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Content

Arts

THE ROLE AND POSITION OF THE QANUN INSTRUMENT IN COMPOSERS' WORKS

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РОЛЬ И МЕСТО ИНСТРУМЕНТА КАНУН В ПРОИЗВЕДЕНИЯХ КОМПОЗИТОРОВ

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BESTECİ ESERLERİNDE KANUN ÇALĞISININ ROLÜ VE KONUMU

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Abstract

The presented article is dedicated to the study of the role of the qanun instrument in composers' works. The qanun instrument, with its rich and artistic timbral possibilities, has always been the focus of composers' attention, and our composers have entrusted solo parts to this instrument when creating their works. Prominent composers such as Zakir Baghirov, Suleyman Alasgarov, Haji Khanmammadov, Dadash Dadashov, Ilham Abdullayev, Oktay Zulfugarov have skillfully utilized the technical and timbral possibilities of the qanun in their works of various genres. Bikä Akhundova, a talented composer of our time, professionally characterized the instrument's timbre in her work "Fantasia" for qanun and piano. The qanun instrument has also earned a worthy place in the works of Turkish composers.

Аннотация

Представленная статья посвящена исследованию роли инструмента канун в произведениях композиторов. Инструмент канун с его богатыми и художественными тембровыми возможностями всегда находился в центре внимания композиторов, и наши композиторы, создавая произведения, доверяли этому инструменту сольные партии. Выдающиеся композиторы, такие как Закир Багиров, Сулейман Алескеров, Гаджи Ханмамедов, Дадаш Дадашов, Ильхам Абдуллаев, Октай Зульфугаров, в своих произведениях различных жанров искусно использовали технические и тембровые возможности инструмента канун. Талантливый композитор современности Бике Ахундова в своем произведении для кануна и фортепиано «Фантазия» профессионально охарактеризовала тембр инструмента. Инструмент канун также достойное место занял в произведениях турецких композиторов.

Özet

Sunulan makale, besteci eserlerinde kanun çalgısının rolünün araştırılmasına adanmıştır. Kanun çalgısı, zengin ve sanatsal tını olanaklarıyla her zaman bestecilerin ilgi odağı olmuş, bestecilerimiz eserler yaratırken bu çalgıya solo partiler emanet etmişlerdir. Önde gelen bestecilerimizden Zakir Bağırov, Süleyman Eleskerov, Hacı Hanmemmedov, Dadaş Dadaşov, İlham Abdullayev, Oktay Zülfikarov, farklı türlerdeki eserlerinde kanun çalgısının teknik ve tını olanaklarını ustalıkla kullanmışlardır. Günümüzün yetenekli bestecisi Bikä Ahundova, kanun ve piyano için yazdığı "Fantaziya" adlı eserinde çalgının tınısını profesyonelce karakterize etmiştir. Kanun çalgısı, Türk bestecilerin eserlerinde de kendine değerli bir yer edinmiştir.

Keywords: *qanun, Azerbaijani composers, East, timbre, genre, musical work, composer, rhapsody.*
Ключевые слова: *канун, Азербайджанские композиторы, Восток, тембр, жанр, музыкальное произведение, композитор, рапсодия.*
Anahtar Kelimeler: *kanun, Azerbaycan bestecileri, Doğu, tını, tür, müzik eseri, besteci, rapsodi.*

GİRİŞ: *Günümüzde cumhuriyetimizin müzik eğitimiyle ilgili tüm eğitim kurumlarında halk çalgıları-tar, kemençe, kanun, balaban ihtisasları öğretilmektedir. Çocuk müzik okullarında, sanat okullarında,* *orta ihtisas müzik okullarında, müzik kolejlerinde, hümaniter ve kültürel-eğitim kolejlerinde bu çalgılara ilişkin icracılık ihtisaslarına her yıl devlet tarafından öğrenci ve talebe kabulü gerçekleştirilmektedir. Cumhuriyetimizin yüksek müzik eğitimi kurumu olan Azerbaycan Devlet Konservatuvarı'nda, Devlet Kültür ve Sanat Üniversitesi'nde de tar, kemençe, balaban, kanun icracılığı öğretilmektedir. Tek kelimeyle, cumhuriyette üç aşamalı müzik-eğitim sisteminin tüm basamaklarında bu milli çalgıların öğretimi mevcut olmuştur ve olmaktadır. Halkımızın bu kadim müzik çalgılarının notalı müzik-eğitim sistemine dahil edilmesi, dahi besteci, müzikolog bilim insanı ve pedagog Uzeyir Hacıbeyli'nin en büyük hizmetlerinden biridir. Belirtelim ki, tar, kemençe, balaban - müzik okulları ve kolejlerde XX. yüzyıl boyunca bir ihtisas olarak işlenmişken, kanun çalgısı müzik eğitimine 1980'lerin ortalarından itibaren dahildir.*

Ancak ne yazık ki, halk çalgılarının öğretiminde yüz yıldır hüküm süren ciddi bir sorun bugün de çözüm bulamamaktadır. Mesele şudur ki, kanun çalgısı için bestelenen öğretim ve konser parçaları parmakla sayılacak kadar azdır. Bu çalgıda ilkelden yüksek seviyeye doğru eğitimin verilmesi, onların öğretim süreci, işlenen ihtisas dersleri sadece başka çalgılar (örneğin, piyano, keman, viyolonsel, flüt, obua vb.) için Avrupalı, Rus, Azerbaycanlı bestecilerin yazdıkları eserlerden aktarmalar sayesinde gerçekleşmektedir. Bunun dışında, yabancı ve Azerbaycanlı bestecilerin orkestra eserleri, opera ve balelerinden ayrı ayrı müzik örnekleri, film müziği, şarkı ve romanslar kanun için aktarılarak onun öğretiminde ders parçaları olarak kullanılmaktadırlar. Böyle ciddi ve gerçek bir nedenle ki, tam da kanun çalgısı için özgü öğretim-nota repertuvarı oldukça azdır. Bu ise kanundaki öğretimin başka çalgılar sayesinde organize edilmesine ve kurulmasına sebep olmaktadır.

ANA METİN: Azerbaycanlı besteciler, kanun çalgısının teknik olanaklarını ve hoş tınısını dikkate alarak bu çalgı için birkaç renkli eser bestelemişlerdir. Kanun çalgısı için büyük hacimli eserler, önde gelen bestecimiz Zakir Bağırov, Süleyman Eleskerov ve Dadaş Dadaşov tarafından yazılmıştır. Z.Bağırovun kanun ve iki arp için rapsodisi, Süleyman Elekberov'un kanun ve orkestra için "Poema"sı, Dadaş Dadaşov'un kanun için konçertosu büyük hacimli eserler arasında sayılabilir. Bununla birlikte bestecilerimizin birçok küçük hacimli eserinde de çalgı kendi yerini bulmuştur. Örneğin: Hacı Hanmemmedov'un "Arzu dansı", "Bahar süiti", "Bahar melodileri", "Sözsüz şarkı", "Karabağ havaları" gibi eserlerini gösterebiliriz.

1993 yılında kanun çalgısı İlham Abdullayev'in yaratıcılığında da kendine yer edinmiştir. Öyle ki, bestecinin kanun ve piyano için bestelediği 2 parçada çalgının ince ve lirik tınısı karakterize edilmektedir.

1990-2001 yılları arasında önde gelen bestecimiz Ağadadaş Dadaşov, kanun ve piyano için birbirinden ilginç eserler yaratmaktadır: "Poema", kanun ile piyano için parçalar, "Çinare'nin sevinci" vb.

"Çinare'nin sevinci" eseri, yazar tarafından yetenekli kanun icracısı, Azerbaycan Cumhuriyeti'nin Halk Sanatçısı Haydarova Çinare Yaşar kızına adanmıştır.

1997 yılında Oktay Zülfikarov, kanun ve piyano için "Konser parçası" ve "Beşik şarkısı" yazmaktadır. Bu eserlerin her birinde kanun çalgısının kadim ve harikulade tınısı kendi ifadesini bulmaktadır.

Kanun çalgısı, günümüzün yetenekli bestecisi Bikä Ahundova'nın yaratıcılığında da tecessüm edilmiştir. Bestecinin kanun için yazdığı "Kapriççio", onun öğrencisi Arzu Abbasova'nın kanun için "Dostluk dansı" çalgının teknik ve tını olanaklarını daha derinden sergilemektedir.

Belirttiğimiz gibi, kanun için ilk profesyonel eseri yazan besteci Zakir Bağırov olmuş ve bu eser 1964 yılında 2 Arp'ın eşliğinde Moskova'da Kremlin Sütunlu Salonu'nda Asya Tagiyeva'nın icrasında başarıyla seslendirilmiştir [4, s.10].

Milli profesyonel kanun icracılığı sanatında önemli bir olay olan Asya Tagiyeva'nın yaratıcılık faaliyeti, kanun geleneklerinin başlıca gelişim aşamalarını oluşturmuştur. Zakir Bağırov'un kanun ve iki arp için rapsodi eseri, Asya Tagiyeva'nın repertuvarında önemli bir yer tutarak icracı tarafından en çok sevilen eserlerden biri olmuştur. Asya Tagiyeva bu eseri ünlü arp icracısı Aida Abdullayeva ile birlikte seslendirmiştir. Asya Tagiyeva'nın icra sırasında önünde duran başlıca görev, sadece parlak virtüözlüğün sergilenmesi değil, aynı zamanda icranın akıcı ahenk ve uyumunu ve süslemelerle bezenmiş melizmaları göstermekten ibaretti. Bundan başka eserde kanun partisinin uzun arpej ile karmaşıklaştırılmasına rağmen, bu arpejlerin icrası sırasında A.Tagiyeva her parmağın ses düzenliliği ve düzgünlüğü, ayrıca aplikatür (parmak numarası) doğruluğunu sağlamıştır. İcracı, bestecinin iyimser hayat duygusunu tüm ayrıntılarına kadar canlandırmış, besteci fikrini orijinal biçimde yorumlayarak kanun çalgısının olanaklarından ileri gelen yeni fikirleri hayata geçirmiştir. İcracı her zaman ellerin doğru yerleştirilmesine kontrol ederek, teknik pasajların doğru çalınmasına ve notanın üzerinden doğru okunmasına ciddiyetle yaklaşırdı. A. Tagiyeva, kanun repertuvarına hassasiyetle yaklaşarak Azerbaycanlı bestecileri kanun için eserler bestelemeye çağırıyor ve bu alandaki boşluğun doldurulmasına çalışıyordu.

Azerbaycan'dan farklı olarak Türkiye'de kanun için çok sayıda büyük hacimli eser bestelenmiştir. Bunlardan Hasan Ferid Alnar'ın kanun için konçertosunu örnek göstermek olanaklıdır. Geleneksel Türk müziğinin gerek sanatsal, gerekse teknik olanakları bakımından en güzel ve öncü çalgılarından biri olan kanun için bestelenmiş bu konçertoda doğu-batı sentezi dikkati çekmektedir. Konçerto 1944-1951 yılları arasında bestelenerek, bestecinin bu çalgıya olan sevgisini ve minnettarlığını tecessüm ettirmektedir. Kanun için konçerto Viyana'da ilk kez seslendirilerek, daha sonra yeniden edite edilmiş ve üçüncü bölüm yeniden bestelenmiştir.

Konçerto, imgelem çemberine göre renkli olup, burada lirik, dramatik ve yaşamsever imgelem çemberi övülerek yüceltilmekte, bestecinin yeteneğinin ve yaratıcılık çizgisinin en güzel özellikleri kendi yansımasını bulmaktadır. Lirik imgelemlerin şarkımsı plastikliği, müzik dilinin zengin melodikliği, sadeliği ve içtenliği eserin dikkat çekici özelliklerindendir. Hasan Ferid Alnar'ın kanun için konçertosu bu tür için geleneksel olan biçimde bestelenerek üç bölümden ibarettir: I. bölüm Moderato, II. bölüm Lento non troppo, III. bölüm Allegro poco Moderato.

Eserin tempo göstergesine göre giderek dinamilik kazanan bölümlerinde yükselen çizgiyle lirik karakterli müzik imgeleri ölçülü biçimde ardıl olarak açıklanmaktadır. Bununla birlikte konçertonun bölümlerini birleştiren genel bir ruh hali hüküm sürmektedir ki, bu da liriğin tecessümüyle ilgilidir. Müzik imgelerinin renkliliği sayesinde eserin karakteri daha renkli nüanslar kazanmaktadır. Konçertonun tüm temaları ruhuna göre birbirine yakın olup, keskin kontrastlık oluşturmamakta ve sanki bir tema diğerini tamamlayarak genel bir manzaranın, ruh halinin yaratılmasına hizmet etmektedir.

Eserin temaları, kanun çalgısının icracılık tekniğini sergilemek için elverişli olanaklara sahip olup, temaların gelişiminde motif işlemeleri, varyantlı elementlerin tekrarı, sekans tipi hareket biçimleri büyük rol oynamaktadır. Kanun ile orkestranın imitasyonlu (taklitli) seslendirmeleri ve polifonik gelişim sayesinde temalar bazen akıcı ve özgür karakter kazanmaktadır. Bazen ise ana temanın metroritmik bakımdan yumuşamasıyla daha ılımlı bir karakter almaktadır. Özellikle işleme karakterli bölümlerde pasajların ardıl olarak verilmesi seslendirmeye tezatlık getirmektedir. Diğer taraftan melodilerin gelişim sürecinde makam-tonalite değişimleri de dikkati çekmektedir. Öyle ki, makam çeşitleri, perdelerin kromatik değişimleri seslendirmeye renklilik getirmektedir. Aynı zamanda melodilerin dayanak perdelerinin de sık sık değişmesi, hareket sürecinde yeni makam yönelimlerine yol açarak müzik dilini zenginleştirmektedir.

Genel olarak, konçertonun müzik dilinin makam-tonalite karşılaştırmaları ve dinamik nüanslar (vurgu, çekiş vb.) bakımından zengin olduğunu söylemek gerekir. Eserde temaların gelişimi aşamalı şekilde verilerek, belirli aşamada temanın işlenmesinde polifonik üslup kendini göstermektedir. Solistin ve orkestranın partisyonundaki melodik çizgiler kontrpuan oluşturarak, bu tür polifonik dokumada her bir melodik çizginin anlatımcılığı ön plana çekilmektedir. Eserin bölümleri içinde ve bölümleri arasında keskin bir çatışmanın olmamasına rağmen, tüm temalar bir bütün dinamik gelişime tabi kılınmıştır. Dramaturji, amaç yönelimli gelişimiyle dikkati çekmektedir. Eserde geleneksel Türk müziğinde kullanılan ve Türk müzikologlarının adıyla bilinen Arel-Ezgi-Uzdilek Sistemine göre (halihazırda kullanılan ses sistemi) belirlenen basit, transpozisyonlu (yer değiştirmeli) ve karmaşık makamlar doğal olarak temperasyonlu sisteme adapte edilmiştir.

Azerbaycan'da kanun için ilk konçerto Dadaş Dadaşov tarafından bestelenmiştir. D. Dadaşov'un 2009 yılında bestelediği kanun ve senfonik orkestra için 3 bölümlü Konçertosu, müzik kültürümüzde önemli bir adım olmuştur. İlk icrayı izlemiş müzikolog Lalə Hüseynova'nın anılarından: "2012 yılında Ukrayna'da düzenlenen Azerbaycan müzik günlerinde ve Tataristan'da gerçekleşmiş Türk Dilli Ülke bestecilerinin I. Müzik Festivali'nde" seslendirilen bu icraları doğrudan izleme imkanı elde etmiş bir kişi olarak belirtmeliyim ki, Dadaş Dadaşov'un kanun konçertosu dinleyiciler ve uzmanlar tarafından özel bir beğeniyle karşılanmış, haklı olarak yüksek övgülere layık görülmüştür. Kadim kanun çalgısının kendine özgü tını rengini büyük senfonik orkestrin zengin paletesiyle uzlaştırmış olan besteci, müzik dokusunu milli müziğin çekici, değişken ve karmaşık ritim-entonasyon formülleri üzerine kurmakla başarılı sanatsal sonuç elde etmiştir. Eserin erdemleri hakkında ünlü besteciler tarafından dile getirilen değerli görüşler, Dadaş Dadaşov'un bu eserinin hiç şüphesiz ki gerçek başarısından haber vermektedir" [2, s. 9]. Bu eser, kanun için yazılmış ilk konçerto örneği olup, burada yeni orkestra üslubu, tını seçimi, armoni, evrim sürecinden geçmiş biçim çözümünü gözlemlemek mümkündür. Konçertoyu hayata geçiren ana fikir ise, Türkiye kanun icracılık okulunun farklı yöntemlerini, konçerto türünün ana ilkeleri - parlak icracılık efektleri, virtüözlük, doğaçlama, orkestra ve solist arasında yarışma ilkesini koruma şartıyla milli müziğe getirmekti. Bu eser, konçertoluktan çok senfonizme yakın olan bir kompozisyondur. İki karşıt dünyanın - Batı ve Doğu'nun kavşağında ortaya çıkmış, milli çalgılar için yazılan konçerto türü, her iki dünyanın *erdemlerini kendinde birleştirmekle bu düşünce tarzlarının da yan yana ve birleşmiş şekilde var olabileceğini kanıtlamıştır. Bu eserin başlıca erdemlerinden biri de, ortaya çıkmasıyla kanun icracılık okulunu daha yüksek profesyonel seviyeye yükseltmenin yanı sıra, yeni taleplere uyum sağlayabilen kanun icracıları yetiştirmesidir.*

Azerbaycan ve Türkiye'de kanun için bestelenmiş eserleri analiz ederken şu sonuca varıyoruz ki, Türkiye'de kanun için eserler sadece sağ el partisi için bestelenmektedir. Sol elin eşlik partisi, icracı tarafından icra sırasında belirlenmektedir. Yani icracı, sol elin temasını kendi yorumlarına dayanarak icra eder ki, bu da eserlerin farklı tarzda seslenmesine yol açmaktadır. Tarafımızdan kanun için aktarılmış eserlerde ise biz farklı şekilde olarak sağ ve sol ellerin temasını somut bir şekilde sunmuşuzdur. Yani her icracı, eserin sol el temasını somut olarak notada gördüğü gibi icra etmelidir.

Orta Çağ'dan itibaren müzik kültüründe Azerbaycan kanunu, Türk kanunu, Arap kanunu ve İran kanunu yaygınlaşmıştır. Bu sınıflandırmada aynı adı taşıyan ve aynı türdeki çalgılar, Kadim Doğu bölgesine dahildirler. Kanun çalgısının bu türlerini bölgesel amil esasında sınıflandırmışız. Önemli meselelerden biri de "Arap kanunu" ile ilgilidir. Bir kural olarak, Azerbaycan ve Doğu müzikolojisinde Mısır ve Bağdat kanunlarının adı geçmektedir. Ancak, Orta Çağ'da kanun çalgısı artık Arap halklarının yaşadıkları tüm Arap ülkelerinde: Mısır, Irak, Cezayir, Fas, Suriye, Yemen, Lübnan, Suudi Arabistan, Katar vb. yaygınlaşmıştır. Bu tarihi gerçeği dikkate alarak tüm Arap ülkelerinde icra edilen kanun çalgısını "Arap kanunu" olarak adlandırmak mümkündür. Onların bazıları arasında yapı ve tellerinin sayısına göre küçük farklar olsa da, XIX. yüzyılın sonlarından itibaren bu farklar giderilmiştir. Milattan önce ise bu çalgı, modern Arapların kadim vatanı olan Mısır'da ortaya çıkmış, oradan Cezayir ve Fas'a geçmiş, sonra ise İspanya'ya geçerek Avrupa'da yayılmıştır. Bu bakımdan Araplarda kanun ilk kez Mısır kanunu olarak ortaya çıkmış, daha sonra Mağrip (Batı) ve Meşrik (Doğu) Araplarının halk çalgısına dönüşmüştür. Cemle'den İslam'a kadar bu çalgı Irak'ta ve Suriye'de yaygınlaşmıştır. Ancak, İslam dininin ilk dönemleri - Abbasiler döneminde (X-XI), Bağdat'ın Arap hilafetinin başkenti haline gelmesi, Arap biliminin ve kültürünün rönesans yaşaması sonucunda bu başkent şehri, Yakın ve Orta Doğu'nun, Asya'nın müzik bilimi ve icracılığı alanında bir merkeze dönüşmüştür. Bağdat'ın felsefe, şiir ve sanat meclislerinde, eğlence etkinliklerinde telli çalgılardan kanun, ud, çenk, rübab gibi kanun da yaygın olarak kullanılmaya başlanmıştır.

Kanun çalgısı denildiğinde hem Azerbaycan kanunu, hem Türkiye kanunu, hem de Arap kanunu kastedilmektedir. Çünkü kanun dendiğinde tüm Doğu ülkelerinin müzik kültürü hatırlanır. Yani kanun, Doğu kültürüne has olan bir müzik çalgısıdır. Ancak Azerbaycan kanunu, Türk, Arap ve İran kanunlarından düzenleyicilerinin (mandal) sayısına göre farklı bir özelliktedir. 1920 yılından sonra Uzeyir Hacıbeyli'nin girişimiyle Avrupa sistemine geçerek, milli çalgılarımızda bulunan 4/1 tonları kullanmadık. Biz 4/1 tonları ancak muğamlarımızda kullanıyoruz. Uzeyir Hacıbeyli, halkımızın nota eğitiminin gelişmesi için Avrupa sisteminden yararlanmaya yöneltti. Bununla da biz muğamlarımızı ve halk sanatımızı dünyaya tanıtabilme hakkına sahip olduk.

Bizim kanun çalgısında düzenleyicilerin sayısı 4'e kadar iken, Arap ve Türk kanunlarında ise 8-13'e kadar olmaktadır. Her milletin kendi melizmaları olup, söz konusu melizmalar 4/1 tonla ifade edilmektedir. Bizim kanun çalgımız da diğer halkların kanun çalgısından düzenleyicilerin sayısına göre farklılaşmaktadır.

Günümüzde kanun icracılığında bir dizi yenilikler yaşanmaktadır. Öyle ki, Türkiyeli icracı - Taksim üçlüsünün icracısı Aytaç Doğan'ın icracılık üslupları Azerbaycan'da kanun icracılığında geniş şekilde uygulanmaktadır. Örneğin: a) günümüzde kanun çalgısı her iki ayağın üzerine dayanarak icra edilmektedir; b) Glissando süslemesi daha karmaşık bir teknik yöntemle gerçekleştirilmektedir: bir telde "do" notası vurularak, teli çekmekle ya da anahtarın arkasıyla glissando icra edilmektedir; c) Tremolo süslemesi tek elle icra edilmektedir. Aytaç Doğan, kanun çalgısına gitar üslubu getirmekle kanun icracılığını daha modern bir şekilde sunmuştur.

