The picture of the world will then be a corresponding canvas of existence as a whole. The picture of the world, however, speaks of more. Here we mean the world itself, its being as a whole, as it is defining and binding for us. Here, “picture” does not mean what is copied, but what is heard in speech: we have created a picture of something for ourselves... To construct a picture of something for oneself means: to present oneself, the being, as it is, and to have it constantly presented to one. But there is not yet a decisive definition regarding the essence of such a picture. “We have formed a picture of something” means not only that the existent is represented to us in some way in general, but also that it has presented itself to us in all that is inherent to it and constitutes it as a system. In this “creating a picture,” competence, equipment, and purposefulness are heard. Where the world becomes a picture, existence as a whole is approached as what a person aims at and what they therefore want to present to themselves accordingly, to have before them. The picture of the world, understood essentially, thus signifies not a picture depicting the world, but a world understood in the sense of such a picture... Wherever it comes to a picture of the world, a cardinal decision is made regarding existence as a whole. The being of the existent is sought and found in the representation of the existent” [2].

Results and Discussions

Within the very term “world picture,” the concept of “world” requires clarification. In accordance with the usages of the word

"world," the world is understood in two ways. First, it is the world in general, perceived as a kind of all-encompassing reality into which man is included alongside other people and which unites him with all other people. At the same time, "the world in general" is not contrasted with any other world. Here we are talking about the opposition to the human subject, who is linked to the world by a special relationship. Subjective perception inevitably leaves its mark on the world picture recreated in the speaker's mind, which becomes the subject of the message in their statement about the world. [5]

On the other hand, there are so-called alternative worlds. Such a world may represent some sphere of being that differs from other comparable spheres and is characterized by its own specific patterns. This world is perceived, as a rule, against the background of opposing worlds. For example, the world of fantasy is contrasted with the world of reality, and one social world is contrasted with another social world. The linguistic picture of the world is understood as a systematically ordered socially significant model of signs expressed through various linguistic means, conveying information about the surrounding world. Its foundation, according to many scientists, is the conceptual picture of the world. At the same time, it is argued that the conceptual picture of the world is a more complex phenomenon than the linguistic picture of the world, as not everything perceived and known by a person acquires a verbal form. The units of the linguistic picture of the world are two-sided and two-dimensional, as they combine meaning with the "bodies" of signs. S.T. Ter-Minasova distinguishes three forms of representing the world surrounding a person: the real picture of the world, the cultural (or conceptual) picture of the world, and the linguistic picture of the world [7]. The real picture of the world is an objective

non-human reality, the world surrounding a person. The cultural picture of the world is the reflection of the real picture through the prism of concepts formed on the basis of human perceptions received through the senses and passed through his consciousness, both collective and individual. The linguistic worldview reflects reality through the cultural worldview. Furthermore, the author notes that it is still more correct to speak not of the part-whole, or language-part of culture, but of interaction.

Language is a part of culture, but culture is only a part of language. Consequently, the linguistic picture of the world is not fully absorbed by the cultural one, if the latter is understood as the image of the world broken in human consciousness, i.e., the worldview of a person created as a result of their physical experience and spiritual activity. Thus, cultural and linguistic worldviews are closely interconnected, are in a state of continuous interaction, and trace back to the real worldview. [6]

According to S.T. Ter-Minasova, the national picture of the world is primary in relation to the linguistic one. It is fuller, richer, and deeper than the corresponding linguistic one. [7] However, it is the language that realizes, verbalizes, preserves, and transmits the national cultural picture of the world from generation to generation. Language does not capture everything that exists in the national worldview, but it is capable of describing everything. We believe that it is inappropriate to speak of the primacy of culture in relation to language or, conversely, language in relation to culture. Rather, these are two interconnected "world pictures" to which cause-and-effect relationships cannot be applied.

Characterizing the current state of the linguistic picture of the world, Yu.D. Apresyan notes that such research proceeds in two main directions [1].

1. On the one hand, "stereotypes" of linguistic and general cultural consciousness, as well as individual concepts characteristic of a given ethnos, are investigated. The author refers to them as a kind of linguocultural isoglosses and isogloss bundles. These are typically Russian concepts such as soul, longing, fate, courage, will, and others. On the other hand, the author notes, these are specific connotations of non-specific concepts (for example, the symbolism of color designations in different cultures).

2. Simultaneously, "a search and reconstruction are being conducted for a holistic, albeit pre-scientific view of the world inherent in language." That is, the "dialect as a whole" is investigated.

According to Yu.D. Apresyan, while taking into account national specificity, the emphasis is placed precisely on the holistic linguistic picture of the world.

Conclusion

The linguistic picture of the world can be represented in two models: 1) the linguistic model, 2) the conceptual model. The content, methods, and techniques for describing these models are not the same. Differences in the perception and conceptualization of the world by linguistic means in different languages can be significant even with their kinship. In other words, worldviews in different languages can have their own characteristics. In the linguistic picture of the world, ethnic mentality is actualized in "key" cultural concepts verbalized in symbolic images that reflect the mental representation of language speakers about the surrounding world.

Words in different languages denoting the same concept may differ in semantic capacity and may cover different parts of reality. The methods and forms of reflection, as well as the formation of concepts, are in turn determined by the specifics of the

socio-cultural and natural characteristics of the life of this speech collective.

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Transformer-Based Object Detection in Natural Images. State-of-the-Art Architectures and Recent Algorithms

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Abstract

Object detection in natural images is a fundamental computer-vision task that underpins applications ranging from autonomous driving to industrial inspection. Since the introduction of the DETection TRansformer (DETR), the field has shifted from anchor-based convolutional pipelines toward end-to-end, attention-driven set-prediction frameworks that remove hand-crafted components such as anchor generation and non-maximum suppression. This paper presents a structured review of transformer-based object detectors, tracing their evolution from the original DETR through deformable attention, query-design refinements (DAB-DETR, DN-DETR), contrastive denoising (DINO), collaborative hybrid assignment (Co-DETR), and the most recent real-time variants (RT-DETR, RT-DETRv2, RF-DETR). We organise these methods into a taxonomy according to their core innovations in attention mechanisms, query formulation, and label-assignment strategies, and we compare their reported accuracy and inference speed on the MS-COCO benchmark. The analysis shows that contemporary detection transformers now match or surpass convolutional and YOLO-family detectors in both accuracy and real-time efficiency, with leading models exceeding 60 mean Average Precision on standard benchmarks. We further discuss persistent challenges—small-object localisation, training convergence, and computational cost—and outline promising research directions, including open-vocabulary detection and lightweight deployment.

Keywords: object detection; vision transformer; DETR; self-attention; set prediction; real-time detection; MS-COCO; deep learning.

Introduction

Object detection—the task of simultaneously localising and classifying every object instance in an image—is one of the central problems of computer vision and a key enabler of autonomous systems, robotics, surveillance, medical imaging, and visual search [1], [17]. For nearly a decade, the dominant solutions were convolutional neural network (CNN) detectors built around region proposals, predefined anchor boxes, and a non-maximum suppression (NMS) post-processing stage. Although highly successful, these pipelines rely on hand-crafted components and heuristics that complicate training and limit end-to-end optimisation [18].

The transformer architecture, originally proposed for sequence modelling in natural language processing [1], introduced the

self-attention mechanism, which models long-range dependencies between all elements of an input. Its adaptation to images through the Vision Transformer (ViT) [2] demonstrated that purely attention-based models can rival CNNs on image classification. This success motivated researchers to reformulate detection itself as an attention-driven problem.

The DETection TRansformer (DETR) [3] marked a turning point by casting object detection as a direct set-prediction problem. By combining a CNN backbone with a transformer encoder-decoder and a bipartite-matching loss, DETR predicts a fixed-size set of objects end to end, eliminating anchors and NMS entirely. This conceptual elegance, however, came at the cost of slow convergence and weak performance on small objects, which

prompted an intense wave of follow-up research [20].

This paper reviews the resulting family of transformer-based detectors with an emphasis on the most recent and highest-performing algorithms. The contributions are threefold: (i) we provide a concise taxonomy of detection transformers based on their core innovations; (ii) we compare representative models on the MS-COCO benchmark in terms of accuracy and inference speed using figures reported in the primary literature; and (iii) we identify open challenges and future directions. The remainder of the paper is organised as follows. Section 2 reviews the background of vision transformers and the set-prediction paradigm. Section 3 presents the DETR family and its evolution. Section 4 describes the comparison methodology, and Section 5 discusses the comparative results. Section 6 analyses open challenges, Section 7 surveys applications, Section 8 outlines future directions, and Section 9 concludes.

The self-attention mechanism computes a weighted sum of value vectors, where the weights are derived from the similarity between query and key vectors. Formally, attention is expressed as a scaled dot-product of queries Q , keys K , and values V . Unlike convolution, which aggregates information from a fixed local neighbourhood, self-attention allows every position to attend to every other position, enabling global context modelling in a single layer [1]. Multi-head attention extends this idea by learning several attention patterns in parallel.

The Vision Transformer [2] applies this mechanism to images by splitting an image into fixed-size patches, linearly embedding them, adding positional encodings, and processing the resulting token sequence with a standard transformer encoder. ViT showed that, given sufficient data, attention-only models can outperform

CNNs on classification. Hierarchical variants such as the Swin Transformer [12] introduced shifted local windows to reduce the quadratic cost of global attention and to produce multi-scale feature maps suitable for dense prediction tasks, making them popular backbones for detection.

Classical detectors produce a large number of candidate boxes that are later filtered by NMS. DETR instead predicts a fixed set of N object queries, each of which is decoded into either an object or a 'no-object' label. Training uses the Hungarian algorithm to find a one-to-one matching between predictions and ground-truth objects, after which a combined classification and box-regression loss is applied [3]. Two innovations underpin the paradigm shift: the use of self-attention for global context, and an end-to-end learning framework that removes hand-crafted components such as anchors and NMS [18]. This unified formulation simplifies the detection pipeline but introduces optimisation difficulties that subsequent models address.

DETR [3] established the encoder–decoder set-prediction framework. With a ResNet-50 backbone it attains roughly 42 mean Average Precision (AP) on MS-COCO, but only after about 500 training epochs, and it underperforms on small objects because its global attention is uniform and slow to focus [20]. These two weaknesses—slow convergence and small-object accuracy—define the research agenda of the models that follow.

Deformable DETR [4] replaces dense global attention with deformable attention, which attends only to a small set of learnable sampling points around each reference location. This sparse sampling drastically reduces computation, integrates multi-scale features, and accelerates convergence from hundreds of epochs to roughly fifty, while substantially improving small-object detection. Deformable attention has since become a standard

building block of nearly all later detection transformers.

A second line of work re-examined what an object query should represent. DAB-DETR [5] formulates queries as dynamic anchor boxes—four-dimensional coordinates that are refined layer by layer—giving queries an explicit spatial meaning and improving interpretability and convergence. DN-DETR [6] identified the instability of bipartite matching as a major cause of slow training and introduced query denoising: noisy versions of ground-truth boxes are fed to the decoder, which learns to reconstruct them, thereby stabilising the matching process and further accelerating training. DINO [7] consolidated these advances into a single high-performing framework. It combines a contrastive denoising (CDN) module that adds both positive and negative noised queries, a mixed query-selection strategy for anchor initialisation, and a 'look-forward-twice' box-refinement scheme. DINO reaches about 49 AP with a ResNet-50 backbone in only 12 training epochs [20]. When scaled to a Swin-Large backbone and pre-trained on the Objects365 dataset, DINO achieves 63.2 and 63.3 AP on COCO val2017 and test-dev, respectively, becoming the first end-to-end transformer detector to top the COCO leaderboard [16] (DINO). Stable-DINO [16] later improved the matching stability further, reporting up to 57.7–58.6 AP with a Swin-Large backbone under shorter schedules.

Co-DETR [8] addressed a limitation of one-to-one matching: the small number of positive samples per image weakens encoder supervision. It introduces parallel auxiliary heads that apply conventional one-to-many label assignment (as in Faster R-CNN and ATSS) during training, while keeping the one-to-one DETR head for inference. This collaborative hybrid assignment enriches gradient flow, accelerates convergence, and yields leading accuracy on COCO and LVIS,

exceeding 64 AP with large backbones, all without altering the inference pipeline [8], [14].

Until recently, the high latency of attention prevented detection transformers from competing with the real-time YOLO family. RT-DETR [9] changed this by designing an efficient hybrid encoder that decouples intra-scale interaction from cross-scale fusion, together with IoU-aware query selection that initialises object queries from high-confidence regions. As the first real-time end-to-end detector, RT-DETR-L reaches 53.0 AP at 114 frames per second (FPS) on an NVIDIA T4 GPU, and RT-DETR-X reaches 54.8 AP at 74 FPS; the ResNet-50 variant attains 53.1 AP at 108 FPS, surpassing a comparable DINO-Deformable-DETR by 2.2 AP while running about twenty times faster [10], [12]. RT-DETRv2 [10] adds a set of training 'bag-of-freebies' that raise accuracy across all scales without reducing speed, for example improving the small model by 1.4 AP.

Lightweight and domain-robust real-time variants continued this trend. LW-DETR [14] streamlines the architecture for high accuracy at real-time speed, while RF-DETR [11], released in 2025, builds on the deformable-DETR foundation and adopts a DINOv2 vision backbone for strong transfer learning. RF-DETR reportedly became the first real-time detector to exceed 60 mAP on the RF100-VL domain-adaptation benchmark, highlighting the maturity of transformer detectors for diverse real-world deployment.

Several orthogonal directions enrich the design space. Saliency DETR [15] introduces hierarchical saliency filtering to select informative encoder tokens and reduce redundancy. YOLOS [13] demonstrates that a plain ViT, augmented with learnable detection tokens, can perform detection without any convolutional components, underscoring the flexibility of pure transformers. OWL-ViT [14] extends

detection to the open-vocabulary setting by aligning image features with text queries, enabling zero-shot recognition of categories described only in natural language. Sparse and conditional attention variants further trade accuracy for efficiency.

Methodology

To compare the reviewed models on an equal footing, we adopt the MS-COCO 2017 benchmark [17], the de-facto standard for natural-image object detection, and report mean Average Precision (AP) averaged over Intersection-over-Union thresholds from 0.50 to 0.95. For real-time models we additionally report inference throughput in frames per second (FPS) on an NVIDIA T4 GPU, and for convergence behaviour we note the number of training epochs, since this differs by an order of magnitude across models. All figures are taken from the respective primary

publications rather than re-implemented, so absolute values should be read as indicative of architectural trends rather than as the outcome of a single controlled experiment. Where models use different backbones or large-scale pre-training (for example Objects365), this is stated explicitly because it strongly affects accuracy.

Table 1 summarises representative detection transformers. Two trends are evident. First, successive query and assignment innovations have compressed training from roughly 500 epochs for the original DETR to about 12 epochs for DINO, while simultaneously raising accuracy. Second, the hybrid-encoder real-time models have closed the latency gap with YOLO detectors, so that transformers now lead in both accuracy and speed at comparable scales [10].

Model	Year	Backbone	COCO AP	Speed / Epochs	Key innovation
DETR [3]	2020	ResNet-50	~42	500 ep	Set prediction; no anchors/NMS
Deformable DETR [4]	2021	ResNet-50	~46	50 ep	Deformable multi-scale attention
DAB-DETR [5]	2022	ResNet-50	~45	50 ep	Dynamic anchor-box queries
DN-DETR [6]	2022	ResNet-50	~48.6	50 ep	Query denoising for stable matching
DINO [7]	2023	ResNet-50	49.0	12 ep	Contrastive denoising; mixed queries
DINO [7]	2023	Swin-L + O365	63.2	—	Scaled SOTA on COCO leaderboard
Stable-DINO [16]	2023	Swin-L	57.7–58.6	—	Stable matching
Co-DETR [8]	2023	Large + O365	>64	—	Collaborative hybrid assignment
RT-DETR-L [9]	2024	HGNetv2	53.0	114 FPS	Real-time hybrid encoder
RT-DETR-X [9]	2024	HGNetv2	54.8	74 FPS	IoU-aware query selection
RT-DETRv2-L [10]	2024	ResNet-50	53.4	108 FPS	Bag-of-freebies
RF-DETR [11]	2025	DINOv2	>60*	real-time	Domain-robust; DINOv2 backbone

*Table 1. Representative transformer-based detectors on MS-COCO. Values are as reported in the cited primary sources; backbones and pre-training differ. *RF-DETR exceeds 60 mAP on the RF100-VL domain benchmark.*

The accuracy progression from DETR to DINO and Co-DETR confirms that the principal gains stem not from larger backbones alone but from better query formulation and label assignment, which improve the use of training signal. Meanwhile, RT-DETR and its successors show that careful encoder design can eliminate the historical speed penalty of attention, achieving over 100 FPS without sacrificing accuracy [10]. The 2025 release of RF-DETR, built on a self-supervised DINOv2 backbone, further indicates that strong pre-trained representations are becoming a decisive factor for robustness across domains [11].

Despite rapid progress, several challenges remain. Small-object detection continues to lag behind large-object accuracy; although deformable and multi-scale attention have narrowed the gap, dense scenes with tiny, overlapping instances remain difficult [19]. Training convergence, while greatly improved, still depends on careful query initialisation and denoising schedules. The quadratic complexity of attention makes high-resolution inputs and very deep encoders computationally expensive, motivating sparse, windowed, and hybrid designs [12], [15]. Finally, detection transformers are data-hungry: their strongest results rely on large-scale pre-training datasets such as Objects365, which are costly to assemble and may not transfer cleanly to specialised domains.

Transformer-based detectors are increasingly deployed across natural-image domains. In autonomous driving and robotics, the end-to-end formulation and global context modelling improve detection in cluttered scenes, while real-time variants

meet strict latency budgets [9]. In remote sensing and aerial imagery, Swin- and DETR-based detectors handle scale variation and oriented objects [7]. In industrial inspection, medical imaging, and agriculture, domain-robust models such as RF-DETR transfer effectively to small, specialised datasets [11]. Open-vocabulary detectors such as OWL-ViT enable flexible recognition of novel categories described in text, broadening the practical scope of detection beyond fixed label sets [14].

Future research is likely to advance along four axes. The first is efficiency: lightweight and hardware-aware architectures that preserve accuracy under tight compute and energy budgets, extending the real-time line begun by RT-DETR and LW-DETR. The second is robustness and generalisation through self-supervised and foundation-model backbones such as DINOv2, reducing dependence on large labelled datasets. The third is unification, in which detection is integrated with segmentation, tracking, and vision-language understanding inside a single transformer, enabling open-vocabulary and promptable detection. The fourth is reliable small-object and dense-scene detection, where hierarchical salience filtering and improved multi-scale fusion are promising. Progress along these axes will determine how broadly detection transformers replace convolutional pipelines in deployed systems.

Conclusion

Transformer-based object detection has matured from an elegant but slow proof of concept into the state of the art for natural-image detection. Beginning with DETR's set-prediction formulation, successive innovations—deformable attention, anchor-box and denoising queries, contrastive denoising in DINO, and collaborative hybrid assignment in Co-DETR—have delivered large gains in both accuracy and training efficiency. The latest real-time models, RT-

DETR, RT-DETRv2, and RF-DETR, demonstrate that attention-based detectors can now match or exceed the YOLO family in speed while leading in accuracy, with top systems surpassing 60 AP on standard benchmarks. Remaining challenges in small-object accuracy, convergence, computational cost, and data efficiency define an active research frontier, but the trajectory is clear: detection transformers have become a unifying and increasingly practical paradigm for object detection in natural images.

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The East Turkistan Issue

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Abstract

The East Turkestan issue is one of the most significant ethnic, political, and human rights problems in contemporary Asia. This study examines the historical background of East Turkestan, the region's geopolitical and geostrategic importance, and the policies implemented by the People's Republic of China toward the Uyghur Turks. The paper traces the historical development of East Turkestan from ancient Turkic states to the modern era and analyzes the impact of Chinese rule on the region. Particular attention is given to assimilation policies, demographic changes, cultural restrictions, and allegations of human rights violations. Furthermore, the study evaluates the responses of the international community, international organizations, and human rights institutions to developments in the region. The findings suggest that the East Turkestan issue cannot be understood solely as a security concern but must also be addressed within the framework of minority rights, cultural identity, and human rights. Sustainable stability in the region depends on policies that promote integration, cultural preservation, and respect for fundamental freedoms rather than assimilation and coercion.

Keywords: East Turkestan, Uyghur Turks, China, Xinjiang, Human Rights, Assimilation Policies, Geopolitics, Ethnic Identity.

Introduction

East Turkestan is the center where many Turkic states were founded throughout history. The Huns are at the forefront of these. It was T'ou-man (Teoman) (220 BC) who established the first Hunnic state by achieving unity among the Huns. The center of the Huns was in the region of Ötüken, which the Turks considered a sacred land, between the Orkhon-Selenga rivers and immediately to the west of these rivers. After T'ou-man, his son Mo-tun (Mete) ruled for 35 years, expanding the borders of his state from Siberia in the north to the Himalayas in the south, and from the Pacific Ocean in the east to the Caspian Sea in the west (1).

There were many khanates in the region stretching from East Turkestan to Fergana in the west. Mete Khan gained control over these khanates, uniting them and expanding the state's borders over a vast area. As a result, the state grew stronger, expanding its borders almost across Asia and uniting nearly all the peoples of the region under one banner. However, these

small states under Mete Khan's rule maintained a degree of autonomy. This was not favorable for China. Previously, China could easily trade its high-income products, such as silk, through these small states, but now it had to contend with a large empire like the Hun Empire. In this context, China launched a major effort to destroy the Hun Empire. It chose to find a new ally as the best way. For the first time, large armies were assembled, and propaganda campaigns were conducted among the smaller states in the region. Thus, between 133 and 119 BC, China launched an all-out war against the Huns. In this context, China wanted to give gifts to these small states in Turkestan and establish kinship relations with them. Having succeeded in this, China turned a significant number of these states into its friends and allies. So much so that the khans of some states in Western Turkestan applied to the Chinese emperor to separate from the Huns and come under Chinese rule. This divide-and-rule policy that China applied against the Huns became effective over time and played an

important role in the collapse of the Hun Empire (2).

The Great Hun Empire A.D. 216 'd a from its collapse later East In Turkestan The Kangkıl (Kao-ch), Göktürk, Türgiş, Karluk, and Uygur states were established in succession . (840 AD) in the year İslam His religion first aspect acceptance Turkish State Karahanids It was founded in East Turkestan. During the Karakhanid period (840–1212), Turks began converting to Islam at a rapid pace. After the Karakhanids, other Turkic states were established in East Turkestan, including the Chagatai, Timurid, Seidiye Khanate, Kashgariyya State, and the East Turkestan Republic (Chinese Manchu Empire) by occupation much East in Turkestan Turks independently they lived (3).

In 1755, Chinese Manchu invaders, taking advantage of the power struggles among the Jungars, attacked the lands of Turkestan almost a millennium after their heavy defeat at the Battle of Talas in 751, and in 1757 they occupied all of East Turkestan. With the beginning of the Chinese occupation, peace and security disappeared from the region. After the occupation, China imposed incredible pressure on the local population. A regime of fear was established, and people began to be subjected to cruelty and torture. The Turkic people of East Turkestan, resisting oppression and enslavement, revolted against the Chinese invaders from time to time. The liberation movement launched throughout the country quickly bore fruit, and under the leadership of Yakup Han, the Kashgari State (1865–1878) was established in 1865. (The Ottomans , England ...) And Russia by official recognition despite This The state 's lifespan was short, and East Turkestan, reoccupied by the Chinese-Manchu State in 1876, was renamed in 1884, a name in Chinese meaning 'new colony', 'new border

', ' newly acquired territory ' coming Sincan with the name To the Chinese Empire connected (4).

The 20th century was a century of resistance against Han rule and systematic and continuous colonialism for the Uyghurs. After the 1920s, the Chinese ruler Yang Zangxi recognized Beijing's authority , achieving almost complete independence . One politics watch it . In 1931 uprisings It started . Eastern Islam The Turkic Republic was declared on November 22, 1933. But it was dissolved shortly after as a result of the intense efforts of the Russians and the Chinese (5). Within the framework of the Sino-Soviet Treaty of Friendship and Alliance signed on August 14, 1945, Russia agreed to East Turkestan remaining under Chinese rule. In 1949, Stalin stated that the US had a presence in the region and the neighboring Chinese Muslim region . big One Islam d state ku rac a ğı with the claim, communist The Chinese China supported the occupation of East Turkestan (6). As a result , in 1955, China made the occupied territory one of the five autonomous regions of the People's Republic of China, under the name of Xinjiang Uyghur Autonomous Region. came (7).

The upheavals following the Great Leap Forward (1958–1962) and the Cultural Revolution (1966–1976) transformed almost every aspect of Uyghur society. Both movements emanated from Beijing and were primarily led by Han Chinese, but their effects were deeply felt by the Uyghurs; they now faced a double burden of assimilation. Like all citizens of the People's Republic of China, they were forced to reshape their socio-economic relations in line with Mao's utopian visions. At the same time, they faced an overtly assimilationist agenda from the authorities in Xinjiang, which aimed to solve the nationality problem by forcing Uyghurs to conform to Chinese cultural norms. This campaign

developed alongside the Religious Reform Campaign, which initiated the process of completely eliminating Uyghur religious institutions and practices. The Religious Reform was followed by the Great Leap Forward, which not only led to economic disaster and famine in many cases, but also shattered Uyghur social structures (8).

In the early 1950s, six different alphabets were introduced to the Uyghur people. These included three different writing systems and changes in the names and order of letters, as well as spelling changes. While we see similar changes among other language groups in Xinjiang and South China (the Yi people adopted the Latin alphabet in 1956 but re-adopted the old Yi writing system with some standardization in 1980), the Uyghur experience is extraordinary. The frequent changes affected not only the intellectual community but also an entire generation of Uyghurs who were literate when these changes occurred, and a similar group among their ethnic brethren, the Uzbeks, Tatars and Tajiks, still use the same Uyghur writing system (9).

Following the Barin uprising in April 1990 and the Yining uprising in Ghulja province in February 1997, the Chinese government significantly intensified its repressive policies. To such an extent that China, rejecting the use of terms like "East Turkestan" and "Chinese Turkestan" because they imply external historical ties that could call into question Chinese sovereignty, further extended this stance, adopting a negative attitude towards states that have established official relations with Taiwan, to also target states using the term "East Turkestan." (10). On the other hand, the emergence of five independent Central Asian states following the collapse of the USSR in 1991 brought to the forefront discussions in many capitals, especially Beijing, about whether the ongoing process of fragmentation would spread to East

Turkestan, which is ethnically and culturally a part of Turkestan. The collapse of the Soviet Union encouraged Uyghur, Tibetan, and Mongol nationalists in China to pursue independence (11). The Uyghur diaspora living in the Central Asian Republics, a large part of whom came from East Turkestan, numbered approximately 250,000 according to Chinese data from 2003. Most were encouraged by the Soviet administration to work against the Chinese administration in East Turkestan during the 1969 Sino-Russian conflict. The winds of democratization that began in the Soviet Union towards the end of the 1980s also affected the Uyghurs in the Central Asian Republics, and they formed organizations in their respective republics aiming for the independence of East Turkestan (12).

The fight against extremist religious movements and terrorism, which are the most important problems of the Central Asian states after independence, was also supported by Beijing. The most important factor behind this support is the 3000 km border shared by the Central Asian states and China's Uyghur region, and the potential threat this border poses to China (13). During this period, Chinese officials insisted that they would not fall into the same situation as the Soviet Union. To this end, Beijing took a series of measures to prevent East Turkestan from seceding from China and emerging as the sixth Central Asian Republic. Beijing primarily tried to prevent instability that could spread from Central Asia to the region by increasing border security. Following the visits of the Head of the Xinjiang Regional Government, Timur Damawat, to Uzbekistan and Kazakhstan in 1990 and 1991, a five-year agreement was signed between China and Kazakhstan on cooperation in security and economy, as well as reducing customs tariffs applied to imports and exports. The issue of border security was an important topic in the first meetings held in 1992

between Kazakhstan, Kyrgyzstan, Tajikistan, Russia, and China. agenda article It has happened. Four year along continue e d en negotiations with the establishment of the Shanghai Five in April 1996, which forms the basis of the SCO has been concluded (14).

The struggle, which had taken a political turn since the 1980s, took on a new face in 1990; it transformed into an epic uprising, typical of peoples living under overt or covert subjugation. Bombings began and multiplied – around 200 between 1987 and 1990 – continued in 1993, 1994, and 1997, and even included bombings in Beijing in 1997. Generally, clashes took place in the streets, and the demonstrations spiraled out of control. These uprisings were naturally suppressed in a horrific manner. Popular movements, drug trafficking, and gang wars resulted in arrests, murders, and even executions that continued into the late 20th century (15).

China has long pursued a two-pronged policy in this region to increase its ethnic Chinese population and establish demographic dominance. On the one hand, it has intensified its presence in the region ... One Chinese population migration while realizing especially d e 200 3 from the year since within the framework of the "redirecting surplus labor to other regions" policy, the Uyghur Turks in this area (especially the young population) are being moved to inland regions of China with the aim of assimilating them into the general population. This assimilation policy implemented by China involves moving young Uyghurs to inland regions of China with promises of employment and assimilating them into the general Chinese population. The most striking example of these assimilation policies is the removal of Uyghur girls aged 16-25 from East Turkestan to inland regions of China under the guise of better education and job opportunities. Since June 1, 2006, this

policy has resulted in the relocation of 240,000 Uyghur girls to inland regions of China. China aims to move 1 million Uyghur girls to other regions of China under this program. It is reported (16). The protests that took place in East Turkestan on July 5, 2009, and the intervention of the Chinese Security forces in these protests were met with outrage all over the world and once again drew the attention of the international public to the region (17). Indeed, news from the region after the Urumqi incidents stated that the Chinese administration further increased its oppression of the Uyghurs, arresting thousands of people and subjecting hundreds to extrajudicial executions (18).

In conclusion, since China codes the East Turkestan issue as a security problem, it seems unlikely that its policies towards the Uyghur Turks will change in the near future. We are faced with a dilemma: the fear that 9 million Uyghurs could achieve independence in a country with a population of 1.4 billion is utterly meaningless. On the other hand, it would be equally naive to think that the Uyghur Turks could "voluntarily" accept the policies of oppression and assimilation. Therefore, the solution to the problem lies not in assimilation policies, but in integration policies that meet the demands of the Uyghur Turks (19).

Importance of the Region

Northwest China corresponds to Xinjiang (East Turkestan), an ancient country with a long history of political autonomy. Here, historically, many regions have replaced one another . number state available It has happened . Furthermore , This and a This soils on The Turkic ethnicity belonging to the Islamic faith is the Uyghurs. In the mentioned regions, the Chinese maintain control through direct force and overt colonization, exploitation of the local population, and suppression of all attempts

to defend religious and ethnic autonomy (20) .

Halford Mackinder's *Heartland* theory, a power that controls the Eurasian mainland, especially its central Central Asia, controls the whole world (21). East Turkestan, being an inseparable part of Central Asia from a geopolitical point of view, is a region that China does not want to relinquish. In addition, East Turkestan has rich natural gas and oil reserves. Western experts believe that the region's wealth, with 8.2 billion tons of crude oil and 2.5 million cubic meters of natural gas, is as great as that of Saudi Arabia. Half of China's coal reserves are also located in East Turkestan (22) .

East Turkestan is like a main gateway to the world. Just listing its neighboring countries is enough to give an idea. Its neighbors are Pakistan, Afghanistan, Kashmir, Kyrgyzstan, Kazakhstan, Russia, Mongolia, and Nepal within it. In a way, it is the furthest, northwesternmost corner of China. It is the starting point of ancient trade caravan routes. Today, incredibly modern centers have been established there, and it functions as the brain of energy-based trade (23). Therefore, Beijing has begun to increase its trade with Central Asian countries through East Turkestan. According to International Monetary Fund (IMF) data, China's trade with Central Asian countries has shown great growth. China's Only 2000 in the year Middle Asia with their countries he/she performed Exports were \$1.051 billion while imports were \$767 million (24).

China's Assimilationist and Genocidal Policies

East Turkestan was separated from the Turkestan region by the Chinese invasions that began in 1759. Its name was changed to the New Region (Xinjiang - 1884). The people of East Turkestan, never giving up the struggle, frequently revolted. In 1931,

the largest popular uprising occurred, and on November 12, 1933, the East Turkestan Republic was declared. However, it became ineffective because the Prime Minister and ministers were handed over to China by Khoja Niyaz, who was elected President for life. China generally demonstrated its oppression of the Turkic people by executing their leaders. With the Communist Party's rise to power in 1949, China quickly transformed into a state that instilled fear throughout the world. Its initial policy of violence and oppression has continued uninterrupted to this day. The insensitive and ruthless attitude of communist ideology towards humanity and all human phenomena, its materialistic approach that mechanizes interpersonal relationships, and its rejection of a compassionate and just governance model have resulted in a cruel and tyrannical system of rule. Although some Western circles believe that China is democratizing due to liberal reforms in the economy, the Communist Chinese government has no intention of abandoning its dictatorial regime. What is happening on Chinese soil is proof of this, and both the Chinese and East Turkestan peoples are the most important witnesses to these brutal practices. The communist regime resorted to the physical extermination of Muslims who refused to assimilate. The number of Muslims killed was horrific. Between 1949 and 1952, 2,800,000; between 1952 and 1957, 3,509,000; between 1958 and 1960, 6,700,000; and between 1961 and 1965, 13,300,000 people were either killed by the Chinese army or died as a result of the famine caused by the regime.

The surviving portion of the population was subjected to severe oppression and torture. East Turkestan 's long duration in exile living merhum leader leather Is a Yusuf Alptekin , in his books "The East Turkestan Cause" and " The Forgotten Homeland : East Turkestan , " published in Turkey,

describes these oppressions and tortures in detail. According to these books, the oppression inflicted on the people of East Turkestan is no different from that inflicted by the Serbs on Muslim Bosniaks in Bosnia or on the Albanian majority in Kosovo. The "punishment" methods of the Chinese courts in the country are also extremely cruel and brutal. These include burying people alive, leaving a person who has been beaten to death naked in the snow, and cutting a person in two by tying their legs to two separate oxen. has been implemented (25).

China's assimilation policy towards the Uyghur Turks of East Turkistan began in the 1960s . It had begun . First aspect Uyghurs 1 00 0 year use they came Arabic The traditional alphabet , based on the Chinese Pinyin script , was replaced with the Latin alphabet. From the 1950s onwards, the population transfer policy led to a significant increase in the Chinese population brought to East Turkestan, while the position of Uyghur Turks in state institutions gradually weakened. The successive nuclear tests conducted in East Turkestan from the 1960s onwards can also be considered another link in the chain of the assimilation policy. Between 1964 and 1996, the Chinese conducted a total of 46 nuclear tests in East Turkestan, resulting in 190,000 deaths. By the 1980s, the Chinese government, through a planned birth policy, was simultaneously targeting the reproduction and proliferation of Uyghur Turks while intensely transferring populations to the region. The number of Uyghur children forcibly aborted and eliminated under this planned birth policy can be estimated in the millions. In China's interior regions, Chinese people had a one-child policy, but when they came to East Turkestan, they were exempt from this policy. Today, the demographic balance of East Turkestan has been completely

disrupted, and Uyghur Turks have become a minority in many cities. (26)

In addition to these efforts to assimilate Uyghur identity, a colonization policy is being implemented, similar to the one Moscow pursued towards Central Asia during the Soviet era, aiming to end the demographic dominance of Uyghurs by settling Chinese populations in the region. Another important point, as frequently noted by regional experts, is that the economic development experienced by China in its process of capitalist development is also seen in East Turkestan, but Uyghurs have not benefited at all from this change. All major businesses in the region belong to the Chinese, and the Uyghurs, the vast majority of whom make a living from farming and market trading, live on the margins of society. In this respect, we witness that the process of capitalist development has increased socio-economic stratification in the region on an ethnic basis (27).

The major terrorist attacks against the United States on September 11, 2001, brought about a new strategic arrangement that would alter many balances in the world. The US launched a global fight against international terrorism targeting its country. However, some countries intended to exploit this struggle and use it for their own interests. China was at the forefront of these. Seeking to portray the US response to terrorism as a "war against Muslims," China issued a message in October 2001. In summary, the message stated that "China also wants to see the East ... " in Turkestan Islamist to terrorists opposite West world with partnership It was said that " what they wanted to do " was a clear distortion by China. Because the people of East Turkistan are waging a just struggle to protect their spiritual values, to preserve their culture and customs, to freely practice their religion and use their language. And this struggle has been carried out for many years on an extremely democratic platform

thanks to the common sense of the East Turkistan leaders. However, as in any society, there may be individuals or groups prone to violence among the people of East Turkistan. But this does not negate the fact that East Turkistan is waging a just struggle. The real terrorist force in the region, as we have examined throughout this book, is the Chinese administration, which is carrying out a long-term genocide against the oppressed Muslims in East Turkistan (28).

The East Turkestan Issue in the International Community

The international community does not deny that states should take certain measures when real and imminent situations arise that threaten their national security. Even in these cases, states cannot disregard the right not to be tortured. However, in China, the concept of "maintaining national stability" has been interpreted to include almost any activity that appears to threaten the sovereign state order. This means that in China, people have been arbitrarily imprisoned, tortured, and detained for exchanging information or expressing opinions within the framework of the rule of law and through peaceful means. They were killed.

Having joined the UN in 1971, China is theoretically a party to the fundamental human rights principles outlined in the UN Charter. China has also adopted the general principle, accepted by UN members, that recognizing persistent human rights violations as an international issue rather than an internal judicial matter. Nevertheless, China has fundamentally... UN Person rights their contracts He did not sign it. China's UN Person The decision to join the Rights Commission demonstrates its acceptance of international standards of human rights. This was an important sign that it was ready to do so (29). Furthermore, although there have been some improvements in China's

stance on human rights as a result of the deepening economic relations between the Chinese government and EU countries, and the human rights debates and discussions on laws between the parties, the legitimate demands of the people in East Turkestan, which the Chinese government refers to as the "Xinjiang Uyghur Autonomous Region," are being harshly suppressed, and therefore the dimensions of national antagonisms and conflicts are growing day by day (30). The events of July 5, 2009, are the most striking example of this. Because the events that took place in Urumqi on the night of July 5 quickly spread to other cities in the East Turkestan Autonomous Region, the events in the region once again called on the international community and The events have drawn the attention of the Turkish public to the region. The Chinese official news agency Xinhua announced that 184 people had died and more than 1,000 were injured. However, both international sources and the Uyghur diaspora have stated that the number of dead and injured is much higher. For example, the spokesperson of the World Uyghur Congress. The BBC gave interview local from sources what they took According to the information , the death toll is over 600 explained (31).

International NGOs also reacted to the events in a short time. Amnesty International called for an immediate independent and impartial investigation into reports that 140 people were killed in Urumqi on July 5, 2009, as a result of the violence of the protest demonstrations. Roseann Rife, Deputy Director of Amnesty International Asia-Pacific, said, "Chinese authorities must be held accountable for those who died and were detained. Those detained for peacefully expressing their views or exercising their freedom of association and assembly must be released immediately. A fair and full investigation

must be launched, with fair courts appointed in accordance with international standards, without resorting to the death penalty” (32). Islam conference organization (OIC) d e East In Turkestan lived after the events movement It is in the past . General Secretary Ekmelettin Ihsanoglu 's instructions Information was obtained by contacting the foreign ministers of some member countries at the headquarters in Jeddah in shopping It has been found. Ihsanoglu, what he did in the explanation East He expressed deep concern about the worsening situation in Turkestan, particularly the numerous casualties and property damage among civilians. He also expressed his profound sorrow that the Uyghurs are forced to live in a climate of fear . China He called on the government to restore peace and tranquility so that Uyghurs and all civilians in East Turkestan can return to their normal lives (33). The events of July 5th have once again demonstrated that developments in East Turkestan significantly impact China's national and international standing. The Beijing administration must resolve this issue as soon as possible within the framework of minority and human rights.

CONCLUSION

China, the world's fourth largest country by area, with a population of 1.3 billion (approximately one-sixth of the world's population), a permanent seat on the UN Security Council, a vast market, and a geopolitical location, along with the expectation of becoming the world's largest nuclear power by 2050, has led many observers to predict that it will become a superpower in the 21st century. However, the problems stemming from China's demographic expansion into the region, its inability to resolve border issues with India, its internal problems in East Turkestan, Taiwan, and Tibet, its economy's dependence on foreign investment, unemployment and social security issues,

the obsolescence of its armed forces technology, environmental problems, disparities in living standards between regions, income inequality, and its increasingly reliant energy needs on imports will be the most significant obstacles to China becoming a superpower. Although official Chinese discourse from Mao to the present day has avoided the concept of a "global power," arguing instead that it should be a "regional power," the main factor behind this is the awareness among Chinese leaders that they are still not at the level of major powers in economic and military terms. Any political, economic, and cultural decision Beijing makes regarding East Turkestan will affect all minorities within China. Consequently, stability and development in East Turkestan are among the most important factors affecting the development and stability of the entire country. In this context, it is predictable that China will not soften its policy towards the Uyghurs, and may even increase this oppression in the future. It is possible.

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The Status Issue Of The Caspian Sea And Coastal States Approaches To The Subject

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Abstract

This article examines the legal status issue of the Caspian Sea and analyzes the approaches of the five littoral states—Russia, Azerbaijan, Kazakhstan, Turkmenistan, and Iran—to this longstanding dispute. The study explores the historical evolution of the legal regime governing the Caspian Sea, the significance of its rich hydrocarbon resources, and the competing legal and political arguments regarding its classification as either a sea or a lake. Particular attention is paid to the interests and policies of the coastal states, their bilateral and multilateral agreements, and the impact of energy resources on regional geopolitics. The article argues that the unresolved status of the Caspian Sea continues to affect regional stability, economic development, and international cooperation. It concludes that a mutually acceptable legal framework based on dialogue, equal rights, and international law is essential for ensuring sustainable development and peace in the Caspian region.

Keywords: Caspian Sea, international law, energy resources, geopolitics, Russia, Azerbaijan, Kazakhstan, Turkmenistan, Iran.

Introduction

The Caspian Sea, whose political status has remained undetermined for approximately 18 years, has been a major point of contention between Russia, Kazakhstan, Azerbaijan, Turkmenistan, and Iran from the past to the present. It is important to note that in this article, the Caspian Sea will not be referred to as a sea, lake, or any other name, as its status remains undetermined. Therefore, it is useful to first provide some technical information about the Caspian Sea: The Caspian Sea is a body of saltwater covering an area of approximately 371,000 square kilometers, with no natural connection to seas and oceans other than a network of rivers and canals. It is connected to the Black Sea and the Baltic Sea via canals that join the tributaries of the Volga and Don rivers. The length of the Caspian coast from north to south is approximately 1,200 km, and its width from east to west varies between 210 km and 490 km. Ten major rivers flow into the Caspian Sea (1).

Azerbaijan, Kazakhstan, and Turkmenistan, as young states bordering the Caspian Sea, are striving to establish themselves, Russia, despite being larger and significantly wealthier, is feeling the effects of the abrupt transition from a controlled economy to a free-market economy. Iran, isolated internationally, is seeking ways to extricate itself from this situation. Therefore, for the coastal states, the Caspian Sea's environmental and strategic value, along with its economic potential, is of paramount importance; as the Caspian is quite rich in natural resources. For example, fishing is a significant source of income in the Caspian, and the Caspian region supplies 90% of the world's caviar needs. However, for both the coastal states and Western countries, the most important thing is the Caspian's oil and natural gas reserves (2).

Like all resources, oil and natural gas gain value more when they can be sold than when they are produced. At the root of the political impasse and disagreements in the Caspian lies the concern of the newly independent states to achieve economic

development and consolidate their political sovereignty. However, economic development and political independence, which are vital for these countries, have not been a facilitating factor in resolving the conflict, but rather have created problems between them. It is necessary to analyze the reasons for this carefully (3). To do this analysis, let's take a look at the richness of the Caspian Sea's energy resources: Oil production has existed in the Caspian region, particularly around Baku, since the 1800s. The first commercial use of oil began in 1820 with the establishment of the first refinery complex near Baku. Azerbaijan and Kazakhstan are rich in oil, while Turkmenistan is rich in natural gas. The Caspian Sea has six different hydrocarbon basins offshore. Additionally, the countries bordering the Caspian Sea also possess fields along their coastline.

According to the US Department of Energy, the five Caspian Sea littoral states (Iran, Azerbaijan, Russia, Kazakhstan, and Turkmenistan) possess 3.5 billion tons of recoverable oil reserves. According to data obtained by American experts via satellites, there are a total of 200 billion barrels of oil reserves under the Caspian Sea, beyond the coasts of Azerbaijan and Kazakhstan, as well as in the Tengiz region of Kazakhstan near this sea and along the coast of Azerbaijan. This reserve is estimated to be worth \$4 trillion in the current market. This estimated oil reserve in the Caspian Sea is 100 billion barrels more than the proven oil reserves in Iraq. It is approximately two-thirds of the 261 billion barrels of oil reserves in Saudi Arabia, which has the world's largest known oil field. Significant oil reserves have not been found in the Russian and Iranian sections of the Caspian Sea. The Caspian region is estimated to have approximately 8 trillion cubic meters of natural gas reserves. Approximately 3.1 trillion cubic meters of this reserve is located in Turkmenistan

alone, while 0.6 trillion cubic meters are in Azerbaijan and 2 trillion cubic meters in Kazakhstan. The region's natural gas reserves account for about 6% of the world's natural gas reserves (4).

Historical Development

Efforts to determine the status of the Caspian Sea date back centuries. At the beginning of the 19th century, following two Russo-Iranian wars, two peace treaties were signed between the two countries (the Treaties of Gulistan in 1813 and Turkmenchay in 1828). According to the Treaty of Turkmenchay, the land border between Russia and Iran ended at the Caspian Sea, thus subjecting the Caspian to border demarcation at that time. These treaties, concluded between the victorious and the vanquished, among other important provisions, abolished Iran's right to maintain a navy in the Caspian Sea.

In 1921, the Bolsheviks officially abrogated these treaties. The Treaty of Friendship of February 1921, between the USSR and Iran, and the subsequent Treaty of 1940 (which was intended to bind other Caspian littoral states after the collapse of the USSR), attempted to resolve issues of the time such as trade, navigation, and fishing. However, it failed to define the legal status of the Caspian Sea in terms of the use of the seabed and its resources, the ecological regime, the use of airspace, the demarcation of borders between countries, and sovereignty. In fact, what is generally meant by the legal status of the Caspian Sea is the issue of sovereignty over this sea and its division. The primary aim of the Russian in wanting to view the Caspian Sea as a landlocked basin or lake is first to remove it from the jurisdiction of the Convention on the Law of the Sea, and then to ensure that the 1921-1940 treaties are the sole reference point in determining the outcome (5).

In 1926, an agreement was signed regarding the mutual use of border rivers

and seas. The agreement of August 27, 1935 reiterated freedom of navigation on the Caspian Sea and established a 10-mile fishing zone. However, no official border demarcation took place. In 1935 and 1949, official institutions of the USSR and Iran declared ownership of the seabed resources in the coastal regions. In the early 1950s, Soviet authorities divided the Caspian Sea, which has lake status, into sectors. The part of the Caspian Sea belonging to the Soviet Union is the area north of the line connecting the Astrakhan-Hasankulu regions. The area south of this line is under political influence (6). According to an exchange of notes between the parties on September 15, 1962, it was stated that the establishment of missile launch sites and naval bases by foreign states on Iranian territory and in the Caspian Sea would not be permitted.

In 1970, the Soviet Union's part of the sea was partitioned by Russia, Kazakhstan, Turkmenistan, and Azerbaijan. This partition, based on internationally accepted principles, involved drawing a line through the middle of the sea and extending it to the point where the borders of the aforementioned countries met, leaving the areas within these lines for the use of the coastal states. Moscow's suggestions and preferences were the decisive factor in this partition. Oil development in the sectors allocated to the republics was carried out by institutions located within and identified with the territories of these state entities (7). Following the collapse of the Soviet Union, naval assets in the Caspian Sea were divided among the new countries in 1992. This division, which was not considered particularly important by Russia, resulted in significant ammunition depots and naval bases being transferred to Azerbaijan, while 18 combat ships and 62 auxiliary vessels were given to the new countries. For the first time in 1993, at a meeting in Astrakhan attended by the Russian and Azerbaijani

Defense Ministers, Russia requested that Azerbaijan accept a 12-nautical-mile continental shelf in the Caspian Sea (8).

The commission established to determine the status of the Caspian Sea met 15 times until 2004. Each meeting was held in the capital of one of the littoral states. Their last meeting was in Moscow on October, 2004. In 2002, a meeting at the presidential level was held in Ashgabat. After this meeting, it was decided that the next meeting at the presidential level would be held in Tehran. The foreign ministers who met between June 2007 to lay the groundwork for this summit did not achieve a positive outcome. At the presidential summit held on October 16, 2007 as in previous meetings, no concrete result was achieved regarding the status (9). This would be a significant step towards finding a middle ground among the five countries. This unity would greatly facilitate the transportation of Caspian energy resources to world markets.

Legal Status of the Caspian Sea

Throughout history, various agreements have been made regarding the status of the Caspian Sea. These can be divided into two categories: agreements made before the 1994 "Deal of the Century" and those made after. Agreements made before 1994 were primarily between two states, Iran and Russia. These agreements mainly concerned the use of the Caspian Sea and did not hold significant strategic importance. Since 1994, the status issue has emerged, and all subsequent negotiations and agreements have reflected the strategies of the littoral states and presented their views on the status (10). However, a consensus has not yet been reached. Currently, states are working to determine the status of the Caspian Sea through commissions established at the level of foreign ministers. These commissions meet annually on November 17th to discuss opinions and make decisions regarding steps to be taken

on the status issue. However, these decisions have not yet been finalized.

In the struggle for power in the Caspian Sea, the five littoral states – Russia, Azerbaijan, Kazakhstan, Turkmenistan, and Iran – as well as the United States, the European Union, China, and Turkey, play a significant role. The five littoral states have been unable to reach an agreement on the status of the Caspian Sea. It is clear that this issue, which requires a political solution, will occupy the agenda for quite some time. Although the Caspian Sea is unique in the world due to its geographical features and economic resources, similar water basins in many parts of the world have already been resolved. However, the fundamental positions of almost all littoral states regarding the Caspian Sea have changed and evolved according to changing circumstances. While discussions continue on determining the status of the Caspian Sea, there are three general approaches to defining its legal status: According to the first view, the Caspian Sea is a basin unlike other lakes and seas, and many of its characteristics cannot be subject to existing international legal norms and practices. Therefore, unconventional approaches should be used in the process of regulating the legal status of the Caspian Sea in detail. Sometimes the Caspian Sea is described as a "border lake" or an "open sea" (11).

The Caspian Sea's legal status is recognized as a lake, then international customary law rules regarding border waters will apply, and the Caspian Sea, like other lakes, will need to be divided. This is because the littoral states will want to establish and protect their sovereignty in the use of biological and natural resources within their borders, as well as in water and transportation. There are many methods for dividing lakes (12). However, determining which method the littoral states will use is difficult and legally impractical if no

consensus can be reached. Indeed, it is known that the states bordering the Caspian Sea have not been able to agree on a border line or other methods of division. Turkmenistan, Kazakhstan, and Azerbaijan have adopted the principle of an equidistant line, but have not been able to agree on how it will be implemented. The problem is not which method will be used or how it will be divided, but the loss of sovereignty that will result from its division and the damage it will cause to economic interests (13).

Since 1982, 135 member states have signed the 1982 United Nations Convention on the Law of the Sea (UNCLOS). According to the Convention, countries bordering seas and oceans have a continental shelf of 12 nautical miles and an Exclusive Economic Zone of 200 nautical miles beyond it, while all waters outside these boundaries are considered the common property of the world's peoples. The Caspian Sea, however, lies outside the boundaries drawn by this convention. While UNCLOS defines the term "inland sea" international law also uses the concept of "international lake". But neither fully reflects the unique situation of the Caspian (14).

In the past, there has been a continuous negotiation process among the states in the region regarding the determination of status, and a series of agreements have been signed. However, due to factors such as changes in the attitudes of some states and political transformations, existing agreements have been terminated and replaced with other agreements and treaties. Nevertheless, no definitive conclusion has been reached. If we take a brief look at the history of these agreements;

Treaty of Turkmenchay, February 10, 1828: Article 4 of the treaty states that the border between Russia and Iran ends at the Caspian Sea, while Article 8 specifies that only Russia has the right to maintain warships in the Caspian Sea. Thus, the

Caspian Sea was used as a measure in determining the land border.

The Moscow Treaty of Friendship, signed on February 26, 1921, annulled the Treaty of Turkmenchay, which, according to Article 11, prevented the Khanate from maintaining a navy in the Caspian Sea. Both sides would have equal rights regarding navigation in the Caspian under their own flags.

Treaty of August 27, 1935: Articles 14 and 15 of the treaty stipulated the right of free navigation for Soviet and Iranian vessels and the establishment of a 10-mile exclusive fishing zone. However, no official border was defined. In the exchange of notes regarding the treaty, the Caspian Sea was referred to as a "Soviet- Iranian Sea".

The Tehran Agreement of March 25, 1940: This agreement largely confirms the provisions of the 1935 Agreement. Article 12, paragraph 4, stipulates that fishing rights in waters up to 10 miles belong to vessels flying the flag of the coastal state. It is being recorded (15).

Approach of Coastal States to the Issue
After the collapse of the Soviet Union, the newly formed states were preoccupied with their own problems, so there was no issue regarding the status of the Caspian Sea until 1994. Following Azerbaijan's agreement on the extraction of Chirag and Guneshli oil fields on September 20, 1994, Russia raised the issue of the Caspian Sea's status. Russian Deputy Foreign Minister Albert Chernyshev stated that the agreement Azerbaijan made regarding Caspian oil should be shared jointly by the littoral states. He also accused Azerbaijan of theft. At the same time, Russia appealed to the UN, requesting that the issue of the Caspian Sea's legal regime be included on the agenda of the UN General Assembly's winter session (16). From this point on, the issue of the Caspian Sea's status became an international problem. Following this, the

five Caspian littoral states began negotiations to determine the sea's status.

Russian Federation

The Russian Federation, one of the most important players in the discussions about the status of the Caspian Sea that began after the collapse of the USSR, first raised the issue in October 1993 (apart from the 1992 Tehran Conference) (17). Russia's approach during this period was that the Caspian Sea was not a border lake, but an indivisible, closed water reservoir with a single ecosystem, its status determined by the 1921 Moscow Treaty and the 1940 Tehran Treaty between the USSR and Iran, that areas outside the 10/12 nautical mile exclusive fishing zone defined by these treaties were open to the common use of coastal states, and that the 1982 Convention on the Law of the Sea was not applicable to the Caspian Sea (18).

Russia opposes the idea of the Caspian Sea being used by littoral states. While the rights of littoral states can be established in international agreements, in practice, Russia has a veto right regarding the resolution of the Caspian problem. This Russian position is supported by Iran and Turkmenistan. Russia, Iran, and Turkmenistan recognize the Caspian Sea as a "closed inland sea" and utilize its 20-mile territorial waters. This maritime zone is defined as part of the "Aquatorial waters" and is limited by the international borders of the Caspian surrounding countries. The claimant state can use the surface water, the seabed, and the airspace. Beyond the 20-mile territorial waters, there is a 20-mile exclusive economic zone. The claimant state can utilize this zone, including its seabed resources. Third countries can use this zone for purposes such as navigation, cable laying, and recreation (19).

Russia, which plays a significant role in determining the status of the Caspian Sea, attaches great importance to the Caspian region. Initially, the Russian Federation

believed it could gain momentum by pressuring Azerbaijan regarding the Caspian Sea. However, its Caspian policy changed with Putin's rise to power. The fact that energy became a fundamental element in Russia's foreign policy, particularly in its policy towards the former USSR, became clear with Putin's statement following a meeting of the Russian National Security Council on April 21, 2000. In his statement, Putin said that "their partners are very active in the Caspian region, and they will exhibit similar activity" (20).

Azerbaijan

Azerbaijan, also known as the Land of Fires, possesses the richest oil reserves in the South Caucasus. Even before the discovery of Middle Eastern oil, Azerbaijan was a significant oil production center. While oil production dates back a long time, industrial oil production in Azerbaijan only began in the second half of the 19th century. Historical data shows that until 1940, Azerbaijan alone accounted for approximately 70% of the Soviet Union's oil production (21). Despite discovering a significant natural gas field like Shah Deniz in recent years, Azerbaijan remains a gas importer. The main obstacle is that the necessary investments have not yet been completed and the pipelines have not been constructed. All of the current gas production comes from the Bakhar field in the Caspian Sea, produced by the Azerbaijani national oil company (Azneft: SOCAR) (22).

Azerbaijan, the most active littoral state in the Caspian Sea, has become the newly emerging political and economic center of the Caspian region since the collapse of the Soviet Union. Azerbaijan has particularly distinguished itself by attracting Western capital to the region's energy resources, and has also held a significant position alongside the Russian Federation in status disputes (23). Initially, Azerbaijan referred to this water basin as a lake. From the very

beginning of the Caspian issue, articles frequently appeared in the Azerbaijani press stating that the Caspian was a "lake" and this view was defended by official channels. Indeed, Azerbaijan's argument that the Caspian is an international lake and therefore should be divided entirely among the littoral states is a more accurate assessment. If Baku's aim is to achieve the division of the entire Caspian into national sectors, then the "Caspian Lake" would provide a more favorable environment for achieving its goals (24). Azerbaijan bases its argument for the division of the Caspian Sea into national sectors on the sectoral division of the Soviet part of the Caspian Sea into four in 1970, a division that Azerbaijan demands be accepted as is. This thesis also includes the division of the airspace. However, Iran does not accept this division, which the USSR made internally in 1970, on the grounds that it "lacks legal basis" (25).

Disputes exist between Azerbaijan and Turkmenistan over the Kepez oil fields, based on differing maps. This situation has led Turkmenistan to increasingly align with Iran. Initially, Turkmenistan accepted the joint use proposal of Russia and Iran, and a memorandum was signed between these three countries on November 12, 1996. However, at the December 1998 summit of coastal states in Moscow, it moved closer to the policies of the Rus-Kazakh-Azeri trio. Today, Turkmenistan and Iran, acting together, argue that this issue can only be resolved through a joint decision of the five coastal states and oppose resolving it through bilateral agreements (26).