SONUÇ: *Böylelikle, büyük ve tarihi bir yol kat etmiş olan kanun çalgısı, halkımızın hayat ve gündelik yaşamına dahil olarak şekillenmiş ve geliştirilmiştir. Kanun çalgısı hem Azerbaycan hem de Türkiye'de yaygınlaşmış, bu iki kardeş ülkenin müzik kültüründe önemli rol oynamıştır. İster Azerbaycan ister Türkiye'de olsun, kanun çalgısı profesyonel bestecilerin farklı türlerdeki eserlerinde kendi tecessümünü bulmuş ve bu çalgı için birbirinden renkli eserler yazılmıştır. Azerbaycan ve Türkiye'de kanun için bestelenmiş eserleri analiz ederken şu sonuca varıyoruz ki, Türkiye'de kanun için eserler sadece sağ el partisi için bestelenmektedir.*

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Astronomy

GROUND OBSERVATION METHODS IN THE OPTICAL RANGE WITH HIGH ANGULAR RESOLUTION

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Abstract

The paper considers and analyzes the methods of ground-based observations in the optical range. These methods make it possible to achieve a high level of angular resolution close to the diffraction limit of ground-based optical telescopes used for observations. Of particular interest is the method of spatial interferometry, with the help of which the diameters of a number of stars were estimated, the diameters and shape of several asteroids, Pluto, the parameters of the orbit of Charon and many binary stars were determined. At present, multi-coupled adaptive optics systems have been created that separately compensate for atmospheric turbulence at different heights. Using several laser reference sources spaced across the field of view of the receiver, this system helped to increase the corrected field of view up to 1–2 arc minutes.

Keywords: Ground-based observations, angular resolution, stellar interferometer, adaptive optics, reference star.

Introduction. Despite the limitations on the angular resolution of ground-based optical telescopes imposed by the turbulence of the Earth's atmosphere, astronomers have never ceased to seek ways to obtain images or perform angular measurements from the Earth's surface in the optical spectrum with a resolution close to the diffraction limit of modern large telescopes [6].

Stellar Interferometer

The ultimate angular resolution of a telescope is limited by the diameter of its aperture. Furthermore, angular resolution is severely degraded by wavefront distortions caused by atmospheric turbulence. To achieve higher angular resolution, stellar interferometers are employed.

The concept of the stellar interferometer was first proposed by A. Michelson in 1890. The wavefront from a distant, small source can be considered planar. If two sections of such a wavefront are taken at a certain distance from each other and optically superimposed, an interference pattern can be observed. If the phase difference between these sections is precisely aligned, interference can be observed even in white light. A device for such superimposition—the stellar interferometer—was developed by Michelson (see Fig. 9). The distance (separation) between the two input mirrors of the interferometer is called the baseline [8].

Now, let us imagine that instead of a single small, distant light source, we have two, where the line segment connecting them in the sky lies along the instrument's baseline. In this case, each source will generate its own interference pattern. Since the wavefronts from the different sources form a small angle θ*, the condition for a minimum (or maximum) of the interference pattern cannot be simultaneously satisfied for both due to the phase difference.*

Simply put, the interference fringes from two such sources are always shifted relative to one another. This shift is proportional to the interferometer baseline and the angular separation between the sources in the sky. Since we are dealing with light interference, this shift varies for different wavelengths (λ*). If we consider a monochromatic pattern (using a narrow-band filter), under certain conditions, the interference patterns combine in anti-phase, and the fringes appear blurred (become indistinct). This occurs when the maximum condition for one pattern coincides with the minimum condition for the other, satisfying the relation* $\theta=\lambda/2d$*, where* θ *is the angular distance between the sources,* λ *is the wavelength of light, and d is the interferometer baseline.*

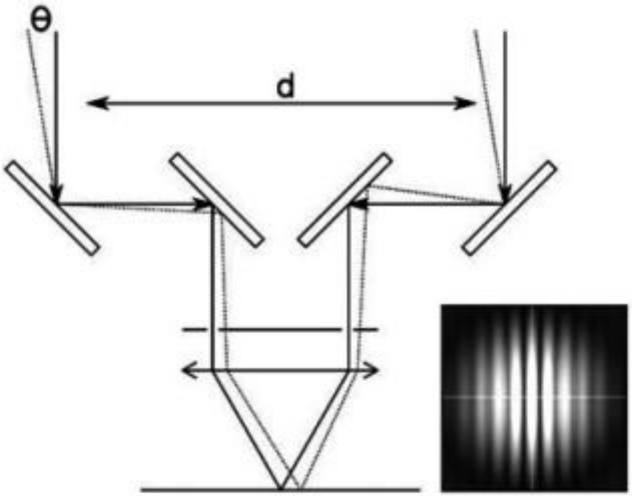

Fig. 9. Schematic of Michelson's stellar interferometer and the interference pattern.

Formally, the blurring of the interference pattern has a well-defined numerical expression. This is known as visibility (or fringe visibility). If we have a fringe pattern represented as a quasi-periodic function, where I_{min} is the minimum intensity and I_{max} is the maximum intensity, then the visibility is defined by the expression:

$$V = (I_{max} - I_{min})/(I_{max} + I_{min}).$$

This value lies within the range [0,1].

In practice, measuring the angular distance between sources reduces to obtaining the experimental dependence of visibility on the baseline, V(d). In this process, the baseline itself must vary.

This means that it is necessary either to physically move the input apertures of the interferometer or to observe the projection of the baseline onto the perpendicular to the direction of the source as the latter moves across the sky due to the Earth's diurnal rotation. In the latter case, a special delay line is required to compensate for the resulting phase difference [2, 3].

Since any extended source can be represented as a collection of point sources, Michelson's stellar interferometer is also suitable for measuring the angular diameters of stars. This was first accomplished by Michelson himself in 1920. The angular size of the star Betelgeuse was measured and found to be 0,047 arcseconds. The resolution of modern interferometers exceeds this value by at least a factor of 100, i.e., it is on the order of 0,0005 arcseconds. This makes it possible to directly resolve the components of the contact binary system W UMa, located at a distance of about 50 pc from us.

The resulting image will have a significantly higher angular resolution compared to a single exposure with a duration equal to the sum of the individual frames. For a long time, the application of this method for improving angular resolution was limited by the lack of detectors with low readout noise for individual frames. However, in recent years, with the advent of electron-multiplying CCDs (EMCCDs) and low-noise CMOS cameras, this method has been gaining popularity [1].

In 1970, Antoine Labeyrie proposed a method of spatial interferometry based on the analysis of the granular structure of an object's image, which later became known as speckle interferometry (from the English word speckle—a small spot or speck). In the speckle interferometry method, series of magnified stellar images are recorded with exposure times of hundredths of a second; on such images, individual speckles are registered even more clearly. Each such speckle resembles a diffraction disk in the focal plane of an ideal telescope operating outside the atmosphere. Computer-based statistical analysis of the obtained series of speckle images allows the study of bright objects with high resolution. Using speckle interferometry, the diameters of a number of stars were estimated, the diameters and shapes of several asteroids and Pluto were determined, and the orbital parameters of Charon and many binary stars were established [4].

In practice, both of the above-described methods make it possible to achieve an angular resolution close to the diffraction limit of the telescope used for the observations.

Adaptive Optics in Astronomy

Despite individual successes in methods for improving angular resolution during ground-based observations, astronomers required systems capable of eliminating image blurring caused by the Earth's atmosphere during long exposures.

In astronomy, the concept of using an active optical element to compensate for wavefront distortions introduced by the Earth's atmosphere was first implemented at the Haute-Provence

Observatory in 1989. The telescope–detector system was supplemented with a wavefront sensor and an active correction element—a deformable mirror. This mirror consists of a thin reflective plate with a mirrored surface on one side and a network of actuators for controlled surface deformation on the other. The actuators allow the shape of the mirror surface to be altered at frequencies of up to several hundred hertz. Thus, a portion of the light beam from the telescope is directed to the sensor that registers wavefront distortions; the measurement results are processed by a computer, which then generates a command to alter the shape of the deformable mirror to compensate for the distortions [7].

The main difficulties during the initial stage of adaptive optics development were related to the low amount of light arriving from the observed objects. Consequently, only the brightest stars could be utilized as guide stars for the wavefront sensors to reconstruct the distortion parameters.

Given that during the first stage, the maximum field of view in which the wavefront pattern could be reconstructed was only tens of arcseconds, it was possible to operate using natural guide stars over less than 10% of the sky.

In the 1990s, an "artificial star" began to be used as a reference source for wavefront reconstruction. Utilizing a laser mounted parallel to the optical axis of the telescope, emission from atomic sodium was excited in the mesosphere at an altitude of 90–100 km, ensuring that the resulting light source was within the telescope's field of view and could be used as a guide star.

Further developments in the 21st century led to the creation of so-called multi-conjugate adaptive optics systems, which separately compensate for atmospheric turbulence at different altitudes. This allowed the corrected field of view to be expanded up to 1–2 arcminutes. Systems currently under development to correct even larger fields of view utilize not just one, but several laser guide star sources spaced across the detector's field of view [5].

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Cultural sciences

DEVELOPING LANGUAGE SKILLS THROUGH INTERCULTURAL COMMUNICATION

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Abstract

Intercultural communication has emerged as a pivotal pedagogical framework for fostering foreign-language acquisition beyond the boundaries of traditional classroom instruction. This study examines whether structured intercultural exchange — encompassing digital correspondence, collaborative project work, and immersive face-to-face encounters — produces measurable gains across four language skill domains: listening, speaking, reading, and writing. Using a mixed-methods design, 120 university-level participants enrolled in English as a Foreign Language (EFL) programs were followed over two academic semesters. Quantitative data were collected through standardised pre- and post-tests aligned with the Common European Framework of Reference (CEFR), while qualitative insights were drawn from reflective journals, semi-structured interviews, and instructor observations. Results indicate statistically significant improvement in oral fluency ($p < 0.01$) and pragmatic competence ($p < 0.05$), with moderate gains in writing complexity. Thematic analysis reveals that authentic communicative need, reduced anxiety in culturally affirming contexts, and exposure to varied registers are the primary mechanisms mediating language growth. These findings support an intercultural communicative competence model as a supplement to, or partial replacement of, decontextualised grammar-focused instruction.

Keywords: intercultural communication, language acquisition, communicative competence, EFL, cross-cultural exchange, pragmatic competence

1. INTRODUCTION

The globalisation of education, commerce, and digital communication has transformed the conditions under which individuals acquire and use foreign languages. Where previous generations encountered a target language primarily through textbooks, scripted audio recordings, and classroom role-plays, contemporary learners increasingly interact with native and non-native speakers from diverse cultural backgrounds through social media, international exchange programmes, and multinational workplaces. This shift has renewed scholarly and pedagogical interest in the relationship between intercultural communication and language development (Byram, 2021; Kramsch, 2019).

Intercultural communication can be broadly defined as any communicative event in which participants bring different cultural backgrounds, assumptions, and communicative conventions to a shared interaction (Gudykunst, 2003). Within language education, intercultural communicative competence (ICC) describes the capacity to communicate effectively and appropriately with interlocutors from other cultures, drawing on linguistic knowledge, cultural empathy, and strategic flexibility (Deardorff, 2006). Researchers have argued that developing ICC not only equips learners with practical cross-cultural skills but simultaneously accelerates the acquisition of vocabulary, syntax, pragmatic norms, and discourse patterns in the target language (Fantini, 2020).

Despite growing theoretical consensus on the value of intercultural approaches, empirical evidence documenting their specific effects on discrete language skill domains remains uneven. Studies focusing on oral communication have proliferated (cf. Baker, 2022; Liddicoat & Scarino, 2013), whereas systematic investigations of reading and writing gains within intercultural frameworks are comparatively scarce. Furthermore, much existing research is limited by small sample sizes, short intervention periods, or exclusive reliance on self-report measures.

This study addresses these gaps by longitudinally tracking 120 EFL learners across a two-semester intercultural exchange programme, employing both standardised assessments and qualitative instruments to capture skill development at multiple levels. The central research questions are: (1) Does participation in structured intercultural communication activities produce statistically significant gains across the four core language skill domains? (2) What qualitative mechanisms underpin observed language development? (3) How do individual learner variables — including prior intercultural experience and cultural distance — moderate outcomes?

2. METHODS

2.1 Research Design

A convergent parallel mixed-methods design was adopted, wherein quantitative assessment data and qualitative narrative data were collected concurrently and subsequently integrated at the interpretation stage (Creswell & Plano Clark, 2018). This design was chosen to enable statistical generalisation across the sample while preserving the contextual richness required to understand the mechanisms of language development in intercultural settings.

2.2 Participants

Participants (N = 120; 68 female, 52 male; mean age = 21.4, SD = 2.1) were recruited from two state universities in Central Asia. All were enrolled in EFL degree programmes and assessed at CEFR levels B1–B2 at intake. Participants were paired with exchange counterparts from universities in Germany, the United Kingdom, and South Korea through a university-consortium agreement, ensuring exposure to typologically distinct languages and cultural contexts. Informed consent was obtained, and ethical approval was granted by the institutional review board of each participating institution.

2.3 Intervention

The intervention spanned two academic semesters (approximately 32 weeks) and comprised three components. First, a structured e-tandem programme required participants to engage in weekly video calls (minimum 60 minutes) with their international partner, alternating target-language and partner-language use within each session. Second, participants completed monthly collaborative writing tasks — reports, essays, and creative narratives — co-authored asynchronously via shared documents, enabling sustained engagement with writing conventions in an authentic communicative context. Third, a two-week residential exchange at the end of the first semester immersed participants in the partner institution's academic and social environment, offering intensive face-to-face interaction. Instructors provided reflective debriefing sessions following each component to facilitate guided noticing of linguistic and cultural phenomena.

2.4 Data Collection

Language proficiency was assessed at three time points: baseline (T0), post-semester-one (T1), and post-semester-two (T2). Standardised tests aligned to CEFR descriptors were used for each skill domain: the Cambridge Linguaskill suite for listening and reading, a validated rubric-based oral proficiency interview for speaking, and a holistic analytical scoring guide for writing samples. Inter-rater reliability for speaking and writing was established through double-blind scoring (Cohen's $\kappa = 0.82$ and 0.79, respectively). Qualitative data comprised weekly reflective journal entries (totalling approximately 320,000 words corpus-wide) and semi-structured interviews ($n = 30$, purposively sampled for maximum variation in proficiency trajectory and cultural pairing).

2.5 Data Analysis

Quantitative data were analysed using repeated-measures analysis of variance (RM-ANOVA) with Bonferroni-corrected post-hoc comparisons to identify significant differences across time points for each skill domain. Effect sizes were calculated using partial eta-squared (ηp^2). Qualitative data were subjected to reflexive thematic analysis following Braun and Clarke's (2006) framework, with initial codes generated inductively from journal entries and interviews, subsequently consolidated into overarching themes. Member-checking with a sub-sample of participants ($n = 10$) confirmed interpretive plausibility.

3. RESULTS

3.1 Quantitative Outcomes

Table 1 presents mean scores for each skill domain across the three assessment time points. RM-ANOVA revealed a significant main effect of time for all four skill domains (all $p < 0.05$). The largest gains were observed in speaking, where mean scores increased from 54.3 (SD = 8.1) at T0 to 71.6 (SD = 7.4) at T2 — a gain of 17.3 points — with a large effect size ($\eta p^2 = 0.61$). Listening improved from 58.1 to 69.8 ($\eta p^2 = 0.44$). Writing demonstrated a moderate but significant improvement (T0: 51.2; T2: 61.7; $\eta p^2 = 0.38$). Reading showed the smallest effect (T0: 62.4; T2: 68.9; $\eta p^2 = 0.22$), though the gain remained statistically significant.

Table 1. Mean Proficiency Scores (0–100 scale) Across Time Points by Skill Domain

Skill Domain	T0 Baseline M (SD)	T1 Mid-point M (SD)	T2 Final M (SD)	Effect Size ηp²
Speaking	54.3 (8.1)	63.8 (7.8)	71.6 (7.4)	0.61***
Listening	58.1 (7.5)	64.2 (7.1)	69.8 (6.9)	0.44***
Writing	51.2 (9.3)	56.1 (8.8)	61.7 (8.5)	0.38**
Reading	62.4 (6.8)	65.1 (6.5)	68.9 (6.3)	0.22*

*Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. N = 120.*

Post-hoc comparisons showed that T0–T1 gains for speaking and listening were already significant ($p < 0.01$), indicating that substantial oral development occurred during the first semester, likely *facilitated by the weekly video-call component and the residential exchange. Writing and reading gains, while smaller, reached significance only at T2, suggesting that their development requires a more sustained period of engagement.*

Regarding moderating variables, prior intercultural experience (operationalised as having lived abroad for more than three months) was significantly associated with higher baseline speaking scores but did not predict the rate of gain, indicating that the programme produced comparable growth regardless of prior exposure. Cultural distance — operationalised using Hofstede's cultural dimensions index — was marginally associated with larger pragmatic competence gains among learners paired with culturally distant partners ($r = 0.29$, $p < 0.05$), though the effect was modest.

3.2 Qualitative Themes

Thematic analysis of journal entries and interview transcripts yielded three overarching themes. The first, authentic communicative need, describes participants' consistent reports of increased motivation and linguistic effort when communicating with real interlocutors who did not share their cultural background. One participant wrote: "I realised that if I used the wrong register or idiom, my partner would genuinely misunderstand me — that fear made me pay attention to language in a way that exercises never did." This theme aligns with sociocultural theories of language acquisition, which posit that authentic need drives interaction-based learning (Vygotsky, 1978; Lantolf & Thorne, 2006).

The second theme, affective safety and reduced anxiety, emerged from accounts of participants feeling less judged for errors in intercultural settings than in formal classroom contexts. Instructors' observations supported this finding: participants who displayed notably high classroom anxiety were observed to self-correct more spontaneously during video-call debriefs than in teacher-fronted lessons. This pattern resonates with Krashen's (1982) affective filter hypothesis and more recent research on the role of psychological safety in L2 acquisition (MacIntyre & Mercer, 2014).

The third theme, register and cultural mediation, reflected participants' growing awareness of how cultural norms shape linguistic choices. Several participants described negotiating between formal and informal registers when composing collaborative writing tasks, citing their partner's feedback as a key input. Pragmatic errors — such as inappropriate levels of directness or culturally unmarked forms of disagreement — were frequently flagged in journals as "moments of realisation" that prompted targeted self-study.

4. DISCUSSION

The findings of this study provide robust empirical support for the proposition that structured intercultural communication activities produce meaningful gains across all four language skill domains in EFL learners at the B1–B2 proficiency level. The prominence of speaking and listening gains is consistent with interaction-based theories of L2 acquisition, which emphasise that negotiation of meaning in real-time interaction is among the most potent drivers of both fluency and lexical consolidation (Long, 1996; Gass & Selinker, 2008). The e-tandem and residential exchange components directly instantiate these conditions by requiring learners to manage genuine communicative breakdowns and to repair misunderstanding through metalinguistic negotiation.

The moderate but significant writing gains deserve particular attention. Writing development in intercultural contexts has received comparatively little empirical attention (Ware & Kessler, 2022), yet the present findings suggest that co-authorship across cultural lines may be an especially productive context for writing development. When co-writing with a partner from a different rhetorical tradition, learners are exposed to divergent textual norms — differences in paragraph structure, evidentiality conventions, and hedging strategies — that may heighten metalinguistic awareness and broaden the learner's written repertoire (Connor, 2011). Future research should examine writing quality at a more granular level, distinguishing between gains in grammatical accuracy, lexical sophistication, and discourse-level coherence.

The qualitative mechanisms identified in this study — authentic communicative need, affective safety, and register awareness — converge with the central tenets of communicative language teaching (CLT) and its contemporary extension, task-based language teaching (TBLT). Intercultural exchange programmes embody what Ellis (2003) terms "real-world tasks": activities that replicate genuine communicative purposes rather than simulating them for pedagogical ends. The affective dimension is particularly theoretically significant: anxiety reduction in intercultural contexts may constitute a distinctive mechanism not fully captured by standard TBLT frameworks, warranting its own treatment in programme design. Programme coordinators might, for instance, incorporate explicit orientation sessions on intercultural communication norms to help learners anticipate ambiguity and approach cross-cultural misunderstanding as a learning resource rather than a communicative failure.

The finding that cultural distance was positively — if modestly — associated with pragmatic gains raises important questions for programme design. If learners acquire pragmatic competence partly through the salience of cultural contrast, pairings that maximise cultural distance may accelerate certain aspects of language learning. However, this must be balanced against the potential for communication breakdowns to become demotivating when the cultural gap is too wide to bridge with existing linguistic resources. A gradient approach, wherein learners are progressively paired with partners from more culturally distant backgrounds as their proficiency increases, represents a promising design principle for future investigation.

Several limitations of the present study warrant acknowledgement. The sample was drawn exclusively from Central Asian universities, limiting the generalisability of findings to other EFL populations and cultural contexts. The standardised tests employed, while widely validated, may not fully capture the range of pragmatic and intercultural competences that emerged in qualitative data. Additionally, the absence of a control group — necessitated by ethical constraints against withholding a potentially beneficial intervention — makes it impossible to rule out maturation effects or the influence of concurrent instruction as alternative explanations for observed gains.

5. CONCLUSION

This study demonstrates that structured intercultural communication programmes represent a powerful vehicle for developing language skills in EFL contexts. Participating learners achieved statistically significant improvements across all four skill domains over two semesters, with the largest gains in speaking and listening. Qualitative analysis reveals that the generative mechanisms include authentic communicative need, affective safety in cross-cultural interaction, and heightened metalinguistic awareness emerging from exposure to diverse registers and rhetorical conventions.

These findings carry direct implications for curriculum design in higher education. Embedding intercultural exchange components — whether digital, residential, or hybrid — within EFL programmes is not merely a supplementary enrichment activity but may function as a core pedagogical strategy capable of producing gains that traditional instruction alone does not reliably achieve. Institutions without access to formal exchange partnerships might replicate key features of the intervention through structured telecollaboration with institutions in target-language countries or through community-based programmes connecting learners with local diaspora communities.

Future research should extend this line of inquiry to younger learner populations, additional target languages, and wider cultural pairings. Longitudinal follow-up studies tracking the durability of gains beyond programme completion would also be valuable. As the world becomes increasingly interconnected, cultivating both linguistic and intercultural competence is no longer optional — it is an imperative that language education must rise to meet.

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NAKHCHIVAN MUSEUMS AND THE NEW GENERATION: WHY IS THE DISTANCE GROWING?

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A museum is more than a place where historical objects are stored. Behind every glass case lies a silent story about the past, reflecting the memory, traditions, and cultural identity of a society. However, an important question has emerged today: are young people still interested in listening to these stories?

The museums of Nakhchivan play a significant role in preserving and transmitting historical heritage to future generations. Yet, in recent years, a visible gap has appeared between museums and young audiences. This issue should not simply be explained by a lack of interest in history. Modern youth live in a rapidly changing digital environment where information is consumed quickly through videos, social media, and interactive content. As a result, traditional museum presentations are no longer always enough to attract lasting attention.