Turkmenistan

Natural gas, once used only within the Soviet Union and located in Central Asia, now appears to have the potential to meet the needs of both Europe and Asia. The natural gas reserves in Turkmenistan, in particular, constitute a very large

proportion. Besides possessing natural gas, another crucial factor is the transportation of the produced gas. Turkmenistan, with its Caspian coastline, plays an influential role in natural gas transportation projects (27). However, Turkmenistan, unable to fully define its position on the Caspian Sea, initially adopted the joint use proposal of Russia and Iran. To this end, on November 12, 1996, Turkmenistan signed a memorandum with these three countries at a meeting of the Foreign Ministers of the Caspian littoral states in Ashgabat. However, later, at the summit of littoral states in Moscow in December 1998, it adopted a different stance, declaring its acceptance of the division of the Caspian Sea and the determination of the border between Turkmenistan and Azerbaijan according to the median line principle. In general principles, Turkmenistan has aligned itself more closely with the policies pursued by the Rus-Kazakh-Azeri trio (28). The point where Turkmenistan differs from these countries, and especially from Azerbaijan, is its inability to determine the areas where the median line will pass.

The reason Turkmenistan shares similar views with Iran regarding the Caspian Sea is the Azeri, Kepez, Chirag, and Guneshli fields. Discovered between 1949 and 1967, this fields, located in the Azerbaijani sector of the Caspian Sea, are of great importance in terms of oil and gas reserves. Turkmenistan claims that the Azeri and Chirag fields are within its territory. Regarding the designation of the Azeri and Chirag fields in the Turkmenistani sector of the Caspian Sea, Azerbaijan presents as evidence maps from the Soviet Union's Ministry of Oil Industry, showing the division of the Caspian Sea into national sectors using a converged line system, and subsequently maps prepared by Azerbaijan, Kazakhstan, and foreign organizations, all of which show the Azeri

and Chirag fields as being located in the Azerbaijani region (29).

Turkmenistan and Iran appear to have formed an alliance against those in the northern Caspian Sea. In 2003, the two countries signed an agreement on the partition of the southern sector of the Caspian Sea, agreeing on the sharing of the seabed in accordance with the principles and norms of international law and the UN Convention on the Law of the Sea. However, while the agreement does not specify what these principles entail, it gives the impression that the two countries favor each Caspian state possessing 20% of the Caspian Sea and a division into five equal parts. Thus, in the Caspian Sea, Iran and Turkmenistan are taking a stance against the consensus formed by Russia, Azerbaijan, and Kazakhstan in the north (30).

The Kepez (Serdar) Issue Between Azerbaijan and Turkmenistan

The Kepez/Serdar oil field, located between the Azerbaijani and Turkmenistani regions of the Caspian Sea and now the most significant point of contention between the two countries, was discovered by Azerbaijani geologists in 1959, but the first oil production began in 1989. Each of the five countries gives its own "national" name to the fields it considers to be within its "national territory". Among these disputed fields are the rich oil fields that Azerbaijan calls "Kepez" and Turkmenistan calls "Serdar". In the disputes, particularly those focused on this field, both sides use different maps, claiming that this region is within their respective national territories. Turkmenistan claims rights to the Kepez field, which Azerbaijan considers to be within its national territory, and wants to rename it Serdar and open it to international operation (31). This desire has led to disagreements between the two countries, and the course of relations does not appear

to be very positive. In July 1997, an agreement signed between the Russian companies Rosneft and Lukoil and Azerbaijan concerning this oil field drew a strong reaction from Turkmenistan. Ashgabat stated that the field was located in its waters and belonged to Turkmenistan (32).

Disputes between Azerbaijan and Turkmenistan over the Kepez (Serdar) oil field have resurfaced. The problem stems from Turkmenistan's seismic surveys in this field. Azerbaijan has reacted negatively to this action, protesting Turkmenistan's conducting any work in the area. The Azerbaijani Ministry of Foreign Affairs has stated that Turkmenistan should not conduct any work in this field until the status of the Caspian Sea is clarified. This is because this field is located on the border of both countries (33). The disputed offshore oil and gas field in the Caspian Sea had been known as "Kepez" in Azerbaijan and "Serdar" in Turkmenistan. In 2021, the two countries agreed to jointly develop the field and renamed it "Dostluk" ("Friendship") as a symbol of bilateral cooperation and the resolution of their long-standing dispute (34).

Iran

Iran believes that the status of the Caspian Sea should be determined by consensus among the five littoral states, and that unilateral actions by any party would constitute a violation of the 1921 and 1940 agreements. It proposes a 20% sharing of the seabed and surface among the five states (35). Iran is acting in this way to avoid being excluded from the process of exploiting the Caspian Sea's hydrocarbon reserves. The prominence of these agreements between Iran and the USSR stems from the perception of the Caspian Sea as a Soviet-Iranian Sea. The regimes established in these agreements are presented as the basis for claims that a "condominium" regime was historically

established between the two states. However, the definition of "Soviet-Iranian Sea" in these agreements is not fully explained. Iran's reference to the condominium concept reflects both unrealistic expectations and lacks practical applicability (36). Nevertheless, Iran attempts to create a political position by making this claim a subject of negotiation. Negotiations regarding the Caspian Sea intensified considerably in 2010. Representatives met in Baku in mid-October and in Tehran in early November. Some believed that this diplomatic activity would lead to progress on the status issue. However, Tehran's stance on the status remained unchanged. Tehran has not abandoned its demand for the Caspian Sea to be divided into five equal parts among the littoral states. It is clear that this is contrary to international law (37). Because Iran maintains the same position today, a status for the Caspian Sea cannot be achieved. This suits Iran better, as, according to Iran, an unresolved Caspian issue is far more advantageous than losing sovereign rights through an agreement.

Kazakhstan

Until February 1998, Kazakhstan shared similar views with Azerbaijan regarding the status of the Caspian Sea. This country's approach was that, within the framework of the UNCLOS (United Nations Convention on the Law of the Sea), the Caspian Sea should be considered an inland sea. State borders are defined by the width of territorial waters, and the boundaries of each state's economic zone are also delineated (38). Although the meetings held regarding the status of the Caspian Sea did not yield definitive results, some progress was made during this process. The first development concerning the sharing of the Caspian Sea occurred in 1996. At the Ashgabat talks on November 12, 1996, Kazakhstan requested that the Caspian Sea's jurisdiction and fishing zones be defined in accordance with

international law, and that the seabed be divided into national sectors. Russia, Iran, and Turkmenistan, however, signed a memorandum on cooperation in the use of mineral resources. Kazakhstan and Azerbaijan did not participate in this memorandum (39).

On July 6, 1998, Russia and Kazakhstan divided the northern part of the seabed equally between themselves with a line. However, this agreement only concerned the seabed. Russia continued to insist on the joint use of Caspian waters. This agreement between Kazakhstan and Russia was a positive development regarding the use of the Caspian. Azerbaijan later joined this duo. On May 14, 2003, in Almaty, Azerbaijan, Russia, and Kazakhstan signed a protocol on the division of the Caspian seabed. According to this agreement, 19% of the Caspian would belong to Russia, 29% to Kazakhstan, and approximately 18-19% to Azerbaijan. The remaining portion remains uncertain due to opposition from Turkmenistan and Iran to this division (40). Kazakhstan now argues that the status of the Caspian Sea should be determined by applying the 1982 UN Convention on the Law of the Sea; that it can show flexibility regarding navigation, fishing, and environmental protection; that the seabed should be divided according to the median line; that the waters of the Caspian Sea can be used jointly, except for a specific exclusive jurisdiction; that areas outside the territorial waters and fishing zones of each coastal state should be open to free navigation for coastal states; and that each coastal state should use the waterways opening to the Caspian Sea and located within the territory of the Russian Federation within the framework of bilateral agreements with the Russian Federation (41).

Conclusion

The Caspian Sea, strategically as well as geographically significant, possesses an oil and natural gas potential that, according to experts, can rival that of many other regions. Utilizing this potential—that is, both exploiting the resources and constructing the necessary pipelines to transport oil and natural gas to world markets—requires a sound legal framework. However, the collapse of the Soviet Union in 1991 and the emergence of new littoral states, along with their opening of the Caspian's oil and natural gas fields for exploitation, brought about significant controversy. The issue of the Caspian's status has been raised, particularly since 1993, and remains unresolved. In fact, the debates surrounding the Caspian have focused less on whether it is a lake or a sea, and more on how its resources, especially oil and natural gas, should be shared and utilized. The fact that the political and economic sovereignty of the littoral states is also at stake further exacerbates the contradictions and makes reaching a consensus more difficult. The lack of definitive arrangements regarding the sharing of the Caspian to this day further fuels these debates. The swift resolution of the Caspian Sea's legal status, which is currently pending, is crucial not only for the consortium countries investing to benefit from its resources and gain economic advantages, but also for the newly formed republics in terms of their political and economic transformation and development. Therefore, negotiations should continue and conclude with the aim of achieving peace and cooperation in the region, without one party imposing its views on the other, based on mutual interests and equal rights. If negotiations fail, we believe that, as a final course of action, resolving the issue through an international court or arbitration would be appropriate.

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A Review of Machine Learning Approaches for DDoS Attack Detection and Mitigation in Software-Defined Networking

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Abstract

Software-defined networking (SDN) has changed the way networks are designed and controlled by separating the control plane from the data plane. This separation gives administrators a more programmable, centralized, and flexible way to manage traffic. At the same time, the SDN controller becomes a critical point of exposure. Distributed denial-of-service (DDoS) attacks can overload the controller, switches, links, or servers and can prevent legitimate users from accessing network services. The reviewed paper examines DDoS threats in SDN by discussing attack categories, public datasets, detection methods, and mitigation frameworks. It emphasizes the importance of open datasets for reproducible experiments and highlights that many available datasets are either outdated, not SDN-specific, or limited in attack diversity. The study also shows that machine learning and deep learning models have become central tools for detection, although their real-world usefulness depends on dataset quality, controller overhead, scalability, and false-positive control.

Keywords: software-defined networking; distributed denial-of-service; DDoS detection; SDN security; machine learning; open datasets; cyberattack mitigation.

1. Introduction

In conventional distributed networks, devices such as routers and switches normally combine forwarding responsibilities with control decisions. Network policies, routing behavior, quality of service settings, and security rules are commonly configured device by device. This approach has supported many forms of networked computing, including client-server systems, peer-to-peer communication, and distributed storage. However, it can become rigid and difficult to manage when networks grow, change frequently, or require fast policy updates. SDN addresses many of these limitations by separating the control plane from the data plane. The control plane is moved to a logically centralized controller, while switches primarily perform packet forwarding according to rules issued by that controller. This design improves network visibility, simplifies policy management, enables vendor-independent operation, and makes it easier to automate network behavior. As a result, SDN is attractive for

cloud computing, 5G systems, Internet of Things (IoT) networks, data centers, and large enterprise infrastructures.

The same architectural feature that makes SDN powerful also introduces a security risk. Because the controller has a global view of the network and manages forwarding rules, it becomes a high-value target. A successful DDoS attack can flood the controller with excessive requests, overload switch flow tables, consume bandwidth, or interrupt communication between the controller and network devices. Once the controller is slowed down or disabled, legitimate flows may be delayed, dropped, or incorrectly handled. Therefore, protecting SDN from DDoS attacks is a central problem in network security research.

DDoS attacks are normally launched through many compromised machines, often called bots or zombies. The direct victim is the service or network being attacked, while the compromised machines act as secondary victims because they are abused to generate malicious traffic. This

distributed nature makes attribution difficult and enables attackers to produce very high traffic volumes. DDoS attacks may be motivated by financial gain, political conflict, extortion, sabotage, or attempts to disrupt public services and business operations.

1.1. DDoS Attack Categories

The reviewed paper organizes DDoS attacks into two broad groups: bandwidth-depletion attacks and resource-depletion attacks. Bandwidth-depletion attacks attempt to saturate the network link so that legitimate traffic cannot reach the service. Resource-depletion attacks try to exhaust computing, memory, protocol, or flow-table resources so that a server, controller, or switch cannot process normal requests. Bandwidth attacks include flood and amplification attacks. Flood attacks send large volumes of traffic directly toward the target. UDP floods and ICMP floods are common examples. In a UDP flood, attackers send many datagrams to random or selected ports, forcing the victim to process them and sometimes respond with unreachable messages. In an ICMP flood, large numbers of ping-related packets consume the victim network bandwidth and processing capacity. Amplification attacks exploit broadcast or reflection behavior so that a small attacker request causes a much larger response to be sent toward the victim. Smurf and Fraggle attacks are examples of such amplified traffic patterns. Resource-depletion attacks include protocol-exploitation and malformed-packet attacks. TCP SYN floods misuse the connection setup process by sending many incomplete connection requests, tying up server or controller resources. PUSH+ACK misuse forces unnecessary buffer handling. Malformed-packet attacks send invalid or unusual packet structures, such as packets with confusing source and destination addresses or manipulated IP options, which can cause additional processing effort or even system crashes.

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2. Literature Review

The reviewed article surveys a wide range of studies that use SDN, open datasets, machine learning, deep learning, and security frameworks to detect or mitigate DoS and DDoS attacks. The works differ in their testbeds, controllers, traffic-generation tools, datasets, features, algorithms, and evaluation metrics. Some studies focus on SDN-enabled IoT environments; others focus on controller protection, flow-table overload, traceback, vehicular networks, or general intrusion detection.

2.1. SDN-Managed IoT Networks

IoT environments are especially vulnerable because many devices have limited memory, processing power, and security capabilities. Several studies reviewed in the source paper combine SDN with automated intrusion detection to improve IoT network protection. One approach uses flow-feature extraction and a Random Forest classifier at the SDN application layer to identify malicious traffic and install high-priority rules in the data plane. This design shows that SDN can respond actively to detected attacks, not merely observe them. However, some experiments were limited to a small number of attack types or relied on one malicious host, which does not fully represent real-world botnet behavior.

Other researchers generated SDN-based IoT datasets containing millions of records from static and dynamic networks. These datasets included benign traffic and attacks such as DoS, DDoS, port scanning, operating-system fingerprinting, and fuzzing. Such datasets are valuable because they reflect IoT-specific traffic, but the lack of fully open traffic-generation tools can make reproduction difficult.

The Bot-IoT dataset is another important resource. It contains normal IoT traffic and multiple attack categories associated with botnet behavior. Researchers evaluated models such as Support Vector Machines, Recurrent Neural Networks, and Long

Short-Term Memory networks on this dataset. The dataset helped demonstrate how statistical and machine learning methods can detect IoT attacks, although its very large size made full-scale testing difficult and required researchers to use smaller samples.

Frameworks such as Counter-based DDoS Attack Detection (C-DAD) and SD-IoT detection algorithms also show the value of SDN in IoT networks. These approaches observe counters, packet-in rates, or similarity patterns to detect attack behavior. Their main benefit is fast reaction, but some are tested only in limited simulated environments, and their performance across multiple heterogeneous IoT networks remains uncertain.

2.2. Detection and Mitigation of DoS and DDoS Using SDN

A central group of studies focuses on detecting and mitigating attacks through SDN controllers and programmable switches. Stateful SDN approaches use extensions to OpenFlow switches so that traffic states can be monitored and suspicious behavior can be acted upon quickly. Experiments using Ryu, Mininet, and datasets such as Bot-IoT show that entropy and bandwidth-related measurements can identify attack periods. However, using only one attack protocol, such as UDP, limits the generality of findings.

Other researchers propose two-phase detection systems in which packet-header information is collected first and then used to compute trust scores for users or flows. A dynamic trust value can help distinguish suspicious users from legitimate users more flexibly than a single static threshold. Nevertheless, threshold-based systems always face the challenge of balancing false positives and false negatives. If the threshold is too strict, normal users may be blocked; if it is too lenient, attacks may pass unnoticed.

Machine learning has also been integrated into SDN defense systems. For example, convolutional neural networks have been tested for detecting DDoS traffic by inspecting network activity in short time intervals. These systems may be combined with mitigation modules that adjust packet discard policies or install defensive forwarding rules. The advantage is accurate detection, while the limitation is that testbeds often contain fewer hosts and simpler traffic patterns than production networks.

Traceback mechanisms attempt to identify the source path of malicious traffic. Hybrid deep learning models such as CNN-ELM have been evaluated with datasets including CICIDS2017 and InSDN. The reported results show high accuracy, but supervised models require labeled training data. In real operational environments, obtaining accurate labels for new and changing attacks remains difficult.

Frameworks such as ProDefence and OpCloudSec represent broader architectural responses. ProDefence uses components such as flow collectors, policy engines, detectors, and mitigation engines to support smart-city-scale SDN environments. OpCloudSec uses anomaly detection and deep belief networks to improve attack response in cloud settings. These frameworks are promising, but their generalizability depends on controller consistency, programming environments, and whether the datasets used truly represent SDN behavior.

2.3. Deep Learning and Machine Learning Techniques

The reviewed literature shows a strong movement toward machine learning and deep learning for DDoS detection. LSTM-based frameworks are used because they can learn temporal patterns in traffic. This is useful when attacks develop over time or when normal traffic has seasonal behavior. Source-side DDoS detection using LSTM

can reduce downstream congestion, but it requires careful selection of collaborating detection sites and adaptive treatment of changing traffic patterns.

Semi-supervised learning is another direction because attack labels are often incomplete or expensive to obtain. The LEDEM approach, based on semi-supervised extreme learning, demonstrates that partially labeled data can still support effective DDoS detection. However, semi-supervised methods can also suffer from false positives when normal traffic patterns are incorrectly interpreted as suspicious.

Traditional machine learning algorithms remain important because they can be faster and easier to deploy than complex neural networks. Decision Trees, Random Forests, Support Vector Machines, Multi-Layer Perceptrons, K-Nearest Neighbors, Naive Bayes, and Logistic Regression have all been evaluated in SDN attack-detection settings. Random Forest often produces high accuracy, while Decision Trees can offer shorter processing time. In SDN, detection speed matters because an accurate model that reacts too slowly may still fail to protect the controller.

Feature selection is a recurring theme. Studies comparing Information Gain, correlation coefficients, Chi-square, forward selection, backward elimination, recursive feature elimination, and embedded methods such as Lasso demonstrate that feature quality strongly affects classification performance and controller load. Reducing irrelevant features can increase accuracy and decrease computational burden. Yet oversimplification may remove features that are useful for identifying complex attacks.

Entropy-based detection is also widely used because attack traffic often changes the distribution of source IP addresses, destination ports, packet counts, or flow characteristics. Static entropy thresholds are easy to implement but may not work across different datasets. Dynamic

thresholds can adapt to changing traffic, but they may increase false positives unless combined with classification models.

2.4. XGBoost-Based Intrusion Detection

The source paper also reviews studies that use XGBoost for intrusion detection, including settings related to vehicular ad hoc networks and IoT systems. XGBoost is attractive because it combines multiple decision trees through gradient boosting and often performs well on tabular security datasets. In one reviewed study, Chi-square feature selection reduced a large feature set to a smaller group, while SMOTE addressed class imbalance. This improved model efficiency and helped reduce bias toward the majority class.

Other systems use artificial neural networks or XGBoost on datasets such as UNSW-NB15 and IoT-23. These studies show that modern classifiers can achieve good detection rates, but fair comparison requires consistent datasets, comparable preprocessing, and equivalent evaluation protocols. When different studies use different datasets, sampling rates, or attack categories, their accuracy values cannot be compared directly without caution.

2.5. Artificial Intelligence and Machine Learning in SDN Security

AI and machine learning are increasingly viewed as essential tools for SDN and network function virtualization. Their long-term promise is to support networks that can self-configure, self-adapt, and self-protect. However, this promise is limited by scarce public datasets, constrained network resources, and the need to make decisions quickly without overloading the controller.

Some research uses moving target defense and cyber deception. These methods aim to mislead attackers by changing the apparent attack surface, making reconnaissance and exploitation more difficult. SDN is suitable for such techniques because it can modify forwarding rules and network views dynamically. Nevertheless, deception

frameworks may still be vulnerable to resource-exhaustion attacks and may struggle to detect insider threats.

Other approaches combine algorithms, such as Support Vector Machines with Kernel Principal Component Analysis and Genetic Algorithms. KPCA can extract more useful nonlinear features, while genetic algorithms can optimize model parameters. Combined algorithms may improve accuracy, but they can increase complexity and may not scale well when multiple controllers, switches, and large traffic volumes are involved.

The InSDN dataset is an important contribution because it was designed specifically for SDN intrusion research. It contains normal traffic and multiple attack categories, including DoS, DDoS, web attacks, botnet traffic, password guessing, probing, and exploitation. Evaluation with classifiers such as Decision Tree, Random Forest, AdaBoost, KNN, Naive Bayes, SVM, and MLP shows the dataset's usefulness. At the same time, class imbalance, controller diversity, and limited hardware scale remain weaknesses.

3. Open Datasets for DDoS and SDN Security Research

Open datasets are one of the most important requirements for progress in SDN security. They allow researchers to train models, compare methods, repeat experiments, and evaluate detection accuracy under similar conditions. Without shared datasets, each study may use a different environment, making results difficult to compare. The reviewed article therefore places strong emphasis on datasets containing DDoS attacks and, where possible, SDN-specific traffic.

Older datasets such as DARPA 1998, DARPA 1999, and DARPA 2000 contributed to early intrusion detection research by providing labeled attack and normal traffic. They remain historically important, but they do not fully represent

modern SDN, cloud, IoT, or encrypted traffic environments. The CAIDA DDoS 2007 dataset is useful for studying real DDoS traffic traces, although it lacks the full range of SDN-specific controller and flow-table behavior.

Datasets such as KDD99 and NSL-KDD are widely used in machine learning experiments, but they are frequently criticized for age, redundancy, unrealistic traffic distribution, and limited reflection of current attack techniques. Despite this, many studies still use them because they are accessible and familiar. Researchers must therefore interpret high accuracy on these datasets carefully.

More recent datasets include UNB ISCX, CICIDS2017, CSE-CIC-IDS2018, and CICDDoS2019. These datasets provide richer traffic and broader attack categories, and CICDDoS2019 contains many DDoS variants. They are useful for training and testing machine learning models, but not all were generated in SDN testbeds. Therefore, results from these datasets may not fully predict performance in SDN networks.

IoT-focused datasets such as Bot-IoT, ToN-IoT, and IoT-23 help researchers study attacks against IoT devices and botnets. Their advantage is that they include IoT-specific traffic and attack behavior. Their weakness is that they can require heavy preprocessing, may have strong class imbalance, and may not include enough SDN-controller behavior.

InSDN and other SDN-oriented datasets are especially valuable because they include traffic generated in SDN environments. They help researchers test how attacks interact with controllers, switches, flow tables, and SDN APIs. However, even SDN datasets are often limited by small testbeds, one controller type, restricted hardware resources, and a narrower range of topologies than real enterprise or carrier-grade networks.

Table 1. Condensed overview of dataset groups discussed in the reviewed paper

Dataset group	Typical examples	Main value	Main limitation
Classical IDS datasets	DARPA, KDD99, NSL-KDD	Useful for historical comparison and basic ML testing	Often outdated and not SDN-specific
Modern IDS/DDoS datasets	UNB, ISCX, CICIDS2017, CSE-CIC-IDS2018, CICDDoS2019	Broader attack coverage and richer traffic	May not capture SDN controller behavior
IoT datasets	Bot-IoT, ToN-IoT, IoT-23	Important for IoT botnet and device-level attacks	Large size, imbalance, preprocessing complexity
SDN-specific datasets	InSDN and SDN testbed datasets	Closer to controller, switch, and flow-table behavior	Limited topology scale and controller diversity

4. Detection and Mitigation Strategies

The reviewed paper groups defensive work into detection and mitigation. Detection identifies whether a flow, host, or traffic pattern is suspicious. Mitigation then attempts to reduce damage by filtering packets, installing new rules, rate-limiting traffic, isolating sources, balancing loads, or changing routing behavior. In SDN, these tasks can be coordinated centrally through the controller, which is both an advantage and a risk.

Flow-based monitoring is common because SDN switches expose useful information about flows, ports, packet counts, byte counts, and flow-table entries. By observing unusual increases in packet-in messages, flow creation requests, entropy changes, or traffic concentration, a controller can detect signs of a DDoS attack. The challenge is to collect enough information for accurate detection without overwhelming the controller with monitoring tasks.

Rule-based and threshold-based systems are easy to deploy and can respond quickly. For example, a controller can block sources that exceed a packet-in threshold or ports that show abnormal traffic levels. However, attackers can evade static thresholds by

using low-rate or distributed patterns. Thresholds also need to adapt to normal traffic variation, such as daily peaks or sudden legitimate demand.

Machine learning systems improve adaptability by learning normal and malicious traffic patterns from data. Random Forest, Decision Tree, SVM, KNN, XGBoost, CNN, LSTM, and hybrid models all appear in the reviewed studies. Their performance is usually measured with accuracy, precision, recall, F1-score, false positive rate, and sometimes detection time. High accuracy is useful, but SDN systems also require low latency and low computational overhead.

Mitigation may involve installing high-priority drop rules, redirecting suspicious traffic, limiting packet rates, updating forwarding paths, balancing traffic across controllers, or using traceback methods to locate attack sources. Some frameworks also use game theory, deception, or moving-target defense to make attacks less effective. The best mitigation strategy depends on the attack type. A UDP flood, a TCP SYN flood, a low-rate DDoS attack, and a flow-table exhaustion attack each require different indicators and responses.

Table 2. Paraphrased summary of defense strategies

Strategy	How it works	Key concern
Entropy/statistical detection	Tracks changes in traffic distribution, packet rates, or flow behavior	Static thresholds may fail across different networks
Machine learning classification	Learns attack and benign patterns from labeled or partially labeled datasets	Needs high-quality datasets and low controller overhead
Deep learning	Uses temporal or spatial traffic patterns through CNN, LSTM, DBN, or hybrid models	May require large data and careful deployment
Traceback and source identification	Attempts to locate the origin or path of malicious traffic	Hard when botnets use spoofing and distributed sources
Rule installation and filtering	Blocks, redirects, or limits suspicious traffic through SDN rules	Incorrect rules may block legitimate users
Distributed controller defense	Spreads control workload across multiple controllers	Needs consistency and secure controller coordination

5. Critical Discussion

The main strength of the reviewed paper is that it brings together three connected topics: DDoS attack vectors, public datasets, and SDN detection and mitigation frameworks. This combination is useful because a defense system cannot be evaluated properly without suitable data, and datasets are meaningful only when they support realistic attack and mitigation research.

A major finding is that dataset availability remains a serious challenge. Many studies report very high accuracy, sometimes above 99%, but those results are often obtained through offline experiments. In real SDN networks, traffic changes quickly, attack patterns evolve, and controller resources are limited. A classifier that performs well on an offline dataset may produce different results when deployed inside a controller that must make decisions in real time.

Another issue is reproducibility. Research papers often use different traffic generators, simulation settings, controller platforms, feature sets, sampling methods, preprocessing steps, training-test splits, and performance metrics. Because of these differences, comparing one accuracy value with another can be misleading. Standardized benchmark datasets and consistent evaluation procedures would make the field more reliable.

Scalability is also central. Many experiments are conducted with Mininet and a small number of switches, hosts, and controllers. Such testbeds are useful for controlled research, but they cannot fully represent large service-provider networks, smart cities, 5G systems, or industrial IoT infrastructures. Future studies need larger, more diverse, and more realistic SDN environments.

The reviewed work also shows that attack diversity matters. DDoS is not a single technique. Bandwidth floods, amplification attacks, protocol misuse, malformed packets, low-rate attacks, and flow-table exhaustion attacks behave differently. A

defense model trained on one attack type may not detect another. Modern benchmark datasets should therefore include multiple DDoS families, benign traffic variations, encrypted traffic, and mixed attack scenarios.

Finally, SDN security must balance accuracy with operational cost. Monitoring every packet or running heavy deep learning models in the controller may reduce performance. Lightweight feature extraction, edge-assisted detection, distributed controllers, and efficient mitigation rules are therefore important directions for practical deployment.

6. Conclusion and Future Work

The reviewed paper concludes that DDoS defense in SDN depends on three foundations: understanding attack vectors, using appropriate open datasets, and designing detection and mitigation frameworks that can operate efficiently in SDN environments. SDN improves flexibility and centralized control, but it also increases the importance of protecting the controller, switches, APIs, and flow tables. Open datasets allow researchers to test models and compare results, but current datasets have limitations. Some are outdated, some are not SDN-specific, some are too small or imbalanced, and some do not include enough attack diversity. SDN-specific datasets such as InSDN are valuable, but more comprehensive benchmark datasets are needed.

Future work should focus on building realistic SDN testbeds, generating datasets with multiple topologies and controllers, including broad DDoS scenarios, and defining standard evaluation metrics. Collaboration between universities, industry, and cybersecurity organizations can help create datasets that are both realistic and shareable. In addition, future models should be evaluated not only by accuracy but also by detection delay,

controller overhead, scalability, false-positive cost, and mitigation effectiveness. Overall, machine learning and deep learning will continue to play an important role in SDN security, but they must be supported by reliable data, reproducible experiments, and practical deployment strategies. A strong DDoS defense for SDN should combine fast traffic monitoring, adaptive detection, accurate classification, controller-aware mitigation, and continuous evaluation against new attack patterns.

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Methods Of Teaching Speaking In English Language Classrooms

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Abstract

This article examines the theoretical and practical aspects of teaching speaking in English language classrooms. Speaking is considered one of the most important and challenging language skills because it requires learners to use linguistic knowledge actively in real communication. The study discusses psychological and linguistic characteristics of speech, common difficulties in listening and speaking, prepared and unprepared speech, error correction techniques, and effective classroom activities for developing oral communication skills. Special attention is given to methods that help teachers foster learners' communicative competence through meaningful interaction.

Keywords: speaking skills, language teaching, communicative competence, listening comprehension, dialogue, monologue, oral communication, English language learning.

Language functions primarily as a means of communication, and speaking plays a central role in this process. In foreign language education, the development of speaking skills is essential because learners must be able not only to understand speech but also to express their own thoughts effectively. Teaching speaking involves two interconnected processes: listening comprehension and oral production. Therefore, successful language instruction should provide opportunities for learners to develop both receptive and productive skills.

The purpose of this article is to analyze the main principles of teaching speaking, identify common difficulties faced by learners, and discuss effective techniques that can be applied in classroom practice.

Psychological and Linguistic Characteristics of Speaking

Speech is a motivated activity through which individuals communicate ideas, feelings, and opinions. Effective speaking requires a communicative purpose and interaction with an interlocutor. Psychologists emphasize that speech is always motivated, addressed to someone, emotionally colored, and situational.

From a linguistic perspective, spoken language differs from written language. Oral communication often includes incomplete sentences, contractions, conversational expressions, and spontaneous responses. Therefore, language instruction should prepare learners to participate in authentic communication rather than merely reproduce memorized texts.

Difficulties in Teaching Speaking and Listening

One of the major challenges in language learning is listening comprehension. Learners often experience phonetic, lexical, and grammatical difficulties when processing spoken language. Differences between native and target language sound systems may lead to misunderstandings, while unfamiliar vocabulary and grammatical structures can further complicate comprehension.

Speaking itself is equally challenging because students must quickly select appropriate vocabulary, grammar, and pronunciation while expressing their thoughts. Many learners hesitate to speak due to fear of making mistakes or lack of confidence. Consequently, teachers should create supportive classroom environments that encourage meaningful communication.

Prepared and Unprepared Speech

Speaking activities can be divided into prepared and unprepared forms. Prepared speech allows learners time to organize ideas and practice language before speaking. Examples include presentations, retellings, and planned discussions.

Unprepared speech, on the other hand, requires spontaneous language use. Learners may be asked to discuss a topic, respond to questions, summarize a text, or participate in role plays without prior preparation. Although more difficult, unprepared speaking is essential for developing real communicative competence and should gradually become a major component of classroom instruction.

Error Correction in Speaking Activities

Errors are a natural part of language learning. Effective correction should support communication rather than interrupt it. Minor mistakes in familiar language may be corrected immediately through teacher reformulation, while more complex errors can be addressed after the learner finishes speaking.

Teachers should avoid excessive interruption because it may reduce learners' confidence and willingness to participate. Instead, correction should focus on helping students improve accuracy while maintaining fluency and motivation.

Techniques for Developing Speaking Skills

A variety of classroom techniques can be used to develop speaking abilities:

- substitution and transformation exercises;
- picture description activities;
- question-and-answer tasks;
- information-gap activities;
- role plays and simulations;
- interviews and discussions;
- storytelling and retelling exercises;
- dialogue construction and performance.

Teaching speaking should progress from simple sentence production to extended utterances and finally to coherent discourse. Both monologue and dialogue activities are important. While dialogues help learners practice interaction, monologues develop the ability to organize and present ideas logically.

Conclusion

Teaching speaking is a complex process that requires systematic development of both listening and oral communication skills. Learners encounter numerous psychological, linguistic, and communicative challenges when speaking a foreign language. Effective instruction should combine prepared and unprepared speaking activities, encourage meaningful interaction, and provide opportunities for authentic communication.

The use of appropriate teaching techniques, supportive feedback, and communicative tasks helps learners gain confidence and achieve greater fluency in English. As a result, speaking becomes not only a classroom activity but also a practical tool for real-life communication.

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Machine Learning Algorithms for Classification Tasks after Valuable Data Preprocessing: Evidence from Economic Indicator Data

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Abstract

Machine learning algorithms are increasingly used for classification tasks in artificial intelligence, cybersecurity, economics, and data-driven decision-making. However, the quality of classification results depends not only on the selected algorithm but also on the quality of data preprocessing. This study investigates the role of valuable data preprocessing in improving machine learning-based classification performance using economic indicator data. The dataset contains 147 monthly observations from February 2013 to April 2025 and includes monetary and deposit-related variables such as broad money supply, national currency money supply, narrow money supply, cash in circulation, demand deposits, other national currency deposits, and foreign currency deposits expressed in national currency equivalent. The research follows the IMRAD structure and applies exploratory data analysis, missing value checking, descriptive statistics, distribution analysis, correlation analysis, feature preparation, and classification modeling. Four machine learning algorithms were applied: Decision Tree, Random Forest, Logistic Regression, and Support Vector Machine. The models were evaluated using ROC curves and confusion matrix-based metrics, including accuracy, precision, recall, specificity, and F1-score. The results show that preprocessing produced a clean dataset with no missing values and revealed strong positive correlations among the selected variables. The final classification result achieved an accuracy of approximately 98.83%, precision of 97.87%, recall of 100%, and F1-score of 98.92%. The findings confirm that systematic preprocessing and exploratory analysis are essential for obtaining reliable machine learning classification results. At the same time, because economic indicators have strong time-series characteristics, future studies should apply chronological validation and rolling-window testing to avoid overly optimistic performance estimation.

Keywords: machine learning; classification; data preprocessing; economic indicators; monetary aggregates; ROC curve; confusion matrix

1. Introduction

In recent years, machine learning has become one of the most important tools for solving classification, prediction, anomaly detection, and decision-support problems. Its applications cover many fields, including artificial intelligence, cybersecurity, finance, economics, healthcare, and public administration. In classification tasks, machine learning algorithms learn patterns from historical data and assign observations to predefined classes. The quality of such models depends on several factors, including the structure of the dataset, the relevance of variables, the

preprocessing strategy, and the choice of algorithm [1-4].

Data preprocessing is one of the most important stages in any machine learning pipeline. Raw data may contain missing values, inconsistent formats, outliers, duplicated records, scale differences, and highly correlated variables. These issues can negatively affect classification performance and may lead to inaccurate conclusions. Therefore, before applying machine learning models, it is necessary to analyze the dataset, clean the data, transform variables, examine distributions,

and evaluate relationships among features [5,6].

This study focuses on a classification task based on economic indicator data. The dataset includes monthly monetary and deposit-related indicators from February 2013 to April 2025. These variables represent important components of monetary circulation and financial activity. Economic indicators often contain strong trends, high correlations, and time-dependent patterns. Therefore, they provide a useful case for studying the importance of preprocessing before machine learning classification.

The main purpose of this paper is to evaluate the effectiveness of machine learning algorithms for classification after valuable data preprocessing. The study applies Decision Tree, Random Forest, Logistic Regression, and Support Vector Machine models. The performance of these models is assessed using ROC curves and confusion matrix-based evaluation metrics. The main contributions of this study are as follows. First, the paper presents a practical preprocessing-based framework for classification tasks. Second, it

demonstrates how descriptive statistics, missing value analysis, distribution analysis, and correlation analysis can improve understanding of the dataset before model training. Third, it compares several machine learning algorithms on a classification task using economic indicator data. Fourth, it discusses the importance of careful validation when working with time-series economic data.

2. Materials and Methods

2.1. Dataset Description

The dataset used in this study consists of 147 monthly observations covering the period from February 2013 to April 2025. The data contain monetary and deposit-related economic indicators. The variables included in the dataset are presented in Table 1.

The dataset is suitable for classification modeling because it contains structured numerical variables. However, since the variables are economic indicators, they may contain strong trend behavior and high correlation. For this reason, exploratory data analysis was conducted before model training.

No.	Variable	Description
1	Date	Monthly observation date
2	Broad money supply	General money supply indicator
3	National currency money supply	Money supply in national currency
4	Narrow money supply	Narrow monetary aggregate
5	Cash in circulation	Cash money in circulation
6	Demand deposits in national currency	Deposits available on demand
7	Other deposits in national currency	Other national currency deposits
8	Foreign currency deposits	Foreign currency deposits expressed in national currency equivalent

Table 1. Variables used in the study

data.head()

	Sana	Keng ma'nodagi pul massasi	Milliy valyutadagi pul massasi	Tor ma'nodagi pul massasi \n(ML)2	Muomaladagi \nnaqd pullar\n(n98)	Milliy valyutadagi talab qilib olinguncha depozitlar	Milliy valyutadagi boshqa depozitlar	Chet el valyutadagi depozitlar, \nmilliy valyuta ekvivalentida\n
0	2013-02-01	24432.690855	18900.750121	12589.001424	5786.389542	6822.611882	6311.757697	5531.931734
1	2013-03-01	24502.445158	18943.086657	12731.731201	6005.944703	6725.786495	6211.350456	5559.358501
2	2013-04-01	24961.911866	19082.114876	12801.825450	6223.047228	6578.778222	6280.289426	5899.796990
3	2013-05-01	24927.939524	18893.785473	12685.101393	6317.629747	6267.471646	6308.684080	6034.154351
4	2013-06-01	25424.860416	19888.939001	13246.999191	6382.167615	6854.831576	6361.939810	5825.921415

Figure 1. Preview of the dataset using data.head().

2.2. Data Preprocessing

The preprocessing stage was designed to prepare the dataset for machine learning classification. The following steps were performed:

The date column was converted into a suitable time format.

Missing values were checked using data.isnull().sum().

Descriptive statistics were obtained using data.describe().

Distribution plots were generated for numerical variables.

Two-dimensional scatter plots were used to observe relationships between selected variables.

Time-series plots were used to examine changes over time.

A correlation heatmap was created to identify relationships among features.

Features and target classes were prepared for classification.

Machine learning models were trained and evaluated.

The missing value analysis showed that the dataset does not contain missing values. This means that no imputation was required before modeling.

Variable	Missing values
Date	0
Broad money supply	0
National currency money supply	0
Narrow money supply	0
Cash in circulation	0
Demand deposits in national currency	0
Other deposits in national currency	0
Foreign currency deposits	0

Table 2. Missing value analysis

```
data.isnull().sum()
```

	0
Sana	0
Keng ma'nodagi pul massasi1)	0
Milliy valyutadagi pul massasi	0
Tor ma'nodagi pul massasi ln(M1)2)	0
Muomaladagi lnnaqd pullarln(M0)	0
Milliy valyutagadi talab qilib olinguncha depozitlar	0
Milliy valyutadagi boshqa depozitlar	0
Chet el valyutasidagi depozitlar, lnmilliy valyuta ekvivalentida ln	0

```
dtype: int64
```

Figure 2. Missing value checking output.

2.3. Descriptive Statistical Analysis

Descriptive statistics were used to understand the scale, range, and variability of the selected indicators. The analysis showed that all variables had 147 valid observations.

Indicator	Mean	Minimum	Maximum	Standard deviation
Broad money supply	103188.57	24432.69	281516.32	70100.26
National currency money supply	76941.96	18893.79	225485.77	53537.72
Narrow money supply	45986.54	12585.10	114401.27	27360.92
Cash in circulation	24015.57	5766.39	54020.79	14096.24
Demand deposits in national currency	21970.96	6267.47	61072.76	13515.78
Other deposits in national currency	30955.42	6211.36	119232.09	26743.41
Foreign currency deposits	26246.61	4703.60	58296.29	17634.70

Table 3. Main descriptive statistics

The results indicate that monetary and deposit indicators increased significantly during the analyzed period. For example, broad money supply increased from 24432.69 to 281516.32, while national

currency money supply increased from 18893.79 to 225485.77. This confirms that the dataset contains strong growth patterns over time.

data.describe()

	Sana	Keng ma'nodagi pul massasi1	Milliy valyutadagi pul massasi	Tor ma'nodagi pul massasi \n(M1)2	Hisomladagi \nnaqd pullar\n(M0)	Milliy valyutadagi talab qilib olinguncha depozitlar	Milliy valyutadagi boshqa depozitlar	Chet el valyutasidagi depozitlar, \nmilliy valyuta ekvivalentida\n
count	147	147.000000	147.000000	147.000000	147.000000	147.000000	147.000000	147.000000
mean	2019-03-02 07:20:48.575091936	103188.569249	76941.959288	45986.538367	24015.574028	21970.864360	30955.420901	26246.609861
min	2013-02-01 00:00:00	24432.690855	18893.785473	12585.101393	5766.386642	6267.471648	6211.355456	4703.602814
25%	2016-02-15 12:00:00	43023.222080	36336.928669	23460.077125	10810.238760	12540.741188	13198.736820	8536.170383
50%	2019-03-01 00:00:00	83965.547283	57721.182358	38114.959376	22404.509741	15756.420811	20691.866285	26806.020213
75%	2022-03-16 12:00:00	141805.771783	96946.552969	59997.523547	29541.150051	31160.954254	38347.803963	42110.966150
max	2025-04-01 00:00:00	281516.310816	225485.773877	114401.270164	54020.790812	61072.763623	119232.092360	58296.292480
std	NaN	70100.259821	53537.719124	27360.922746	14096.240796	13515.777147	26743.485307	17634.704841

Figure 3. Descriptive statistics generated using data.describe().

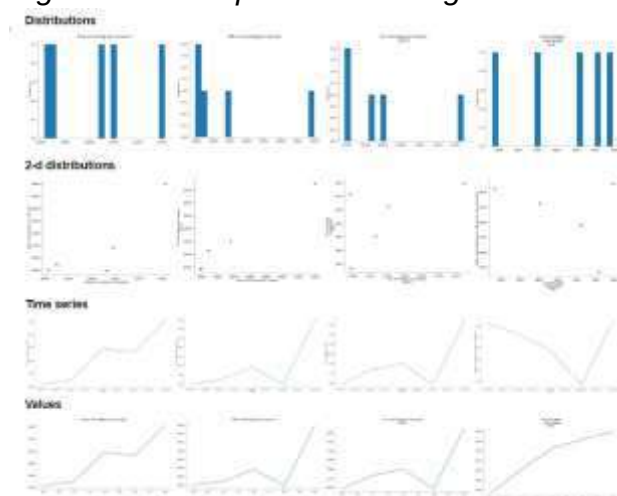


Figure 4. Distribution, two-dimensional, time-series, and value plots for selected variables.

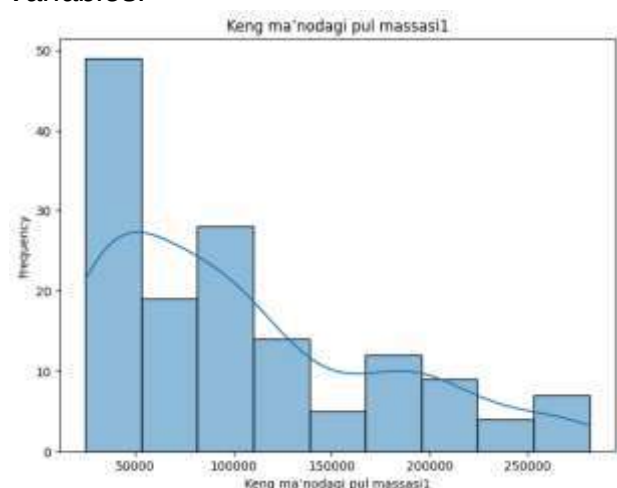


Figure 5. Histogram and density curve for broad money supply.

2.4. Correlation Analysis

Correlation analysis was used to identify the strength of relationships among the variables. The correlation heatmap showed strong positive relationships between most features. The correlation coefficients were

generally high, ranging approximately from 0.87 to 1.00.

This result indicates that monetary and deposit indicators tend to move together. For example, broad money supply, national currency money supply, narrow money supply, and deposits showed very strong correlations. However, high correlation may also indicate multicollinearity. In machine learning, multicollinearity may not seriously affect tree-based models such as Decision Tree and Random Forest, but it can influence linear models such as Logistic Regression. Therefore, correlation analysis is an important preprocessing step.

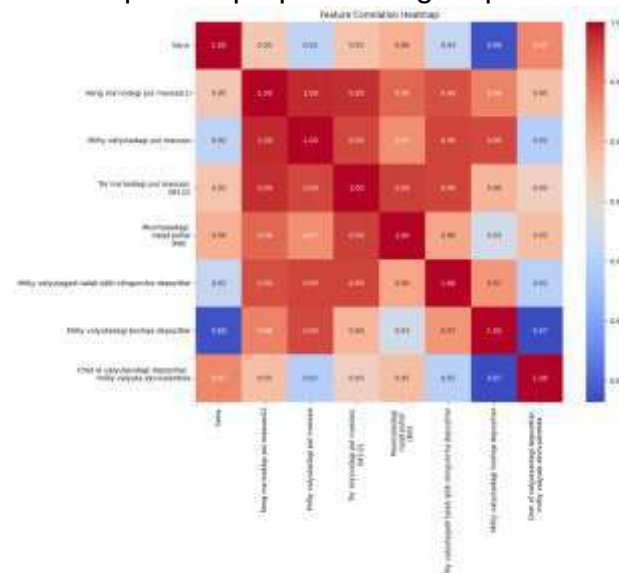


Figure 6. Feature correlation heatmap.

2.5. Machine Learning Algorithms

Four machine learning algorithms were applied in this study.

Decision Tree. Decision Tree is a supervised learning algorithm that classifies

observations by dividing the dataset into branches based on feature conditions. It is easy to interpret and useful for understanding decision rules [7].

Random Forest. Random Forest is an ensemble learning method that builds multiple decision trees and combines their predictions. It usually provides better generalization than a single decision tree and reduces the risk of overfitting [1].

Logistic Regression. Logistic Regression is a statistical machine learning method used for binary classification. It estimates the probability that an observation belongs to a particular class [8].

Support Vector Machine. Support Vector Machine is a classification algorithm that finds an optimal separating boundary between classes. It is effective for classification tasks with clear separation between classes [2].

2.6. Evaluation Metrics

The performance of the classification models was evaluated using ROC curves and a confusion matrix. The following metrics were calculated [3]:

$$\text{Accuracy} = (TP + TN) / (TP + TN + FP + FN)$$

$$\text{Precision} = TP / (TP + FP)$$

$$\text{Recall} = TP / (TP + FN)$$

$$\text{Specificity} = TN / (TN + FP)$$

$$F1\text{-score} = 2 \times \text{Precision} \times \text{Recall} / (\text{Precision} + \text{Recall})$$

where TP means true positive, TN means true negative, FP means false positive, and FN means false negative.

3. Results

3.1. Exploratory Data Analysis Results

The exploratory data analysis showed that the dataset was clean and complete. No missing values were detected in any column. The distribution plots showed that several variables were not normally distributed and had increasing patterns over time. This is expected in economic time-series data because monetary aggregates and deposits usually grow as the economy expands.

The time-series plots showed clear upward movement in broad money supply, national currency money supply, narrow money supply, cash in circulation, and deposits. This confirms that the dataset contains strong temporal dynamics.

The correlation heatmap demonstrated that most variables are strongly positively correlated. Correlation values between the main monetary indicators were close to 1.00. This means that the selected features contain similar economic movement patterns.

3.2. ROC Curve Results

The ROC curve was used to compare the classification performance of Decision Tree, Random Forest, Logistic Regression, and Support Vector Machine. The ROC curves showed that all tested models achieved strong classification performance. The curves were close to the upper-left corner, which indicates a high true positive rate and a low false positive rate.

Among the tested algorithms, Support Vector Machine and Random Forest demonstrated particularly strong performance. Logistic Regression also showed good results, although its curve was slightly lower than the tree-based and SVM models. These results indicate that the selected variables provide strong predictive information for the classification task.

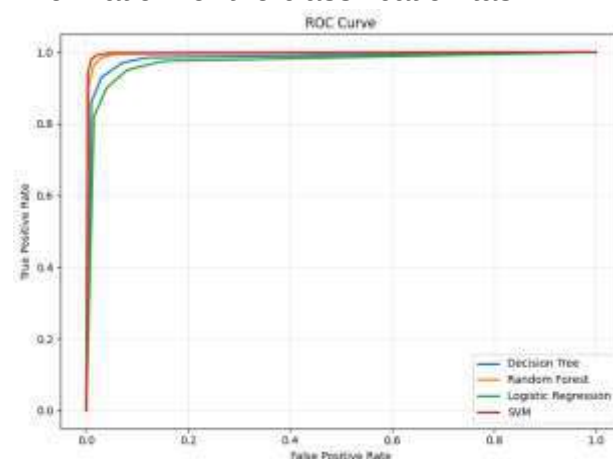


Figure 7. ROC curves of Decision Tree, Random Forest, Logistic Regression, and SVM models.

3.3. Confusion Matrix Results

The confusion matrix result is presented in Table 4 and Figure 8.

True / Predicted	Positive	Negative
Positive	25189	0
Negative	548	21256

Table 4. Confusion matrix result

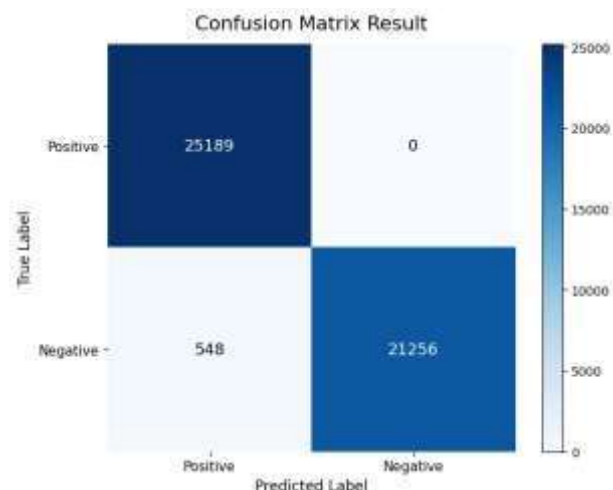


Figure 8. Confusion matrix result.

Based on the confusion matrix, the model produced 25189 true positive classifications, 21256 true negative classifications, 548 false positive classifications, and 0 false negative classifications. The model correctly classified 25189 positive cases and 21256 negative cases. Only 548 negative cases were incorrectly classified as positive. No positive cases were incorrectly classified as negative.

3.4. Classification Performance Metrics

Metric	Value
Accuracy	98.83%
Precision	97.87%
Recall	100.00%
Specificity	97.49%
F1-score	98.92%

Table 5. Classification performance metrics

The accuracy of 98.83% shows that the model correctly classified most observations. The recall value of 100% indicates that all positive cases were detected. The precision value of 97.87% shows that most observations predicted as

positive were actually positive. The F1-score of 98.92% confirms that the model achieved a strong balance between precision and recall.

4. Discussion

The results of this study confirm that data preprocessing plays a critical role in machine learning classification tasks. The dataset was first analyzed using missing value checking, descriptive statistics, distribution plots, time-series visualization, and correlation analysis. This preprocessing process helped identify the main structure of the data and prepared it for classification modeling.

The absence of missing values improved the reliability of the modeling process. Since all variables had complete observations, there was no need to apply missing value imputation. This reduced the risk of artificial bias that may appear when missing values are replaced with estimated values.

The descriptive statistics showed large differences between minimum and maximum values. This indicates significant growth in monetary and deposit indicators over the observation period. Such growth patterns are common in economic data, but they may influence machine learning models if not properly handled.

The correlation analysis showed very strong positive relationships among the variables. This means that the selected economic indicators move together over time. From a modeling perspective, this can be useful because related variables may improve classification accuracy. However, it can also create multicollinearity, especially for linear models such as Logistic Regression. Therefore, future research should consider feature selection, principal component analysis, or regularization techniques.

The ROC curve results demonstrated that all selected algorithms performed well. This suggests that the preprocessed features contained enough information for effective

classification. The confusion matrix also confirmed strong classification performance, with only 548 misclassified cases out of 46993 evaluated predictions. However, the very high performance should be interpreted carefully. Economic data usually have time-dependent structure. If a random train-test split is used, the model may indirectly learn future patterns from the data, which can lead to overly optimistic results. Therefore, chronological train-test splitting, rolling-window validation, and out-of-sample testing are recommended for future experiments.

Another important point is that the original dataset contains 147 monthly observations, while the confusion matrix includes a larger number of evaluated predictions. This may be explained by additional preprocessing, transformation, resampling, or generated classification instances. In the final version of the paper, this step should be clearly described based on the exact code and dataset preparation process.

Overall, the findings show that machine learning algorithms can successfully classify structured economic data when preprocessing is performed carefully. The study also demonstrates that preprocessing is not a technical formality, but a fundamental stage that directly affects model performance and the reliability of conclusions.

5. Conclusion

This study investigated the application of machine learning algorithms for a classification task after valuable data preprocessing. The research used monthly economic indicator data covering the period from February 2013 to April 2025. The dataset included broad money supply, national currency money supply, narrow money supply, cash in circulation, demand deposits, other national currency deposits, and foreign currency deposits expressed in national currency equivalent.

The preprocessing stage included missing value checking, descriptive statistics, distribution analysis, time-series visualization, and correlation analysis. The results showed that the dataset contained no missing values and that most variables were strongly positively correlated. The descriptive analysis also showed significant growth in monetary and deposit indicators during the analyzed period.

Four machine learning algorithms were applied: Decision Tree, Random Forest, Logistic Regression, and Support Vector Machine. The models were evaluated using ROC curves and confusion matrix-based metrics. The final classification result achieved 98.83% accuracy, 97.87% precision, 100% recall, 97.49% specificity, and 98.92% F1-score.

The findings confirm that valuable data preprocessing improves the quality and reliability of machine learning classification. The study also shows that economic indicator data can be effectively used in classification tasks when proper preprocessing and model evaluation methods are applied.

Future research should apply chronological validation, rolling-window testing, feature selection, and additional machine learning algorithms. It is also recommended to compare classical machine learning models with deep learning and time-series classification methods.

6. Limitations and Future Work

The main limitation of this study is connected with the time-series nature of the data. Economic indicators change over time and may contain strong trend effects. Therefore, random train-test splitting can produce overly high results. Future studies should use chronological split, walk-forward validation, or rolling-window testing.

A second limitation is the difference between the original number of monthly observations and the larger number of evaluated predictions shown in the

confusion matrix. This transformation should be fully documented in the final experimental code and dataset description. Future research should clearly explain whether the increase is caused by windowing, resampling, class generation, or another transformation method.

Future work may also include additional preprocessing methods such as normalization, differencing, feature selection, principal component analysis, and model explainability tools such as SHAP or permutation importance.

Central Bank of the Republic of Uzbekistan.
Monetary and deposit indicators
database.

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Methodology Of Using Ecotourism And Agroturism Opportunities In Teaching Geography On The Example Of Namangan Region

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Abstract

This methodological recommendation develops a methodology for using the potential of ecotourism and agrotourism in Namangan region based on a territorial approach to teaching geography. The recommendation is based on modern pedagogical technologies, in particular, the 5E and 7E models, a competency-based approach, ICT tools and interactive methods. This methodology serves to develop ecological thinking, analytical thinking and practical skills in students.

Keywords: Ecotourism, agrotourism, territorial approach, 5E model, 7E model, competency, geographical thinking, project method, interactive methods, ICT, Namangan region

Annotatsiya

Mazkur metodik tavsiyada geografiya fanini o'qitishda hududiy yondashuv asosida Namangan viloyatining ekoturizm va agroturizm salohiyatidan foydalanish metodikasi ishlab chiqilgan. Tavsiya zamonaviy pedagogik texnologiyalar, xususan 5E va 7E modellari, kompetensiyaviy yondashuv, AKT vositalari va interfaol metodlarga asoslanadi. Ushbu metodika o'quvchilarda ekologik tafakkur, tahliliy fikrlash va amaliy ko'nikmalarni rivojlantirishga xizmat qiladi.

Kalit so'zlar: Ekoturizm, agroturizm, hududiy yondashuv, 5E modeli, 7E modeli, kompetensiya, geografik tafakkur, loyiha metodi, interfaol metodlar, AKT, Namangan viloyati

KIRISH

Hozirgi kunda ta'lim tizimida olib borilayotgan islohotlar o'quv jarayonini zamonaviy pedagogik texnologiyalar asosida tashkil etishni, o'quvchilarda mustaqil fikrlash, tahlil qilish va amaliy faoliyat ko'nikmalarini rivojlantirishni talab etmoqda. Ayniqsa, geografiya fanini o'qitishda hududiy yondashuvni qo'llash orqali o'quvchilarga o'z yashab turgan hududi misolida bilim berish muhim ahamiyat kasb etadi. Bu esa nafaqat nazariy bilimlarni mustahkamlash, balki ularni real hayot bilan bog'lash imkonini ham yaratadi.