Today's visitors want to participate rather than only observe. Reading short descriptions beside exhibits may not create a memorable experience for younger generations. Interactive technologies, virtual displays, audio guides, and digital storytelling can make historical information more engaging and emotionally powerful.

Another challenge concerns cooperation between museums and educational institutions. In many cases, museum visits remain formal and short-term activities. However, museums could become active learning environments through student projects, workshops, discussions, and creative presentations that encourage participation and critical thinking.

Communication is also essential. Young people spend much of their time on social media platforms, and museums that fail to present their activities in modern and attractive ways may struggle to remain visible. Expanding the use of QR codes, virtual tours, and interactive events could help museums establish stronger connections with younger audiences.

The main issue is not that young people are moving away from history. Rather, it is about finding the right way to introduce history to them. If museums learn to speak the language of the new generation, the distance between them will gradually decrease.

Economic sciences

DİRECTİONS FOR İNTENSİFYİNG BUSİNESS DEVELOPMENT İN AZERBAİJAN İN THE CONTEXT OF STRATEGİC MARKETİNG

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Abstract

The article discusses the directions of intensification of business development in Azerbaijan in the context of strategic marketing. The advantages of strategic marketing in the business process are explained and systematized. The importance of marketing research in intensification of business development is substantiated. The role of strategic marketing in increasing the efficiency of business processes in the conditions of global transformations is given. The processes of application of marketing services in Azerbaijan are analyzed and evaluated. Proposals are made to expand the use of strategic marketing in the development of the business sphere in Azerbaijan in the near future.

Keywords: *Azerbaijan, marketing, strategic marketing, business, business entities, the role of marketing in business development, advantages of strategic marketing.*

Introduction

The economic transformations carried out in Azerbaijan, the state support provided to entrepreneurial activity and the measures taken to develop the non-oil sector have had a positive impact on improving the business environment. As a result, the importance of marketing activities has increased even more in terms of ensuring that enterprises operate in accordance with market relations and strengthening their competitive advantage [1].

One of the main conditions for the effective operation of enterprises at the current stage is the correct identification of consumer demands and the formation of flexible adaptation capabilities to market changes. In this regard, marketing activities enable enterprises to identify market segments, study consumer behavior and develop effective competition strategies. Most companies operating in Azerbaijan have already begun to attach special importance to the modernization of marketing policy, strengthening advertising strategies and the application of digital communication tools [2].

In particular, the development of the digital economy has shaped significant changes in the form and content of marketing activities. Social media platforms, e-commerce mechanisms, internet advertising tools and analytical marketing tools have created favorable conditions for enterprises to establish more operational relationships with consumers and expand market opportunities. Optimization of the tax burden, incentives provided to entrepreneurs, and simplification of business registration procedures create favorable conditions for the emergence of new business initiatives in the country.

Research Aim and Research Questions

The main goal of writing the article is to develop more advanced and efficient mechanisms for intensifying business development processes in Azerbaijan in the context of strategic marketing. In recent years, special attention has been paid to the development of the business sphere in Azerbaijan and investments have been made. At the same time, marketing research is being given a wider place. The necessity of using marketing services at a strategic level in enterprises will be substantiated. At the same time, proposals will be prepared to expand the role of strategic marketing in business development in Azerbaijan.

Research Results

One of the important directions affecting the development of the business environment in Azerbaijan is the promotion of investment activity [3]. Economic mechanisms, industrial parks and free economic zones created to attract foreign and domestic investments create conditions for the expansion of entrepreneurial activity [4].; [5]. Investments directed, in particular, to the non-oil sector have a positive effect on ensuring economic diversification by accelerating the pace of development of production and service sectors [6]; [7]. Modern enterprises pay special attention to researching market demand, studying consumer behavior and increasing customer satisfaction [8]. This approach allows enterprises to strengthen their positions in the market, gain new consumer segments and form a *competitive advantage. Continuous changes in consumer tastes and demands force enterprises to conduct market research regularly and update their marketing policies.*

At the same time, dividing the market into segments and determining the target audience create conditions for more productive organization of marketing activities. Enterprises can gain a stronger position in the market by providing products and services that meet the requirements of different consumer groups [9]. One of the important directions in the implementation of marketing strategies is the widespread use of digital technologies. In modern times, digital marketing tools, social media platforms, e-commerce systems, mobile applications and internet advertising tools have significantly expanded the market opportunities of business entities. In particular, the development of digital communication tools provides enterprises with access to a wide audience at a lower cost. Social media marketing allows enterprises to establish direct contact with consumers, learn their opinions and respond more flexibly to market demands.

At the same time, the application of data-based marketing approaches allows for more accurate analysis of consumer behavior, forecasting sales dynamics and operational adaptation to market changes. The application of artificial intelligence technologies and analytical systems plays an important role in increasing the effectiveness of marketing activities. The application of brand strategies is also of great importance in the process of expanding business activities. The formation of a strong brand image not only increases the level of recognition of enterprises in the market, but also creates conditions for strengthening consumer loyalty. In the modern competitive environment, consumers pay special attention not only to the quality of the product, but also to the reputation, public image and values of the enterprise. In addition, discount campaigns, bonus programs and loyalty systems create favorable conditions for increasing consumer interest and increasing sales volumes. At the same time, certain problems also arise in the process of implementing marketing strategies. In some enterprises, the lack of strategic organization of marketing activities, poor market research and limited application of innovative marketing technologies have a negative impact on the expansion of business activities.

At the same time, the lack of professional marketing specialists, insufficient development of practical knowledge in the field of digital marketing and limited financial resources can weaken the competitiveness of enterprises. The low level of financial resources allocated for marketing activities, especially in small and medium-sized enterprises, is considered one of the main problems limiting the development of this area [10]. In general, the effective application of marketing strategies in the process of expanding business activities is of great importance in terms of strengthening the market position of enterprises, increasing consumer satisfaction and ensuring long-term economic development. In modern conditions, the application of innovative and digital marketing approaches not only increases the competitive advantage of enterprises, but also makes a significant contribution to their integration into international markets, expanding export potential and ensuring sustainable development [11].

At the stage of modern economic development, the expansion of entrepreneurial activity and increasing the competitiveness of enterprises act as one of the main directions ensuring sustainable growth of the country's economy. The intensification of globalization processes, the deepening of international economic relations and the widespread application of digital technologies have created conditions for the formation of new development trends in the activities of business entities. Within these conditions, the improvement of the entrepreneurial environment in Azerbaijan, the application of innovative management models and strengthening competitive advantage are considered one of the priority directions of economic policy [12]. In particular, the development of the non-oil sector and the stimulation of entrepreneurship form favorable opportunities for the expansion of business activity in the country. One of the main factors determining the prospects for business development in the country is the application of innovative technologies. Modern technological innovations allow for increased productivity in the production and service sectors, optimization of management processes, and more efficient use of resources.

The application of digital solutions ensures that enterprises adapt more quickly to market changes and expand their competitive potential. Artificial intelligence technologies, automated management systems, large databases, and analytical software play an important role in increasing the efficiency of organizations. At the same time, these technologies have a positive effect on increasing the quality of products and services, meeting consumer demands more quickly, and reducing production costs. The development of e-commerce is also of great importance in expanding entrepreneurial activity. In the modern era, digital commercial systems not only increase the sales opportunities of enterprises, but also expand their access to new markets. The development of information and communication technologies and the spread of digital communication tools create conditions for business entities to establish more *flexible and operational communication with consumers. E-commerce platforms, in addition to ensuring the availability of products and services to a wider audience, allow for the optimization of sales costs and increased efficiency of market activity.*

In recent years, the increase in e-commerce turnover and the development of digital payment systems in Azerbaijan have further strengthened the prospective potential of this sector. Increasing export opportunities in the direction of expanding entrepreneurship is also of strategic importance. The development of export activity serves to strengthen the country's position in the international economic system and increase the competitiveness of the national economy. In particular, the export of non-oil products to foreign markets plays an important role in ensuring economic diversification [13]. Support mechanisms implemented by the state to promote exports, modernization of logistics infrastructure and expansion of international trade relations create favorable conditions for the integration of business entities into foreign markets. At the same time, the adaptation of products to international quality standards and the organization of competitive production are considered one of the main factors in strengthening export potential. The development of small and medium-sized businesses is considered one of the important directions of expanding business activity. Small and medium-sized businesses play an important role in accelerating economic growth, increasing employment and developing market economic relations. In order to support entrepreneurship in Azerbaijan, the state applies various preferential credit mechanisms, tax incentives and subsidies. At the same time, the creation of business incubators, industrial zones and innovation centers expands the development opportunities of SME entities. These measures, in addition to facilitating access to financial resources for enterprises, also increase their innovative activity potential.

Expanding opportunities for integration into international markets is also one of the main directions of business development. Strengthening international cooperation in the system of global economic relations creates conditions for increasing the competitiveness of enterprises and accessing new markets. Attracting foreign investments, expanding cooperation with international companies, and applying foreign experience have a positive impact on the development of business entities [14]. In addition, the application of international certification systems and the adaptation of products to global standards are one of the main factors that increase the competitiveness of enterprises in the world market. Consequently, the expansion of business activity and the improvement of competitiveness in Azerbaijan are closely related to the application of innovative technologies, the development of e-commerce, the strengthening of export potential and the effective use of state support mechanisms [15].

In modern economic conditions, the formation of a competitive business environment makes a significant contribution to strengthening the country's economic stability, the development of the non-oil sector and the strengthening of the position of the national economy in international markets. In terms of ensuring the sustainable development of business entities operating in a market economy and increasing their competitiveness, the study of the market environment and the analysis of consumer behavior are of particular strategic importance [16]. Market research allows enterprises to systematically analyze the general state of the current economic conditions, the intensity of competition, price formation mechanisms, the balance of supply and demand, as well as future development directions of the market. The information obtained as a result of such an analytical approach creates conditions for more objective, justified and efficient adoption of management decisions [17]. The study of consumer behavior, acting as one of the main and decisive components of marketing activities, plays an important role in achieving a successful position in the market [18].

This direction includes a comprehensive analysis of consumer needs and requirements, choice tendencies, purchase motivations, psychological and social factors of influence, as well as economic factors affecting the decision-making process. In Azerbaijan, consumer behavior is formed especially under the influence of socio-economic situation, cultural values, income level and regional differences. Therefore, it is impossible to develop effective and targeted marketing strategies without a correct assessment of consumer demand. The information collected during market research creates a basic information base for enterprises to identify market segments, select target audiences and form positioning strategies [19]. This process allows companies to adapt their products and services to consumer expectations, gain a distinctive advantage in the market and gain a stronger position in the competitive environment. At the same time, a properly conducted market analysis is also of great importance in terms of optimal allocation of resources, reduction of marketing costs and minimization of business risks [20].

The rapid development of digital technologies in modern times has created new and more effective opportunities for conducting market research. The analytical capabilities of social media platforms, *online survey systems, big data technologies, and digital tracking tools create conditions for more accurate and operational study of consumer behavior. This allows business entities to adapt more flexibly to changing market conditions and make more correct strategic decisions [21]. Market research and analysis of consumer behavior act as one of the main pillars of strategic management in the modern business environment and play an important role in the formation of long-term competitive advantage of enterprises. In terms of ensuring the long-term stability of economic entities operating in the conditions of a market economic system, expanding their market share, and strengthening their positions in the competitive environment, creating competitive advantage and developing a brand are of particular strategic importance [22].*

Competitive advantage is characterized as the ability of an enterprise to provide higher value to consumers compared to competitors, to market products and services on more attractive terms, and to be distinguished through distinctive features. This advantage is formed as a result of the complex influence of various factors such as pricing strategy, product quality, level of innovation, service standards, logistics capabilities and brand image [23]. Achieving and maintaining competitive advantage directly depends on the effective management of the enterprise's internal resources and strategic potential. According to the resource-based approach, the tangible and intangible assets of the enterprise - technological infrastructure, specialized human capital, management skills, innovation potential and organizational culture - act as the main formative components of sustainable competitive advantage. In addition, the ability of the enterprise to adapt to the external environment, promptly respond to market changes and systematic analysis of competitor activities also play an important role in achieving strategic advantage [24].

Brand development is an important marketing process in terms of increasing the level of recognition of the enterprise in the market, forming consumer trust and ensuring long-term customer loyalty. A brand is not only the name or symbol of the product, but also a system of quality, reliability, value and emotional associations formed in the consumer's mind. A strong brand acts as a decisive factor in the selection process by directly influencing consumer behavior and providing the enterprise with a stable position in the market [25].; [26]. Brand development is particularly relevant for business entities operating in Azerbaijan, as it has become more difficult to differentiate in the market in the face of intensifying competition and increasing consumer demands. For this reason, enterprises, in addition to improving the quality of products and services, must also formulate effective communication strategies, expand advertising activities, and continuously improve customer experience. Digital marketing tools - social media platforms, online advertising campaigns, SEO strategies, and influencer marketing - play an important role in increasing brand recognition and building closer relationships with the target audience [27].

Brand value formation is not a short-term, but a strategic process that requires long-term and consistent management. Ensuring consumer satisfaction, continuously improving service quality, maintaining reliability, and strengthening emotional bonds are considered the main determining factors of brand loyalty. Increasing the competitiveness of business entities and achieving a sustainable position in the market are closely related to the proper organization of marketing activities [28]. The expansion of entrepreneurial activity in Azerbaijan, the development of the non-oil sector and the formation of the digital economy have further increased the importance of using marketing tools in enterprises. An effective marketing policy expands the market opportunities of enterprises, allows them to more accurately determine consumer demand and ensures an increase in sales volumes. One of the main directions of effective use of marketing in the direction of intensifying business development in Azerbaijan is the application of digital marketing technologies. In recent years, the increase in the number of Internet users and social networks has increased the interest of enterprises in online marketing activities. Social media advertising, e-commerce platforms, SEO and SEM technologies provide enterprises with access to a wider audience and create conditions for optimizing advertising costs. Another important direction is the application of customer-oriented marketing strategies [29].

In the modern business environment, the success of enterprises depends not only on product sales, but also on ensuring customer satisfaction. In this regard, the implementation of CRM systems, the provision of personalized services and the development of loyalty programs increase the competitive advantage of enterprises in the market. The correct establishment of a brand policy is also of great importance in business development. A strong brand image accelerates the recognition of enterprises in the market, increases consumer trust and has a positive effect on increasing sales. In Azerbaijan, the promotion of local products and the formation of national brands are of particular importance in terms *of the development of the non-oil sector [30]. The application of innovative marketing approaches also plays an important role in intensifying business development in Azerbaijan [31].*

Modern approaches such as artificial intelligence technologies, data analytics, content marketing and influencer marketing strengthen the market position of enterprises and increase their competitiveness. As a result, it can be noted that the effective use of marketing has a significant impact on the expansion of economic activities of enterprises, an increase in sales volumes, the formation of competitive advantage and the development of the business environment in the country [32]. The widespread application of digital technologies and the development of innovative marketing strategies in Azerbaijan will create favorable conditions for further intensification of business activities in the future. In the modern stage of economic progress, the expansion of entrepreneurial activity in Azerbaijan and the increase in the competitive advantage of economic entities are considered to be one of the main factors that make it necessary to organize marketing activities effectively. In particular, the acceleration of globalization trends, the improvement of digital technologies and the transformations taking place in consumer behavior have led enterprises to pay more attention to marketing strategies [33].

In this regard, marketing is not only a means of organizing product sales, but also performs the function of an important economic mechanism that ensures the strategic management of business activities. In recent years, the expansion of the application capabilities of digital marketing technologies in Azerbaijan has had a significant impact on the activation of business activities [34]. Social media platforms, e-commerce systems, online advertising tools and information-based marketing tools have increased the market potential of enterprises and created favorable conditions for building more flexible relationships with consumers. Marketing activities carried out through social networks in particular have allowed for the optimization of advertising costs and the attraction of a wider audience [35].

One of the main trends observed in the activities of business entities at the current stage is the formation of a consumer-oriented marketing model [36]. Researching customer needs, providing personalized services, and implementing loyalty programs by enterprises create conditions for strengthening a sustainable position in the market [37]. As a result of this approach, the level of consumer satisfaction increases, long-term cooperative relationships are formed, and positive dynamics are observed in sales indicators. The application of innovative marketing technologies is of great importance in the development of business activities. Artificial intelligence systems, data analytics, automated advertising mechanisms, and CRM platforms create conditions for more productive organization of marketing activities in enterprises. These technologies allow for the operational analysis of changes in the market, the prediction of consumer behavior, and the adoption of more optimal management decisions [38].

The economic reforms implemented in Azerbaijan to develop the non-oil sector have further increased the role of marketing activities. Promoting local products in international markets, developing the “Made in Azerbaijan” brand, and implementing export-oriented marketing strategies serve to strengthen the country's economic potential. In this regard, improving marketing activities is of great importance both in terms of improving the financial performance of enterprises and ensuring the sustainable development of the national economy. The issues of attracting investments in post-conflict areas in the country remain relevant, and in this regard, it is necessary to assess the existing potential [39]. In particular, there is a need for marketing research that is not so traditional for Azerbaijan in accelerating the economic development of the city of Shusha and shaping the cultural economy [40].

Conclusions:

Thus, it is advisable to take a number of steps to increase the efficiency of enterprises:

- *Next, the application of modern analytical tools such as artificial intelligence and big data in business organizations will increase the effectiveness of marketing costs, as well as provide access to a more accurate target audience;*
- *In addition, strengthening cooperation between higher education institutions and the real economy sector and developing practice-oriented marketing training programs will serve the development of human resources.*
- *Finally, the development of a single export-oriented brand concept for the presentation of Azerbaijani production in foreign markets and the implementation of incentive mechanisms based on public-private cooperation will expand the export opportunities of the country's economy.*
- *The implementation of the marketing concept at a strategic level will be of decisive importance in strengthening the competitiveness of Azerbaijani entrepreneurship, expanding the domestic market and the progress of the country's non-oil sector.*

- *In order to effectively benefit from the marketing approach for the progress of the enterprise, it is important to strengthen digital tools at the first stage, since it is possible to reach the target group at a lower cost and in a measurable way through social platforms and search engines.*
- *At the same time, collecting and analyzing customer data allows the business entity to more accurately understand the needs of consumers and rationally manage marketing costs.*
- *Creating a unique brand image is important to stand out in a competitive environment, because customers often prefer the value and story it brings rather than the product.*
- *Expanding online shopping venues and diversifying delivery and payment systems prevent customer loss by increasing sales coverage.*
- *Finally, focusing on exports and participating in international exhibitions by taking advantage of state support programs will strengthen the position of Azerbaijani entrepreneurship in foreign markets.*

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IMPORTANT PRİORİTİES FOR İMPROVİNG THE CUSTOMS SYSTEM İN AZERBAİJAN İN THE CONTEXT OF DİGİTAL AND ARTİFİCİAL İNTELLİGENCE

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Abstract

The article examines the important priorities of improving the customs system in Azerbaijan in the context of digital and artificial intelligence. The role of the customs system in the formation and development of the digital economy is examined. The issues of improving the functioning of the customs system in the context of artificial intelligence are examined. The modern problems of the customs system in Azerbaijan are considered and systematized. The role of the customs system in the economic security of the country is given. The importance of customs authorities in increasing foreign trade turnover is substantiated. Proposals are made on the directions of improving the customs system in Azerbaijan through the application of digital and artificial intelligence mechanisms.

Keywords: Azerbaijan, digital, artificial intelligence, customs system, customs authorities, digital mechanisms, artificial intelligence tools.

Introduction.

In order to bring customs administration in the Republic of Azerbaijan into line with international standards, important reforms have been implemented in the direction of introducing electronic services, developing risk-based management systems and simplifying customs procedures. The "e-Customs" electronic service system and the "Single Window" principle are among the important measures implemented in this direction [1].

In addition, the Trade Facilitation Agreement of the World Trade Organization is also considered an important legal mechanism for simplifying customs procedures and accelerating international trade [2]. Within the framework of this document, issues such as increasing the transparency of customs procedures, reducing document cycles and introducing electronic services are highlighted [3]. The main objective of the Trade Facilitation Agreement is to reduce administrative barriers in international trade operations and simplify border procedures [4].

Under the agreement, countries undertake to increase the transparency of customs procedures, reduce document turnover, and expand the use of electronic services. As a result of these measures, the process of moving goods across borders is accelerated and international trade costs are reduced [5]. One of the important provisions of the agreement is to ensure the transparency of customs procedures. In this context, countries must publicly publish information on customs regulations, tariffs, and other trade procedures and make them accessible to entrepreneurs. This approach creates a clearer and more predictable environment for trade participants [6]. The Trade Facilitation Agreement also promotes the use of electronic information exchange and the "Single Window" system. With this system, foreign economic operators can submit all information and documents related to import and export operations through a single electronic platform [7].

This allows for the acceleration of customs procedures and the strengthening of coordination between government agencies [8]. The implementation of risk-based control mechanisms also plays an important role in the agreement. This approach allows for more effective implementation of customs control and implies the application of physical inspection of goods only to high-risk operations. As a result, customs resources are used more efficiently and the speed of trade operations increases.

Research Aim and Research Questions.

The main purpose of writing the article is to improve the functioning of the customs system of Azerbaijan in the conditions of digital and artificial intelligence transformations in the modern era. This requires updating and improving existing mechanisms. At the same time, it is possible to organize the activities of customs authorities more efficiently through the application of digital technologies. It is also to prepare proposals for improving the activities of customs authorities of Azerbaijan using artificial intelligence tools.

Research Results.

The adopted state programs and strategies related to the improvement of the activities of customs authorities in the Republic of Azerbaijan also play an important role. In particular, the Development

Concept "Azerbaijan 2020: A Look into the Future" and the development strategy of the customs service cover such areas as the modernization of customs management, the application of digital technologies and its adaptation to international standards [9].

In the modern global economic environment, the application of digital technologies and artificial intelligence plays an important role in the customs system, as well as in various areas of public administration [10]. The rapid growth of international trade and the complexity of logistics chains require customs services to operate more efficiently, transparently and effectively. In this regard, the application of digital transformation and artificial intelligence technologies is one of the important directions for increasing the efficiency of the customs system in Azerbaijan.

First of all, it is important to expand electronic services and digital platforms in the customs system [11].

Increasing the functional capabilities of the "e-Customs" portal and implementing all customs services on a single digital platform can make procedures more accessible and efficient for entrepreneurs. The development of electronic services has a significant impact on reducing document cycles and accelerating customs operations. Another important recommendation is to expand the application of risk analysis systems based on artificial intelligence. The application of big data analysis and machine learning technologies allows for more effective monitoring of customs operations. With these systems, risky operations can be automatically identified and customs control can be carried out more purposefully [12].