O'zbekiston Respublikasida turizm sohasini rivojlantirish davlat siyosatining ustuvor yo'nalishlaridan biri hisoblanadi. Xususan, ekoturizm va agroturizm yo'nalishlari mamlakatimiz hududlarining tabiiy-geografik xususiyatlariga mos ravishda jadal rivojlanib bormoqda. Shu nuqtai nazardan, mazkur yo'nalishlarni geografiya

fanini o'qitish jarayoniga integratsiya qilish o'quvchilarning bilimlarini yanada boyitadi, ularning ekologik madaniyatini shakllantiradi hamda kasbiy yo'nalish tanlashiga ijobiy ta'sir ko'rsatadi.

Namangan viloyati o'zining tog'li va tog'oldi hududlari, boy tabiiy resurslari, iqlim sharoiti hamda rivojlangan bog'dorchilik va dehqonchilik an'analari bilan ekoturizm va agroturizmni rivojlantirish uchun katta imkoniyatlarga ega hudud hisoblanadi. Ushbu hududni geografiya fanida o'rganish orqali o'quvchilar real geografik obyektlar asosida bilim olish, tahlil qilish va xulosalar chiqarish imkoniyatiga ega bo'ladilar.

Mazkur metodik tavsiya geografiya fanini o'qitishda Namangan viloyati misolida ekoturizm va agroturizm imkoniyatlaridan foydalanish orqali ta'lim samaradorligini oshirishga qaratilgan. Tavsiyada zamonaviy pedagogik yondashuvlar, xususan 5E va 7E modellari, kompetensiyaviy yondashuv, interfaol

metodlar hamda axborot-kommunikatsiya texnologiyalaridan foydalanishning metodik asoslari yoritib beriladi. Shuningdek, o'quvchilarning yosh xususiyatlariga mos holda darsni tashkil etish, ularni faol ishtirok etishga jalb qilish va amaliy faoliyatga yo'naltirish usullari ko'rsatib beriladi.

Mazkur ishning asosiy maqsadi geografiya fanini o'qitishda mahalliy materiallar asosida ekoturizm va agroturizm imkoniyatlarini o'rgatish orqali o'quvchilarda geografik tafakkur, ekologik madaniyat va amaliy ko'nikmalarni shakllantirishdan iboratdir. Shu bilan birga, dars jarayonida o'quvchilarning kollaboratsiya, kommunikativlik, kreativ va tanqidiy fikrlash ko'nikmalarini rivojlantirishga alohida e'tibor qaratiladi.

Metodik tavsiyada darsni tashkil etish bosqichlari, zamonaviy metod va texnologiyalarni qo'llash yo'llari, baholash usullari, fanlararo integratsiya imkoniyatlari hamda amaliy topshiriqlar tizimi batafsil yoritilgan. Shuningdek, o'quvchilarning bilim darajasini aniqlash va baholashda formativ va summativ baholash usullaridan foydalanish, loyiha asosida ta'limni tashkil etish va AKT vositalaridan samarali foydalanish mexanizmlari ham ko'rsatib berilgan.

Ushbu metodik tavsiya geografiya fanini o'qitishda innovatsion yondashuvlarni joriy etish, ta'lim jarayonini amaliy faoliyat bilan uyg'unlashtirish va o'quvchilarning har tomonlama rivojlanishini ta'minlashga xizmat qiladi. Mazkur tajriba boshqa hududlarda ham qo'llash uchun metodik asos bo'lib xizmat qilishi mumkin.



I BOB. GEOGRAFIYA FANINI O'QITISHDA NAZARIY-METODIK ASOSLAR

Hududiy yondashuv va kompetensiyaviy ta'lim

Geografiya fanini o'qitishda hududiy yondashuvdan foydalanish ta'lim samaradorligini oshirishning muhim omillaridan biri hisoblanadi. Hududiy yondashuv o'quvchilarga o'z yashab turgan hududi misolida bilimlarni o'zlashtirish imkonini beradi va bu orqali o'rganilayotgan mavzular yanada tushunarli hamda amaliy ahamiyatga ega bo'ladi. Ayniqsa, 7–8-sinf o'quvchilari uchun konkret misollar asosida bilim berish ularning qiziqishini oshiradi va mavzuni chuqurroq anglashga yordam beradi.

Hududiy yondashuvning asosiy mohiyati – umumiy geografik qonuniyatlarni mahalliy sharoit bilan bog'lab tushuntirishdan iborat. Masalan, ekoturizm va agroturizm tushunchalarini faqat nazariy jihatdan emas, balki Namangan viloyatining tabiiy sharoiti, iqlimi, relyefi va xo'jalik faoliyati asosida o'rganish o'quvchilarda real tasavvurni shakllantiradi. Bu esa bilimlarning mustahkam o'zlashtirilishini ta'minlaydi.

Kompetensiyaviy yondashuv esa o'quvchilarda faqat bilim emas, balki uni amaliyotda qo'llash ko'nikmalarini ham shakllantirishga qaratilgan. Ushbu yondashuv asosida o'quvchilar geografik ma'lumotlarni tahlil qilish, xulosa chiqarish, muammolarni hal qilish va mustaqil qaror

qabul qilishni o'rganadilar. Natijada ular nafaqat fan doirasida, balki real hayotda ham zarur bo'lgan ko'nikmalarga ega bo'ladilar.

Mazkur metodik yondashuvda "Qanday o'qitish kerak?" degan savolga quyidagi metodik yechimlar orqali javob beriladi. Avvalo, dars jarayonida o'quvchilarni faol ishtirok etishga jalb etish zarur. Buning uchun muammoli vaziyatlar yaratish, savol-javoblar orqali fikrlashga undash va interfaol metodlardan foydalanish muhim hisoblanadi. Shuningdek, o'quvchilarga mustaqil ishlash imkonini beruvchi amaliy topshiriqlarni tashkil etish ham katta ahamiyatga ega.

Darsni tashkil etishda 5E modeli samarali hisoblanadi. Darsning boshlanishida o'quvchilarning e'tiborini jalb qilish uchun qiziqarli savollar yoki real hayotiy misollar keltiriladi (Engage). Keyingi bosqichda o'quvchilar mustaqil ravishda ma'lumotlarni o'rganadilar va tahlil qiladilar (Explore). So'ng o'qituvchi tomonidan asosiy tushunchalar tushuntiriladi (Explain). O'rganilgan bilimlar amaliy topshiriqlar orqali mustahkamlanadi (Elaborate). Yakunda esa o'quvchilarning bilimlari baholanadi (Evaluate).

Hududiy yondashuv asosida dars o'tkazishda fanlararo integratsiya ham muhim o'rin tutadi. Masalan, ekoturizmni o'rganishda biologiya fanidagi ekotizimlar haqidagi bilimlar, agroturizmni o'rganishda esa texnologiya va iqtisodiyot fanlariga oid tushunchalar qo'llaniladi. Bu esa o'quvchilarda kompleks fikrlashni rivojlantiradi.

O'quvchilarning yosh xususiyatlarini inobatga olish ham metodikaning muhim jihatlaridan biridir. 7-sinf o'quvchilariga ko'proq ko'rgazmali materiallar va sodda tushuntirishlar berilsa, 8-sinf o'quvchilariga tahliliy topshiriqlar va kichik loyihalar orqali bilim berish samarali hisoblanadi. Bu yondashuv o'quvchilarning individual

rivojlanishiga mos ravishda ta'limni tashkil etish imkonini beradi.

Mazkur metodika doirasida o'quvchilarga quyidagi amaliy topshiriqlar berilishi mumkin: xarita asosida turizm hududlarini aniqlash, berilgan ma'lumotlar asosida tahlil qilish, hududning turistik salohiyatini baholash va kichik loyiha ishlab chiqish. Bu topshiriqlar o'quvchilarning mustaqil fikrlashini, tahliliy yondashuvini va ijodiy qobiliyatlarini rivojlantiradi.

Natijada, hududiy va kompetensiyaviy yondashuv asosida tashkil etilgan darslar o'quvchilarda quyidagi natijalarni shakllantiradi: geografik bilimlarning mustahkamligi, amaliy ko'nikmalarning rivojlanishi, ekologik madaniyatning shakllanishi va kasbiy yo'nalishga qiziqishning ortishi. Shu bois ushbu yondashuv geografiya fanini o'qitishda samarali metodik asos sifatida tavsiya etiladi.

Ekoturizm va agroturizm tushunchalarining geografik mazmuni

Geografiya fanini o'qitishda ekoturizm va agroturizm tushunchalarini o'rganish muhim nazariy va amaliy ahamiyatga ega bo'lib, ular o'quvchilarda tabiiy resurslardan oqilona foydalanish, ekologik muvozanatni saqlash hamda iqtisodiy faoliyatni tushunish ko'nikmalarini shakllantiradi. Mazkur tushunchalarni geografik nuqtai nazardan yoritish orqali o'quvchilar tabiat va jamiyat o'rtasidagi o'zaro bog'liqlikni chuqur anglay boshlaydilar.

Ekoturizm – bu tabiiy hududlarda amalga oshiriladigan, atrof-muhitni muhofaza qilishga qaratilgan hamda ekologik madaniyatni rivojlantirishga xizmat qiluvchi turizm turi hisoblanadi. Ekoturizmning asosiy maqsadi tabiatni asrab-avaylash bilan birga, insonlarning tabiatga bo'lgan munosabatini ijobiy tomonga o'zgartirishdan iborat. Geografik jihatdan ekoturizm tog'li hududlar, qo'riqxonalar, milliy bog'lar va ekologik jihatdan toza hududlarda rivojlanadi. Namangan

viloyatining tog'li hududlari aynan shu jihatdan ekoturizm uchun qulay hisoblanadi. Agroturizm esa qishloq xo'jaligi faoliyati bilan bog'liq turizm turi bo'lib, u dehqonchilik, bog'dorchilik va chorvachilik jarayonlarini o'rganish, ularda ishtirok etish hamda qishloq hayoti bilan tanishishni o'z ichiga oladi. Agroturizm orqali o'quvchilar qishloq xo'jaligining geografik joylashuvi, iqlim sharoiti, tuproq xususiyatlari va inson faoliyati o'rtasidagi bog'liqlikni tushunib yetadilar. Bu esa ularning iqtisodiy-geografik bilimlarini boyitadi.

Mazkur tushunchalarni o'qitishda "Qanday o'qitish kerak?" savoliga quyidagi metodik yondashuvlar orqali javob beriladi. Avvalo, ekoturizm va agroturizm tushunchalarini o'quvchilarga oddiy va tushunarli misollar orqali tushuntirish zarur. Masalan, o'quvchilardan o'z hududidagi dam olish maskanlari yoki qishloq xo'jaligi faoliyati haqida so'rash orqali mavzuga kirish mumkin. Bu esa ularning mavzuga nisbatan qiziqishini oshiradi.

Dars jarayonida 7E modeli asosida ta'limni tashkil etish samarali hisoblanadi. Dars boshida o'quvchilarning mavjud bilimlari aniqlanadi (Elicit), so'ng qiziqtirish bosqichida mavzuga oid savollar beriladi (Engage). Keyingi bosqichda o'quvchilar mustaqil ravishda ma'lumotlarni o'rganadilar (Explore). O'qituvchi tomonidan asosiy tushunchalar izohlanadi (Explain), so'ng bilimlar amaliy topshiriqlar orqali mustahkamlanadi (Elaborate). Yakunda o'quvchilar bilimlari baholanadi (Evaluate) va o'rganilgan bilimlar yangi vaziyatlarga qo'llanadi (Extend).

Ekoturizm va agroturizm mavzularini o'rganishda fanlararo integratsiya muhim ahamiyatga ega. Biologiya fanida o'rganilgan ekotizimlar, tabiiy muvozanat tushunchalari ekoturizm bilan bevosita bog'liq. Iqtisodiyot fanida turizmning iqtisodiy ahamiyati, daromad manbalari haqida o'rganilgan bilimlar agroturizmni

tushunishda yordam beradi. Texnologiya fanida esa qishloq xo'jaligi jarayonlari haqida olingan bilimlar mustahkamlanadi. Dars jarayonida AKT vositalaridan foydalanish ham katta samaradorlik beradi. Masalan, video materiallar, virtual sayohatlar, interaktiv xaritalar orqali o'quvchilarga real obyektlar haqida tasavvur berish mumkin. Bu esa ularning ko'rgazmali tafakkurini rivojlantiradi va mavzuni yanada tushunarli qiladi.

O'quvchilarning yosh xususiyatlarini hisobga olgan holda, 7-sinfda ko'proq tushunchalarni shakllantirish va oddiy misollar keltirish maqsadga muvofiq bo'lsa, 8-sinfda esa tahliliy topshiriqlar, solishtirish va xulosa chiqarishga yo'naltirilgan vazifalarni berish samarali hisoblanadi. Masalan, o'quvchilarga ekoturizm va agroturizmni solishtirish, ularning afzallik va kamchiliklarini aniqlash topshiriqlari berilishi mumkin.

Amaliy topshiriqlar sifatida o'quvchilarga quyidagilar taklif etiladi: berilgan hududni ekoturizm yoki agroturizm nuqtai nazaridan tahlil qilish, turizm yo'nalishlarini aniqlash, kichik loyiha ishlab chiqish. Bu topshiriqlar o'quvchilarning kreativ fikrlashini, tahliliy qobiliyatlarini va mustaqil ishlash ko'nikmalarini rivojlantiradi.

Natijada, ekoturizm va agroturizm tushunchalarini geografik mazmunda o'qitish o'quvchilarda ekologik madaniyatni shakllantiradi, tabiatga nisbatan ongli munosabatni rivojlantiradi hamda iqtisodiy-geografik tafakkurni kengaytiradi. Shu bois mazkur mavzu geografiya fanini o'qitishda muhim metodik ahamiyat kasb etadi.

Zamonaviy pedagogik texnologiyalar (5E, 7E, 4K)

Zamonaviy ta'lim tizimida pedagogik texnologiyalardan samarali foydalanish o'quv jarayonining sifatini oshirish, o'quvchilarning faolligini ta'minlash va ularning mustaqil fikrlash ko'nikmalarini rivojlantirishda muhim ahamiyat kasb etadi.

Ayniqsa, geografiya fanini o'qitishda 5E va 7E modellari, 4K ko'nikmalari hamda axborot-kommunikatsiya texnologiyalaridan (AKT) foydalanish darsni interfaol va samarali tashkil etish imkonini beradi.

5E modeli o'quv jarayonini bosqichma-bosqich tashkil etishga xizmat qiladi va o'quvchilarni faol o'rganishga jalb etadi. Ushbu modelda dars avvalo o'quvchilarning e'tiborini jalb qilish orqali boshlanadi. Bu bosqichda o'qituvchi muammoli savollar, qiziqarli faktlar yoki vizual materiallardan foydalanadi. Keyingi bosqichda o'quvchilar mustaqil ravishda mavzuni o'rganishga jalb etiladi, bu esa ularning tadqiqotchilik qobiliyatlarini rivojlantiradi. So'ngra o'qituvchi asosiy tushunchalarni izohlaydi va o'quvchilarning bilimlarini tizimlashtiradi. Keyingi bosqichda o'quvchilar o'rganilgan bilimlarni amaliy vaziyatlarda qo'llaydilar. Yakunda esa baholash orqali o'quvchilarning bilim darajasi aniqlanadi.

7E modeli esa 5E modelining kengaytirilgan shakli bo'lib, unda o'quvchilarning avvalgi bilimlarini aniqlash va yangi bilimlarni hayotiy vaziyatlarda qo'llashga alohida e'tibor qaratiladi. Ushbu model orqali o'quvchilar o'z bilimlarini kengaytiradi va mustaqil ravishda yangi xulosalar chiqarishga o'rganadi. Bu esa ularning tanqidiy fikrlashini rivojlantirishda muhim ahamiyatga ega.

Zamonaviy ta'limning muhim tarkibiy qismi hisoblangan 4K ko'nikmalari

– kollaboratsiya, kommunikativlik, kreativ fikrlash va tanqidiy fikrlash o'quvchilarning har tomonlama rivojlanishini ta'minlaydi. Kollaboratsiya o'quvchilarning guruhda ishlash, o'zaro hamkorlik qilish ko'nikmalarini

rivojlantiradi. Kommunikativlik esa o'z fikrini aniq va ravon ifodalash, boshqalar fikrini tinglash va tushunishni o'rgatadi. Kreativ fikrlash o'quvchilarning yangicha g'oyalar yaratish qobiliyatini shakllantiradi, tanqidiy fikrlash esa muammolarni tahlil qilish va asosli xulosa chiqarishga yordam beradi.

Geografiya fanini o'qitishda AKT vositalaridan foydalanish darsni yanada samarali tashkil etish imkonini beradi. Interaktiv xaritalar, elektron darsliklar, videomateriallar, virtual sayohatlar orqali o'quvchilarga real geografik obyektlar haqida tasavvur berish mumkin. Masalan, Namangan viloyatining turizm hududlarini virtual xarita orqali ko'rsatish o'quvchilarda ko'rgazmali tafakkurni rivojlantiradi va mavzuni chuqurroq anglashga yordam beradi.

Mazkur pedagogik texnologiyalarni qo'llashda "Qanday o'qitish kerak?" savoliga quyidagi metodik yechimlar orqali javob beriladi. Avvalo, darsni interfaol shaklda tashkil etish, o'quvchilarni faol ishtirok etishga jalb qilish va ularni mustaqil fikrlashga undash zarur. Buning uchun guruhli ishlar, muammoli vaziyatlar, loyiha asosida o'qitish va amaliy topshiriqlardan foydalanish muhim hisoblanadi.

Darsni tashkil etish bosqichlarida zamonaviy texnologiyalar quyidagicha integratsiya qilinadi: boshlang'ich bosqichda o'quvchilarning e'tiborini jalb qilish uchun video va rasmlardan foydalaniladi, tadqiqot bosqichida o'quvchilar xaritalar va ma'lumotlar bilan ishlaydi, tushuntirish bosqichida o'qituvchi asosiy tushunchalarni izohlaydi, amaliy bosqichda esa o'quvchilar loyiha yoki topshiriqlar bajaradi, yakunda esa baholash amalga oshiriladi.

Baholash jarayonida zamonaviy yondashuvlardan foydalanish muhimdir. Formativ baholash orqali o'quvchilarning o'rganish jarayoni davomida rivojlanishi kuzatiladi, summativ baholash orqali esa yakuniy natijalar aniqlanadi. Shuningdek, o'z-o'zini baholash va o'zaro baholash usullari ham o'quvchilarning mas'uliyatini oshiradi.

O'quvchilarning yosh xususiyatlarini hisobga olgan holda, 7-sinfda ko'proq ko'rgazmali va sodda topshiriqlar, 8-sinfda esa murakkabroq tahliliy va

ijodiy topshiriqlar berish maqsadga muvofiq hisoblanadi. Bu esa ta'lim jarayonining samaradorligini oshiradi.

Zamonaviy pedagogik texnologiyalarni geografiya fanini o'qitishda qo'llash o'quvchilarning bilim darajasini oshiradi, ularning amaliy ko'nikmalarini rivojlantiradi va ta'lim jarayonini yanada qiziqarli hamda samarali qiladi. Shu bois mazkur texnologiyalarni dars jarayoniga joriy etish muhim metodik ahamiyat kasb etadi.



II BOB. NAMANGAN VILOYATI MISOLIDA AMALIY METODIKA

Ekoturizm salohiyatini o'rganish metodikasi Geografiya fanini o'qitishda hududiy materiallardan foydalanish o'quvchilarda real geografik tasavvurlarni shakllantirish va bilimlarni amaliyot bilan bog'lashda muhim ahamiyatga ega. Namangan viloyatining ekoturizm salohiyatini o'rganish metodikasi aynan shu maqsadga xizmat qilib, o'quvchilarning ekologik tafakkuri, tahliliy fikrlashi va mustaqil ishlash ko'nikmalarini rivojlantirishga yo'naltirilgan.

Namangan viloyati tog'li va tog'oldi hududlarga ega bo'lib, bu hududlar ekologik turizm uchun qulay tabiiy sharoitlarni yaratadi. Xususan, Chortoq hududi mineral suv manbalari va sog'lomlashtirish maskanlari bilan mashhur bo'lsa, Chodak va Nanay hududlari o'zining go'zal tabiiy landshaftlari, toza havosi va tog'li relyefi bilan ajralib turadi. Ushbu hududlar orqali

o'quvchilarga ekoturizm tushunchasini real misollar asosida tushuntirish mumkin.

Mazkur mavzuni o'qitishda "Qanday o'qitish kerak?" savoliga javoban darsni zamonaviy pedagogik yondashuvlar asosida tashkil etish tavsiya etiladi. Ayniqsa, 5E modeli asosida darsni bosqichma-bosqich tashkil etish yuqori samaradorlik beradi.

Darsning birinchi bosqichida (Engage) o'quvchilarning e'tiborini jalb qilish maqsadida Namangan viloyatining tabiiy manzaralari aks etgan video yoki rasmlar namoyish etiladi hamda "Nima uchun bu hududlar turizm uchun qulay?" kabi savollar beriladi. Bu bosqich o'quvchilarning mavzuga qiziqishini oshiradi.

Keyingi bosqichda (Explore) o'quvchilar kichik guruhlariga bo'linadi va ularga xaritalar, statistik ma'lumotlar hamda tavsiflar beriladi. O'quvchilar ushbu ma'lumotlar asosida hududlarning geografik xususiyatlarini mustaqil o'rganadilar. Bu jarayon o'quvchilarning tadqiqotchilik faoliyatini rivojlantiradi. Uchinchi bosqichda

(Explain) o'qituvchi tomonidan

ekoturizm tushunchasi, uning turlari va Namangan viloyatidagi asosiy ekoturizm hududlari haqida tizimli ma'lumot beriladi. O'quvchilar o'z kuzatuvlari asosida savollarga

javob beradilar va bilimlarini mustahkamlaydilar.

To'rtinchi bosqichda (Elaborate) o'quvchilarga amaliy topshiriqlar beriladi. Masalan, har bir guruhga "Namangan viloyatida ekoturizm marshruti ishlab chiqish" vazifasi yuklatiladi. O'quvchilar marshrutni ishlab chiqishda hududning tabiiy sharoiti, transport imkoniyatlari va ekologik holatini hisobga olishlari kerak bo'ladi. Bu bosqichda ularning kreativ fikrlash va muammoli vaziyatlarni hal qilish ko'nikmalari rivojlanadi.

Yakuniy bosqichda (Evaluate) o'quvchilarning ishlari baholanadi. Baholash jarayonida quyidagi mezonlardan foydalaniladi: topshiriqni to'g'ri bajarish,

ijodiy yondashuv, guruhda ishlash faolligi va taqdimot sifati. Shuningdek, o'z-o'zini baholash va o'zaro baholash usullari ham qo'llaniladi.

Mazkur metodikada AKT vositalaridan foydalanish muhim ahamiyatga ega. Interaktiv xaritalar, Google Maps, videomateriallar va virtual sayohatlar orqali o'quvchilarga hudud haqida yanada aniq tasavvur beriladi. Bu esa ularning ko'rgazmali va fazoviy fikrlashini rivojlantiradi.

Fanlararo integratsiya ham ushbu mavzuni o'qitishda muhim rol o'ynaydi. Biologiya fanida o'rganilgan ekotizimlar va tabiiy muvozanat tushunchalari ekoturizm bilan bevosita bog'liq. Iqtisodiyot fanida esa turizmning hududiy rivojlanishdagi o'rni haqida bilimlar qo'llaniladi. Bu esa o'quvchilarning kompleks fikrlashini rivojlantiradi.

O'quvchilarning yosh xususiyatlarini hisobga olgan holda, 7-sinf o'quvchilariga ko'proq ko'rgazmali va sodda topshiriqlar berish, 8 -sinf o'quvchilariga esa tahliliy va mustaqil ishlar yuklash maqsadga muvofiq hisoblanadi. Bu yondashuv ta'limning differensial tashkil etilishini ta'minlaydi. Mazkur metodika asosida tashkil etilgan darslar natijasida o'quvchilarda quyidagi ko'nikmalar shakllanadi: geografik obyektlarni tahlil qilish, hududiy xususiyatlarni aniqlash, ekologik muammolarni tushunish va ularni hal qilish bo'yicha takliflar ishlab chiqish. Shu bilan birga, o'quvchilarda tabiatga nisbatan mas'uliyatli munosabat shakllanadi.

Namangan viloyatining ekoturizm salohiyatini o'rganish metodikasi geografiya fanini amaliy yo'nalishda o'qitishning samarali vositasi hisoblanadi. Ushbu yondashuv o'quvchilarning bilimini mustahkamlash, ularning ijodiy va tahliliy fikrlashini rivojlantirish hamda ekologik madaniyatini shakllantirishga xizmat qiladi.

Agroturizm asosida amaliy darslarni tashkil etish

Geografiya fanini o'qitishda agroturizm imkoniyatlaridan foydalanish o'quvchilarda qishloq xo'jaligi, tabiiy resurslardan foydalanish va iqtisodiy faoliyat o'rtasidagi o'zaro bog'liqlikni anglashga yordam beradi. Agroturizm asosida tashkil etilgan darslar o'quvchilarning nazariy bilimlarini amaliy faoliyat bilan uyg'unlashtirishga xizmat qiladi hamda ularning kasbiy yo'nalishini shakllantirishda muhim ahamiyat kasb etadi.

Namangan viloyati o'zining rivojlangan bog'dorchilik, dehqonchilik va qishloq xo'jaligi an'analari bilan agroturizmni rivojlantirish uchun qulay hudud hisoblanadi. Ayniqsa, Chortoq hududi va tog'oldi qishloqlari meva yetishtirish, uzumchilik va milliy qishloq turmush tarzini namoyish etish imkoniyatlari bilan ajralib turadi. Shu bois ushbu hududlar asosida o'quvchilarga agroturizm tushunchasini real misollar orqali o'rgatish mumkin.

Mazkur mavzuni o'qitishda "Qanday o'qitish kerak?" savoliga javoban darsni amaliy faoliyatga yo'naltirilgan holda tashkil etish muhim hisoblanadi. Bu jarayonda 7E modeli asosida darsni tashkil etish yuqori samaradorlik beradi.

Darsning boshlanishida (Elicit, Engage) o'quvchilarning mavjud bilimlari aniqlanadi va ularga qishloq xo'jaligi faoliyati bilan bog'liq savollar beriladi. Masalan, "Sizning hududingizda qanday mahsulotlar yetishtiriladi?" yoki "Qishloq turmushi turizmga qanday ta'sir qiladi?" kabi savollar orqali o'quvchilar mavzuga jalb qilinadi.

Keyingi bosqichda (Explore) o'quvchilar guruhlarga bo'linib, ularga Namangan viloyatining qishloq xo'jaligi xaritasi, mahsulot turlari va hududiy ma'lumotlar beriladi. O'quvchilar ushbu ma'lumotlar asosida agroturizm imkoniyatlarini mustaqil ravishda tahlil qiladilar. Bu bosqich

o'quvchilarning izlanish va tahlil qilish ko'nikmalarini rivojlantiradi.

Tushuntirish bosqichida (Explain) o'qituvchi tomonidan agroturizm tushunchasi, uning turlari, iqtisodiy ahamiyati va Namangan viloyatidagi imkoniyatlari haqida tizimli ma'lumot beriladi. O'quvchilar o'z fikrlarini bayon etib, savollarga javob beradilar.

Keyingi bosqichda (Elaborate) o'quvchilarga amaliy topshiriqlar beriladi. Masalan, "Agroturizm loyihasini ishlab chiqish" topshirig'i beriladi. Har bir guruh o'z loyihasida quyidagilarni ko'rsatishi kerak: hudud tanlash, taklif etiladigan xizmatlar (meva terish, milliy taom tayyorlash, qishloq hayoti bilan tanishish), iqtisodiy foyda va ekologik ta'sir. Bu topshiriq o'quvchilarning kreativ fikrlashini, muammolarni hal qilish qobiliyatini va jamoada ishlash ko'nikmalarini rivojlantiradi.

Baholash bosqichida (Evaluate) o'quvchilarning ishlari quyidagi mezonlar asosida baholanadi: loyihaning mazmuni, amaliy ahamiyati, ijodiy yondashuv, taqdimot sifati va guruhdagi faollik. Shuningdek, o'zaro baholash va o'z-o'zini baholash usullari ham qo'llaniladi. Yakuniy bosqichda (Extend) o'quvchilarga o'z loyihalarini real hayot bilan bog'lash, ya'ni o'z hududida qo'llash imkoniyatlari haqida fikr yuritish taklif etiladi.

Mazkur metodikada AKT vositalaridan foydalanish muhim o'rin tutadi. Masalan, o'quvchilar internet orqali qishloq turizmi misollarini o'rganishlari, video materiallar ko'rishlari va interaktiv xaritalar yordamida hududlarni tahlil qilishlari mumkin. Bu esa o'quvchilarning axborot bilan ishlash ko'nikmalarini rivojlantiradi.

Fanlararo integratsiya ham muhim hisoblanadi. Biologiya fanida o'rganilgan o'simliklar va ekotizimlar haqidagi bilimlar, iqtisodiyot fanidagi ishlab chiqarish va daromad tushunchalari hamda texnologiya fanidagi qishloq xo'jaligi jarayonlari ushbu mavzuni chuqurroq o'rganishga yordam beradi.

O'quvchilarning yosh xususiyatlarini hisobga olgan holda, 7-sinf o'quvchilariga sodda va ko'rgazmali topshiriqlar berish, 8-sinf o'quvchilariga esa tahliliy va loyiha asosidagi topshiriqlarni berish maqsadga muvofiq hisoblanadi. Bu esa ta'lim jarayonining samaradorligini oshiradi.