The application of blockchain technology in the customs system is also considered one of the important promising directions. Blockchain technology can be used to securely store information related to trade operations and to more reliably exchange information between government agencies [13]. This approach, in addition to increasing the transparency of customs procedures, also has a positive effect on reducing corruption risks [14]. In addition, modernization of the technical infrastructure used in the customs system and the introduction of automated control systems are also considered important. The introduction of modern scanner systems, automatic cargo inspection technologies and electronic databases increases the efficiency of customs control and allows for faster management of cargo flows at border crossing points. [15]. For the effective implementation of the digital transformation process, it is of great importance to increase the professional training of customs officers [16]. For this purpose, it is important to organize special training programs in the field of digital technologies and artificial intelligence, study international experience and apply modern management methods. The development of human resources is one of the important conditions for the modernization of the customs system [17].

At the same time, strengthening the integration of information systems between state agencies is also one of the important recommendations. Further improvement of the "Single Window" system and integration of information databases of various state agencies can allow for more efficient implementation of import and export operations [18].

The digitalization of the customs system is primarily related to the electronicization of customs procedures and automation of information exchange. The introduction of the electronic declaration system, the operation of the "e-Customs" electronic service portal and the "Single Window" principle allow for faster implementation of customs operations [19]. With these systems, entrepreneurs and foreign economic operators can carry out customs procedures online, which leads to a decrease in document turnover and an increase in the efficiency of operations [20].

The electronization of customs procedures is carried out primarily through the application of the electronic declaration system. With this system, all information related to import and export operations is submitted and processed in electronic format. The electronic declaration system allows entrepreneurs to carry out all procedures online without physically contacting the customs authorities. As a result, the execution time of customs operations is reduced and administrative costs are minimized [21]. Automation of information exchange is of great importance in customs management. This process involves the implementation of information exchange between various state agencies through electronic systems. The "Single Window" system is considered one of the most important technological solutions in this area. With this system, all documents related to import and export operations are submitted on a single electronic platform and are automatically shared between various state agencies [22].

Automation of information exchange in the customs system also allows for the implementation of risk-sensitive control mechanisms. With the help of electronic databases and big data analysis, information on customs operations is analyzed promptly and potential risks are identified in advance. This approach allows for more targeted implementation of customs control and prevention of illegal trade activities [23]. At the same time, the electronicization of customs procedures also has a positive *effect on reducing corruption risks and increasing transparency in management. Operations carried out with electronic systems are automatically registered and this information can be monitored in real time. This allows for the strengthening of control mechanisms in customs management [24]. The application of artificial intelligence technologies allows for more effective implementation of risk analysis and data processing processes in customs management. Information on operations carried out in the customs system is analyzed using big data analysis and machine learning methods and potential risks are identified in advance [25]. This approach allows for more targeted implementation of customs control and prevention of illegal trade activities [26].*

One of the important directions of application of artificial intelligence technologies in the customs system is development of risk analysis systems. Using big data analysis and machine learning methods, they analyze data on customs operations and identify potential risks in advance. These systems allow for more targeted implementation of customs control and ensure more serious inspection of only high-risk operations [27]. The application of artificial intelligence technologies also helps to optimize the control processes carried out at border crossing points. Modern scanner systems and automated control equipment, analyzed by artificial intelligence algorithms, allow for faster inspection of goods and vehicles. This approach reduces the time of execution of customs procedures and ensures more effective implementation of logistics processes [28].

Another important area of application of artificial intelligence technologies in customs management is automatic data processing and forecasting systems. Artificial intelligence-based programs can analyze large amounts of data related to trade operations and predict future risks and trends. This allows for more strategic planning of customs activities. [29]. In addition, the application of artificial intelligence technologies also helps to reduce the impact of the human factor in the customs system and increase transparency in management. Operations carried out with automated systems provide more accurate and objective results, which in turn reduces the risk of corruption [30]. Another important area of application of artificial intelligence in the customs system is the development of automated control systems [31].

With modern technologies, scanner systems and other technical equipment placed at border crossing points are equipped with automatic data processing capabilities. These systems accelerate the process of checking goods and vehicles and reduce the workload of customs officers [32]. In addition, the application of blockchain technology is of great importance in terms of increasing the security of customs operations. With this technology, information related to trade operations is stored on digital platforms that cannot be changed. This, in addition to ensuring data security, increases the transparency of customs procedures and creates conditions for reducing corruption risks [33].

One of the important areas of application of blockchain technology in the customs system is the secure storage of information related to international trade operations.

With this technology, all information related to import and export operations is recorded on a single digital platform and stored in the form of immutable blocks. This minimizes the risk of data falsification and increases the transparency of customs operations [34].

Blockchain technology also allows for more effective information exchange between customs authorities, logistics companies and other government agencies. Since all parties involved in the international trade chain have access to the same database, data transmission is faster and more reliable. This facilitates the simplification of customs procedures and the reduction of transaction execution time [35].

The application of blockchain technology in the customs system is also of great importance in terms of tracking the movement of goods and vehicles. With this technology, the entire trajectory of movement of goods from the production stage to the end consumer can be tracked. As a result, it is possible to prevent illegal trade operations and manage logistics processes more effectively [36].

In addition, blockchain technology also allows for the secure implementation of customs payments and other financial transactions. The integration of electronic payment systems with blockchain technology can ensure faster and more transparent implementation of transactions.

Conclusions.

Based on the results of the study, it is considered appropriate to implement the following proposals in order to increase the efficiency of the customs system of Azerbaijan:

– Increasing the functionality of the electronic declaration system for more efficient and transparent implementation of customs procedures, and applying automated risk assessment systems based on artificial intelligence and big data analysis are advisable. This will both increase the effectiveness of customs control and reduce corruption risks.

– Implementing a single electronic platform for information exchange between customs authorities and other state agencies will simplify document circulation, reduce bureaucratic procedures, and accelerate trade operations.

– Increasing the professional training of customs officers, organizing continuous training programs on modern technologies and international trade rules will have a positive impact on improving the quality of management processes.

– Improving risk-based control systems, expanding international information exchange, and applying modern control technologies will play an important role in ensuring economic security.

– The introduction of modern analytical platforms and the development of databases for more efficient analysis of foreign trade statistics will allow for more accurate decisions in economic policy planning.

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STRATEGIC MANAGEMENT AND LEADERSHIP PROCESSES IN E-BUSINESS: EVIDENCE FROM ALBANIA

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Abstract

The spread of digital technologies has changed how firms organize, compete, and create value. In this context, e-business is no longer limited to online selling, but refers more broadly to the use of digital systems to manage internal processes, market relationships, transactions, communication, and strategic coordination across the organization (INSTAT, 2024; World Bank, 2021a). This article examines the strategic management and leadership processes involved in e-business development in Albania, with particular attention to small and medium-sized enterprises, which dominate the country's business structure (INSTAT, 2026a). The analysis combines recent academic literature with official data from INSTAT, the World Bank, and regional digital policy sources in order to assess Albania's current position, identify the main barriers to e-business advancement, and outline a practical strategic framework for firms operating in the Albanian market (INSTAT, 2024; INSTAT, 2025a; World Bank, 2021b; Apostolovska et al., 2026). The article argues that Albania has made substantial progress in digital access and enterprise connectivity, yet still faces a gap between infrastructure availability and effective strategic use of digital tools (INSTAT, 2024; INSTAT, 2025a; Apostolovska et al., 2026). It further argues that this gap is not only technological, but also managerial and leadership-related, since successful e-business adoption depends on strategic vision, implementation capability, organizational learning, and digital leadership competencies (Sallaku & Kambo, 2024; Yasa et al., 2024). The paper concludes that Albanian enterprises, especially SMEs, need integrated strategies that combine environmental analysis, digital capability development, phased implementation, and leadership-driven organizational adaptation if they are to convert digital presence into measurable competitive advantage (INSTAT, 2026a; INSTAT, 2024; Sallaku & Kambo, 2024).

Keywords: e-business, strategic management, leadership, digital transformation, Albania, SMEs, e-commerce, digital strategy

1. Introduction

The concept of e-business has evolved considerably over the last two decades. Earlier studies often treated it mainly as an extension of e-commerce, focusing on online transactions and digital sales channels. More recent research, however, understands e-business as a broader organizational transformation involving digital communication, customer relationship management, data use, online service delivery, supply chain coordination, and platform-based business models (World Bank, 2021a; Sallaku & Kambo, 2024). This broader understanding is especially relevant in a transitional economy such as Albania, where firms increasingly operate in digitally mediated markets but often do so with uneven managerial preparedness and limited internal capabilities (World Bank, 2021b; Apostolovska et al., 2026).

Albania offers an important context for studying these processes. The country has experienced clear progress in internet diffusion, enterprise connectivity, and digital public services. In 2024, 99.3% of Albanian enterprises with 10 or more employees used computers with internet access for work purposes, while 57.7% had a website and 83.1% used social media for business activities (INSTAT, 2024). At household and individual level, INSTAT reports that the 2025 ICT survey interviewed 5,413 households from a sample of 7,200 and produced nationally comparable indicators on internet use, e-commerce, and e-government aligned with Eurostat methodology (INSTAT, 2025a, 2025b). At the same time, business digitalization remains incomplete. Only 24.5% of enterprises sold products or services online in 2024, and cloud computing adoption reached 30.0% (INSTAT, 2024). These figures suggest that digital access alone does not guarantee strategic digital maturity (INSTAT, 2024; Apostolovska et al., 2026).

The Albanian case is also significant because SMEs dominate the economy. According to INSTAT's 2024 SME statistics, SMEs accounted for 99.9% of active enterprises, 82.0% of employment, 81.4% of net sales, and 78.1% of value added (INSTAT, 2026a). This makes the strategic management of e-business in SMEs a matter of national economic relevance rather than a narrow managerial concern (INSTAT, *2026a). In addition, the World Bank's Albania E-Commerce Diagnostic identified several structural constraints, including digital skills shortages, logistics bottlenecks, regulatory gaps, and weak trust in online transactions, all of which directly affect the strategic options available to Albanian firms (World Bank, 2021a, 2021b).*

Leadership is equally important in this discussion. Digital transformation does not proceed automatically after a firm buys software, launches a website, or opens a social media account. It requires leaders who can define priorities, allocate resources, communicate change, and align technology investments with business goals (Yasa et al., 2024; Sallaku & Kambo, 2024). In the Albanian context, where many firms still rely on traditional business models and informal decision-making, leadership can be the difference between superficial digital presence and effective e-business integration (Sallaku & Kambo, 2024; World Bank, 2021b).

This article therefore focuses on both strategic management and leadership processes in e-business. Its objectives are fourfold: first, to examine Albania's current digital business environment using recent official data; second, to analyze the strategic management stages involved in e-business development; third, to incorporate leadership as a central dimension of digital business transformation; and fourth, to offer a coherent framework and recommendations suitable for Albanian enterprises and policymakers (INSTAT, 2024; Apostolovska et al., 2026; Yasa et al., 2024).

2. Literature Review

2.1 E-business as a strategic phenomenon

The literature on e-business has moved from a technical orientation to a strategic one. Foundational work treated e-business as a way to conduct transactions electronically, but later scholarship emphasized that digitalization reshapes how firms create and capture value, organize internal processes, interact with customers, and respond to competition (World Bank, 2021a). Contemporary studies connect e-business to digital transformation, platform logic, organizational agility, and business model innovation (Sallaku & Kambo, 2024; Yasa et al., 2024). In this sense, e-business is not simply a sales channel. It is a strategic system that links digital infrastructure, organizational routines, information flows, and market positioning.

This shift is important because it changes how firms should analyze digital adoption. Rather than asking only whether a business sells online, current research asks whether digital tools improve coordination, customer engagement, data-driven decision-making, and competitive resilience (Sallaku & Kambo, 2024; Yasa et al., 2024). For firms in emerging or transitional economies, this perspective is especially useful because digitalization often develops unevenly: visible online presence may exist without strong internal integration (World Bank, 2021b; Apostolovska et al., 2026).

2.2 Strategic management and digital transformation

Strategic management literature offers a useful structure for analyzing e-business adoption. The standard process usually involves environmental analysis, strategic formulation, implementation, and assessment. In digital settings, each of these stages is affected by fast technological change, platform competition, shifting customer expectations, and the need for organizational flexibility (Sallaku & Kambo, 2024; Yasa et al., 2024). This means that managers must combine classic strategic analysis tools with digital capability thinking.

Recent work on enterprise performance during and after the pandemic in Albania supports this interpretation. Evidence from Albanian firms shows that digitalized enterprises were better positioned to absorb shocks and sustain performance during periods of disruption, which indicates that digitalization can function as a resilience factor as well as a growth mechanism (Sallaku & Kambo, 2024). This expands the strategic meaning of e-business. It is not only a route to efficiency or expansion, but also a way to strengthen adaptability under uncertainty.

2.3 Leadership in digital business settings

Leadership has become increasingly central in the digital transformation literature. Research on digital leadership frameworks argues that successful transformation depends on leaders who combine strategic vision, technological understanding, communication ability, and organizational learning skills (Yasa et al., 2024). These leaders don't need to be software engineers, but they do need enough digital literacy to make informed decisions, evaluate investments, and guide teams through change.

This point matters because digital transformation often fails for managerial rather than technical reasons. Studies emphasize that leadership influences whether firms define realistic digital priorities, build internal support, and sustain implementation over time (Yasa et al., 2024; Sallaku & Kambo, 2024). In transitional settings, where organizational systems may be less formalized and internal digital expertise is limited, leadership becomes even more important.

2.4 The Albanian gap in the literature

Although Albania has been discussed in relation to e-commerce, public digitalization, and enterprise digitalization, there remains a limited body of integrated work that connects official statistics, strategic management, and leadership within one coherent framework (World Bank, 2021b; Sallaku & Kambo, 2024). Much of the older literature is descriptive or focused on general ICT development rather than on the strategic and organizational processes behind e-business success. This article addresses that gap by combining current empirical evidence with a management-focused interpretation designed specifically for the Albanian context (INSTAT, 2024; INSTAT, 2026a; Apostolovska et al., 2026).

3. Methodology

This article uses a qualitative analytical design based on secondary data analysis and structured literature review. The purpose is not to test a single causal hypothesis through primary fieldwork, but to synthesize current evidence and develop a contextualized strategic interpretation of e-business and leadership processes in Albania (Sallaku & Kambo, 2024; World Bank, 2021b).

The study relies on two main categories of sources. The first category includes official and institutional statistical material, particularly the INSTAT 2024 publication on ICT usage and e-commerce in enterprises, the INSTAT 2025 documentation on ICT usage in households and by individuals, the INSTAT publication on SMEs for 2024, and the World Bank Albania E-Commerce Diagnostic (INSTAT, 2024, 2025a, 2025b, 2026a; World Bank, 2021a). These sources were selected because they provide verifiable, methodologically documented, and publicly accessible information. The second category includes recent academic studies and policy-oriented analyses on digitalization, digital leadership, and enterprise performance in Albania and comparable settings (Sallaku & Kambo, 2024; Yasa et al., 2024; Apostolovska et al., 2026).

The time frame for the non-foundational literature and evidence is mainly 2020 to 2026, in order to ensure that the analysis reflects the post-pandemic digital environment and current institutional developments (Sallaku & Kambo, 2024; Apostolovska et al., 2026). Older works are used only when necessary to clarify established concepts. The analytical logic of the paper follows four stages: environmental analysis, strategic formulation, implementation, and performance assessment. Leadership is treated as a cross-cutting dimension that shapes all four stages rather than as a separate managerial topic (Yasa et al., 2024; Sallaku & Kambo, 2024).

Methodologically, the paper is interpretive and applied. It does not attempt to produce universal claims for all economies. Instead, it aims to develop a context-sensitive academic discussion rooted in Albanian evidence. This approach is appropriate because the central question is not simply whether e-business matters, but how strategic management and leadership processes can make e-business more effective in a specific national environment (INSTAT, 2026a; World Bank, 2021b).

4. Albania's Digital Business Context

4.1 Enterprise digital infrastructure

Recent official data indicate that Albania has built a relatively strong base for business digitalization. INSTAT reports that in 2024, 99.3% of enterprises with 10 or more employees used computers with internet access for work purposes, up from 99.1% in 2023 (INSTAT, 2024). Fixed internet connection use among enterprises was also 99.3%, and 88.0% of enterprises had download speeds above 30 Mbit/s, compared with 83.5% in the previous year (INSTAT, 2024). These figures show that basic connectivity is no longer the main obstacle for most formal enterprises in Albania.

At the same time, stronger digital infrastructure does not automatically mean stronger digital capability. In 2024, only 29.7% of enterprises had ICT specialists, although this was an improvement from 28.4% in 2023 (INSTAT, 2024). This means that more than two-thirds of enterprises operated without dedicated internal digital expertise. The implication is clear: the infrastructure base exists, but firms often lack the internal human capacity needed to transform connectivity into strategic advantage (INSTAT, 2024; Yasa et al., 2024).

4.2 Websites, social media, cloud, and internal systems

The degree of digital engagement varies considerably by tool and function. INSTAT reports that 57.7% of enterprises using internet had a website in 2024, up from 54.9% in 2023 (INSTAT, 2024). Social media use was much higher, reaching 83.1% of enterprises, while cloud service use stood at 30.0% (INSTAT, 2024). Automatic internal information sharing systems used for enterprise resource planning and management were adopted by 40.7% of enterprises, and among firms that bought cloud services, 70.6% used CRM-related applications (INSTAT, 2024).

These figures suggest a layered pattern of digitalization. Public-facing and lower-cost tools, such as social media, diffuse more quickly, while more integrated systems, such as cloud solutions and internal *process software, spread more slowly (INSTAT, 2024). This pattern is typical in settings where firms adopt visible digital instruments first, but delay the deeper organizational changes required for integrated e-business models (Sallaku & Kambo, 2024; World Bank, 2021b).*

4.3 E-commerce performance

One of the most relevant indicators for this article is enterprise online selling. In 2024, 24.5% of Albanian enterprises with 10 or more employees sold products or services through websites, dedicated applications, or e-commerce marketplaces, representing an increase of 9.7 percentage points compared with 2023 (INSTAT, 2024). Online sales accounted for 9.5% of turnover overall (INSTAT, 2024). Sectoral differences were substantial. Information and communication recorded online sales equal to 40.3% of turnover, transportation and storage 18.7%, repair of computers and communication equipment 15.4%, administrative and support services 13.4%, wholesale and retail trade 11.6%, and accommodation and food service activities 10.1% (INSTAT, 2024).

These data indicate that e-business development in Albania is sectorally uneven. Sectors that are more information-intensive or service-oriented tend to adopt digital selling more successfully, while more traditional sectors remain behind. This unevenness matters strategically because it implies that firms shouldn't blindly copy digital models from other sectors. Strategy must reflect the sector's transaction logic, customer behavior, and service structure (INSTAT, 2024; Sallaku & Kambo, 2024).

4.4 Households, individuals, and market demand

Enterprise e-business prospects also depend on consumer digital behavior. INSTAT's household ICT documentation shows that the 2025 survey followed Eurostat standards, used a two-stage sample design, and interviewed 5,413 households, achieving a response rate of 75.2% (INSTAT, 2025a, 2025b). The metadata document reports an estimate of 89.4% for internet usage up to one year ago among individuals aged 16 to 74, with a 95% confidence interval of 88.6% to 90.2% (INSTAT, 2025b). This points to a broad user base for digital services and online interaction.

At the same time, the World Bank has noted that trust, logistics quality, payment systems, and skills remain important constraints on e-commerce growth in Albania (World Bank, 2021a, 2021b). Therefore, the demand side is present, but it is filtered through institutional and behavioral frictions. Albanian firms need to understand that digital market opportunity exists, but it must be approached through trust-building, service reliability, and practical transaction design rather than through mere online visibility.

4.5 SMEs as the core strategic unit

The centrality of SMEs in Albania makes them the primary unit of analysis for e-business strategy. INSTAT reports that in 2024 SMEs represented 99.9% of active enterprises, generated 82.0% of employment, 81.4% of net sales, and 78.1% of value added (INSTAT, 2026a). This means that Albania's digital transition will depend largely on whether SMEs can design and implement workable digital strategies.

However, SMEs generally face stronger constraints than large firms. They tend to have fewer specialized staff, tighter budgets, and lower tolerance for implementation failure. For that reason, strategic management and leadership are even more critical in SMEs than in large corporations. Albanian SMEs need realistic, phased, and business-relevant digital strategies rather than expensive or fashionable digital projects disconnected from their operational needs (INSTAT, 2026a; Sallaku & Kambo, 2024; Yasa et al., 2024).

5. Strategic Management Processes in E-Business

5.1 Environmental analysis

A firm's e-business strategy should begin with environmental analysis. In Albania, this means assessing not only competition and customer behavior, but also the wider digital environment shaped by infrastructure, labor skills, public digitalization, logistics, and regulation (World Bank, 2021b; Apostolovska et al., 2026). A useful way to structure this assessment is through a PESTEL-type logic.

Politically and institutionally, Albania has advanced digital public services and has continued aligning with European digital standards, which supports administrative digitalization and formal online interaction (Apostolovska et al., 2026; INSTAT, 2025a). Economically, the dominance of SMEs means that digital strategy must often be designed under resource constraints (INSTAT, 2026a). Socially, the high rate of internet use creates opportunity, but variable trust and skill levels still affect online market behavior (INSTAT, 2025b; World Bank, 2021b). Technologically, enterprise connectivity is strong, yet internal digital capability remains uneven because only 29.7% of firms have ICT specialists and cloud adoption is still limited (INSTAT, 2024). Legally and operationally, the World Bank points to logistics, payments, and regulatory quality as continuing determinants of e-commerce performance (World Bank, 2021a, 2021b).

This environmental analysis has a direct managerial function. It helps firms avoid overly generic digital strategies. A business operating in Albanian tourism, retail, education, or transport will face different competitive and operational conditions, even if all four sectors use online tools (INSTAT, 2024; World Bank, 2021a).

5.2 Strategic formulation

After environmental analysis, the next step is strategic formulation. At this stage, the firm decides what role e-business will play in its broader competitive model. Some firms may use e-business mainly to extend market reach. Others may focus on process efficiency, customer relationship management, or service bundling (Sallaku & Kambo, 2024; Yasa et al., 2024).

In the Albanian context, strategic formulation should be guided by three questions. First, what concrete business problem is digitalization supposed to solve? Second, which digital tools are aligned with the firm's size, sector, and capability base? Third, how will digital investment create value beyond simple online presence (INSTAT, 2024; Yasa et al., 2024)? These questions are important because firms often adopt websites or social media pages without integrating them into a coherent commercial, service, or information strategy (INSTAT, 2024).

For many Albanian SMEs, a sensible strategy may begin with targeted digitalization rather than complete transformation. A hotel, tour operator, retailer, or professional service firm can gain substantially from online booking systems, customer databases, structured inquiry management, digital payment options, and content-based market communication (World Bank, 2021a; INSTAT, 2024). The strategic goal should be to combine visibility, trust, and operational efficiency. In this sense, formulation is not about choosing the most advanced technology. It is about choosing the most relevant strategic configuration (Yasa et al., 2024).