Natijada, agroturizm asosida tashkil etilgan darslar o'quvchilarda quyidagi ko'nikmalarni shakllantiradi: iqtisodiy-geografik tafakkur, amaliy faoliyat ko'nikmalari, ekologik mas'uliyat va kasbiy qiziqish. Shu bilan birga, o'quvchilar real hayotdagi jarayonlarni tushunish va ularga baho berish imkoniyatiga ega bo'ladilar.

Agroturizm asosida amaliy darslarni tashkil etish geografiya fanini o'qitishda innovatsion va samarali yondashuv bo'lib, u o'quvchilarning bilimlarini chuqurlashtirish, ularni faol ishtirok etishga jalb qilish va amaliy ko'nikmalarini rivojlantirishga xizmat qiladi.

Interfaol metodlar va loyiha asosida o'qitish Geografiya fanini o'qitishda interfaol metodlar va loyiha asosida ta'limni tashkil etish o'quvchilarning bilim olish jarayonini faollashtirish, ularning mustaqil fikrlash, muammolarni hal qilish va ijodiy yondashuv ko'nikmalarini rivojlantirishda muhim ahamiyatga ega. Ayniqsa, ekoturizm va agroturizm kabi amaliy yo'nalishdagi mavzularni o'rganishda ushbu metodlar yuqori samaradorlik beradi.

Interfaol metodlarning asosiy maqsadi o'quvchilarni dars jarayonining faol ishtirokchisiga aylantirishdan iborat. Bu metodlar orqali o'quvchilar faqat tinglovchi emas, balki muhokama qiluvchi, tahlil qiluvchi va xulosa chiqaruvchi subyekt sifatida ishtirok etadilar. Bu esa ularning bilimni chuqur o'zlashtirishiga yordam beradi.

Mazkur mavzuni o'qitishda "Qanday o'qitish kerak?" savoliga javoban interfaol metodlardan tizimli foydalanish tavsiya etiladi. Dars jarayonida quyidagi

metodlardan foydalanish samarali hisoblanadi:

Aqliy hujum metodi orqali o'quvchilarning mavzu bo'yicha dastlabki bilimlari aniqlanadi va yangi g'oyalar ilgari suriladi. Masalan, "Ekoturizm nimani anglatadi?" yoki "Agroturizmni rivojlantirish uchun qanday sharoitlar zarur?" kabi savollar beriladi. Bu metod o'quvchilarning erkin fikrlashini rivojlantiradi.

Klaster metodi yordamida o'quvchilar mavzuga oid tushunchalarni tizimlashtiradilar. Masalan, "Ekoturizm" markaziy tushunchasi atrofida uning turlari, afzalliklari va imkoniyatlari yoziladi. Bu metod o'quvchilarning mantiqiy fikrlashini rivojlantiradi.

SWOT-tahlil metodi orqali o'quvchilar ma'lum bir hududning turizm salohiyatini baholaydilar. Masalan, Namangan viloyatining ekoturizm imkoniyatlarini kuchli va zaif tomonlari, imkoniyatlari va xavflari asosida tahlil qilish topshirig'i beriladi. Bu metod tanqidiy fikrlashni rivojlantirishda muhim ahamiyatga ega.

Xarita bilan ishlash metodi geografiya fanining ajralmas qismi bo'lib, o'quvchilarda fazoviy tasavvurni shakllantiradi. O'quvchilar xarita asosida turizm hududlarini aniqlash, marshrutlar tuzish va hududiy tahlil qilishni o'rganadilar.

Loyiha metodi esa o'quvchilarning bilimlarini amaliyotda qo'llashga imkon beradi. Bu metodda o'quvchilar mustaqil yoki guruhda ishlash orqali ma'lum bir muammoni hal qilishga qaratilgan loyiha ishlab chiqadilar. Masalan, "Namangan viloyatida yangi ekoturizm marshruti yaratish" yoki "Agroturizm loyihasini ishlab chiqish" kabi topshiriqlar berilishi mumkin.

Darsni tashkil etishda loyiha metodi quyidagi bosqichlarda amalga oshiriladi. Avvalo, muammo aniqlanadi va loyiha mavzusi tanlanadi. Keyin o'quvchilar guruhlariga bo'linib, ma'lumot to'plash va tahlil qilish ishlarini olib boradilar. So'ng loyiha ishlab chiqiladi va yakunda taqdimot

qilinadi. Bu jarayon o'quvchilarning kollaboratsiya va kommunikativlik ko'nikmalarini rivojlantiradi.

Zamonaviy pedagogik yondashuvlar, xususan 5E va 7E modellari interfaol metodlar bilan uyg'un holda qo'llaniladi. Masalan, darsning boshlanishida aqliy hujum metodi orqali o'quvchilar jalb qilinadi, tadqiqot bosqichida guruhli ishlar tashkil etiladi, tushuntirish bosqichida o'qituvchi tomonidan asosiy tushunchalar izohlanadi, amaliy bosqichda loyiha ishlari bajariladi va yakunda baholash amalga oshiriladi. Baholash jarayonida zamonaviy yondashuvlardan foydalanish muhim hisoblanadi. Formativ baholash orqali o'quvchilarning dars jarayonidagi faolligi va rivojlanishi baholanadi. Summativ baholash esa yakuniy natijalarni aniqlashga xizmat qiladi. Shuningdek, o'zaro baholash va o'z-o'zini baholash usullari o'quvchilarda mas'uliyat va tanqidiy fikrlashni rivojlantiradi.

O'quvchilarning yosh xususiyatlarini hisobga olgan holda, 7-sinf o'quvchilariga sodda va ko'rgazmali interfaol topshiriqlar, 8-sinf o'quvchilariga esa murakkabroq tahliliy va loyiha asosidagi vazifalar berilishi maqsadga muvofiq hisoblanadi. Bu yondashuv ta'lim jarayonining differensial tashkil etilishini ta'minlaydi.

Fanlararo integratsiya ham ushbu metodikada muhim o'rin tutadi. Biologiya fanida o'rganilgan tabiiy muhit va ekotizimlar, iqtisodiyot fanidagi turizmning iqtisodiy ahamiyati, texnologiya fanidagi ishlab chiqarish jarayonlari bilan bog'liq bilimlar mazkur mavzuni chuqurroq o'zlashtirishga yordam beradi. Natijada, interfaol metodlar va loyiha asosida o'qitish o'quvchilarda quyidagi kompetensiyalarni shakllantiradi: mustaqil fikrlash, tahlil qilish, ijodiy yondashuv, jamoada ishlash va o'z fikrini aniq ifodalash. Shu bilan birga, o'quvchilarda amaliy ko'nikmalar va real hayotga mos bilimlar shakllanadi.

Interfaol metodlar va loyiha asosida o'qitish geografiya fanini samarali va zamonaviy tarzda tashkil etishning muhim vositasi hisoblanadi. Ushbu metodlar o'quvchilarning faolligini oshiradi, ularning bilimlarini chuqurlashtiradi va ta'lim jarayonini qiziqarli hamda samarali qiladi.



XULOSA

Geografiya fanini zamonaviy yondashuvlar asosida o'qitish ta'lim sifatini oshirishning muhim omillaridan biri hisoblanadi. Ayniqsa, hududiy materiallarga tayangan holda darslarni tashkil etish o'quvchilarning bilimlarini real hayot bilan bog'lash, ularni amaliy faoliyatga yo'naltirish va mustaqil fikrlash ko'nikmalarini rivojlantirishda katta ahamiyat kasb etadi. Namangan viloyati misolida ekoturizm va agroturizm imkoniyatlarini o'rganish orqali geografiya fanining amaliy ahamiyati yanada yaqqol namoyon bo'ladi.

Mazkur metodik tavsiya doirasida ishlab chiqilgan yondashuvlar – hududiylik tamoyili, kompetensiyaviy ta'lim, interfaol metodlar, loyiha asosida o'qitish hamda 5E va 7E modellari – o'quvchilarning bilim olish jarayonini faollashtirishga xizmat qiladi. Ushbu yondashuvlar orqali o'quvchilar nafaqat nazariy bilimlarni o'zlashtiradilar, balki ularni amaliyotda qo'llash, muammolarni tahlil qilish va mustaqil qaror qabul qilish ko'nikmalariga ega bo'ladilar.

Tadqiqot natijalari shuni ko'rsatadiki, ekoturizm va agroturizm asosida tashkil etilgan darslar o'quvchilarning fanga bo'lgan qiziqishini oshiradi, ularning

geografik tafakkurini rivojlantiradi hamda ekologik madaniyatini shakllantiradi. Ayniqsa, loyiha asosida bajarilgan amaliy topshiriqlar o'quvchilarning kreativ fikrlash, jamoada ishlash va kommunikativ ko'nikmalarini rivojlantirishda samarali vosita bo'lib xizmat qiladi. Monitoring natijalariga ko'ra, o'quvchilarning o'zlashtirish darajasi sezilarli darajada oshgani kuzatiladi.

Shuningdek, mazkur metodikada AKT vositalaridan foydalanish, fanlararo integratsiyani yo'lga qo'yish va o'quvchilarning yosh xususiyatlarini hisobga olish ta'lim jarayonining samaradorligini yanada oshiradi. Interaktiv xaritalar, videomateriallar va virtual sayohatlar orqali o'quvchilarga geografik obyektlar haqida aniq tasavvur beriladi, bu esa ularning bilimlarini mustahkamlashga yordam beradi.

Ushbu metodik tavsiya o'quvchilarda 4K ko'nikmalarini, ya'ni kollaboratsiya, kommunikativlik, kreativ va tanqidiy fikrlashni rivojlantirishga xizmat qiladi. Natijada o'quvchilar nafaqat fan doirasida, balki kundalik hayotda ham zarur bo'lgan muhim kompetensiyalarga ega bo'ladilar. Bu esa ularning kelajakdagi kasbiy faoliyatida muhim ahamiyat kasb etadi.

Xulosa, Namangan viloyati misolida ekoturizm va agroturizm imkoniyatlaridan foydalanish asosida geografiya fanini o'qitish zamonaviy, samarali va innovatsion yondashuv hisoblanadi. Ushbu metodika ta'lim jarayonini boyitadi, o'quvchilarning bilim va ko'nikmalarini rivojlantiradi hamda ularni ekologik jihatdan ongli, ijtimoiy faol va kasbiy yo'nalishga ega shaxs sifatida shakllantirishga xizmat qiladi. Mazkur ilg'or ish tajribasini boshqa hududlarda ham qo'llash mumkin va u ommalashtirish uchun tavsiya etiladi.

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Typological And Structural Differences Between English And Uzbek Languages: A Comparative Linguistic Analysis

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Abstract

This article presents a comparative typological and structural analysis of English and Uzbek languages. English, belonging to the Germanic branch of the Indo-European family, is predominantly analytic, stress-timed, and follows SVO word order. In contrast, Uzbek, a member of the Karluk branch of the Turkic family, is agglutinative, syllable-timed, and primarily uses SOV word order. The study examines key linguistic levels including historical-genetic background, phonetics and phonology, morphology, syntax, and lexicon. Particular attention is paid to the differences in grammatical expression — auxiliary words and articles in English versus rich suffixation in Uzbek — as well as prosodic features and lexical borrowing patterns. The findings demonstrate that genetic and typological differences between the two languages create specific challenges and opportunities for learners and translators.

Keywords: English language, Uzbek language, comparative linguistics, linguistic typology, analytic vs. agglutinative languages, phonology, morphology, syntax, SVO vs. SOV word order, language teaching, contrastive analysis.

1. Introduction

The world's languages differ greatly in terms of language families, typology, and structural features. English belongs to the Germanic branch of the Indo-European language family, while Uzbek belongs to the Karluk (Eastern Turkic) branch of the Turkic language family. These genetic differences have left a deep imprint on the phonetics, morphology, syntax, and lexicon of both languages [1].

In an era of growing globalization, cross-linguistic communication has become more important than ever. For students in Central Asia who are learning English, and for English speakers who attempt to engage with Uzbek, the structural distance between the two languages can feel striking. The absence of articles in Uzbek, the verb-final structure, and the dense chain of suffixes on a single word root can be genuinely puzzling for someone who grew up with English. Equally, an Uzbek learner facing English stress patterns and the unpredictability of irregular verbs is

navigating a very different kind of linguistic logic.

This article provides a comparative typological analysis of English and Uzbek, examining their similarities and differences across several linguistic levels. The relevance of the study lies in the challenges of language learning, translation, and contrastive linguistics in the context of globalization [2]. The aim is to identify the main linguistic differences at various levels and offer practical recommendations for language teaching.

Specifically, the study addresses the following questions: (1) How do the historical and genetic origins of each language shape their current structural features? (2) What are the key phonological, morphological, and syntactic contrasts between English and Uzbek? (3) What implications do these contrasts hold for language pedagogy and translation practice?

2. Materials and Methods

This study employs a qualitative comparative-typological approach grounded in contrastive linguistics. The methodology draws on theoretical frameworks established in the field of linguistic typology, particularly those distinguishing analytic from synthetic and agglutinative language structures. The primary method is systematic cross-linguistic comparison — each grammatical and phonological feature of English is examined alongside its corresponding feature (or absence thereof) in Uzbek.

The data used in this analysis are drawn from descriptive grammars, phonological studies, and typological surveys of both languages. Particular reliance is placed on recent scholarship focused on English-Uzbek contrasts [1, 2, 4, 5, 8], as well as established historical-comparative linguistics for the diachronic sections.

The linguistic levels examined in this study are: (a) historical and genetic background, (b) phonetics and phonology, (c) morphology, (d) syntax, and (e) lexicon and semantics. For each level, representative examples are provided in both languages to illustrate the nature and extent of the contrasts. Where relevant, small data tables are included to consolidate comparison in a structured format.

It should be noted that this study is descriptive rather than experimental; no corpus analysis or native-speaker elicitation was conducted. The observations are based on the standard literary varieties of both English and Uzbek, setting aside dialectal or regional variation unless explicitly noted.

3. Results

3.1 Historical and Genetic Background

English has passed through the stages of Old English (5th–11th centuries), Middle English (heavily influenced by the Norman Conquest), and Modern English. It is closely related to other Germanic languages such

as Gothic, German, and Dutch, but has borrowed extensively from French, Latin, and Greek [3]. As a result of these historical processes, English has evolved into a predominantly analytic language, shedding most of its earlier inflectional morphology.

Uzbek, on the other hand, developed within the Turkic language family, specifically from the Chagatai (Old Uzbek) literary tradition. It was consolidated as a major literary language during the era of Alisher Navoi in the 15th century. During the Soviet period, Uzbek switched from an Arabic-based script to the Cyrillic alphabet, and following independence in 1991, it transitioned to a Latin-based orthography. Uzbek contains numerous loanwords from Arabic, Persian, Russian, and more recently English. Structurally, it has remained firmly agglutinative throughout its documented history.

The two languages thus represent entirely distinct genealogical lines — neither shares a common ancestor within any historically traceable timeframe. This fundamental genetic distance underlies many of the structural contrasts that follow.

3.2 Phonetics and Phonology

English has approximately 12–20 vowels (including diphthongs) and around 24 consonants [4]. Vowel reduction — particularly the schwa /ə/ in unstressed syllables — is a defining feature of spoken English. English is a stress-timed language: the interval between stressed syllables remains roughly equal regardless of the number of unstressed syllables between them, which means that unstressed syllables are considerably compressed or reduced in rapid speech.

Stress placement in English is variable and can change the grammatical category of a word without any morphological change: compare the noun *récord* (stress on the first syllable) with the verb *recórd* (stress on the second syllable). This suprasegmental

flexibility adds an additional layer of complexity for learners whose native language has more predictable stress rules. Uzbek has six main vowels (a, e, i, o, o', u), and vowel harmony — though present in some dialects — has largely receded in the standard literary language. Stress in standard Uzbek falls on the final syllable of a word in most cases, making it highly predictable by comparison. Uzbek is a syllable-timed language, meaning that each syllable is given approximately equal duration; vowel reduction is almost entirely absent. This difference in prosodic rhythm — stress-timed English versus syllable-timed Uzbek — is one of the most practically significant contrasts for learners of either language.

Examples:

- English: "The stúdent is réading a bóok." (dynamic stress and vowel reduction)
- Uzbek: "Talaba kitob o'qiydi." (stable vowels, final-syllable stress)

3.3 Morphology

English is an analytic language: grammatical meanings are primarily expressed through auxiliary words (articles such as a/the; auxiliary verbs such as will, have, be) and word order rather than by adding suffixes to a root [5]. The number of distinct morphemes in an average English word is comparatively small, and the

language tolerates a high degree of irregularity — particularly in verb paradigms (e.g., go–went–gone, buy–bought, sing–sang–sung). Case marking is vestigial, surviving only in the genitive construction with 's.

Uzbek, by contrast, is agglutinative: a single root can carry a long chain of suffixes, each contributing one additional layer of grammatical meaning. The word kitoblarimda, for example, breaks down as kitob (book) + lar (plural) + im (my/first person singular possessive) + da (locative case marker), yielding the meaning 'in my books.' This kind of transparent, regular stacking of suffixes is characteristic of Turkic languages. Uzbek marks six grammatical cases (nominative, genitive, accusative, locative, dative, ablative), possesses a rich set of possessive suffixes (–im, –ing, –i, etc.), and encodes tense, aspect, and person directly on the verb stem.

It is worth noting that the absence of articles in Uzbek — one of the first things English-speaking learners notice — is compensated by context, word order, and pragmatic cues rather than dedicated grammatical forms. Definiteness and indefiniteness are not grammatically obligatory categories in Uzbek the way they are in English.

Table 1: Morphological Differences (Examples)

English (Analytic)	Uzbek (Agglutinative)
My books	Kitoblarim
I will go	Boraman
The book is on the table	Kitob stol ustida

3.4 Syntax

English has a rigid SVO (Subject-Verb-Object) word order: 'I eat an apple.' Departures from this order are limited and

usually signal specific pragmatic effects or syntactic constructions. Questions require inversion of the subject and auxiliary verb, and negation similarly depends on the presence of an auxiliary. The passive voice

is extremely common in English and serves important discourse functions — particularly in academic and formal registers [7].

Uzbek follows a basic SOV (Subject-Object-Verb) order: 'Men olma yeyman' (literally: I apple eat). While this order is the default, Uzbek allows considerably more flexibility than English, with constituent movement driven by pragmatic factors such as topic and focus. A speaker might front the object for emphasis without the sentence becoming ungrammatical. The verb, however, almost invariably remains at the end. Uzbek uses postpositions rather than prepositions (e.g., *bilan* meaning 'with', *uchun* meaning 'for'), which is typical of SOV languages.

Another notable syntactic difference involves subordination. In English, relative clauses typically follow the noun they modify ('the book that I bought'). In Uzbek, relative clauses are formed as participial constructions that precede the head noun, which again reflects the head-final typology characteristic of SOV languages.

3.5 Lexicon and Semantics

English vocabulary is layered across several historical strata. Its Germanic core supplies the most common everyday words (house, eat, come, small), while a large proportion of its learned, technical, and abstract vocabulary is drawn from Latin and French — together comprising roughly 50% of the total lexicon [6]. Greek roots are especially prominent in scientific and philosophical terminology. This stratification means that English often possesses near-synonyms with different stylistic registers: ask (Germanic) versus inquire (Latin), buy versus purchase, begin versus commence. The Uzbek lexicon similarly reflects a layered borrowing history. Arabic has contributed heavily in the domains of religion, science, and abstract thought (*ilm* — knowledge, *kitob* — book, *fikr* — thought). Persian borrowings are pervasive in everyday cultural life and aesthetics.

Russian contributed extensively to technical and administrative vocabulary during the Soviet era, and today English is the dominant source of new borrowings in IT, business, and popular culture (*kompyuter*, *internet*, *menejer*).

Semantic equivalence between English and Uzbek is not always straightforward. The English concept of 'privacy', for instance, carries rich cultural and legal connotations that have no simple single-word equivalent in Uzbek. Similarly, the Uzbek concept of *mahalla* — the traditional neighborhood community — does not map neatly onto any English term. These lexical gaps are not mere translation inconveniences; they reflect genuine differences in cultural experience and social organization that translators and language teachers must navigate thoughtfully.

4. Discussion

The results of this comparative analysis confirm that English and Uzbek are deeply different at virtually every level of linguistic structure. These differences are not arbitrary; they follow from the distinct genealogical lines the two languages belong to, as well as the very different socio-historical environments in which they developed.

From a language teaching perspective, the contrasts identified here have clear pedagogical implications. Uzbek learners of English must grapple with a stress-timed prosodic system that produces vowel reduction — a phenomenon that has no equivalent in their native language. The irregular verb system and the obligatory use of articles represent additional hurdles that require extensive and deliberate practice. The article system is especially challenging because it encodes a definiteness distinction that Uzbek simply does not grammaticalize, meaning learners must build an entirely new cognitive category from scratch.

Conversely, English-speaking learners of Uzbek face the challenge of processing agglutinative morphology — learning to decode and produce long suffix chains where each morpheme carries a distinct grammatical meaning. The SOV word order requires learners to hold the verb in memory until the end of a clause, which can be cognitively demanding when processing longer sentences in real time. The postpositional system, the six-case morphology, and the participial relative-clause structure all require significant restructuring of learners' expectations about how sentences are built.

For translation practice, the most significant challenge lies in the structural asymmetry between the two languages. Passive voice, so common in English academic writing, has no direct parallel in Uzbek and must typically be rendered through alternative constructions. The obligatory English article system disappears in Uzbek, leaving translators to decide how to compensate for lost definiteness information when translating from Uzbek into English. Lexical gaps — such as 'privacy' and mahalla — require not just translation but cultural mediation.

It is worth situating this study in the broader context of contrastive linguistics. Research in this tradition has long demonstrated that the degree of structural difference between a learner's native language and their target language is a strong predictor of learning difficulty. The English-Uzbek pairing represents a case of maximal typological distance: different families, different morphological types, opposite word orders, and contrasting prosodic systems. This does not mean the languages are impossible to learn from each other's starting point — Uzbek speakers do acquire English fluently and vice versa — but it does mean that the learning trajectory is longer and the specific difficulties are predictable and systematic. Recognizing these patterns

allows teachers and curriculum designers to target instruction more efficiently.

5. Conclusion

This study has examined English and Uzbek across five linguistic levels — historical background, phonology, morphology, syntax, and lexicon — using a comparative-typological framework. The central finding is that the two languages differ significantly in genetic origin and structural typology: English is analytic, stress-timed, and SVO; Uzbek is agglutinative, syllable-timed, and SOV. These differences are systematic and pervasive, rooted in the distinct genealogical paths the two languages have followed over centuries.

The practical significance of these findings extends to language teaching, translation, and contrastive linguistics research. For language educators, awareness of these contrasts should inform which features receive more scaffolding and deliberate practice in the classroom. For translators, the structural asymmetries highlighted here — particularly around passivization, definiteness, and lexical gaps — are recurring sites of difficulty that benefit from conscious strategy. For contrastive linguists, the English-Uzbek pairing represents a valuable case study in maximal typological distance, one that can illuminate broader questions about the nature of linguistic diversity and the limits of cross-linguistic transfer.

Future research should deepen contrastive analysis through corpus-based methods and empirical studies of learner language. The development of targeted teaching materials and translation guidelines specifically tailored to the English-Uzbek language pair would be a natural next step.

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Pedagogical And Psychological Basis Of Training Preschool Children To Work

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Annotation

This article analyzes the pedagogical and psychological features of raising preschool children in the spirit of hard work, forming their first labor skills. Forms of organizing labor education in preschool educational organizations and in the family environment, the specific aspects of self-service, work in a corner of nature and collective activities are highlighted. Also, practical recommendations have been developed on combining labor with play activities, taking into account the age characteristics of children.

Keywords: preschool age, labor education, independence, self-service, duty, teamwork, elements of play, personality formation, pedagogical skills.

Annotatsiya

Ushbu maqolada maktabgacha yoshdagi bolalarni mehnatsevarlik ruhida tarbiyalash, ularda ilk mehnat ko'nikmalarini shakllantirishning pedagogik hamda psixologik xususiyatlari tahlil qilingan. Maktabgacha ta'lim tashkilotlarida va oila muhitida mehnat tarbiyasini tashkil etishning shakllari, o'z-o'ziga xizmat ko'rsatish, tabiat burchagidagi mehnat hamda jamoaviy faoliyat turlarining o'ziga xos jihatlari yoritilgan. Shuningdek, bolalarning yosh xususiyatlarini hisobga olgan holda mehnatni o'yin faoliyati bilan uyg'unlashtirish bo'yicha amaliy tavsiyalar ishlab chiqilgan.

Kalit so'zlar: maktabgacha yosh, mehnat tarbiyasi, mustaqillik, o'z-o'ziga xizmat, navbatchilik, jamoaviy mehnat, o'yin elementlari, shaxs shakllanishi, pedagogik mahorat.

Maktabgacha yoshdagi bolalik davri inson shaxsiyatining ma'naviy-axloqiy poydevori qo'yiladigan, uning atrof-muhitga, odamlarga va mehnatga bo'lgan munosabati pishib yetiladigan eng muhim bosqichdir. Sharqona tarbiya tizimida qadimdan bolani kichikligidan mehnatga o'rgatish, halol luqma va g'ayratli bo'lish ruhida voyaga yetkazishga alohida e'tibor qaratilgan. Bugungi kunda zamonaviy maktabgacha ta'lim sohasida ham bolalarni har tomonlama rivojlantirish va ularda mustaqil hayotiy ko'nikmalarni shakllantirish davlat miqyosidagi dolzarb vazifalardan biri bo'lib qolmoqda.

Mehnat tarbiyasi — bu shunchaki bolaga ma'lum bir jismoniy harakatlarni bajartirish yoki majburiy topshiriqlar berish tizimi emas. Bu jarayon, eng avvalo, bolada atrofidagi insonlar mehnatini qadrlash, o'z mehnati natijasidan ma'naviy zavq olish va jamoada mas'uliyatni his qilish tuyg'usini

uyg'otishga qaratilgan murakkab pedagogik tizimdir. Axborot texnologiyalari jadal rivojlanayotgan hozirgi davrda bolalarning ko'p vaqti virtual olam, smartfonlar va passiv kuzatuvchanlik bilan o'tayotganligi sir emas. Bunday sharoitda bolalarda tayyorga ayyorlik (boqimandalik) kayfiyati paydo bo'lishining oldini olish, ularni jismoniy va aqliy faollikka chorlashda to'g'ri tashkil etilgan mehnat faoliyati eng samarali vosita bo'lib xizmat qiladi.

Maktabgacha ta'lim tashkilotlari amaliyotida bolalar mehnati kattalarning ijtimoiy-ishlab chiqarish mehnatidan tubdan farq qiladi. Bolalar mehnati moddiy boylik yaratishni maqsad qilmaydi; u ko'proq tarbiyaviy va rivojlantiruvchi xarakterga ega. Mehnat jarayonida bolaning jismoniy holati yaxshilanadi, mayda va yirik motorikasi rivojlanadi, harakatlar koordinatsiyasi shakllanadi. Shu bilan birga, mehnat faoliyati bolaning aqliy rivojlanishiga ham

ijobiy ta'sir ko'rsatadi: u ob'ektlarning xususiyatlarini, asboblardan foydalanish qoidalarini o'rganadi, sabab-oqibat bog'liqliklarini tushunib boradi.

Pedagogik va psixologik tadqiqotlar shuni ko'rsatadiki, maktabgacha yoshdagi bolalar mehnati asosan to'rtta asosiy turga bo'linadi va ularning har biri bolaning yosh xususiyatlariga mos ravishda bosqichma-bosqich murakkablashib boradi:

Birinchisi va eng asosiysi — o'z-o'ziga xizmat ko'rish mehnatidir. Bu mehnat turi bolaning mustaqil hayotga qadam qo'yishidagi ilk ko'nikmasi hisoblanadi. Kiyimlari va poyabzallarini o'zi kiyishi, yuvinishi, ovqatlanish jarayonida madaniy ko'nikmalarga rioya qilishi, o'ynab bo'lgach o'yinchoqlarini o'z joyiga tartib bilan yig'ishtirishi — bularning barchasi o'z-o'ziga xizmat ko'rishning elementlaridir. Ushbu faoliyat kichik guruhlardan oq (3 yosh) boshlab tizimli rag'batlantirib borilsa, bolada "men o'zim qila olaman" degan ijobiy psixologik pozitsiya va o'ziga bo'lgan ishonch mustahkamlanadi.

Ikkinchi tur — xo'jalik-maishiy mehnat bo'lib, u bolalarni qurshab turgan muhitda tartib va tozalikni saqlashga yo'naltirilgan. Guruh xonasidagi kitob javonlarini tartibga keltirish, tarbiyachiga mashg'ulotlar uchun tarqatma materiallarni joylashtirishda ko'maklashish, navbatchilik paytida stollarga idish-tovoqlarni to'g'ri qo'yish kabi ishlar bularga yaqqol misoldir. Bu jarayon bolada guruh va tengdoshlari oldidagi mas'uliyatni uyg'otadi.