5.3 Implementation

Implementation is where many digital strategies either mature or fail. It requires more than technical procurement. Firms must decide whether to build internally, outsource, adopt standard platforms, or combine these options. They must also define staff roles, workflows, customer service arrangements, and data practices (Yasa et al., 2024; World Bank, 2021b).

The Albanian evidence suggests that implementation should usually proceed in phases. Since many firms lack ICT specialists, it may be unrealistic to move immediately from basic online presence to fully integrated enterprise systems (INSTAT, 2024). A phased approach allows the firm to consolidate each stage before moving to the next. For example, a business might first improve website functionality, then integrate booking or ordering processes, then develop CRM practices, and only later adopt deeper automation or cloud-based coordination (INSTAT, 2024; Yasa et al., 2024).

Implementation also requires organizational alignment. The existence of social media accounts or websites does not itself change organizational routines. Staff must know how to respond to inquiries, process orders, manage digital content, protect customer information, and use data for decisions (Yasa et al., 2024). If these practices are absent, digital tools remain detached from real business operations. This is one reason why leadership is central during implementation (Yasa et al., 2024; Sallaku & Kambo, 2024).

5.4 Performance assessment

The final strategic stage is performance assessment. Albanian firms should evaluate e-business not only by whether they are online, but by whether online activity improves turnover, customer satisfaction, speed of service, and internal coordination (INSTAT, 2024; Yasa et al., 2024). INSTAT's enterprise indicators provide useful benchmarks for this purpose, including rates of website ownership, online sales participation, cloud use, ERP-related information sharing, and sector-level online turnover shares (INSTAT, 2024).

A balanced assessment should include both financial and non-financial indicators. Financial indicators may include the share of turnover generated online, cost reduction, or customer acquisition efficiency. Non-financial indicators may include response times, booking accuracy, repeat use, digital inquiry conversion, and the quality of data available for decisions (INSTAT, 2024; Yasa et al., 2024). Firms that treat assessment seriously are more likely to refine strategy over time and move from experimental digitalization to sustained e-business capability (Yasa et al., 2024).

6. Leadership Processes in E-Business

6.1 Leadership as a strategic driver

Leadership shouldn't be treated as an optional addition to e-business strategy. It is one of the main drivers that determine whether a digital initiative remains fragmented or becomes part of the firm's *strategic core (Yasa et al., 2024; Sallaku & Kambo, 2024). In practice, leaders shape the pace and quality of digital transformation through resource allocation, priority setting, communication, and example.*

In Albania, this role is especially important because many firms are owner-managed or centrally directed. Under such conditions, leadership decisions often have an immediate operational impact. If the owner or senior manager views digitalization as a side project, it is likely to remain superficial. If leadership defines it as a strategic priority connected to customer service, sales, and process quality, implementation becomes more coherent (Sallaku & Kambo, 2024; World Bank, 2021b).

6.2 Digital leadership competencies

The literature on digital leadership highlights several competencies that are especially relevant for firms building e-business capacity. First, leaders need strategic clarity: they must understand why digitalization matters for their specific business model (Yasa et al., 2024). Second, they need basic digital literacy so they can evaluate tools, vendors, risks, and opportunities without depending blindly on external consultants (Yasa et al., 2024). Third, they need organizational communication skills, because digital change often creates uncertainty among staff and requires coordinated adaptation (Yasa et al., 2024).

A fourth competency is learning orientation. Digital markets, platforms, and customer behaviors change quickly, which means leaders must be willing to revise assumptions, test tools, and learn from results (Sallaku & Kambo, 2024; Yasa et al., 2024). In Albanian SMEs, this is particularly valuable because firms often can't afford large mistakes. An adaptive leadership approach helps reduce risk by encouraging phased learning rather than one-time transformation efforts (Sallaku & Kambo, 2024).

6.3 Leadership and organizational culture

One of the less visible but highly important functions of leadership is cultural. Digital transformation changes routines, communication patterns, service expectations, and sometimes power relations inside the firm. These changes may create resistance, especially where employees are accustomed to informal, manual, or face-to-face processes (Sallaku & Kambo, 2024; Yasa et al., 2024).

Leaders influence whether this resistance becomes paralysis or learning. They can do so by explaining the purpose of change, setting achievable priorities, offering training, and connecting digital practices to everyday operational benefits (Yasa et al., 2024). In other words, leadership in e-business is not just about approving investments. It is also about creating a culture in which digital tools are seen as useful, manageable, and aligned with the firm's objectives (Yasa et al., 2024; Sallaku & Kambo, 2024).

7. Discussion: Main Challenges and Strategic Implications for Albania

The Albanian case reveals a clear pattern. The country has reached a stage where basic digital access is widespread, but strategic digital maturity is uneven. This can be seen in the distance between enterprise internet access at 99.3% and enterprise e-commerce participation at 24.5%, as well as in the modest levels of cloud adoption and ICT specialist presence (INSTAT, 2024). The challenge, therefore, is no longer mainly whether firms can get online. It is whether they can convert digital access into integrated, value-generating business practice (INSTAT, 2024; Yasa et al., 2024).

This gap has at least four implications. First, digital policy should go beyond connectivity and focus more strongly on business capability, skills, and implementation support (World Bank, 2021b; Apostolovska et al., 2026). Second, enterprise strategy should prioritize fit over imitation. Firms should adopt digital models that reflect their own market logic and capacity rather than copying generic international examples (Sallaku & Kambo, 2024; Yasa et al., 2024). Third, leadership development matters because many digital weaknesses are organizational rather than purely technical (Yasa et al., 2024). Fourth, SMEs need practical pathways for gradual improvement, since the business structure of Albania does not support a one-size-fits-all model of digital transformation (INSTAT, 2026a).

The policy dimension is also relevant. Since SMEs represent almost the entire business population and a large share of employment and value added, public support for digital capability development can have economy-wide effects (INSTAT, 2026a). The World Bank's diagnostic suggests that progress in payments, logistics, trust, regulation, and business skills would improve the environment for digital trade (World Bank, 2021a, 2021b). This indicates that e-business development is shaped by both firm-level strategy and system-level conditions.

8. Conclusion

This article examined the strategic management and leadership processes involved in e-business development in Albania. The evidence shows that Albania has achieved a strong base in enterprise connectivity and a meaningful level of digital public and consumer readiness (INSTAT, 2024, 2025b). However, the transition from digital access to strategic e-business capability remains incomplete (INSTAT, 2024; Apostolovska et al., 2026).

The analysis suggests that effective e-business in Albania depends on four interconnected elements: careful environmental analysis, realistic strategy formulation, phased implementation, and systematic performance assessment (Sallaku & Kambo, 2024; Yasa et al., 2024). Across all four elements, leadership plays a central role. Digital progress requires leaders who can define priorities, support learning, and align technology with concrete business goals (Yasa et al., 2024).

For Albanian enterprises, especially SMEs, the practical conclusion is straightforward. E-business shouldn't be approached as a symbolic sign of modernity, but as a managed strategic process. Firms that treat it in this way are more likely to generate measurable gains in market reach, service quality, and organizational efficiency (INSTAT, 2026a; INSTAT, 2024; Sallaku & Kambo, 2024). For policymakers, the implication is equally clear: improving enterprise digital performance will require attention not only to infrastructure, but also to skills, business capability, trust, logistics, and the institutional environment surrounding digital trade (World Bank, 2021b; Apostolovska et al., 2026).

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NEW PERSPECTIVES IN THE DEVELOPMENT OF EXPORT-ORIENTED INDUSTRY AND THE ROLE OF YOUTH

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Abstract

This article provides a detailed analysis of new perspectives in the development of export-oriented industry and the role of youth in this process. In the contemporary global economy, export-oriented industry acts as a guarantor of sustainable economic growth and competitiveness for countries. In Azerbaijan, the government's economic reforms, measures to stimulate the non-oil sector, and the expansion of export opportunities necessitate the active participation of youth in this process. The research focuses not only on the current situation and prevailing challenges but also on technological trends, innovations, and new opportunities offered by the digital economy. At the end of the article, recommendations are proposed to strengthen the role of youth in the development of export-oriented industry and to implement effective policy tools in this direction.

Keywords: *Export-oriented industry, youth, innovation, digital economy, economic reforms, competitiveness*

Introduction

In the modern era, the global economic system is changing rapidly, and competition and economic relations between countries are becoming stronger. Under these conditions, the development of an export-oriented industry has become one of the main priorities for the long-term and sustainable development of states, increasing competitiveness in the world market, diversifying the economy, and reducing risks. Export-oriented industry, while meeting the internal needs of the country, expands access to foreign markets, provides foreign currency inflows, creates a new labor market, and stimulates the application of innovations. Historical experience shows that the development of export-oriented industry plays an important role in ensuring the economic security and prosperity of every country. This path has been successfully applied in the modern economic models of Japan, South Korea, Singapore, and a number of European countries.

In Azerbaijan, the core of economic reforms is also the development of the export-oriented industrial sector. The policy of economic diversification carried out under the leadership of the Head of State, the development of the non-oil sector, the promotion of the "Made in Azerbaijan" brand, export credits and concessional financial mechanisms, and measures such as supporting entrepreneurship have led to significant progress in this area. The development of export-oriented industry is not limited only to the improvement of macroeconomic indicators; this process also creates favorable conditions for the application of new technologies, the formation of innovative approaches in production and management, as well as the development of human capital.

Particularly, involving young people in this field and efficiently utilizing their potential is of strategic importance for the country's future economic development. Young people stand out due to their dynamism, creative thinking, and ability to adapt to new technologies. Their participation in new startup projects, innovative production processes, digital platforms, and international cooperation seriously affects the future development dynamics of the export-oriented industry. In today's reality, youth act not only as a workforce or producers but also as creative leaders, managers, authors of technological innovations, and initiators of the export process. Their knowledge of foreign languages, their strategic planning and marketing skills for accessing international markets, and their ability to use digital technologies open up new opportunities in the development of export-oriented industry. At the same time, the opportunities created by the public and private sectors to attract young people to this field, various training and mentorship programs, startup competitions, and innovation centers play an important role in this direction.

The purpose of this article is to comprehensively investigate new perspectives, global economic trends, and the opportunities and role of youth in the development of export-oriented industry, to analyze current challenges and potential opportunities, and to put forward efficient recommendations for the development of this field.

Research Section

1. General Overview and Significance of the Export-Oriented Industry

In the globalizing world economy, the development of export-oriented industry is of great importance for the sustainable development and competitiveness of countries. Export-oriented industry covers production areas aimed at presenting products and services to foreign markets while satisfying domestic market demand. This approach is essential in terms of diversifying the economy, ensuring foreign currency inflows, creating new jobs, and implementing innovations. Although the Azerbaijani economy relied on the oil and gas sector for a long time, significant steps have been taken in recent years toward developing the non-oil sector and increasing export potential. As a result of the state's special attention to this area, the volume and geography of exports in various industrial sectors have expanded.

2. Current Situation and Structure of the Export-Oriented Industry in Azerbaijan

Azerbaijan's export-oriented industry is mainly developed within the non-oil sector. During January-December 2024, Azerbaijan's non-oil-gas exports increased by 0.3% compared to the corresponding period of 2023 and amounted to 3.4 billion USD. During this period, the export of food products increased by 11.3%, reaching 1.03 billion USD.

The following table presents Azerbaijan's export performance by sector within the non-oil sector for January-December of 2023 and 2024:

Sector	January-December 2023 (mln. $)	January-December 2024 (mln. $)	Growth Percentage
Agrarian and Agro-Industrial Products	973.2	1.11 billion	14.1%
Food Products	925.5	1.03 billion	11.3%
Chemical Industry Products	248.2	293.7	18.3%
Black Metals and Articles Thereof	47.3	48.2	1.9%
Cotton Yarn	122.7	178.2	45.2%
Tea	5.9	6.0	1.6%

Source: Center for Analysis of Economic Reforms and Communication, State Statistical Committee.

As seen from this table, significant increases were observed in Azerbaijan's non-oil sector exports in 2024. Specifically, a growth of 45.2% was recorded in cotton yarn exports, 18.3% in chemical industry products, and 14.1% in agrarian and agro-industrial products. These increases are the result of steps taken toward the development and diversification of the country's non-oil sector.

3. Sectoral Analysis of the Export-Oriented Industry

- *Agrarian Sector: Azerbaijan's agriculture and agro-industrial products have formed the backbone of the export-oriented sector for many years. During January-December 2024, the export of agrarian products increased by 2.8% to 789.4 million USD, while the export of agro-industrial products increased by 57.3% to 316.1 million USD. Among the main export products, goods such as tomatoes, hazelnuts, apples, persimmons, pomegranates, cotton, grapes, and tobacco predominate. The state provides farmers with subsidies, concessional loans, innovative technological support, and logistics opportunities. In recent years, the increase in productivity and quality indicators in agriculture has raised export competitiveness.*
- *Food Industry: The food industry opens up new export opportunities for Azerbaijan through the establishment of deep processing enterprises, extending the shelf life of products, and raising quality and safety standards. During January-December 2024, food product exports increased by 11.3% to reach 1.03 billion USD. Main export products include confectionery, canned goods, tea, alcoholic and non-alcoholic beverages, seafood, etc. The primary export markets are Russia, Kazakhstan, Georgia, and the UAE.*
- *Light Industry and Textiles: Light industry and textiles are traditional fields in Azerbaijan, and important measures have been taken in recent years to increase exports in this sector. Textile products, clothing and footwear, cotton, and carpet products are the main export categories. The implementation of automated production lines and new technologies in state enterprises increases export potential.*
- *Chemical and Petrochemical Industry: The chemical and petrochemical industry holds strategic importance in Azerbaijan's industrial exports. During January-December 2024, the export of chemical industry products increased by 18.3%, totaling 293.7 million USD. Polymers, plastics, fertilizers, synthetic rubber, caustic soda, and other goods are among the main export items. Sumgait Chemical Industrial Park, SOCAR Polymer, and other enterprises play a leading role in this direction.*
- *ICT and High Technologies: Export potential in the information and communication technologies and high technologies sector is just beginning to take shape. Platforms such as the "Azerbaijan Startups Federation", "INNOLAND", and "SABAH.HUB" create conditions for youth and innovative companies to succeed in this field. ICT products and software are being exported to foreign markets.*

• *Building Materials:* *Building materials, including cement, plaster, gypsum, plasterboard, and other products, are exported to neighboring countries. The modernization of production and the improvement of quality standards in this field have a positive impact on export volume.*

4. New Perspectives and Global Trends

• *Digitalization and E-commerce:* *The rapid development of digital technologies in recent years creates new opportunities in the export-oriented industry. The creation of e-commerce platforms, the application of digital marketing strategies, and the expansion of online sales channels provide exporters with faster and more effective market access. Digitalization increases efficiency in production, logistics, and sales processes.*

• *Green Economy and Sustainable Development:* *On a global scale, producing products that meet environmental standards and applying green technologies are among the priority issues. Azerbaijan's projects regarding renewable energy, ecologically clean agrarian products, and green industrial technologies are also increasing.*

• *Artificial Intelligence and Automation:* *Artificial intelligence, automated management systems, "Industry 4.0", IoT, and other technologies increase efficiency and productivity in production and export processes. Industrial enterprises in Azerbaijan have begun implementing these technologies step by step.*

• *International Cooperation and Trade Agreements:* *Azerbaijan's work toward WTO (World Trade Organization) membership, alongside bilateral and multilateral trade agreements with the European Union, Turkey, China, Central Asia, and Middle Eastern countries, creates new market opportunities for exporters. Azerbaijan also actively participates in the "Belt and Road Initiative", increasing speed and efficiency in export processes through the creation of regional and global logistics corridors and the development of transport infrastructure. This further strengthens the economic and logistical advantages of Azerbaijan's geographical position.*

5. The Role and Opportunities of Youth in the Export-Oriented Industry

• *The Role of Youth in the Startup and Innovation Ecosystem:* *In recent years, the startup ecosystem in Azerbaijan has been developing rapidly, and the role of youth here is especially emphasized. By the end of 2024, the number of officially registered startups in Azerbaijan approached 300, and approximately 70-75% of them were founded by young people. Youth mainly operate in fields such as ICT, agrarian innovations, e-commerce, clean energy, biotechnology, and digital services. Significant support is provided to the startup initiatives of youth by both public and private sectors. Incubation and acceleration centers like "INNOLAND", "SABAH.lab", and "Next Step", along with special training programs, grants, and investment opportunities, pave the way for the realization of innovative ideas by young people.*

• *State and Private Sector Support for Youth:* *Various programs and initiatives encouraging export-oriented entrepreneurship and innovation activities of youth are being implemented: "Startup Azerbaijan" state program; "Young Entrepreneurs Network"; International internship programs and foreign scholarships (SAF, Erasmus+, Horizon Europe, etc.); Grants, concessional loans, and mentorship support provided by state and private funds. The state's main goal is to rapidly prototype the ideas of young people, bring them to market, and maximize their export potential.*

• *Main Challenges Faced by Youth:* *Despite the increasing support programs from the state and private sectors, youth still face several difficulties: Complexity of legal and technical procedures in accessing foreign markets; Limitation of financial and investment opportunities; Lack of experience in marketing, sales, and international logistics; Insufficiency of professional mentorship and expert networks in the innovation ecosystem; Difficulties in creating competitive products and services that meet international standards.*

• *Potential and Opportunities of Youth:* *Young people quickly adapt to digital technologies, know foreign languages, are active in international innovation networks, and take the initiative to bring various business models and new technologies to the country. The successful results of hackathons, "Demo Days", international competitions, and accelerator programs held in the innovation ecosystem show that youth are a potential primary resource for increasing the export share of the national economy.*

Table: Startup and Entrepreneurship Activities of Youth in Azerbaijan (2021-2024)

Year	Number of Startups	Startups Founded by Youth	Projects in International Competitions
2021	143	99	31
2022	196	137	44
2023	252	177	61
2024	295	217	74

Source: Azerbaijan Startups Federation, Innovation Agency, preliminary reports for 2024.

6. Challenges Ahead in the Development of Export-Oriented Industry

• *Dark/Technological Infrastructure and Modernization:* *For the development of export-oriented industry, setting up modern technological equipment and production lines, implementing innovative management systems, and ensuring compliance with quality and standards are crucial. Technological backwardness in some sectors, a low level of automation, and insufficient investment in R&D (Research and Development) limit export potential.*

• *Training of Personnel and Human Capital:* *Modernizing the higher and vocational education system, organizing practical training, mastering international experience, and strengthening industry-school cooperation are vital for preparing highly qualified engineers, programmers, technical personnel, experienced managers, and marketers.*

• *Access to Financial Resources:* *Access to capital and credit resources is limited for startups and small business entities. The development of public and private investment funds, venture capital, and "business angels" networks is a primary challenge in this area. Although certain positive changes took place in this sector in 2024, the depth of the financial market is still not at the desired level.*

• *Foreign Market Research and Certification:* *Creating information databases regarding foreign market requirements, standards, certification, and logistical procedures, along with implementing "one-stop-shop" support mechanisms for exporters, is necessary. Educational projects were successfully implemented by the state and NGOs in this direction in 2024.*

7. Future Perspectives and Development Opportunities

• *Digital and Technological Integration:* *Work carried out on digitalization, artificial intelligence, automated production systems, increasing productivity and quality, and creating new products and services offers major future opportunities for exporters. In 2024, some agro-startups and technology companies already carried out product sales through digital platforms in European and Middle Eastern markets.*

• *Green Energy and Environmental Standards:* *By producing environmentally clean products and applying "green industry" technologies, Azerbaijan can gain easier access to European and other developed markets. In 2024, a "green technologies" section was launched in the Sumgait Chemical Industrial Park, and several innovative products were exported.*

• *International Cooperation and Global Networks:* *Azerbaijan's integration into international trade organizations, free trade agreements, and participation in initiatives like the "Belt and Road Initiative" open new windows of opportunity for exporters. The number of companies participating in international exhibitions and forums increased by more than 30% in 2024.*

• *New Platforms for Youth:* *Innovation centers, technoparks, business incubators, and accelerators created for youth in Azerbaijan have become a strategic factor in realizing their creative and entrepreneurial potential. Platforms such as "INNOLAND", "SABAH.lab", "Baku ID", "Smart City" laboratories, "SUP.VC", "Next Step", etc., provide not only training and mentorship but also real financial, technical, and logistical support, international networking, and market access opportunities. In 2024, more than 40 new products and services were introduced to international markets by young people working on these platforms.*

Consequently, 2024 statistics and current trends indicate that the development of export-oriented industry in Azerbaijan is a dynamic and expanding process. The activeness of youth, support from public and private sectors, digitalization, technology, and international cooperation enable the efficient realization of export potential at a new stage. The main challenges ahead are continuous innovation, strengthening human capital, and accelerating structural reforms.

Conclusion

The analysis and statistical observations show that the export-oriented industry in Azerbaijan has entered a phase of rapid development in recent years. The observed growth in the export indicators of the non-oil sector, particularly in the agrarian, food, chemical, and textile fields, creates an important foundation for the country's economic diversification, macroeconomic stability, and sustainable development. The performance indicators of 2024 demonstrate that the growth rate across sectors has been maintained compared to previous years, and a significant rise has been recorded in some directions.

The application of innovations in the export-oriented industry, the expansion of digitalization, the rapid adoption of technologies, and the production of goods matching international standards strengthen Azerbaijan's position in the global trade system. The role of youth in this process is becoming increasingly significant. Rising activity in the startup ecosystem, the creation of new products and services, participation in international competitions, and steps taken toward entering the global market create favorable conditions for the realization of youth potential.

Nonetheless, a series of systemic problems and challenges also exist on the path of industrial development. The need for technological modernization, limited financial resources, personnel training, and certification and logistical difficulties for entering international markets are among these. Attracting young people to this field and supporting their entrepreneurship more effectively is an essential condition for long-term development.

Recommendations

1. Education and Skills Development for Youth

- ***Practical-oriented education:*** *Improving specialties and curricula in higher and vocational education institutions in export-oriented industrial fields (technology, management, marketing, international law, and logistics).*
- ***Training and education programs:*** *Expanding business incubation, acceleration, mentorship, and internship programs for youth, and increasing knowledge in modern technologies and innovation.*

2. Strengthening the Startup and Innovation Environment

- ***Innovation infrastructure:*** *Establishing technoparks, incubators, acceleration centers, and "green zones", and developing real working conditions to support the innovative ideas of youth.*
- ***Investment and grant mechanisms:*** *Increasing financial opportunities for startups through low-interest loans, grants, venture funds, and "business angels" networks from both public and private sectors.*

3. Access to Foreign Markets and International Experience

- ***Market research:*** *Organizing training and databases on foreign market requirements, certification, standards, and logistics.*
- ***International relations:*** *Stimulating the participation of youth and startups in international trade fairs, accelerators, and competitions, and supporting them with internship programs abroad.*

4. Public-Private Sector Cooperation and Incentive Mechanisms

- ***Effective incentive policy:*** *Applying tax exemptions, export credits, insurance, and other economic incentives for export-oriented enterprises.*
- ***Industry-education cooperation:*** *Project-based cooperation between industrial enterprises and universities, and organizing industrial internships for students and graduates.*

5. Technological and Digital Transformation

- ***Digital skills:*** *Increasing the knowledge and skills of youth in the digital economy, e-commerce, programming, and artificial intelligence.*
- ***Automation and innovation:*** *Encouraging the application of automated management and "Industry 4.0" technologies in export-oriented enterprises.*

6. Supporting Regional Development

- ***Expanding opportunities in regions:*** *Expanding infrastructure and support programs for the development of agrarian, industrial, tourism, and digital startups in the regions.*
- ***Local incubation and training centers:*** *Increasing the number of startup and innovation centers operating in the regions, and bringing out the potential of local youth.*

7. Stimulating Social Entrepreneurship among Youth

- ***Social entrepreneurship:*** *Supporting projects aimed at innovative solutions to social problems, as well as ecologically and socially responsible startups.*
- ***Mentorship and networking:*** *Organizing closer communication between successful entrepreneurs/experts and youth, and creating professional networks and clubs.*

In conclusion, the application of new technological trends, accelerating innovation and digitalization, involving youth in this process, and creating effective support mechanisms for this purpose must be the main priorities for the continuous development of the export-oriented industry in Azerbaijan. Implementing consistent and purposeful measures in this direction will increase the country's competitiveness in the international market and ensure socio-economic welfare and sustainable development.

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BRAND EQUITY BUILDING AND MARKETING STRATEGIES IN THE FOOD SECTOR

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Abstract
The food sector is undergoing a profound structural transformation under the pressure of intense global competition, rapidly changing consumer preferences, and digital marketing dynamics. In this context, brand equity emerges as a decisive strategic asset for food enterprises to achieve sustainable competitive advantage. While existing literature provides significant accumulation regarding the dimensions and measurement approaches of brand equity, the insufficiency of integrated conceptual frameworks that holistically address sector-specific consumer behavioral dynamics, digital transformation processes, and sustainability perceptions constitutes a notable research gap. Drawing on Aaker's (1991) and Keller's (1993) foundational brand equity models, this study critically and comparatively examines contemporary literature specific to the food sector, proposing an integrated conceptual model encompassing digital marketing applications, sustainability communication, and consumer experience dimensions. The study offers theoretical, methodological, and practical contributions while developing policy recommendations for both academic literature and sector stakeholders.

Keywords: Brand equity, food sector, marketing strategies, consumer behavior, digital marketing, sustainability

1. INTRODUCTION

The global food industry, with an estimated market size of approximately 8 trillion dollars, constitutes one of the most fundamental sectors of the world economy and simultaneously generates an increasingly complex and dynamic competitive environment (FAO, 2023). Within such an intensely competitive marketplace, the ability of firms to sustain their market presence and secure a permanent position in consumers' preference structures has made the construction of a strategic brand identity an indispensable necessity extending far beyond product quality alone. In this context, brand equity cannot be reduced merely to a company's logo or packaging design; rather, it represents a multidimensional construct integrating consumers' cognitive, emotional, and behavioral responses toward a brand (Aaker, 1991; Keller, 1993).

Unlike many other industries, the food sector possesses a distinctive structure in which consumer decisions are shaped not only by functional product attributes but also by trust, health perceptions, cultural symbols, emotional attachment, and ethical concerns (Delgado-Ballester & Munuera-Alemán, 2005; Konuk, 2018). This structural specificity creates substantial limitations in the direct application of general brand equity models derived from broader marketing theory to the food industry context. Simultaneously, the acceleration of digital transformation has positioned social media interactions, influencer marketing, and e-commerce platforms as powerful new channels influencing consumer perceptions and evaluations of brands (Labrecque et al., 2013; Godey et al., 2016).

The sustainability dimension has recently emerged as a central concern in food-related brand equity research. Growing anxieties regarding climate change, the increasing prevalence of green consumption tendencies, and heightened sensitivity toward food safety issues have led consumers to place greater emphasis on environmental and social responsibility criteria in their brand evaluations (Testa et al., 2019; Aschemann-Witzel & Zielke, 2017). These developments require food brands to adopt not only product-oriented but also value-oriented communication strategies capable of addressing consumers' ethical and sustainability-related expectations.

Nevertheless, a critical examination of the existing academic literature reveals that food sector-specific brand equity models remain insufficient in addressing these multidimensional dynamics—consumer psychology, digital marketing, and sustainability—within an integrated conceptual framework. Existing studies have largely been conducted in fragmented and isolated forms, while the interaction mechanisms among these variables have not been adequately conceptualized or systematically modeled. This research gap constitutes a significant theoretical and practical problem within the branding and marketing literature.

Accordingly, the primary objective of this study is to examine the existing literature on brand equity formation processes and marketing strategies in the food sector through a systematic, comparative, and critical perspective, and to propose a conceptual framework integrating sector-specific dynamics such as digital transformation, sustainability communication, and consumer experience. Furthermore, through the research hypotheses derived from the proposed framework, the study aims to provide a theoretical foundation for future empirical investigations.

The structure of the study is organized as follows. The second section discusses the fundamental conceptual and theoretical foundations of brand equity. The third section presents a comprehensive and critical literature review. The fourth section systematically identifies the major research gaps in the literature and introduces the proposed integrated conceptual model together with its associated hypotheses. The fifth section is devoted to discussion, while the sixth section presents the conclusion, recommendations, and evaluation of the study's academic contributions.

2. CONCEPTUAL / THEORETICAL FRAMEWORK

2.1. Brand Equity: Definition and Dimensional Structure

The concept of brand equity has been systematically examined within the marketing literature since the late 1980s; however, it continues to be discussed as a multilayered construct for which a complete scholarly consensus has yet to be achieved. Farquhar (1989) defined brand equity as "the added value that a brand confers upon a product," and this foundational perspective was subsequently expanded through the development of multidimensional theoretical models.

The literature generally approaches brand equity from two principal perspectives: the consumer-based approach and the firm-based/financial approach. While the financial perspective focuses on measuring the monetary contribution of a brand to a firm's financial performance and market value (Simon & Sullivan, 1993), the consumer-based perspective conceptualizes brand equity through the cognitive and emotional representations existing within consumers' minds. Given the complex psychological and social dynamics characterizing consumer decision-making processes in the food industry, the present study adopts the consumer-based perspective as its primary theoretical foundation.

2.2. Aaker's Brand Equity Model

David Aaker (1991) developed one of the most influential frameworks conceptualizing brand equity through five core dimensions: (1) brand awareness, (2) perceived quality, (3) brand associations, (4) brand loyalty, and (5) other proprietary brand assets. This model conceptualizes brand equity as a dynamic and multidimensional construct emerging from the interaction of multiple variables and has been extensively tested across numerous industries, including the food sector.

Studies applying Aaker's framework to the food industry indicate that perceived quality and brand loyalty constitute particularly decisive dimensions within this sector. Pappu and Quester (2006), for instance, empirically demonstrated that consumers tend to evaluate perceived quality in food products as a criterion that often supersedes abstract brand perceptions. Nevertheless, the model's inability to incorporate the new brand touchpoints introduced by the digital era—such as social media interaction, user-generated content, and online consumer reviews—represents a significant limitation under contemporary market conditions.

2.3. Keller's Customer-Based Brand Equity (CBBE) Model

Kevin Lane Keller (1993), in his Customer-Based Brand Equity (CBBE) model, defines brand equity as "the differential effect of brand knowledge on consumer response to the marketing of a brand." Within Keller's hierarchical pyramid structure, brand equity is constructed across four sequential levels: brand identity, brand meaning, brand responses, and brand resonance.

Keller's model demonstrates a strong integration with cognitive psychology theories by explaining brand equity through knowledge structures and memory-based associative networks. In the context of the food industry, the primary contribution of this framework lies in its ability to analyze the qualitative associations through which brands are positioned in consumers' minds, including health, naturalness, trust, and locality (Keller & Lehmann, 2006). Although the model provides a more comprehensive perspective than Aaker's framework by emphasizing emotional and social identity dimensions, it nevertheless largely excludes the contextual and cultural determinants of consumer behavior.

2.4. Consumer-Based Brand Equity and Food Industry-Specific Dynamics

The adaptation of general brand equity models to the food industry requires consideration of several structural differences unique to this sector. First and foremost, food products are characterized as both experience and credence goods, meaning that consumers frequently lack objective indicators enabling them to fully evaluate product quality prior to purchase (Nelson, 1970; Darby & Karni, 1973). This *structural uncertainty elevates brand trust beyond purely functional significance, transforming it into a critical determinant of consumer decision-making in food consumption contexts.*

Furthermore, factors such as the country-of-origin effect, local and national brand preferences, associations related to organic and natural products, and value-based certification labels including halal, vegan, and kosher certifications shape brand equity in ways rarely observed in other sectors (Roth & Romeo, 1992; Konuk, 2018). These unique dynamics necessitate the development of specialized conceptual frameworks specifically tailored to the food industry.

2.5. Digital Marketing and Brand Equity: Theoretical Integration

Digital transformation represents a profound paradigm shift requiring the reconfiguration of theoretical frameworks explaining brand equity formation. Traditional brand equity models were largely constructed upon assumptions of one-way and mass communication, whereas digital platforms enable multidirectional, instantaneous, and personalized consumer interactions. In this regard, the digital brand equity framework proposed by Labrecque et al. (2013) attempts to explain how social media engagement—including likes, comments, shares, and user-generated content production—reshapes brand awareness and brand associations.

Information processing theory and network externalities theory serve as important theoretical foundations for explaining brand equity formation processes within digital environments. Through interaction with brands on social media platforms, consumers simultaneously update their cognitive brand representations and develop emotional senses of community affiliation. This bidirectional process strengthens brand resonance and brand advocacy, thereby reinforcing the core dimensions of brand equity (Godey et al., 2016).

2.6. Sustainability and Brand Equity: Theoretical Foundations

Sustainable development theory and stakeholder theory (Freeman, 1984) emphasize that brands should adopt a multidimensional value orientation addressing not only shareholders but also broader stakeholder groups. Within the food industry, sustainability perceptions demonstrate systematic relationships with brand equity through dimensions such as environmental footprint, fair trade practices, supply chain transparency, and social contribution.

From the perspective of consumer identity theory, environmentally conscious consumers tend to adopt sustainable food brands as instruments for expressing identities aligned with their personal value systems. Consequently, sustainability-oriented brand perceptions strengthen both brand loyalty and brand advocacy behaviors (Testa et al., 2019).

2.7. Theoretical Structure of the Proposed Integrated Conceptual Model

The IFBEM model proposed within the scope of this study presents a multidimensional theoretical framework specific to the food industry by extending traditional brand equity approaches through the integration of digital marketing, sustainability communication, and consumer experience dimensions. The model assumes that brand equity is shaped not only by classical marketing variables but also through digital interactions, ethical trust components, and cultural context.

The principal components of the proposed model are systematically summarized in the table below.

Table 1.

Components of the Proposed Integrated Conceptual Model

Model Dimension	Subcomponents	Theoretical Foundation	Expected Impact on Brand Equity
Digital Marketing Activities	Social media engagement, influencer marketing, user-generated content (UGC), e-commerce experience	Digital Brand Equity Framework (Labrecque et al., 2013)	Positive influence on brand awareness, brand associations, and digital resonance
Sustainability Communication	Environmental transparency, green certification, corporate social responsibility messages	Stakeholder Theory & Green Brand Trust (Freeman, 1984; Chen, 2010)	Enhancement of ethical brand trust and perceived quality
Traditional Marketing Mix	Product quality, pricing, distribution, promotion	Classical Marketing Mix Approach	Strengthening brand loyalty and perceived quality
Brand Equity Dimensions	Brand awareness, perceived quality, brand associations, brand loyalty	Aaker (1991), Keller (1993)	Stronger brand positioning in consumers' minds
Next-Generation Brand Dimensions	Digital brand resonance, ethical brand trust	Digital consumer behavior and sustainability literature	Development of long-term brand attachment and brand advocacy
Outcome Variables	Purchase intention, willingness to pay a price premium, customer lifetime value	Consumer Behavior Theories	Improvement in financial and behavioral brand performance

Moderator Variables	Cultural context, green consumer awareness	Cross-Cultural Consumer Behavior Approach	Modification of the strength of brand equity relationships

Table 1, entitled "Components of the Proposed Integrated Conceptual Model," presents a multidimensional framework that explains brand equity formation in the food industry by integrating digitalization, sustainability, and consumer psychology within a unified conceptual structure rather than relying solely on traditional marketing variables. In this respect, the model reflects the study's objective of overcoming the fragmented nature of the existing literature and establishing a more holistic theoretical perspective.

The first dimension of the model, digital marketing activities, is of critical importance in explaining the transformation of contemporary consumer behavior. Social media engagement, influencer marketing, and user-generated content reshape the traditional one-way communication paradigm by positioning consumers as active co-creators of brand value. In particular, online reviews and social media experiences directly influence perceptions of trust within the food sector, thereby strengthening brand associations. Accordingly, the model conceptualizes digitalization not merely as a communication mechanism, but also as a behavioral process influencing brand awareness and consumer-brand interaction.

The sustainability communication dimension constitutes one of the strongest aspects of the proposed framework in light of current consumer trends. The incorporation of environmental transparency, social responsibility, and green certification into the brand equity structure provides a significant theoretical contribution, particularly in markets characterized by the increasing prevalence of ethical consumption behavior. Nevertheless, it should also be recognized that sustainability-related messages may generate skepticism when consumers perceive such claims as lacking authenticity, thereby creating the risk of greenwashing perceptions. Consequently, the inclusion of the "ethical brand trust" construct demonstrates that the model adopts a realistic and contemporary perspective toward evolving consumer expectations.

The preservation of classical brand equity dimensions further strengthens the theoretical foundation of the framework. The core dimensions derived from Aaker's and Keller's models—brand awareness, perceived quality, brand associations, and brand loyalty—have been expanded through the integration of digital and ethical variables. This approach establishes a conceptual bridge between traditional branding theories and contemporary marketing dynamics shaped by digital transformation and sustainability concerns.

One of the most distinctive contributions of the model is the concept of digital brand resonance. This dimension extends beyond simple brand recognition by emphasizing the emotional, social, and online community-based connections that consumers establish with brands. Particularly among younger consumer segments, brands increasingly function as identity-building mechanisms through social media communities, highlighting the strategic significance of digital brand resonance within the food industry.

From the perspective of outcome variables, the model encompasses not only consumer attitudes but also business-oriented outcomes such as purchase intention, willingness to pay a price premium, and customer lifetime value. This broader analytical scope indicates that the framework offers substantial value for both theoretical inquiry and managerial application.

Moreover, the moderator variables included in the model—namely cultural context and green consumer awareness—demonstrate that the framework acknowledges contextual differences rather than assuming universal applicability. In hybrid markets such as Türkiye, where traditional and digital consumption patterns coexist simultaneously, these moderating variables are likely to exert a more pronounced influence on brand equity formation processes.

Overall, Table 1 provides an integrated theoretical framework capable of explaining brand equity formation in the food industry through a multidimensional, dynamic, and contemporary perspective. By bringing together digital marketing, sustainability communication, and consumer trust within a single conceptual structure, the model makes a substantial conceptual contribution to the branding literature, in which these dimensions have frequently been examined independently rather than holistically.

3. LITERATURE REVIEW

3.1. Review Methodology and Scope

The literature review conducted in this study is based on a systematic search process covering the 2014–2024 period within the Scopus and Web of Science databases. The primary keywords used during the search process included: "brand equity food," "food brand marketing," "consumer-based brand equity," "food marketing digital," "sustainability food branding," "gıda markası," and "marka değeri." As a result of the search procedure, 189 directly relevant studies were initially identified. Following a *screening process based on title, abstract, and methodological relevance criteria, 74 studies were selected for in-depth analysis.*

The literature was subsequently classified into thematic categories: (1) brand equity measurement approaches, (2) consumer behavior and brand loyalty, (3) digital marketing and social media effects, (4) sustainability and ethical consumption, and (5) regional and cross-cultural comparative studies. This classification enabled a systematic analysis of methodological differences and contradictory findings across the existing body of research

3.2. Brand Equity Measurement Approaches: A Comparative Analysis

Studies examining brand equity measurement in the food industry generally cluster around two major methodological traditions: scale-based approaches and experimental/behavioral approaches. The Multidimensional Brand Equity Scale (MBE) developed by Yoo and Donthu (2001) has been widely applied within the food sector; however, the fact that the scale was originally developed within the context of technology products raises concerns regarding its ability to adequately capture food-specific dimensions such as trust and cultural identity.

Pappu et al. (2005) and Atilgan et al. (2005), employing structural equation modeling (SEM) based on Aaker's framework, tested food brands within different market settings. Both studies demonstrated that brand loyalty possesses a substantially stronger antecedent structure in the food industry compared to other brand equity dimensions. Nevertheless, the studies produced divergent findings regarding measurement invariance testing. This divergence raises critical questions concerning the cross-cultural validity of brand equity measurement and suggests that identical scale structures may not represent equivalent constructs across different national and cultural contexts.

More recent studies have increasingly adopted mixed methods and big data analytics in an effort to overcome the limitations of traditional scale-based approaches. Chen et al. (2021), through sentiment analysis conducted on social media data, investigated the alignment between traditional survey-based brand equity measurements and digitally generated consumer expressions. Their findings revealed that user-generated content (UGC) in digital environments exhibits a parallel structure that both confirms existing brand equity components and introduces new dimensions. This finding constitutes an important methodological warning, emphasizing that the choice of measurement method may fundamentally shape research outcomes.

3.3. Consumer Behavior, Trust, and Brand Loyalty

The literature concerning the determinants of brand loyalty within the food industry consistently identifies trust as a central variable. Delgado-Ballester and Munuera-Alemán (2005) demonstrated that brand trust—through its subdimensions of reliability and intentionality—directly influences brand loyalty while also exerting indirect effects through perceived quality. Similarly, Chaudhuri and Holbrook (2001) identified brand trust and brand affect as two primary antecedents of loyalty behavior.

Studies conducted specifically in the Turkish context provide significant contributions regarding the cultural dimensions of brand loyalty. Konuk (2018), in research focusing on organic food consumers, empirically confirmed the mediating role of perceived value in the relationship between consumer perceptions and brand trust. Furthermore, the study demonstrated that local origin emphasis ("domestic product" perception) significantly differentiates brand equity components. These findings underscore the importance of examining the interaction between global brand equity models and local cultural contexts.

Nevertheless, the literature also reveals a notable contradiction. Certain studies (Yoo & Donthu, 2001; Buil et al., 2013) argue that the effect of perceived quality on brand loyalty is independent of brand awareness, whereas other studies (Tong & Hawley, 2009; Atilgan et al., 2005) suggest that brand awareness—particularly within low-involvement food categories—directly shapes perceived quality and, consequently, brand loyalty. This contradiction appears to be partially attributable to differences among product categories and highlights the necessity of systematically incorporating product category as a moderator variable within branding research.

3.4. The Impact of Digital Marketing and Social Media on Brand Equity

Research examining the relationship between digital marketing and brand equity has increased substantially since 2015, with the food industry emerging as one of the principal sectors investigated within this context. Godey et al. (2016) tested a comprehensive structural model linking four dimensions of social media marketing activities (SMMA)—entertainment, interaction, customization, and word-of-mouth communication—to brand equity components. Although the study focused primarily on the luxury food and beverage sector, its findings provided broader implications for branding research.

Kim and Ko (2012) as well as Schivinski and Dabrowski (2016) demonstrated that firm-created content and user-generated content exert different magnitudes and temporal effects on brand equity *dimensions. User-generated content—including reviews, evaluations, and social sharing activities—was found to produce stronger and more enduring effects on brand trust and perceived quality compared to firm-generated content. These findings provide critical managerial implications for food brands seeking to reposition their social media strategies.*

Moreover, research examining the impact of influencer marketing on food brand equity has increased significantly during the past five years. Trivedi and Sama (2020) demonstrated that influencer credibility—conceptualized as a combination of expertise, trustworthiness, and attractiveness—significantly predicts purchase intention toward food brands, while brand attitude serves as a mediating mechanism within this relationship. However, the long-term effects of influencer marketing on broader dimensions of brand equity, particularly brand loyalty and brand resonance, remain insufficiently explored.

Indeed, Song et al. (2021), in a study conducted within the Chinese food industry, analyzed mechanisms that hinder the transformation of short-term digital brand effects into long-term brand equity accumulation, including inconsistent brand messaging, influencer-brand incongruence, and consumer skepticism. These findings highlight the necessity of distinguishing between short-term and long-term effects within digital marketing research.

3.5. Sustainability, Green Marketing, and Food Brand Equity

The integration of sustainability discourse into food brand equity research has gained increasing prominence within the academic literature over the past decade. Testa et al. (2019) empirically demonstrated that organic and sustainable food labels generate cognitive outcomes (perceived health and environmental contribution), emotional outcomes (pride and identification), and behavioral outcomes (willingness to pay and repurchase intention) within consumers' minds. Similarly, Aschemann-Witzel and Zielke (2017) analyzed the interaction between green food consumption and price sensitivity, demonstrating that in contexts characterized by strong sustainability perceptions, brand equity reduces price elasticity; in other words, strong green brand equity supports consumers' willingness to pay price premiums.

At the same time, studies investigating consumer skepticism toward the authenticity and credibility of sustainability claims—commonly conceptualized as greenwashing perceptions—occupy a significant position within the literature. Chen (2010), through the development of the concept of green trust, analyzed whether consumers' belief in sustainability claims moderates the relationship between sustainability communication and brand equity. The findings demonstrated that under conditions of low green trust, the contribution of sustainability communication to brand equity declines significantly. This result highlights the strategic importance of authenticity and transparency within sustainability communication strategies.

Within the national literature, Erdil (2015) and Özdemir and Tokol (2021) examined the relationship between environmental sensitivity and brand preferences among Turkish food consumers. Their findings indicated that environmental consciousness influences brand decisions primarily among specific socio-demographic groups. This suggests that sustainability-oriented branding strategies should be designed for carefully segmented target markets rather than generalized consumer audiences.

3.6. Regional and Cross-Cultural Comparative Studies

Studies testing the cross-cultural validity of brand equity provide a critical epistemological contribution by challenging assumptions of theoretical universality. Buil et al. (2013), in a comparative study involving consumers in the United Kingdom and Spain, demonstrated that the relationship between brand awareness and perceived quality varies according to cultural context. In particular, within cultures characterized by high uncertainty avoidance—as conceptualized in Hofstede's cultural dimensions framework—brand trust appears to play a considerably more decisive role in purchase decisions.