Uchinchi tur — tabiat bag'ridagi mehnat hisoblanadi. Maktabgacha ta'lim tashkiloti hududidagi yoki guruhdagi tabiat burchagida olib boriladigan bu faoliyat turi o'simliklarni sug'orish, ularning barglarini changdan artish, gulzorlardagi xazonlarni yig'ish, qushlar va kichik hayvonlarga g'amxo'rlik qilishni o'z ichiga oladi. Tabiat burchagidagi mehnat bolada nafaqat jismoniy faollikni, balki ekologik madaniyatni, tirik tabiatga nisbatan

shafqatlilik va mehr-oqibat tuyg'ularini shakllantirishda beqiyos ahamiyatga ega.

To'rtinchi tur — qo'l mehnati yoki badiiy mehnatdir. Ushbu mehnat turi asosan katta va tayyorlov guruhlari (5-7 yosh) bolalari bilan tashkil etiladi. Turli tabiiy materiallar (quruq barglar, daraxt shoxlari, yong'oq po'stlog'i), qog'oz, karton, ip va mato bo'laklaridan foydalanib xilma-xil o'yinchoqlar, maketlar va sovg'alar yasash bolalarning ijodiy tasavvurini (Art-fantasy) yuksaltiradi. Qo'l mehnati bolaning fikrlash doirasini kengaytirib, unda estetik did va diqqatni bir joyga jamlash qobiliyatini tarbiyalaydi.

Pedagogik jarayonda mehnatni bolalarga yetkazish va ularni faoliyatga jalb qilishning bir qancha tashkiliy shakllari mavjud. Kichik yoshdagi bolalar bilan ishlashda yakka tartibdagi topshiriqlar usuli juda qo'l keladi. Tarbiyachi har bir bolaga qisqa, aniq va uning kuchiga mos keladigan vazifalarni individual tarzda yuklaydi. O'rta guruhdan boshlab esa navbatchilik tizimi joriy etiladi. Navbatchi bo'lgan bola o'zini guruhning ma'lum ma'noda yordamchisi va boshqaruvchisi sifatida his qila boshlaydi, bu esa unda ijtimoiy faollikni oshiradi. Katta yoshdagi bolalar uchun esa jamoaviy mehnat shakli tavsiya etiladi. Jamoa bo'lib ishlash jarayonida bolalar o'zaro muloqotga kirishishni, ishni teng taqsimlashni, bir-biriga ko'maklashishni va umumiy maqsad yo'lida jipslashishni o'rganadilar.

Biroq, maktabgacha yoshdagi bolaning yetakchi faoliyati o'yin ekanligini aslo unutmaslik lozim. Bolalarni mehnatga o'rgatishda quruq buyruq, majburlash yoki qo'pol talablar mutlaqo teskari natija beradi — bolada mehnatga nisbatan nafrat va bezorlik paydo qilishi mumkin. Shu sababli mehnat elementlarini o'yin syujetlari bilan sintez qilish tarbiyachidan yuksak pedagogik mahorat talab etadi.

Metodik yondashuv: Tarbiyachi bolaga "Hozir hamma o'yinchoqlarni yig'ishtirsin!" deb buyruq berish o'rniga, o'yin vaziyatini

yaratishi kerak: "Bolajonlar, qaranglar, poezdimiz uzoq yo'ldan charchab keldi, endi uning vagonlarini garajga joylashtirishimiz kerak. Qo'g'irchoqlarimiz ham uxlashga tayyorlanmoqda, ularni joylariga yotqizaylik". Bunday vaziyatda bola buni majburiyat emas, o'yinning davomi sifatida qabul qiladi va g'ayrat bilan kirishadi.

Shuningdek, maktabgacha ta'limda qo'g'irchoq teatri va ertak terapiyasi elementlaridan foydalanish ham mehnat tarbiyasida ijobiy etalonlarni yaratishga xizmat qiladi. Ertaklardagi mehnatsevar va dangasa qahramonlarning qiyofasi (masalan, "Zumrad va Qimmat", "Bo'g'irsoq") bolalar ongida qaysi xulq-atvor ijobiy, qaysisi salbiy ekanligini tahlil qilish imkonini beradi. Bolalar qo'g'irchoq teatri qahramonlariga taqlid qilish orqali o'zlarida ham faollik fazilatlarini shakllantiradilar.

Tizimli va metodik jihatdan to'g'ri tashkil etilgan mehnat tarbiyasi bolaning umumiy rivojlanish darajasini sezilarli darajada oshiradi. Pedagogik kuzatishlar va amaliy tajribalar shuni ko'rsatadiki, doimiy ravishda o'z kuchi yetadigan mehnat faoliyatiga jalb qilingan bolalar o'z tengdoshlariga qaraganda ancha mustaqil, ijtimoiy muhitga moslashuvchan va irodali bo'ladilar. Ularda tengdoshlariga yordam berish, g'amxo'rlik va birdamlik hissi yuqori darajada namoyon bo'ladi.

Maktabgacha yoshdagi bolalarni mehnatga o'rgatish jarayonida tarbiyachilar va ota-onalar quyidagi muhim pedagogik shartlarga amal qilishlari zarur:

- Bola biror ishni bajarishga intilganda (hatto u buni to'g'ri bajara olmasa ham), uning qo'lidan asboblarni tortib olmaslik yoki "sen hali kichkinasan, eplolmaysan, baribir qaytadan qilishimga to'g'ri keladi" deb uning shijoatini so'ndirmaslik kerak. Yo'l qo'yilgan xatolar jarayon davomida, bolaning ko'nglini og'ritmasdan, do'stona tarzda tuzatiladi.
- Bolaning mehnati natijasi kattalarniki kabi mukammal bo'lmasligi tabiiy. Bu yerda

asosiysi — bolaning qilgan harakati va niyati. Pedagog yoki ota-ona bolaning ozgina bo'lsa ham ko'rsatgan yordamini chin dildan e'tirof etishi va maqtashi lozim ("Sening yordaming bilan xonamiz judayam ozoda bo'ldi, sendan minnatdorman").

-Agar bola bog'chada hamma narsani o'zi mustaqil bajarishga odatlangan bo'lsa-yu, ammo uyda ota-onasi yoki buvisi uning ketidan hamma narsani tayyorlab, kiyintirib, ovqatini ham yedirib qo'ysa, tarbiyadagi uzviylik zanjiri uziladi. Mehnatsevarlik ko'nikmasi mustahkam odatga aylanishi uchun MTT va oila talablari bir xil bo'lishi shart.

Xulosa o'rnida aytish mumkinki, maktabgacha yoshdagi bolalarni mehnatga o'rgatish — kelajakda komil va har tomonlama barkamol shaxsni tarbiyalashning eng muhim shartidir. Mehnat jarayonida bolada nafaqat jismoniy chaqqonlik, balki qat'iyatlilik, qiyinchiliklarni yengish, intizom va o'z-o'zini boshqarish kabi yuksak irodaviy fazilatlar shakllanadi. Zamonaviy ta'lim standartlari talablari asosida tashkil etiladigan integratsiyalashgan mashg'ulotlar, o'yinlar va amaliy qo'l mehnatlari bolalarni jamiyat hayotiga tayyorlashda eng faol ko'prik vazifasini o'taydi. Pedagoglar va ota-onalarning birdamlikdagi to'g'ri yondashuvi esa bolalikdan boshlab mehnatni hayotiy ehtiyoj va quvonch manbai sifatida qabul qilishga zamin yaratadi.

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The Effect Of Different Rates And Application Periods Of Nitrogen Fertilizers On The Growth, Development And Yield Of Sweet Pepper

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Abstract

The effect of different rates and application periods of nitrogen fertilizers on the growth, development, and productivity of sweet pepper was studied. The research was conducted on takyr-meadow soils. Nitrogen was applied at various rates ($N_{70}P_{49}K_{35}$, $N_{100}P_{70}K_{50}$, $N_{150}P_{105}K_{75}$, $N_{200}P_{140}K_{100}$, $N_{250}P_{175}K_{125}$) along with phosphorus and potassium fertilizers. The results showed that the optimal nitrogen rate increased the content of ammonium and nitrate nitrogen in the soil and accelerated the onset of budding, flowering, and fruiting stages by 7–12 days. The best results were observed at N_{100} – N_{200} rates. Excessive nitrogen slightly delayed the fruiting period. The study provides practical recommendations for the effective use of nitrogen fertilizers to obtain high and quality yields of sweet pepper.

Keywords: Sweet pepper, nitrogen fertilizers, ammonium nitrogen, nitrate nitrogen, growth and development, productivity, takyr-meadow soil, mineral nutrition.

Annotatsiya

Shirin qalampirning o'sishi, rivojlanishi va hosildorligiga azotli o'g'itlarning turli me'yorlari va qo'llash muddatlarining ta'siri o'rganildi. Tadqiqot taqir-o'tloq tuproqlarda o'tkazildi. Azotning turli me'yorlari ($N_{70}P_{49}K_{35}$, $N_{100}P_{70}K_{50}$, $N_{150}P_{105}K_{75}$, $N_{200}P_{140}K_{100}$, $N_{250}P_{175}K_{125}$) bilan birgalikda fosfor va kaliy o'g'itlari qo'llanildi. Natijalar shuni ko'rsatdiki, optimal azot me'yorlari tuproqdagi ammoniy va nitrat shaklidagi azot miqdorini oshirib, o'simlikning shonalash, gullash va hosilga kirish davrlarini 7–12 kun erta boshlashga yordam berdi. Eng yaxshi natijalar N_{100} – N_{200} me'yorlarida kuzatildi. Ortiqcha azot hosilga kirishni biroz kechiktirdi. Tadqiqot shirin qalampirdan yuqori va sifatli hosil olishda azotli o'g'itlardan samarali foydalanish bo'yicha amaliy tavsiyalar berdi.

Kalit so'zlar: Shirin qalampir, azotli o'g'itlar, ammoniy azot, nitrat azot, o'sish va rivojlanish, hosildorlik, taqir-o'tloq tuproq, mineral oziqlanish.

Kirish. O'simlik, tuproq va o'g'it o'rtasidagi o'zaro bog'liqlik oziqlanish jarayonida yaqqol namoyon bo'ladi. O'g'it tuproqqa qo'shilgandan keyin uning tarkibidagi oziq moddalar eruvchanligi, o'zlashtirilish darajasi va harakatchanligi o'zgaradi. Bu o'zgarishlar o'g'itlarning fizik-kimyoviy va biologik xususiyatlari bilan bevosita bog'liqdir.

Azot — shirin qalampir uchun eng muhim oziq moddalardan biri bo'lib, o'simlikning barg va poya o'sishi, fotosintez, gul va meva hosil bo'lishida katta rol o'ynaydi. Azot yetishmovchiligi o'sishni sekinlashtiradi, barglar oqaradi va kasalliklarga chidamlilik

pasayadi. Ortiqcha azot esa vegetativ massaning haddan tashqari o'sishiga, gullash va mevalashning kechikishiga olib keladi. Shu bois azotning optimal me'yorini aniqlash va uni to'g'ri muddatlarda qo'llash juda muhimdir.

Tadqiqot natijalari va muhokama

Tuproqdagi ammoniy shaklidagi azotning dinamikasi

Tajribada barcha variantlarda ammoniy azotining miqdori o'simlikning hosilga kirish davriga to'g'ri keldi. Bu holat tuproq haroratining ko'tarilishi bilan izohlanadi. O'simlikning jadal o'sishi va oziq moddalarni faol o'zlashtirishi natijasida

tuproqdagi mineral azot miqdori asta-sekin kamayib bordi. Nazorat (o'g'itsiz): 10-fevralda 18,1 mg/kg dan 10-iyunda 24,5 mg/kg gacha oshgan bo'lsa-da, keyingi oylarda pasayish kuzatildi. N₇₀P₄₉K₃₅: Maksimal qiymat 10-iyulda 29,7 mg/kg ni tashkil etdi. N₁₅₀P₁₀₅K₇₅: Azot miqdori sezilarli darajada yuqori bo'lib, 10-iyulda 59,4 mg/kg ga yetdi.

Tuproqdagi nitrat shaklidagi azot va boshqa oziq moddalar

Tuproqda nitrat shaklidagi azot miqdori odatda ammoniy shakliga nisbatan yuqori bo'ladi, chunki nitrifikatsiya jarayoni ammonifikatsiyadan tezroq kechadi. Mineral o'g'itlarning qo'llanilishi nitrat azotining miqdorini ham sezilarli oshirdi.

Fosfor va kaliyli o'g'itlar bilan birgalikda azotning orttirilgan me'yorlari harakatchan fosfor va almashinuvchan kaliy miqdorini ham ijobiy ta'sir etdi. O'simlikning faol o'sish davrida bu moddalar miqdori kamayib, meva pishish bosqichida o'simlik tomonidan intensiv o'zlashtirilishi kuzatildi.

O'simlikning fenologik bosqichlariga ta'siri

O'g'itlarning miqdori shirin qalampirning o'sish va rivojlanish tezligiga sezilarli ta'sir ko'rsatdi. (1-Jadval)

(1-Jadval)

Variant	Ilk shonalash	Ilk gullash	Hosilga kirish
Nazorat	19-may	7-iyun	5-avgust
N ₇₀ P ₄₉ K ₃₅	15-may	27-may	30-iyul
N ₁₀₀ P ₇₀ K ₅₀	13-may	30-may	27-iyul
N ₁₅₀ P ₁₀₅ K ₇₅	16-may	30-may	1-avgust
N ₂₀₀ P ₁₄₀ K ₁₀₀	14-may	28-may	30-iyul
N ₂₅₀ P ₁₇₅ K ₁₂₅	17-may	5-iyun	6-avgust

Nazorat variantida rivojlanish sekinlashgan bo'lsa, o'g'itlangan variantlarda shonalash va gullash 7–12 kun erta boshlandi. Eng optimal natija N₁₀₀P₇₀K₅₀ va N₂₀₀P₁₄₀K₁₀₀ variantlarida kuzatildi.

Shirin qalampirning mevalashi bosqichida azot, fosfor va kaliyning muvozanati ayniqsa muhimdir. Kaliy mevalarning shakllanishi, kasalliklarga chidamlilik va

tunda harorat o'zgarishlariga bardosh berishda katta ahamiyatga ega.

Xulosa

Taqir-o'tloq tuproqlarda shirin qalampir yetishtirishda azotli o'g'itlarni fosfor va kaliy bilan birgalikda optimal me'yorlarda (ayniqsa N₁₀₀–N₂₀₀ oralig'ida) qo'llash tuproqning oziqa rejimini yaxshilaydi, o'simlikning vegetatsiya davrini qisqartiradi va hosilga erta kirishini ta'minlaydi. Ortiqcha azot (N₂₅₀) esa hosilga kirishni biroz kechiktirishi mumkin.

Ushbu natijalar Surxondaryo viloyati sharoitida shirin qalampirning yuqori va sifatli hosilini olish uchun amaliy tavsiyalar beradi hamda azotli o'g'itlardan samarali foydalanish imkonini kengaytiradi.

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Цифровые Средства И Методы Анализа Данных В Психологии

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Аннотация

Актуальность исследования определена стратегическими направлениями страны, а особенно повышение эффективности образовательного процесса, разработка новых методов обучения и оценка их научной обоснованности требуют применения методов математической статистики. В данной статье рассматривается тема применения методов проверки статистических гипотез в психологических исследованиях, изучаются соответствующие теоретические и практические результаты, изучаются соответствующие теоретические и практические результаты, а также возможности использования этих методов на практике для улучшения качества анализа и обработки результатов эксперимента. а также возможности использования этих методов на практике для улучшения качества образовательного процесса.

Ключевые слова: психология, анализ данных, математическая статистика, программы, цифровые инструменты, гипотеза, эксперимент.

Введение. Правительство Республики Узбекистан одним из приоритетных направлений развития экономики обозначило качество образования, так Постановлением Президента Республики Узбекистан Ш.М. Мирзиёева от 7 мая 2020 года № ПП-4708 «О мерах по повышению качества образования и развитию научных исследований в области математики»¹ определено, что повышение качества преподавания математических дисциплин в общеобразовательных и средних специальных учебных заведениях, развитие научных исследований и внедрение научных разработок в практику являются приоритетными

направлениями. В связи с этим, в процессе преподавания математики важно формировать у обучающихся знания и навыки, применимые на практике, включая эффективное обучение методам математической статистики, что способствует повышению качества образования. Повышение эффективности образовательного процесса, разработка новых методов обучения и оценка их научной обоснованности требуют применения методов математической статистики. Поэтому в данной статье рассматривается тема применения методов проверки статистических гипотез в психологических

¹ Постановление Президента Республики Узбекистан Ш.М. Мирзиёева от 7 мая 2020 года № ПП-4708 «О мерах по повышению качества образования и развитию научных исследований

в области математики». Национальная база данных законодательства, 08.05.2020 г., № 07/20/4708/0553; 15.04.2022
<https://lex.uz/docs/4807554>

исследованиях, изучаются соответствующие теоретические и практические результаты, а также возможности использования этих методов на практике для улучшения качества образовательного процесса.

Обзор литературы.

В настоящее время перед психологами стоит важная задача — оказание психологического воздействия на сознание людей в условиях стремительных изменений в обществе, изучение их психологических особенностей и определение их роли в общественной жизни. Для этого проводятся многочисленные психологические исследования, объективность которых зависит от правильной организации используемых методов измерения.

На основе анализа источников по обработке данных в экспериментальных исследованиях, мы выделяли классы математических методов, решающих задачу обработки данных (Н. Джонсон, 1980; В.В. Налимов², 1981; Д.К. Монтгомери, 1980; Ю.Н. Тюрин, 1995³).⁴ Были выделены следующие группы методов:

- Описательная статистика. К описательным статистикам относят числовые характеристики распределений измеренного на выборке признака.
- Корреляционный анализ. Проверка гипотез о связях между переменными с использованием коэффициента корреляции.
- Параметрические критерии сравнения двух выборок. Сравнение

двух выборок по признаку, измеренному в метрической шкале.

- Непараметрические критерии сравнения выборок. Способы проверки статистических гипотез о различии выборок по уровню выраженности признака, измеренного в количественной шкале.

- Анализ номинативных данных. Проверка широкого ряда гипотез об отношении явлений, измерения которых доступно в номинативной шкале.

- Дисперсионный анализ. Это анализ изменчивости признака под влиянием каких-либо контролируемых переменных факторов.

- Многомерные методы. Различные описательные математические модели, применяемые для представления исходных (эмпирических данных) в доступном для интерпретации виде.⁵

Анализ литературы по созданию и адаптации методик, применяемых для психологического тестирования (А. Анастаси, 2001; Л.И. Вассерман, 1997; В.А. Дюк, 1994; П. Клайн, 1994; В.П. Устинов, 2004; А.Г. Шмелев, 1984), показал, что в большинстве случаев применяется определенный набор математических процедур. Таким образом, мы можем обозначить основные методы, применяемые при создании тестов:

- Вычисление описательных статистик - математического ожидания, среднеквадратического отклонения.
- Сравнение распределения результатов с нормальным распределением. Определение «нормальности» распределения может

² Налимов В.В. Логические основания планирования эксперимента. — 2-е изд., перераб. и доп.. — М. : Металлургия, 1981. — 151 с.; 20.

³ Ю. Н. Тюрин, А. А. Макаров Анализ данных на компьютере: учебное пособие. электронное издание. М: МЦМНО, 2014-367с.

⁴ Джонсон Н. Статистика и планирование эксперимента в технике и науке. Методы обработки данных. В 2-х т. М: Мир: 1980, 610 с.

⁵ Математические методы в психологии: учебное пособие / О.С. Карымова, И.С. Якиманская; Оренбургский гос. университет. - Изд. 5-е, испр. и дополн. — Оренбург: ОГУ, 2012. — 169 с.: ил.

осуществляться с помощью проверки асимметрии и эксцесса на основе общего неравенства Чебышева.

– Вычисление различных типов надежности.

Коэффициент ретестовой надежности определяется как коэффициент корреляции между показателями, получаемыми одними и теми же испытуемыми в двух различных ситуациях проведения теста. Для вычисления коэффициента надежности чаще всего применяют коэффициент ранговой корреляции Спирмена или коэффициент корреляции Пирсона.

Моделирование психических процессов является основой исследования во многих областях психологии: инженерной психологии, общей психологии, эргономике, социальной психологии, психофизики. Целью таких исследований является построение математической модели исследуемого психического процесса. Примером таких моделей может быть: модель цветового зрения Измайлова (Ч.А. Измайлов, 1989), модели сенсорных процессов (Ю.М. Забродин, 1979), модели социально-психических процессов (А.К. Гуц, 1998). Данная область применения математических методов в психологии наименее формализована. И в большинстве случаев главной проблемой при моделировании является не применение математического аппарата, а построение экспериментальных процедур, позволяющих получать данные для адекватного перевода на язык математики.

Изучение профильной литературы и результаты анкетирования специалистов позволили выделить четыре программных продукта, широко используемых психологами: Statistica, SPSS, Stadia и Microsoft Excel. В то же время, такие мощные математические

пакеты, как MATLAB, Maple, Mathematica и Mathcad, редко находят применение в психологических исследованиях из-за их сложности и избыточности для типичных задач в этой области. Далее будут рассмотрены особенности каждого из упомянутых программных средств с акцентом на их преимущества и ограничения в контексте психологических исследований.

Методология.

На основе анализированных методов была составлена анкета и проведен опрос для выявления тех методов, которые реально используют психологи в своих научных и практических исследованиях.

Анкетирование проводилось в Google Форме, предназначенной для проведения анонимного анкетирования. Анкетирование проводилось в течение двух месяцев (с 10.11.24 по 10.01.25). В анкетировании приняло участие 212 человек- преподаватели кафедры психологии, студенты выпускного курса направления практической психологии, школьные психологи, производственные психологи.

В результате исследования были выделены математические методы, которые психологи в своих исследованиях используют чаще всего: регрессионный, факторный анализ, меры центральной тенденции.

Изучение профильной литературы и результаты анкетирования специалистов позволили выделить четыре программных продукта, широко используемых психологами: Statistica, SPSS, Stadia и Microsoft Excel. В то же время, такие мощные математические пакеты, как MATLAB, Maple, Mathematica и Mathcad, редко находят применение в психологических исследованиях из-за их сложности и избыточности для типичных задач в этой области. Далее будут рассмотрены особенности каждого из

упомянутых программных средств с акцентом на их преимущества и ограничения в контексте психологических исследований.

SPSS («Statistical Package for the Social Sciences»)

SPSS является комплексной системой анализа данных. SPSS может использовать данные почти из всех типов файлов и генерировать табличные отчёты, графики, рисунки распределений и трендов, описательную статистику и проводить сложные виды статистического анализа.

Программа предоставляет полный набор методов анализа данных, начиная с описательной статистики и заканчивая сложными видами анализа (дисперсионный, факторный, спектральный и т.д.). Представление результатов происходит при помощи различных видов диаграмм и гистограмм. При этом пользователя предоставляется возможность самому создавать шаблоны диаграмм. Но главной особенностью SPSS является ее интеграция с большим количеством внешних программ (MS Excel, dBASE, Lotus, SQL, SYSTAT и т.д.) и форматов (XML, HTML, PC, SAS и т.д.). Еще одной важной особенностью программы является поддержка современных программных решений. Так, последняя версия программ SPSS строится на основе клиент-серверной архитектуры, объявлено, что новая версия программы будет полностью совместима с Windows Vista (Ю.Н. Тюрин, 1995).

Statistica - это система для статистического анализа данных,

включающая широкий набор аналитических процедур и методов: более 100 различных типов графиков, описательные и внутригрупповые статистики, разведочный анализ данных, корреляции, быстрые основные статистики и блоковые статистики, интерактивный вероятностный калькулятор, Т-критерии (и другие критерии групповых различий), таблицы частот, сопряженности, анализ многомерных откликов, множественная регрессия, непараметрические статистики, общая модель дисперсионного и ковариационного анализа, подгонка распределений и многое другое.

Statgraphics (статистическая графическая система)

является первым в мире диалоговым статистическим пакетом для IBM/PC, долгое время служившим своеобразным эталоном. Отличительной особенностью всех версий пакета является наличие объемного раздела «Планирование эксперимента», позволяющего получать высоко достоверные исходные данные для анализа.⁶

С октября 2017 фирмой Statgraphics Technologies, Inc. распространяется версия Statgraphics Centurion 18, включающая более 250 статистических процедур, разнообразную графику и преобразования данных.⁷ Это дает статистические инструменты для достижения совершенства, понимания и реализации важных бизнес-целей. Цель: повышение эффективности систем для обеспечения качества, увеличение производительности, разработка

⁶Беребин М.А. Применение пакета статистических программ statgraphics в психологических исследованиях Учебное пособие - Учебное пособие. Челябинск. Изд. ЮУрГУ, 2012, 92 с. <https://textarchive.ru/c-1153064-pall.html>

⁷ Беребин М.А. Применение пакета статистических программ statgraphics в психологических исследованиях Учебное пособие - Учебное пособие. Челябинск. Изд. ЮУрГУ, 2012, 92 с. <https://textarchive.ru/c-1153064-pall.html>

передовых методов и оптимизация политик и процедур, способствующие экономии средств и контролю.

Stadia.

Программа Stadia разработана в России и за 12 лет своего развития стала аналитическим инструментом, используемым в различных областях науки, техники, планирования, управления, производства, бизнеса, маркетинга, образования, медицины и др. Программа предоставляет следующие возможности (А.П. Кулаичев, 1999)):

- анализ данных, осуществляемый с помощью следующих методов: описательная статистика, критерии различия, различные виды анализа данных (категориальный, дисперсионный, корреляционный, дискриминантный, кластерный и факторный), фильтрация, прогнозирование, регрессия (простая, множественная, пошаговая и нелинейная), шкалирование, методы контроля качества, вычисление и согласие распределений и т.д.
- визуализация данных при помощи 2-ух и 3-ех мерных графиков, гистограмм, диаграмм, поверхностей и карт;
- экспорт и импорт данных и результатов;
- интерактивная помощь, советы и интерпретация результатов.

Программа **Stadia** выпускается в трёх основных модификациях, отличающихся только объемом обрабатываемых данных (чисел в матрице данных):

- версия для учебных классов на 10 ПЭВМ (до 400 чисел).
- базовая версия (до 4000 чисел).;
- профессиональная версия (до 20000 чисел).

Таким образом, можно говорить о том, что программа Stadia предназначена для

индивидуального использования и применения в научных исследованиях.

MS Excel.

Программа MS Excel входит в пакет программ Microsoft Office и предназначена для работы с электронными таблицами. Не являясь специализированной программой для математической обработки данных, MS Excel предоставляет возможность проводить большое количество преобразований над ячейками таблицы и визуализировать получаемые результаты. Программа позволяет проводить весь набор описательной статистики, использовать критерии сравнения, проводить некоторые виды анализа (регрессионный, дискриминационный).

К положительным свойствам системы можно отнести: большое количество диаграмм и графиков, легкость в обучении (основанную на едином интерфейсе всех продуктов Microsoft), возможность создавать свои собственные процедуры обработки на основе уже имеющихся. К отрицательным сторонам программы можно отнести отсутствие сложных видов анализа данных и отсутствие специализации для исследований в психологии. К «минусам» программы следует отнести большое количество ошибок и неточностей, свойственное и самой программе и всей продукции компании Microsoft.

Можно говорить о том, что MS Excel является наиболее доступной программой и позволяет пользователю создавать свои методы обработки данных. Это позиционирует ее для применения частными лицами и в научных исследованиях.

Результаты и обсуждения.



Рисунок 1.

Так, сложные виды анализ в среднем применяются от 3% (регрессионный анализ) до 12% (факторный анализ) психологов.

Наиболее распространенным является применение мер центральной тенденции (92%), их применяет практически каждый психолог. Самыми популярными способами корреляционного анализа является вычисление коэффициентов корреляции Пирсона (64%) и Спирмена (76%). Среди параметрических критериев сравнения двух выборок чаще всего применяют критерий Стьюдента

для анализа независимых выборок (71%) и критерий Фишера (55%).

Таким образом, мы выявили математические методы, которыми чаще других пользуются психологи в своих исследованиях и которые должна содержать любая математическая программа, предназначенная для работы психолога.

Второй сферой применения математических методов в психологии является психометрика. Психометрика - это область психологии, изучающая теоретически и методологические проблемы психологических измерений.⁸ Психометрика регламентирует экспериментальную проверку выявляемых психологических свойств по критериям валидности, надежности и репрезентативности тестовых норм.

Под валидностью понимается действительная способность теста измерять ту психологическую характеристику, для диагностики которой он заявлен. Количественно валидность теста может выражаться через корреляции результатов, полученных с его помощью, с другими показателями, например, с успешностью выполнения соответствующей деятельности. Выделяется несколько типов валидностей - содержательная, внутренняя (эмпирическая) и понятийная (конструктивная). Под надежностью понимается устойчивость, или согласованность, результатов теста, получаемых при повторном его применении к тем же испытуемым в различные моменты времени, при использовании различных наборов эквивалентных заданий или же при изменении других условий исследования. Существует несколько типов надежности - ретестовая,

⁸ Соломин И. Л. Математические методы в психологии: учебное пособие / И. Л. Соломин. – СПб.: ФГБОУ ВО ПГУПС. 2021. – 50 с

надежность взаимозаменяемых форм и надежность эквивалентных половин теста⁹ (А. Анастаси, 2001; П. Клайн, 1994).