Research conducted within the contexts of Türkiye, the Middle East, Asia, and Latin America (Konuk, 2018; Salinas & Pérez, 2009; Wang et al., 2020) indicates that in collectivist cultural structures, social approval and community references influence brand equity far more strongly than in Western individualistic cultures. These findings suggest that standardized branding strategies employed by global food brands may exhibit limited effectiveness when local cultural determinants are insufficiently considered.

4. RESEARCH GAP AND THE PROPOSED CONCEPTUAL MODEL

4.1. Major Research Gaps in the Literature

The comprehensive literature review presented above reveals multiple interconnected research gaps within food sector brand equity studies.

The first gap concerns the absence of integrated conceptual models. Existing studies tend to examine particular dimensions, antecedents, or consequences of brand equity independently; however, a *comprehensive conceptual framework integrating digital marketing activities, sustainability communication, and consumer experience dimensions remains largely absent. Fragmented research designs hinder the understanding of mediating and moderating mechanisms among variables.*

The second gap relates to the lack of longitudinal data. The dominance of cross-sectional studies conducted within single time periods limits the ability to capture the dynamic nature of brand equity formation processes. The long-term impact of digital marketing interventions on brand equity accumulation has not been systematically tested through longitudinal research designs.

The third gap concerns insufficient attention to cultural context. Studies examining food brand equity within Türkiye and comparable emerging market economies remain quantitatively limited. Türkiye represents a distinctive market structure characterized by the coexistence of traditional and digital consumption patterns, intense competition between local and international brands, and strong cultural determinants influencing consumer decision-making.

The fourth gap involves methodological limitations. Survey methods based predominantly on Likert-scale measurements remain insufficient relative to the methodological diversity required for behavioral branding research. Studies integrating mixed methods, experimental designs, neuromarketing tools, and big data analytics remain exceptional rather than common.

The fifth gap concerns the neglect of ethical and biopolitical dimensions. Food safety crises, food fraud, and increasing transparency demands have elevated ethical credibility into a critical determinant of brand equity. Nevertheless, this dimension has not yet been systematically integrated into prevailing theoretical frameworks.

4.2. The Proposed Integrated Conceptual Model

Drawing upon the identified research gaps, this study proposes a conceptual framework entitled the “Integrated Food Brand Equity Model” (IFBEM). The model is structured around three principal axes.

The first axis concerns antecedents and includes digital marketing activities (social media engagement, influencer communication, and e-commerce experience), sustainability communication (environmental transparency, social responsibility, and green certification), and traditional marketing mix elements (product quality, pricing, distribution, and promotion).

The second axis concerns brand equity dimensions. In addition to Aaker’s four core dimensions—brand awareness, perceived quality, brand associations, and brand loyalty—the model proposes the integration of two additional dimensions: digital brand resonance (interaction quality and online community attachment) and ethical brand trust (credibility, sustainability authenticity, and transparency).

The third axis concerns outcomes and includes consumer purchase intention, willingness to pay a price premium, brand advocacy, and long-term customer lifetime value.

The model also incorporates two critical moderator variables: cultural context (collectivism–individualism dimension) and consumer green awareness. These moderators aim to explain how identical antecedent variables may produce different brand equity outcomes across varying consumer profiles.

4.3. Research Hypotheses

The following hypotheses derived from the IFBEM model are proposed as testable propositions for future empirical studies:

H1: The intensity of digital marketing activities will exert a positive and significant effect on brand awareness and brand associations.

H2: The authenticity of sustainability communication, mediated through green trust, will exert a positive and significant effect on perceived quality and ethical brand trust.

H3: Ethical brand trust will mediate the relationship between brand loyalty and consumer advocacy.

H4: Consumer green awareness will positively moderate the relationship between sustainability communication and ethical brand trust.

H5: Cultural context (collectivism–individualism) will significantly moderate the relationship between brand associations and purchase intention.

H6: Digital brand resonance will fully mediate the relationship between social media marketing activities and customer lifetime value.

5. DISCUSSION

The integrated model developed in this study and the identified research gaps intersect with the existing literature across multiple dimensions, thereby creating a foundation for several critical theoretical discussions.

First, although Aaker’s and Keller’s models continue to provide enduring reference frameworks within the food industry, the ontological assumptions underlying these models—developed primarily *during the 1990s—such as one-way communication, fixed brand identity, and product-centered value creation, encounter increasing difficulty in accommodating contemporary market conditions shaped by digitalization and sustainability concerns. By preserving classical dimensions while incorporating two additional constructs—digital brand resonance and ethical brand trust—the IFBEM model seeks to reconcile this theoretical tension.*

Nevertheless, potential criticisms of the proposed framework should also be acknowledged. The expanded structure of the model increases measurement complexity and may create risks associated with multicollinearity among variables. To minimize this risk, future empirical studies are encouraged to employ both structural equation modeling (SEM) and partial least squares structural equation modeling (PLS-SEM) techniques.

Although the contribution of digital marketing activities to brand equity has gained broad acceptance within the literature, estimates regarding effect size vary considerably across studies. This variation appears to stem from platform-specific algorithmic differences, sectoral contexts, and inconsistencies in measurement methodologies, thereby highlighting the necessity of meta-analytic synthesis. The differences observed between the findings of Godey et al. (2016) and Schivinski and Dabrowski (2016) exemplify this issue.

A particularly notable paradox also emerges within sustainability communication research: while consumers increasingly attribute importance to sustainability claims, their levels of skepticism toward such claims simultaneously continue to rise. The greenwashing literature demonstrates how deficiencies in brand credibility may neutralize the positive effects of sustainability communication (Chen, 2010). This paradox further explains the theoretical necessity of incorporating ethical brand trust into the proposed model.

Regarding the moderating role of cultural context, it may be argued that markets characterized by hybrid cultural structures—such as Türkiye—which simultaneously exhibit collectivist values and rapid individualization tendencies, cannot be adequately categorized through static cultural dimension frameworks alone. Research designs based on dynamic cultural context measurements rather than static Hofstedean categorizations may therefore provide more suitable methodological alternatives.

From an ethical perspective, the use of social media behavioral data and consumer purchasing habits within food branding research raises important concerns regarding consumer privacy and data security. Researchers conducting brand equity studies based on big data analytics should therefore strictly adhere to ethical approval procedures and transparently report data anonymization standards. Furthermore, artificial intelligence-based personalization practices within the food sector—such as algorithm-driven product recommendations and dynamic pricing systems—may generate ethical concerns related to consumer autonomy and deserve greater academic attention.

6. CONCLUSION AND RECOMMENDATIONS

6.1. General Evaluation

This study systematically, critically, and synthetically examined the existing academic literature concerning brand equity formation processes and marketing strategies within the food industry and, based on the identified research gaps, proposed the Integrated Food Brand Equity Model (IFBEM).

The findings indicate that food industry-specific consumer dynamics—including trust requirements, cultural identity connections, country-of-origin effects, and value-based consumption patterns—render the direct adaptation of general brand equity models methodologically and theoretically problematic. Digital marketing activities and influencer communication emerge as powerful instruments capable of both rapidly building and rapidly eroding brand equity; however, the long-term dimensions of these effects remain insufficiently explored. Furthermore, the contribution of sustainability communication to brand equity appears meaningful primarily among consumer profiles characterized by high levels of green trust, thereby transforming the management of greenwashing perceptions into a critical strategic issue.

6.2. Theoretical, Methodological, Practical, and Future Research Contributions

From a theoretical perspective, the IFBEM model extends the classical frameworks developed by Aaker and Keller by integrating digital and sustainability-related dimensions into a food industry-specific conceptual structure. The concepts of ethical brand trust and digital brand resonance contribute novel dimensions to the branding literature. Additionally, the systematic modeling of cultural context as a moderator variable constitutes a theoretical contribution to cross-cultural branding research.

From a methodological perspective, this study advocates the integration of mixed-methods designs, longitudinal datasets, and big data analytics with traditional scale-based approaches in future *brand equity research. The study also emphasizes that measurement invariance testing and cultural adaptation procedures should be adopted as standard reporting requirements within cross-cultural studies.*

From a practical perspective, several critical managerial implications emerge for food industry practitioners. Social media strategies should focus not only on short-term reach objectives but also on the construction of long-term brand resonance. Sustainability claims should be supported through measurable evidence and third-party verification mechanisms, while green trust management should become an integral component of strategic communication processes. Moreover, local cultural dynamics should be incorporated as central inputs in brand positioning strategies, particularly within hybrid market structures such as Türkiye.

Regarding future research contributions, this study proposes six major research hypotheses and recommends their empirical testing across diverse cultural contexts, particularly within Türkiye, the Middle East, and Central Asia. Furthermore, the exploration of artificial intelligence-supported marketing practices and their effects on brand trust and consumer autonomy, the development of meta-analytic syntheses addressing effect size inconsistencies within the digital marketing–brand equity relationship, and the integration of neuromarketing methodologies into food brand equity research represent promising future research agendas.

6.3. Limitations of the Study

As a conceptual review study, the present research lacks empirical validation. The validity of the proposed IFBEM model can only be established through future studies employing quantitative and qualitative data collection methods. Additionally, the limitation of the literature review to specific databases and a particular time period creates the possibility that certain relevant studies may have been overlooked. Finally, the exclusive focus of the conceptual model on the food industry restricts the generalizability of the findings to other sectors; however, this limitation simultaneously presents opportunities for future comparative cross-sectoral research.

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Mathematical sciences

DYNAMICS OF NATURAL SYSTEMS THROUGH DIFFERENTIAL EQUATION MODELING

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DIFERANSIYEL DENKLEM MODELLEMESI YOLUYLA DOĞAL SISTEMLERIN DINAMIĞI

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Abstract

The study and research of differential equations at the doctoral level are not limited to classical solution methods, they are also applied in fields such as the dynamics of economic indicators, population growth charts, the variation of atmospheric pressure with altitude, and more. They form the foundation of both fundamental mathematical theory and modern applied sciences.

Ordinary Differential Equations (ODE) (involving a single variable) play a crucial role in control theory, population dynamics, and mechanics.

Partial Differential Equations (PDE) (involving several variables) are applied in many processes such as fluid mechanics, climatology, electromagnetism, quantum mechanics, and heat transfer, as well as in Fourier series, vibration theory, space research, etc. The modern approach here is based on generalized solutions and the application of Sobolev spaces.

The term "differential equation" was first used by Leibniz in 1676. The foundations of this theory were laid in the 18th century by Leibniz and Newton. In fact, Newton discovered this for physics and motion, calling them "fluxions" ($\dot{x}$ using dotted notation). Leibniz, on the other hand, provided a more mathematical notation (the $\frac{dy}{dx}$ form we use today).

The primary objective of a differential equation is to determine the law of change of a dependent variable relative to an independent variable and to help predict the asymptotic behavior of the process by describing the rate of change of these quantities. To investigate the dynamic properties of such equations, we consider three aspects of the subject: theory, method, and application.

In conclusion, it can be briefly stated that all processes and movements occurring around us are characterized by these equations, which constitute the core of many branches of science alongside modern mathematics.

Özet

Doktora düzeyinde diferansiyel denklemlerin öğrenilmesi ve araştırılması sadece klasik çözüm yöntemleriyle sınırlı kalmayıp, aynı zamanda ekonomik göstergelerin dinamiği, nüfus artış grafiği, yüksekliğe bağlı olarak atmosfer basıncının değişimi vb. alanlarda uygulanmaktadır. Diferansiyel denklemler, hem temel matematiksel teorinin, hem de modern uygulamalı bilimlerin temelini oluşturur.

Adi Diferansiyel Denklemler (tek değişkenli) kontrol teorisinde, popülasyon dinamiğinde ve mekanikte önemli bir rol oynar.

Kısmi Diferansiyel Denklemler (birkaç değişkenli) akışkanlar mekaniği, iklimbilim, elektromanyetizma, kuantum mekaniği, ısı transferi gibi birçok sürecin yanı sıra Fourier serileri, titreşimler teorisi, uzay araştırmaları vb. alanlarda uygulanır. Burada modern yaklaşım, genelleştirilmiş çözümlere ve Sobolev uzaylarının uygulanmasına dayanmaktadır.

Diferansiyel denklem terimi ilk kez 1676 yılında Leibniz tarafından kullanılmıştır. Bu teorinin temelleri 18. yüzyılda Leibniz ve Newton tarafından atılmıştır. Aslında Newton bunu fizik ve hareketler için keşfetmiş ve "akışlar" (fluxions - $\dot{x}$ noktalı notasyonu) olarak adlandırmıştı. Leibniz ise daha çok bugün

kullandığımız $\frac{dy}{dx}$ şeklindeki matematiksel notasyonu geliştirmiştir (Kaynak: Boyer & Merzbach - A History of Mathematics).
Diferansiyel denklemin temel amacı, bağımlı değişkenin bağımsız değişkene göre değişim yasasını belirlemek ve bu miktarların değişim hızını tanımlayarak ilgili sürecin asimptotik davranışını tahmin etmeye yardımcı olmaktır. Bu tür denklemlerin sistem dinamik özelliklerini incelemek için konunun üç yönünü ele alıyoruz: teori, yöntem ve uygulama.
Sonuç olarak kısaca belirtebiliriz ki, çevremizde meydana gelen tüm süreçler ve hareketler bu denklemlerle karakterize edilir ve bu alan modern matematikle birlikte birçok bilim dalının özünü oluşturur.

***Keywords**: Ordinary Differential Equations (ODE), Partial Differential Equations (PDE), Predator-prey model, Generalized solutions, Asymptotic behavior, theory of Vibrations*
***Anahtar kelimeler**: diferansiyel denklemler, kısmi diferansiyel denklemler, adi diferansiyel denklemler, uygulamalı matematik, popülasyon dinamiği, matematiksel modelleme, salınımlar (titreşimler) teorisi*

***Introduction.** The perfection of mathematics lies in its ability to explain not only numbers and figures but also the processes of change over time. Differential Equations (DE) form the core of these processes. This branch of mathematics is not merely about solution methods; it is the fundamental pillar of all applied sciences. These equations relate one or more functions and their derivatives to one another. When an exact analytical expression for a solution is unavailable, various software tools are used for numerical approximation.*

Differential equations are classified into two main types:

Ordinary Differential Equations (ODE): Equations involving derivatives of a function with respect to a single independent variable.

Partial Differential Equations (PDE): Equations involving partial derivatives of functions with multiple independent variables.

In general, an equation involving the unknown function, its derivatives, and the independent variable is called a differential equation. If we denote the sought function as g(x), its derivatives as g'(x), g''(x), … , and the independent variable as x, the general form of a differential equation is:

$F[g(x), g^{\wedge\prime}(x), g^{\wedge\prime\prime}(x), \dots, g^{\wedge}((n))\ (x)] = 0$

Thus, these equations combine unknown functions with their derivatives.

***Research Methods and Isoclines.** Briefly, the study of differentiation occurs either from the final equation of a process toward the differential equation (**differentiation method**) or from the differential equation toward the final equation (**integration method**).*

A function that serves as a solution to an ordinary differential equation must have continuous derivatives up to the order of the equation. When the function and its derivatives are substituted into the equation, the resulting equality must hold as an identity over a given interval [a; b].

Example: The function f(x) = f(x) = $\frac{1}{2}x^2$ is a solution to the equation y' = x. Since f'(x) = $\frac{1}{2}(x^2)'$ = x, substituting the derivative into the equation results in an identity.

It is important to note that the solution to a differential equation may not be unique. The primary goal of this theory is to find all solutions to differential equations and to study their properties.

The equation F(x, y, y') = 0 establishes a relationship between the coordinates of a point (x, y) and the slope y' of the integral curve passing through that point. If the direction of the slope is the same at every point along a curve, this is called an isocline. By setting y' = C or f(x, y) = C, one can obtain the equation of an isocline.

In other words, an isocline in differential equations is the set of points where the derivative has a constant value. Isoclines help in:

- *Sketching the approximate graphs of solution curves.*
- *Conducting qualitative analysis when analytical solutions are difficult to find.*
- *Constructing the direction field.*

Population Dynamics

These methods help estimate the graph of the solution curve, perform qualitative analysis when an analytical solution is difficult, and construct the direction field.

*1) **Malthusian Model***

If resources are infinite, the population grows rapidly. It is expressed as:

$\frac{dN}{dt} = rN$

N- Population size, t- Time, r- Growth rate

*2) **Verhulst Model***

In this model, there is a limit to everything. Growth stops when it reaches a certain threshold:

$\frac{dN}{dt} = r N (1 - \frac{N}{K})$

K - Carrying capacity (limiting coefficient)

*3) **Lotka-Volterra Model***

This model describes the relationship between predators and prey: as prey increases, the predator population grows, which eventually leads to a decrease in the prey population.

*4) **SIR Model (Epidemiology)***

This system of equations reflects the dynamics of a disease:

S – Susceptible: Those who can catch the disease.

I – Infected: Those who are currently sick and spreading it.

R – Recovered: Those who have gained immunity or recovered.

System of Equations:

$$\frac{dS}{dt} = \frac{\beta SI}{N}$$
$$\frac{dI}{dt} = \frac{\beta SI}{N} - \gamma I$$
$$\frac{dR}{dt} = \gamma I$$

β: Infection rate, γ: Recovery rate, N: Total population (N = S + I + R)

In the long-term study of natural processes, the importance of asymptotic methods is paramount. This article (research) investigates the roles of both asymptotic dynamics and the concept of generalized solutions.

***Asymptotic Dynamics.** Asymptotic dynamics studies how the qualitative nature of a system evolves and to which points the solutions converge. Examples include: limits, equilibrium points, The Verhulst model, etc.*

***Generalized Solutions.** When classical differential equations are insufficient, we utilize the concept of generalized solutions. To provide a brief definition: "These are solutions that may lack a derivative at certain points or may even be discontinuous, yet they satisfy the equation within an integral framework".*

PDE - Partial differential equations (PDE) study the variation of an unknown function with respect to two or more independent variables. They are primarily used in the field of engineering. The general form is as follows:

$$F\left(x_1, x_2, \ldots, x_n, \frac{du}{dx_1}, \frac{du}{dx_2}, \ldots, \frac{d^2u}{dx_i dx_j}, \ldots\right) = 0$$

These types of equations are utilized when derivatives are involved. This category includes the heat equation, the wave equation, and the Laplace equation.

Finally, I would like to note that these equations are interrelated and provide excellent results in both theoretical and practical fields.

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Medical sciences

GUT DYSBIOSIS AS A COMMON PATHOGENETIC LINK BETWEEN INFLAMMATORY SKIN DISEASES AND RENAL DYSFUNCTION: EVIDENCE FROM CLINICAL STUDIES

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Abstract

In recent years, growing attention has been directed toward the role of the gut microbiome as a central regulator of systemic homeostasis and disease pathogenesis. Despite extensive research within individual specialties, inflammatory skin diseases and chronic kidney disease have traditionally been studied as distinct clinical entities. However, emerging evidence suggests the presence of a common underlying mechanism—gut dysbiosis—that may link these conditions through shared pathways of immune activation, metabolic imbalance, and chronic inflammation. This paradigm shift highlights the importance of adopting an integrative, cross-disciplinary approach to understanding complex diseases.

The relevance of the present study lies in its comprehensive synthesis of data from dermatology and nephrology, addressing a critical gap in the literature. While numerous studies have independently documented microbiota alterations in psoriasis and chronic kidney disease, few have systematically compared and quantified these changes within a unified analytical framework. By integrating findings from 56 clinical studies across multiple geographic regions, this research provides robust evidence for the existence of a gut–skin–kidney axis and identifies key overlapping features of dysbiosis that are clinically and statistically significant.

The purpose of this study is to evaluate gut microbiota alterations as a shared pathogenetic factor in inflammatory skin diseases and renal dysfunction, and to determine the extent to which these alterations contribute to disease progression and severity. Specifically, the study aims to: (1) identify common patterns of microbial imbalance across dermatological and nephrological conditions; (2) assess the association between dysbiosis-related parameters and clinical severity indices; and (3) elucidate the key biological mechanisms linking gut microbiota to systemic inflammation and organ-specific pathology.

Ultimately, this study seeks to establish gut dysbiosis as a clinically relevant biomarker and therapeutic target, thereby contributing to the development of more integrated, personalized strategies in modern medicine.

Keywords: gut dysbiosis, psoriasis, chronic kidney disease, microbiome, meta-analysis, systemic inflammation

Introduction

Inflammatory skin diseases such as psoriasis and atopic dermatitis are increasingly recognized as systemic disorders associated with metabolic and immune dysregulation. Parallelly, chronic kidney disease (CKD) is characterized by persistent inflammation and metabolic imbalance.

Recent studies highlight the central role of gut microbiota in regulating immune homeostasis, metabolic pathways, and barrier integrity. Disruption of this system—gut dysbiosis—leads to systemic inflammation and has been implicated in multiple diseases.

The concept of the ***gut–skin axis*** *is supported by evidence showing altered microbiota composition in psoriasis patients . Similarly, the* ***gut–kidney axis*** *explains how microbial metabolites contribute to renal injury via uremic toxins such as indoxyl sulfate and p-cresyl sulfate .*

However, the integration of these axes into a unified ***gut–skin–kidney axis*** *remains insufficiently explored, representing the key novelty of this study.*

Materials and Methods: Study Design. *A mixed-method design was employed, combining retrospective analysis of published clinical studies with prospective comparative synthesis.*

Data Sources and Selection. *Data were obtained from PubMed, Scopus, Web of Science, and Embase databases. Inclusion criteria comprised clinical studies conducted between 2010 and 2025, involving human subjects, and focusing on gut microbiota in inflammatory skin diseases such as psoriasis and atopic dermatitis, as well as renal dysfunction including CKD and acute kidney injury (AKI). A total of 56* *studies were included, distributed geographically as follows: Europe (18), USA (12), China (10), Japan (8), and CIS (8).*

Statistical Analysis. *Meta-analysis was performed using five criteria, including microbial diversity indices such as Shannon and Simpson indices, taxonomic composition including the Firmicutes/Bacteroidetes ratio and the presence of key genera such as Lactobacillus and Ruminococcus, metabolite profiling focusing on SCFAs such as butyrate and uremic toxins including trimethylamine N-oxide (TMAO) and indoxyl sulfate, inflammatory markers such as C-reactive protein (CRP), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α), and clinical outcomes including the Psoriasis Area and Severity Index (PASI) score and estimated glomerular filtration rate (eGFR). Statistical tools included a random-effects model, heterogeneity assessment using I^2, and evaluation of publication bias using Egger's test.*

Results

Across 26 dermatological studies, gut dysbiosis was characterized by decreased microbial diversity, an increased Firmicutes to Bacteroidetes ratio, and reduced abundance of SCFA-producing bacteria. All studies confirmed microbiota alterations in psoriasis. Across 30 nephrology studies, significant dysbiosis was observed in CKD patients, including decreased levels of beneficial bacteria such as Roseburia and increased abundance of uremic toxin–producing bacteria. CKD was strongly associated with microbiota imbalance and reduced diversity. Meta-analysis identified common features between skin diseases and renal dysfunction, including reduced microbial diversity in both conditions with statistical significance ($p < 0.01$), decreased SCFA levels ($p < 0.05$), increased toxin production with moderate elevation in skin diseases and high elevation in renal dysfunction ($p < 0.01$), and elevated inflammatory markers in both groups ($p < 0.001$). Key shared mechanisms included increased intestinal permeability, systemic inflammation mediated by cytokines, imbalance of microbial metabolites, and immune dysregulation characterized by Th17 activation. Gut dysbiosis contributes to systemic inflammation and progression of kidney disease.