В результате анализа основных направлений применения математических методов в психологии были определены наиболее востребованные подходы к обработке данных, а также сформирована типовая последовательность проведения психометрических процедур.

Выводы. Проведённый сравнительный анализ (см. таблицу 1) показал, что все

Таблица 1 - Сравнение различных программ математической обработки данных

Критерий сравнения	Statistica	SPSS	Stadia	MS Excel
Визуализация результатов	да	да	да	да
Наличие основных статистических методов	да	да	да	да
Наличие сложных методов анализа	да	да	частично	частично
Учет особенностей психологических исследований	нет	нет	частично	нет

Однако у всех программ имеются определённые ограничения: отсутствуют встроенные механизмы верификации применяемых методов обработки данных.

Таким образом, задачей для программистов является создание программного средства, позволяющего психологу с минимальными затратами создавать и использовать различные математические процедуры для сопровождения исследовательской деятельности в психологии.

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Factors and Prospects for the Development of Social Entrepreneurship in Higher Education Institutions

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Abstract

This academic article provides a comprehensive scientific analysis of the primary factors, existing barriers, and future prospects associated with the development of social entrepreneurship within higher education institutions, thereby illuminating the critical importance of the active participation of modern universities in resolving profound socio-economic challenges prevalent in contemporary society. Grounded in the quantitative results of an extensive survey conducted among a diverse cohort of university students and academic faculty members, this research meticulously investigates the multifaceted institutional, financial, and educational determinants that significantly influence the cultivation of a robust social entrepreneurship ecosystem. The thorough analysis of the acquired empirical data conclusively demonstrates that, although there is a substantial abundance of innovative ideas aimed at mitigating social issues among the surveyed respondents, profound structural obstacles perpetually persist, most notably encompassing the severe deficiency of accessible financial resources and the systemic absence of specialized curricular modules explicitly designed to foster practical entrepreneurial competencies. Ultimately, this scholarly work formulates concrete strategic recommendations and highly pragmatic proposals specifically directed toward the establishment of an integrated entrepreneurial ecosystem, the comprehensive modernization of academic curricula, and the sustained institutional support of student-led social initiatives, which collectively serve as an indispensable theoretical foundation for subsequent scientific inquiries in this evolving domain.

Keywords: Social entrepreneurship, higher education institutions, sustainable development, innovation ecosystem, academic entrepreneurship, social responsibility.

Introduction

In the context of profound contemporary global economic transformations and the continuous emergence of unprecedented societal challenges, traditional paradigms of public administration and purely commercial enterprise models have increasingly demonstrated an inherent inadequacy in yielding sufficiently effective outcomes, which has consequently precipitated a remarkably accelerated and globally pervasive surge of academic and practical interest in the conceptual framework of social entrepreneurship, an arena wherein the intellectual and infrastructural potential of higher education institutions is progressively assuming an indispensably central role. Historically, the fundamental institutional architecture of

universities was predominantly orientated toward the fulfillment of two primary, time-honored missions, namely the dissemination of knowledge through pedagogical instruction and the advancement of human understanding via rigorous fundamental scientific research; however, in the present era, operating under the theoretical parameters of the newly delineated third mission paradigm, these academic entities are systematically required to transcend their conventional boundaries by directly contributing to the socio-economic advancement of their respective communities, practically implementing innovative conceptualizations, and serving as the primary drivers of sustainable regional development. Social entrepreneurship, by

its very ontological nature, represents a uniquely multifaceted category of human endeavor that deliberately juxtaposes the legitimate pursuit of economic viability with the paramount objective of resolving deeply entrenched social, ecological, and cultural dilemmas through the application of highly innovative methodologies, thereby possessing an extraordinary, unparalleled potential to comprehensively cultivate quintessential humanistic qualities within the younger generation, including profound empathy, an unwavering sense of social responsibility, and a resolute commitment to the enduring principles of sustainable development.

The ongoing trajectory of extensive, systemic reforms currently being implemented across the global higher educational landscape is fundamentally directed toward the sweeping transformation of university structures, meticulously aiming to secure their academic autonomy and financial self-sufficiency while concurrently establishing an exceptionally conducive legal and institutional environment that proactively nurtures and rigorously supports the innovative entrepreneurial initiatives formulated by the student body. Despite these promising developments and the demonstrable momentum toward institutional modernization, a considerable array of deeply rooted, systemic impediments continues to significantly obstruct the accelerated proliferation and maturation of this sector within the academic sphere, prominently encompassing the pervasive lack of an unambiguous, uniformly accepted theoretical understanding of social entrepreneurship among both academic practitioners and administrative leadership, which severely hinders the formulation of cohesive institutional strategies. Furthermore, this epistemological deficiency is critically compounded by the

pronounced scarcity of specialized, credit-bearing academic disciplines or dedicated curricular modules specifically tailored to the nuances of social enterprise creation, an educational gap that is further exacerbated by the conspicuously underdeveloped, archaic mechanisms currently available for the financial capitalization and sustained economic support of student-driven startup initiatives. Additionally, the remarkably fragile, intermittent nature of collaborative partnerships established between higher education institutions, entities operating within the private commercial sector, and diverse non-governmental, non-profit organizations constitutes another formidable barrier, preventing the seamless transfer of knowledge and resources essential for the successful incubation of socially oriented entrepreneurial ventures. The primary, overarching objective of this meticulously structured scientific investigation is to systematically explore and comprehensively analyze the aforementioned constellation of challenges, thereby identifying and thoroughly evaluating both the direct and indirect determinants that fundamentally shape the developmental trajectory of social entrepreneurship within higher education institutions. By rigorously examining the specific manifestations, interconnected dynamics, and broader systemic implications of these multifaceted factors, this research endeavors to formulate highly sophisticated, scientifically validated strategic recommendations and to conceptualize innovative, forward-looking developmental models that can significantly enhance the operational efficacy of the existing academic paradigm. The profound contemporary relevance of this complex issue is intrinsically anchored in the undeniable reality that the youth demographic, particularly university students, represents a uniquely dynamic

social stratum that is concurrently highly sensitive to prevailing societal inequities and exceptionally capable of generating remarkably innovative, disruptive solutions to these persistent problems. Strategically redirecting the immense, largely untapped entrepreneurial potential of this demographic specifically toward the social sector transcends the mere amelioration of youth unemployment rates; rather, it constitutes a fundamentally transformative socioeconomic intervention that provides indispensable support to vulnerable, marginalized populations, decisively promotes long-term ecological sustainability, and acts as a powerful catalyst for the realization of truly inclusive, equitable economic growth across all strata of society. An exhaustive, critical analysis of prevailing international best practices unequivocally demonstrates that the world's most prestigious, highly ranked universities have long recognized the strategic imperative of this paradigm shift, successfully establishing deeply integrated, highly resourced social entrepreneurship centers that systematically furnish students with a comprehensive, fully articulated ecosystem of support, making it an exceedingly vital, exemplary benchmark that domestic higher education institutions must thoroughly scrutinize and intelligently adapt to their unique sociocultural contexts.

Literature Review

Although the conceptual framework of social entrepreneurship fundamentally originated and began to permeate academic discourse during the concluding decades of the twentieth century, its intricate, synergistic intersection with the formal educational system, particularly concerning the expansive operational capacities of higher education institutions, represents a remarkably novel, exceptionally dynamic, and rapidly evolving trajectory within contemporary socioeconomic research. Within the

extensive compendium of current scientific literature, scholars have articulated a highly diverse, occasionally divergent spectrum of definitions regarding social entrepreneurship, yet the overwhelming majority of these theoretical constructs unanimously emphasize the intrinsic, immutable mission of this phenomenon, which is explicitly oriented toward the deliberate creation of measurable social value and the systematic catalyzation of profound, enduring societal transformations. For instance, according to the seminal conceptualizations advanced by foundational theoreticians operating within this academic domain, social entrepreneurs must be fundamentally comprehended as highly proactive, visionary change agents who relentlessly apply unprecedented, innovative methodologies to resolve intractable societal dilemmas, meticulously leveraging constrained, often scarce resources with maximum operational efficiency to generate a profoundly sustainable, far-reaching social impact [1]. Concurrently, as the theoretical discourse surrounding the extensively debated third mission of universities has progressively matured and gained widespread acceptance, the traditional, somewhat antiquated perceptions delineating the precise role of higher education institutions within the broader social entrepreneurship ecosystem have undergone a profound, revolutionary metamorphosis, prompting a significant multitude of contemporary researchers to re-evaluate and subsequently reposition universities not merely as static, monolithic repositories of theoretical knowledge, but rather as extraordinarily vibrant, proactive incubators fundamentally designed to cultivate and accelerate social innovations [2].

A rigorous, comprehensive analysis of international scholarly publications dedicated to this specific intersection

unequivocally indicates that the ultimate pedagogical and practical success of social entrepreneurship education is inextricably contingent upon a multitude of interconnected factors, most prominently including the overarching strategic vision and proactive commitment demonstrated by university leadership, the profoundly interdisciplinary, highly integrated nature of the academic curricula, and the institution's demonstrable capability to harmoniously synthesize abstract theoretical constructs with tangible, community-based experiential learning projects. Seasoned academic investigators have conclusively corroborated these assertions through extensive, methodologically rigorous empirical studies, persuasively arguing that, in stark contrast to the fundamentally profit-driven paradigms characteristic of traditional corporate business education, the pedagogical delivery of social entrepreneurship necessitates a fundamentally distinct methodological approach designed to deliberately cultivate deeply ingrained emotional intelligence, an unwavering commitment to principles of social justice, and highly developed systemic thinking capabilities among the student populace [3]. Furthermore, highly specialized research investigations conducted within the unique socioeconomic contexts of developing nations and countries currently undergoing complex economic transitions consistently reveal that universities operating under such constrained conditions confront a myriad of formidable, deeply entrenched systemic obstacles that severely inhibit the robust development of social entrepreneurship. These pervasive impediments prominently encompass highly restrictive, deeply institutionalized bureaucratic hurdles, the profound inflexibility characterizing centrally mandated educational standards, the widespread, critical deficiency of appropriate pedagogical expertise and

practical entrepreneurial experience among the professoriate, and the chronic, systemic fragility of both governmental and private sector financial support mechanisms that are essential for nurturing nascent student-led initiatives [4]. While the extant body of international literature provides a remarkably robust, highly comprehensive theoretical foundation unequivocally validating the absolute necessity of integrating social entrepreneurship within the higher education landscape, there remains a critically urgent, demonstrably unmet scientific necessity to conduct profoundly detailed, mixed-methods empirical investigations that systematically examine the specific socio-cultural variables, institutional idiosyncrasies, and micro-economic determinants that uniquely influence this complex developmental process across highly diverse, geographically distinct regional contexts [5].

Methods

In order to successfully achieve the highly complex, multifaceted objectives explicitly articulated within the foundational framework of this academic article, and to rigorously validate the series of scientific hypotheses formulated during the preliminary conceptualization phase, the researchers deliberately adopted a highly sophisticated, comprehensively integrated quantitative research design that seamlessly combines multiple methodological approaches to facilitate the exhaustive, wide-ranging collection of empirical data and its subsequent, profoundly meticulous statistical analysis, thereby guaranteeing the formulation of strictly objective, empirically verifiable conclusions. The primary demographic population targeted for this extensive scholarly investigation exclusively comprised a highly diverse, demographically representative cohort of undergraduate and graduate-level students concurrently enrolled in various academic

programs, seamlessly integrated alongside an esteemed group of active faculty members and pedagogical professionals currently employed at several leading, academically prestigious higher education institutions geographically dispersed across multiple distinct regional territories. From this exceptionally broad, demographically complex foundational population, a precisely calculated, highly representative sample consisting of precisely four hundred and fifty active participants was systematically extracted utilizing a rigorous, highly controlled stratified random sampling methodology, a sophisticated selection technique that definitively ensures an optimal, statistically proportional representation of myriad distinct academic disciplines, varying levels of educational progression, and diverse demographic characteristics.

To facilitate the meticulous, highly structured aggregation of primary empirical data from this carefully selected cohort, the researchers conceptualized, iteratively refined, and rigorously validated an exceptionally comprehensive survey instrument encompassing a highly strategic amalgamation of both precisely targeted closed-ended inquiries and highly nuanced open-ended questions. Furthermore, to accurately quantify and objectively measure the subtle nuances, varying intensities, and deeply held subjective perceptions constituting the respondents' comprehensive evaluations, a highly calibrated, standardized five-point Likert scale was systematically implemented across the entire survey instrument, meticulously ranging from a minimum valuation of one, representing complete and unequivocal disagreement, to a maximum valuation of five, denoting absolute, unconditional agreement with the presented declarative statements. The meticulously engineered survey questionnaire was systematically subdivided into four logically

sequential, conceptually distinct thematic sections, with the initial segment dedicated to the exhaustive aggregation of fundamental demographic characteristics, including chronological age, biological gender, specific academic specialization, and current progression within the educational hierarchy. The subsequent second section was strategically oriented toward rigorously assessing the participants' pre-existing foundational awareness, conceptual comprehension, and subjective valuation regarding the intrinsic socio-economic significance of the social entrepreneurship paradigm, whereas the third and fourth sections were deliberately engineered to quantitatively evaluate the profoundly complex interplay of positive, catalytic drivers and deeply entrenched institutional, systemic, and psychological barriers fundamentally influencing the developmental trajectory of social entrepreneurship within the academic ecosystem.

To rigorously ascertain the fundamental structural integrity, unwavering reliability, and profound internal consistency of the gathered empirical dataset, a highly sophisticated statistical evaluation utilizing the Cronbach's alpha coefficient was systematically executed prior to conducting any inferential analyses, which remarkably yielded consistently robust values significantly exceeding the universally accepted threshold of 0.78 across all primary measurement scales, thereby definitively corroborating the exceptional psychometric validity and absolute methodological suitability of the diagnostic instrument for fulfilling the overarching objectives of this scientific inquiry. Following the rigorous data collection phase, the extraordinarily voluminous dataset was systematically imported into, meticulously processed by, and comprehensively analyzed utilizing the highly advanced capabilities of the

Statistical Package for the Social Sciences, an analytical environment wherein a multitude of diverse statistical methodologies were seamlessly integrated and systematically deployed. These methods encompassed fundamental descriptive techniques to determine precise central tendencies and dispersion metrics, alongside highly complex inferential procedures, notably including Pearson correlation coefficient analyses to accurately map intricate bivariate relationships, and highly sophisticated multivariate linear regression modeling to conclusively isolate, quantify, and scientifically validate the specific, independent predictive impact exerted by various multifaceted independent variables upon the primary dependent variable under investigation.

Results and Analysis

The profoundly detailed, extraordinarily rigorous statistical analysis of the voluminous empirical dataset meticulously gathered throughout the extensive data collection phase of this comprehensive research endeavor facilitated the construction of an exceptionally profound, highly nuanced, and phenomenally multi-dimensional intellectual paradigm concerning the current operational status, the remarkable emergent achievements, and the deeply entrenched systemic vulnerabilities fundamentally characterizing the contemporary development of social entrepreneurship within the intricate ecosystem of higher education institutions. Initially, a highly comprehensive foundational assessment specifically directed toward quantifying the overarching conceptual awareness and foundational cognitive understanding of the social entrepreneurship paradigm among the extensively surveyed participant cohort definitively revealed that, although a substantial and statistically significant majority of the student demographic

confidently affirmed possessing a generalized, albeit superficial, familiarity with this particular socio-economic terminology, an alarmingly substantial proportion subsequently demonstrated a profound conceptual inability to precisely articulate and scientifically differentiate the fundamental, ideologically critical boundaries that distinctively separate authentic social entrepreneurship from highly traditional philanthropic charity paradigms or strictly profit-maximizing commercial business models. This conspicuous, widespread epistemological deficiency conclusively serves as a powerful, empirically undeniable indicator that the prevailing theoretical foundations underpinning this highly complex, deeply transformative socio-economic subject matter are currently being disseminated with an incredibly insufficient degree of academic rigor, conceptual depth, and practical contextualization within the established, largely conventional pedagogical frameworks predominantly utilized across the contemporary higher education landscape. Advancing into the subsequent, highly critical analytical phase of this extensive scholarly investigation, the research methodology systematically transitioned toward conducting a meticulously detailed, profoundly comprehensive quantitative examination specifically intended to isolate, identify, and rigorously evaluate the profoundly formidable, deeply institutionalized structural impediments that consistently and overwhelmingly frustrate the successful initiation, sustainable operationalization, and eventual scalability of socially oriented entrepreneurial ventures within the restrictive confines of the academic environment. The profoundly illuminating statistical data seamlessly extracted from the subjective, experiential evaluations meticulously provided by the vast cohort of engaged participants was subsequently

subjected to a highly rigorous process of systematic categorization, statistical synthesis, and mathematical computation, ultimately yielding precise, highly reliable calculations representing the arithmetic mean and the corresponding standard

deviation for each independently evaluated systemic barrier, the comprehensive results of which are explicitly and exhaustively detailed within the structured parameters of Table 1.

Table 1. Descriptive Statistical Analysis of Systemic Barriers Impeding the Development of Social Entrepreneurship in Higher Education Institutions

Categorized Systemic Barrier	Arithmetic Mean (M)	Standard Deviation (SD)	Rank Order
Severe scarcity of accessible financial capital and absence of dedicated university-based seed funding mechanisms	4.35	0.82	1
Profound deficiency of highly specialized, practically oriented curricular modules focusing on social enterprise creation	4.12	0.89	2
Chronic absence of structured institutional mentorship programs and severe lack of experienced pedagogical guidance	3.95	0.94	3
Excessive, highly rigid bureaucratic protocols and pervasive administrative inertia hindering rapid project initiation	3.80	1.05	4
Inadequate, highly fragmented development of synergistic collaborative networks connecting the university with the private sector	3.65	1.10	5

The unequivocally profound, highly compelling empirical results systematically presented within the meticulously organized structural framework of the preceding table conclusively and irrefutably demonstrate that the demographic cohort consisting of university students perpetually confronts an exceedingly complex, remarkably formidable array of primarily organizational, structural, and critically acute financial impediments whenever they courageously endeavor to transform their highly innovative, socially conscious theoretical concepts into tangible, fully operational, and economically sustainable entrepreneurial realities. Specifically, the remarkably high mathematical mean score calculated for the pervasive lack of accessible financial capital unmistakably underscores the profound, deeply entrenched systemic

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fragility characterizing the contemporary funding architecture currently available within the academic sphere, a deeply problematic situation that effectively paralyses an exceedingly vast multitude of profoundly promising, highly innovative, and potentially transformative social initiatives precisely during their most fragile, critical embryonic stages of conceptual development. Furthermore, the profoundly concerning statistical finding conclusively indicating that the severe deficiency of practically oriented, highly specialized curricular modules ranks as the second most formidable, highly significant barrier powerfully corroborates the previously articulated hypothesis that contemporary universities are fundamentally failing to adequately equip their student populations with the highly specific, deeply complex,

and absolutely essential pragmatic competencies that are categorically indispensable for navigating the incredibly volatile, highly competitive landscape of contemporary social entrepreneurship. In an incredibly deliberate, methodologically rigorous effort to transcend merely descriptive statistical analysis and to definitively unearth the remarkably complex, deeply embedded underlying factors that actively stimulate and highly incentivize the proactive engagement of university students in socially oriented entrepreneurial activities, the researchers subsequently executed a highly sophisticated, mathematically complex multivariate linear regression analysis. This

exceptionally advanced statistical procedure was purposefully designed to rigorously determine, highly accurately quantify, and definitively validate the precise degree of independent predictive influence systematically exerted by a highly diverse, carefully selected array of distinct institutional, educational, and profoundly psychological independent variables directly upon the students' subjectively reported, overarching entrepreneurial behavioral intentions, the highly illuminating, remarkably statistically significant results of which are comprehensively summarized and systematically elucidated within the structured parameters of Table 2.

Table 2. Multivariate Linear Regression Analysis Identifying the Primary Determinants of Student Engagement in Social Entrepreneurship

Independent Variable (Determinant)	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (Beta)	P-Value
Intrinsic psychological motivation and deeply held personal commitment to social justice principles	0.425	0.052	0.380	< 0.001
Perceived quality, practical relevance, and interactive nature of university-provided entrepreneurship education	0.310	0.048	0.295	< 0.001
Accessibility and perceived effectiveness of supportive institutional infrastructure including academic business incubators	0.245	0.055	0.210	< 0.001
Frequency and quality of exposure to successful, inspirational social entrepreneur role models through university channels	0.180	0.060	0.155	0.003

The profoundly sophisticated, exceptionally detailed quantitative findings seamlessly derived from the execution of the highly complex regression model, as exhaustively delineated within Table 2, provide

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undeniably compelling, remarkably robust empirical evidence definitively confirming that an individual's intrinsic psychological motivation, profoundly intertwined with an unwavering, deeply rooted personal

commitment to advancing the fundamental principles of social equity, undeniably constitutes the single most powerful, highly significant predictive determinant meticulously driving a student's highly resolute intention to actively initiate and sustainably operate a social enterprise. However, working in incredibly powerful, highly synergistic conjunction with these profound internal psychological drivers, the demonstrably high perceived quality, the exceptional practical relevance, and the intensely interactive pedagogical nature characterizing the university-provided entrepreneurship education emerged as the second most critically influential, statistically highly significant determining factor, thereby unequivocally proving that strategically designed, highly impactful academic interventions essentially possess an extraordinary, unparalleled capacity to massively amplify, purposefully direct, and highly effectively channel raw student enthusiasm into highly structured, economically viable, and profoundly socially impactful entrepreneurial frameworks. Consequently, the meticulous synthesis and profound integration of these highly complex analytical findings lead to the undeniable, scientifically absolute conclusion that the successful, highly sustainable cultivation of a vibrant, deeply impactful social entrepreneurship ecosystem within the incredibly complex environment of higher education institutions fundamentally requires a remarkably holistic, profoundly systemic, and exceptionally multi-dimensional institutional approach that meticulously integrates both targeted pedagogical modernization and comprehensive infrastructural reform.

Discussion

The immensely profound, remarkably multifaceted empirical findings meticulously generated and systematically synthesized throughout the exhaustive execution of this highly rigorous, comprehensively structured

scientific investigation provide an exceptionally compelling, deeply illuminating foundation for initiating a remarkably complex, highly nuanced, and broadly sweeping academic discourse specifically concerning the fundamentally pivotal, historically unprecedented role that contemporary higher education institutions must urgently assume in actively catalyzing, structurally supporting, and sustainably accelerating the highly complex developmental trajectory of social entrepreneurship. The profoundly concerning, statistically irrefutable observation confirming a widespread, deeply entrenched conceptual ambiguity and a pervasive lack of profound theoretical comprehension regarding the precise ontological parameters of social entrepreneurship among the vast majority of the extensively surveyed student demographic powerfully corroborates and significantly expands upon the foundational theoretical anxieties previously articulated by highly esteemed, internationally recognized scholars operating within this specialized academic domain [1]. This incredibly significant, undeniably problematic epistemological deficiency unequivocally highlights a remarkably critical, highly systemic vulnerability deeply embedded within the prevailing pedagogical architectures currently dominating the contemporary academic landscape, strongly suggesting that traditional universities are predominantly continuing to excessively prioritize the archaic dissemination of strictly theoretical, highly abstracted academic knowledge, whilst catastrophically failing to adequately integrate the profoundly essential, highly pragmatic conceptual frameworks that explicitly address and systematically dissect the profoundly complex, deeply intertwined socioeconomic and ecological dilemmas defining the modern globalized era [3].

Furthermore, the exceptionally robust, undeniably conclusive statistical evidence systematically derived from the meticulous execution of the highly advanced multivariate regression analysis powerfully reinforces the prevailing, widely accepted academic consensus which definitively postulates that the successful, highly sustainable creation of a remarkably vibrant, immensely productive academic entrepreneurship ecosystem is absolutely, unequivocally dependent upon the exceptionally harmonious, flawlessly synchronized integration of multiple diverse institutional components [4]. Specifically, the empirical validation undeniably demonstrating that the unparalleled quality and exceptional practical relevance of specialized entrepreneurship education profoundly and directly influence an individual student's deeply held behavioral intentions to actively engage in socially transformative entrepreneurial activities provides an irrefutable, remarkably powerful mandate for university administrators and academic curriculum designers to immediately orchestrate a remarkably profound, sweeping, and fundamentally transformative overhaul of all existing, largely outdated educational syllabi. This immensely urgent, fundamentally essential pedagogical metamorphosis absolutely must transcend the extraordinarily superficial, highly inadequate practice of merely appending isolated, theoretically dense elective modules to pre-existing academic structures; rather, it necessitates the remarkably profound, deeply systemic, and universally integrated infusion of experiential, highly practical social entrepreneurship principles, profoundly complex ethical problem-solving methodologies, and highly advanced systemic thinking paradigms directly into the fundamental core curricula of all diverse academic disciplines, flawlessly spanning

from the highly quantitative engineering sciences to the deeply qualitative liberal arts and humanities [2]. Ultimately, a highly rigorous, profoundly comprehensive interpretation of the intricately connected, wonderfully revealing data generated by this extensive study inevitably leads to the profoundly transformative conclusion that effectively unlocking the truly immense, largely dormant socioeconomic potential harbored within the university student population unequivocally demands an extraordinarily radical, fundamentally structural institutional paradigm shift, one that decisively transitions higher education institutions away from operating as highly isolated, theoretically insular ivory towers and rapidly transforms them into remarkably dynamic, deeply engaged, and wonderfully inclusive hubs of highly practical, exceptionally impactful societal innovation [5].

Conclusion

In final summation, this immensely comprehensive, methodologically rigorous, and profoundly analytical scientific investigation has exceptionally successfully illuminated the profoundly intricate, beautifully multifaceted, and remarkably complex dynamics that fundamentally characterize the highly challenging developmental trajectory of social entrepreneurship within the uniquely structured, heavily regulated ecosystem of contemporary higher education institutions. By meticulously executing a highly sophisticated, exceptionally robust quantitative research methodology that systematically aggregated and rigorously analyzed the profoundly diverse, deeply insightful perspectives of an incredibly vast and demographically representative cohort of active university students and experienced pedagogical professionals, this scholarly endeavor has provided remarkably compelling, undeniably irrefutable empirical evidence definitively

highlighting the absolutely critical, historically unprecedented necessity of fundamentally transforming traditional academic environments into remarkably vibrant, highly supportive, and exceptionally dynamic incubators specifically designed for the rapid cultivation of high-impact social innovations. The profoundly detailed, wonderfully revealing empirical findings systematically presented and comprehensively discussed throughout this extensive academic treatise unequivocally demonstrate that while an incredibly vast, largely untapped reservoir of profound intrinsic motivation and brilliant, highly innovative conceptual ideas undeniably exists among the socially conscious youth demographic, the successful, highly sustainable actualization of these profoundly promising entrepreneurial visions is currently being severely hindered and tragically constrained by a remarkably formidable, deeply entrenched constellation of systemic barriers, most prominently including the catastrophic inadequacy of specialized financial support mechanisms, the incredibly pervasive absence of profoundly practical, highly specialized educational curricula, and the fundamentally crippling lack of highly synergistic, deeply integrated collaborative networks connecting universities with the broader, highly dynamic commercial ecosystem.

Consequently, strategically overcoming these profoundly deeply rooted, highly complex systemic impediments unequivocally demands an extraordinarily unified, fundamentally collaborative, and remarkably comprehensive strategic effort necessitating the deeply committed, highly proactive participation of all major institutional stakeholders, including visionary government policymakers, innovative university administrators, deeply dedicated academic faculty members, and highly engaged representatives from the

private financial sector. Looking forward toward the profoundly exciting, immensely promising future horizons of this rapidly evolving academic domain, it is incredibly evident that substantially more extensive, wonderfully comprehensive, and deeply longitudinal scientific research is absolutely required to systematically evaluate the long-term, highly complex socioeconomic impacts generated by newly established university-based social business incubators, and to meticulously identify the most exceptionally effective, remarkably sustainable pedagogical methodologies capable of seamlessly transferring highly complex, exceptionally practical entrepreneurial competencies to incredibly diverse, deeply multifaceted student populations. Ultimately, the successful, deeply integrated realization of a remarkably robust, highly supportive social entrepreneurship ecosystem within the foundational architecture of the higher education system will not only phenomenally enhance the highly practical, real-world relevance of contemporary academic institutions, but it will also remarkably serve as a profoundly powerful, historically unprecedented catalyst for achieving incredibly broad, deeply sustainable, and wonderfully inclusive socio-economic development on a truly global scale.

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Message from the Editor-in-Chief

Prof. Chinedu M. Ogundele

Dear Colleagues, Scholars, and Contributors,

On behalf of the editorial board, I extend my deepest gratitude to all authors who have contributed to the latest volume of the *TLEP (Technology, Language, Education, and Psychology)* journal. Your dedication to advancing knowledge in these interdisciplinary fields is not only appreciated—it is essential to the continued growth and impact of our scholarly community.

Each manuscript submitted and published represents a valuable voice in the ongoing global academic dialogue. We thank you for choosing TLEP as the platform to share your original ideas, insightful analyses, and rigorous research.

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Let us continue fostering academic excellence and innovation together. We look forward to receiving your submissions and to further enriching our global academic discourse.

With sincere thanks and best regards,

Prof. Chinedu M. Ogundele

Editor-in-Chief

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