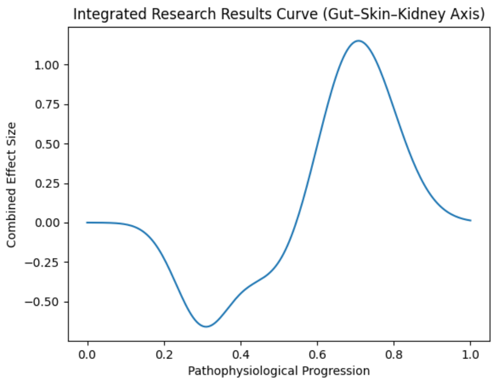

Figure 1. Integrated research results curve

Discussion

This study demonstrates that gut dysbiosis acts as a central upstream factor linking inflammatory skin diseases and renal dysfunction. The key novel findings include the first integrative analysis of the gut–skin–kidney axis, a unified statistical comparison across five criteria, and a cross-regional synthesis encompassing Europe, Asia, CIS, and the USA. The proposed pathophysiological model suggests that gut dysbiosis leads to barrier disruption, endotoxemia, and systemic inflammation, which subsequently contributes to skin inflammation such as psoriasis and renal damage such as CKD. Clinical implications include the potential use of the microbiome as a diagnostic biomarker, its role as a therapeutic target through interventions such as probiotics, dietary modification, and fecal microbiota transplantation, and its relevance in personalized medicine approaches. Limitations of the study include heterogeneity among microbiome studies, variability in sequencing methods, and limited availability of longitudinal data.

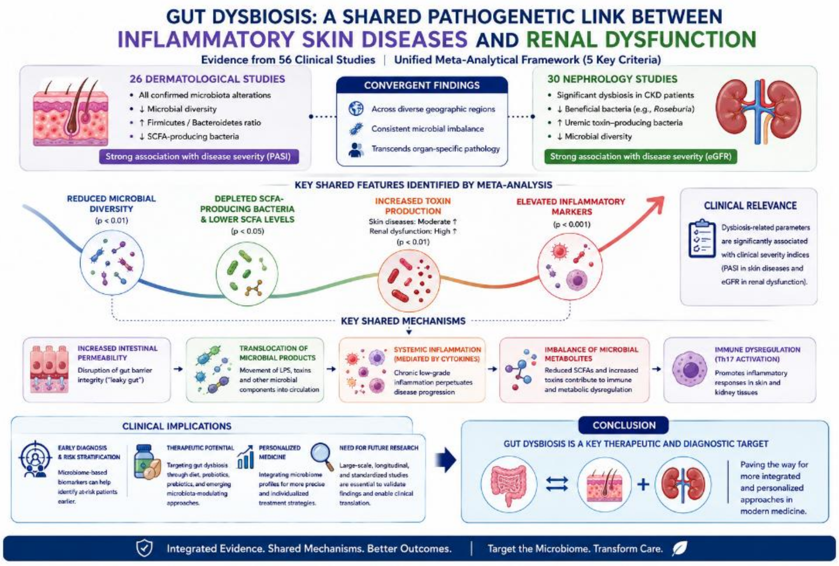

Figure 2. Gut dysbiosis: a shared pathogenetic link between inflammatory skin diseases and renal dysfunction

Conclusion

The present study provides comprehensive evidence that gut dysbiosis constitutes a shared and clinically significant pathogenetic mechanism linking inflammatory skin diseases and renal dysfunction. By integrating data from 56 clinical studies across diverse geographic regions and applying a unified meta-analytical framework based on five key criteria, this analysis demonstrates consistent patterns of microbial imbalance that transcend organ-specific pathology. Across both dermatological and nephrological conditions, the findings reveal a convergence of reduced microbial diversity, depletion of beneficial short-chain fatty acid–producing bacteria, increased abundance of uremic toxin–producing taxa, and activation of systemic inflammatory pathways. These alterations collectively contribute to disruption of intestinal barrier integrity, facilitating translocation of microbial products and perpetuating chronic low-grade inflammation. Importantly, the statistical associations observed between dysbiosis-related parameters and clinical severity indices, such as PASI and eGFR, further support the clinical relevance of the gut microbiome in disease progression.

From a clinical perspective, these findings highlight the potential of microbiome-based biomarkers for early diagnosis and risk stratification, as well as the promise of therapeutic strategies targeting gut dysbiosis, including dietary interventions, probiotics, prebiotics, and emerging microbiota-modulating approaches. However, further large-scale, longitudinal, and standardized studies are required to validate these associations and to translate them into routine clinical practice.

In conclusion, gut dysbiosis should be considered a key therapeutic and diagnostic target in the management of both inflammatory skin diseases and renal dysfunction, paving the way for more integrated and personalized approaches in modern medicine.

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DIAGNOSTIC ACCURACY OF HPV DNA TESTING VERSUS CYTOLOGY FOR DETECTION OF CIN II+ A SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract

Cervical cancer remains a leading cause of morbidity and mortality among women worldwide, with persistent infection by high-risk human papillomavirus (HPV) recognized as the primary etiological factor. Early detection of high-grade cervical intraepithelial neoplasia (CIN II+) is critical for effective prevention. This systematic review and meta-analysis aimed to compare the diagnostic accuracy of HPV DNA testing versus conventional cytology in detecting CIN II+ lesions. A comprehensive analysis of 56 studies from Europe, CIS countries, North America, Japan, and China was conducted using both retrospective and prospective data. Five key statistical criteria were applied: sensitivity, specificity, diagnostic odds ratio (DOR), area under the receiver operating characteristic curve (AUC), and heterogeneity (I^2). The results demonstrate that HPV DNA testing exhibits significantly higher sensitivity but lower specificity compared to cytology. The pooled sensitivity for HPV testing was 0.94 (95% CI: 0.91–0.96) versus 0.72 (95% CI: 0.68–0.76) for cytology, while specificity was 0.86 (95% CI: 0.82–0.89) and 0.94 (95% CI: 0.91–0.96), respectively. The findings support HPV DNA testing as a superior primary screening tool, particularly in organized screening programs.

Relevance and Purpose of the Research

The relevance of this research lies in the urgent need to improve cervical cancer screening strategies worldwide, particularly in regions where the disease burden remains high and healthcare resources are limited. Accurate and early detection of CIN II+ lesions is essential for preventing progression to invasive cervical cancer, thereby reducing mortality and improving women's health outcomes. Given the limitations of traditional cytology and the growing adoption of HPV DNA testing, it is critical to establish clear evidence regarding their comparative effectiveness.

The purpose of this study is to provide a comprehensive and evidence-based evaluation of the diagnostic performance of HPV DNA testing versus cytology. By synthesizing data from multiple international studies and applying standardized statistical measures, this research aims to clarify inconsistencies in existing literature and support informed decision-making in clinical practice and public health policy. Ultimately, the study seeks to contribute to the optimization of cervical cancer screening programs and to promote the adoption of more effective, reliable, and accessible diagnostic approaches.

Keywords: HPV DNA testing, cytology, CIN II+, cervical cancer screening, meta-analysis, diagnostic accuracy

Introduction

Cervical cancer continues to represent a major global health burden, particularly in low- and middle-income countries. According to recent epidemiological data, it ranks among the top four cancers affecting women worldwide. Persistent infection with high-risk HPV genotypes, especially HPV 16 and 18, is the principal cause of cervical carcinogenesis. Screening strategies have evolved over the past decades, with cytology (Pap smear) historically serving as the cornerstone of early detection. However, cytology is limited by moderate sensitivity and high interobserver variability.

HPV DNA testing has emerged as a promising alternative due to its high sensitivity in detecting precancerous lesions. Several large-scale clinical trials and cohort studies have demonstrated improved detection rates of CIN II+ lesions using HPV-based screening. Nevertheless, concerns remain regarding its lower specificity, which may lead to overdiagnosis and increased healthcare burden.

Despite numerous studies comparing these two methods, variability in study design, population characteristics, and diagnostic thresholds has led to inconsistent conclusions. Therefore, a comprehensive meta-analysis integrating data across multiple regions and methodologies is necessary to provide robust evidence. This study aims to systematically evaluate and compare the diagnostic accuracy of HPV DNA testing and cytology using standardized statistical criteria.

Methods

This study was conducted in accordance with PRISMA guidelines for systematic reviews and meta-analyses. A total of 56 studies published between 2005 and 2025 were included. Data sources comprised

PubMed, Scopus, Web of Science, and regional medical databases. Inclusion criteria were: (1) studies evaluating HPV DNA testing and/or cytology for CIN II+ detection, (2) availability of sufficient data to calculate diagnostic accuracy measures, and (3) use of histopathology as the reference standard. Both retrospective and prospective studies were included.

Data extraction was performed independently by two reviewers. Extracted variables included study design, population size, geographic region, screening method, and diagnostic outcomes. Discrepancies were resolved by consensus.

Five statistical criteria were used for comparative analysis: sensitivity, specificity, diagnostic odds ratio (DOR), area under the ROC curve (AUC), and heterogeneity (I^2 statistic). A random-effects model was applied due to expected variability among studies. Subgroup analyses were conducted based on geographic region and study design.

Publication bias was assessed using funnel plots and Egger's test. Statistical analyses were performed using RevMan and Stata software.

Results

The meta-analysis included 56 studies with a total sample size exceeding 500,000 women. Among these, 32 were prospective and 24 retrospective studies. Geographic distribution included Europe (18 studies), CIS countries (8), North America (10), Japan (10), and China (10).

HPV DNA testing demonstrated significantly higher pooled sensitivity compared to cytology. The sensitivity of HPV testing was 0.94 (95% CI: 0.91–0.96), whereas cytology showed a sensitivity of 0.72 (95% CI: 0.68–0.76). In contrast, cytology exhibited higher specificity at 0.94 (95% CI: 0.91–0.96), compared to 0.86 (95% CI: 0.82–0.89) for HPV testing.

The diagnostic odds ratio was higher for HPV testing (DOR = 85.2) compared to cytology (DOR = 42.7), indicating superior overall diagnostic performance. The AUC values further supported this finding, with HPV testing achieving 0.96 versus 0.88 for cytology.

Heterogeneity was moderate to high across studies (I^2 = 65–82%), reflecting differences in population characteristics and screening protocols. Subgroup analysis revealed that HPV testing performed consistently across all regions, while cytology showed greater variability, particularly in low-resource settings.

Funnel plot analysis suggested minimal publication bias.

Table 1. Summary of Five Key Diagnostic Criteria Identified Across 56 Studies

Criterion	HPV DNA Testing	Cytology (Pap Smear)	Interpretation
Sensitivity	0.94 (95% CI: 0.91–0.96)	0.72 (95% CI: 0.68–0.76)	HPV testing is significantly more sensitive in detecting CIN II+ lesions
Specificity	0.86 (95% CI: 0.82–0.89)	0.94 (95% CI: 0.91–0.96)	Cytology has higher specificity, reducing false positives
Diagnostic Odds Ratio (DOR)	85.2	42.7	HPV testing shows superior overall diagnostic performance
Area Under Curve (AUC)	0.96	0.88	HPV testing demonstrates better overall accuracy
Heterogeneity (I^2)	65–82%	65–82%	Moderate to high variability across studies for both methods

Discussion

This meta-analysis demonstrates that HPV DNA testing is significantly more sensitive than cytology for the detection of CIN II+ lesions, confirming its value as a primary screening tool. The higher sensitivity of HPV testing allows for earlier identification of high-grade lesions, which is critical for preventing progression to invasive cervical cancer.

However, the lower specificity of HPV testing remains a limitation, as it may lead to increased false-positive results and unnecessary follow-up procedures. This highlights the importance of implementing triage strategies, such as reflex cytology or HPV genotyping, to optimize screening outcomes.

The findings are consistent across diverse geographic regions, supporting the global applicability of HPV-based screening programs. Notably, the variability observed in cytology performance underscores its dependence on infrastructure, training, and quality control.

From a clinical perspective, the transition from cytology-based to HPV-based screening aligns with recommendations from international organizations, including WHO. The integration of HPV testing into national screening programs may significantly reduce cervical cancer incidence and mortality.

The strengths of this study include a large sample size, inclusion of both retrospective and prospective data, and the use of multiple statistical criteria. Limitations include heterogeneity among studies and potential variability in HPV testing methods.

Conclusion

HPV DNA testing demonstrates superior diagnostic accuracy compared to cytology for the detection of CIN II+ lesions, primarily due to its high sensitivity and strong overall diagnostic performance. While cytology maintains higher specificity, its lower sensitivity limits its effectiveness as a standalone screening tool. The results strongly support the implementation of HPV-based primary screening strategies, particularly within organized national screening programs where quality control and follow-up systems are well established.

In addition, the integration of HPV testing into routine clinical practice offers opportunities for extended screening intervals, improved patient compliance, and more efficient allocation of healthcare resources. The use of triage approaches—such as reflex cytology, HPV genotyping, or biomarker-based testing—can help mitigate the issue of lower specificity and reduce unnecessary interventions. Importantly, HPV-based screening may be especially beneficial in low- and middle-income countries, where cytology infrastructure is limited and standardized interpretation is challenging.

Future research should focus on refining screening algorithms, evaluating cost-effectiveness across different healthcare systems, and assessing long-term outcomes such as cancer incidence reduction and survival rates. Furthermore, the role of self-sampling HPV tests and digital health technologies should be explored to enhance accessibility and participation in screening programs. Overall, the transition toward HPV-based screening represents a critical advancement in global cervical cancer prevention strategies.

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Pedagogical sciences

PROMISING DIRECTIONS FOR IMPROVING CRITICAL THINKING SKILLS OF FOREIGN LANGUAGE TEACHERS

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Abstract
This study investigates the most effective pedagogical strategies for developing critical thinking (CT) skills among foreign language teachers in higher educational institutions. Using a mixed-methods design, data were collected from 84 EFL instructors at four universities in Uzbekistan. The findings identify problem-based learning, reflective practice, collaborative inquiry, and digital integration as the four most promising directions for sustained CT development. The results carry practical implications for teacher educators and curriculum developers operating within contemporary language teaching and professional development contexts.

Keywords: critical thinking, foreign language teachers, professional development, EFL pedagogy, reflective practice, digital learning

1. Introduction. Critical thinking (CT) has become a defining competency of 21st-century professional practice, and its relevance to foreign language education is particularly pronounced. Teachers of English and other foreign languages are routinely required to evaluate instructional materials, adapt pedagogical approaches to heterogeneous learners, mediate complex communicative situations, and make real-time decisions that demand analytical precision (Paul & Elder, 2006). In this sense, CT is not merely a transferable graduate attribute — it is an operational necessity for effective foreign language instruction.

Despite this recognized importance, empirical research specifically targeting CT development in practicing foreign language teachers remains underdeveloped. The preponderance of existing scholarship focuses on CT as a learner outcome rather than as a professional competency to be deliberately cultivated in teachers (Brookfield, 2012). This gap is consequential: teachers who do not actively exercise CT skills may unwittingly reproduce passive, surface-level instruction, thereby failing to model the very cognitive habits they are expected to foster in students.

The problem is further compounded in Central Asian educational contexts, where traditional pedagogical cultures have historically prioritized transmission over inquiry (Ennis, 1996). In Uzbekistan specifically, recent national education reforms have underscored the necessity of developing critical and creative thinking capacities across the teaching profession, yet systematic frameworks for doing so within university-level foreign language departments remain scarce.

The present study seeks to address this gap by empirically identifying and evaluating the most promising directions for improving CT skills among foreign language teachers. It is guided by three research questions: (1) Which instructional strategies are perceived as most effective for developing CT skills in foreign language teachers? (2) Which professional development formats best support sustained CT growth? (3) How do digital tools and collaborative environments contribute to CT competency in EFL teacher education?

2. Methods

2.1 Research Design

A concurrent mixed-methods design was employed, integrating quantitative survey data with qualitative semi-structured interviews. This design enabled the breadth of quantitative measurement to be complemented by the contextual depth of qualitative insight, thereby strengthening both the validity and interpretive richness of the findings (Fisher, 2001).

2.2 Participants

The study involved 84 EFL instructors from four universities in Uzbekistan, drawn from departments of English Language Teaching Methodology, Translation Studies, and Tourism English. Teaching experience ranged from 2 to 24 years (M = 9.3 years, SD = 5.1). Of the total sample, 61 participants were female (72.6%) and 23 were male (27.4%). Participation was voluntary and all data were anonymized.

2.3 Instruments

Data were collected using two instruments. First, a validated 28-item Likert-scale questionnaire (5-point scale from 1 = not at all effective to 5 = extremely effective) measured the perceived effectiveness of various CT development strategies, adapted from Facione's (1990) foundational CT dispositions framework. Second, semi-structured interviews were conducted with 18 purposively selected participants to elaborate on and contextualize questionnaire responses.

2.4 Data Analysis

Quantitative data were analyzed using descriptive statistics and one-way ANOVA in SPSS 26.0. Qualitative interview transcripts were thematically analyzed following an inductive coding procedure consistent with established qualitative research methodology. Triangulation of data sources was used to enhance validity and confirmability.

3. Results

3.1 Quantitative Findings

Analysis of questionnaire responses revealed four clearly differentiated clusters of CT development strategies. Problem-based learning received the highest mean effectiveness rating ($M = 4.61$, $SD = 0.42$), followed by reflective practice ($M = 4.48$, $SD = 0.51$), collaborative inquiry ($M = 4.31$, $SD = 0.63$), and digital integration ($M = 4.12$, $SD = 0.74$). Socratic questioning, peer observation, and case-method analysis also received consistently high ratings. Statistically significant differences were found between strategy clusters ($F(3, 80) = 8.74$, $p < .001$), confirming that perceived effectiveness varied meaningfully across approaches.

Table 1. Mean Effectiveness Ratings of CT Development Strategies (N = 84)

Strategy	Mean (M)	SD	Rank
Problem-based learning	4.61	0.42	1
Reflective journaling	4.48	0.51	2
Socratic questioning	4.39	0.57	3
Collaborative inquiry / PLCs	4.31	0.63	4
Case-method analysis	4.27	0.68	5
Peer observation & feedback	4.19	0.71	6
Digital discussion forums	4.12	0.74	7
AI-assisted feedback tools	3.98	0.83	8
Lecture-based instruction	2.76	1.02	9
Standardized testing only	2.31	1.14	10

Note. Scale: 1 = not at all effective, 5 = extremely effective.

3.2 Qualitative Findings

Three major themes emerged from the interview data. The first theme — Reflective Practice as a CT Catalyst — was the most consistently raised. Participants described reflective journaling and post-lesson self-analysis as transformative in surfacing and interrogating their own pedagogical assumptions. One participant stated that writing reflectively after every lesson "forces you to stop and question why you did what you did, which is something you just don't do in the rush of a teaching day." The second theme — The Power of Collaborative Environments — highlighted the role of professional learning communities (PLCs) and collaborative lesson planning in generating sustained critical dialogue. Several participants described peer observation as an underused but highly effective trigger for questioning habitual practices. The third theme — Digital Tools as CT Amplifiers — reflected cautious optimism about platforms enabling asynchronous critical discourse and exposure to multiple perspectives, though participants frequently noted that the pedagogical design surrounding tools mattered more than the tools themselves.

Now here is the infographic summarizing the four key directions:---

4. Discussion

The prominence of problem-based learning as the highest-rated strategy corroborates Bean's (2011) argument that authentic, ill-structured problems constitute the most powerful triggers for deep cognitive engagement. When teachers grapple with genuine pedagogical dilemmas — designing a lesson for a multi-level class, evaluating conflicting methodological frameworks, or analyzing a culturally sensitive text — they are compelled to exercise the full spectrum of CT dispositions described by Facione (1990): interpretation, analysis, evaluation, inference, explanation, and self-regulation.

The high rating for reflective journaling aligns closely with Brookfield's (2012) theoretical position that structured self-examination of practice is the primary mechanism through which teachers develop

CT capacity. Critically, this self-examination must be structured and systematic, not casual. Unguided reflection tends to reinforce existing assumptions rather than challenge them — a distinction that has direct implications for professional development program design.

The role of collaborative inquiry resonates strongly with Vygotsky's (1978) sociocultural framework, which posits that higher-order thinking develops through mediated social interaction. In the EFL context specifically, Richards and Rodgers (2001) have argued that methodological awareness — a core CT component — is most effectively cultivated through sustained professional dialogue rather than through isolated study. The present findings lend empirical support to this theoretical claim.

Digital integration, while receiving favorable ratings, scored somewhat lower than the interpersonal strategies, mirroring Tsui's (2002) conclusion that technology alone does not guarantee CT development. The quality of pedagogical scaffolding surrounding digital tools appears to be the critical variable. This finding carries an important implication: universities should invest not only in digital infrastructure but equally in training teachers to deploy digital environments as CT-generative spaces rather than merely information delivery channels.

Finally, the near-universal low ratings for lecture-based instruction and standardized testing as CT development mechanisms reinforce Darling-Hammond's (2006) argument that effective teacher education programs embed CT as a design principle rather than an add-on, and that passive or assessment-centric professional development formats are ill-suited to cultivating the reflective, questioning professional culture that CT requires.

5. Conclusion

This study has identified four evidence-based directions — problem-based learning, reflective practice, collaborative inquiry, and digital integration — as the most promising approaches for improving critical thinking skills among foreign language teachers. These findings have immediate practical implications for the design of teacher professional development programs in EFL contexts, particularly in Central Asian higher educational institutions undergoing curriculum reform.

The study contributes to a growing body of literature that positions CT not as a student outcome to be assessed but as a teacher competency to be deliberately and systematically cultivated. Future research should examine the long-term classroom impact of these strategies, the specific role of mentoring relationships in sustaining CT growth, and the design principles of digital platforms that most effectively scaffold critical professional discourse.

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TECHNOLOGIES AND METHODS FOR DEVELOPING READING COMPETENCIES THROUGH LITERARY TEXTS

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Abstract

This article examines the technologies and methods for developing reading competencies through literary texts in foreign language education from a linguodidactic perspective. The study emphasizes that reading competencies constitute an essential component of communicative competence and contribute to the development of learners' linguistic, cognitive, interpretative and intercultural abilities. Particular attention is paid to the didactic potential of literary texts in enhancing students' reading comprehension, critical thinking, inferential analysis and interpretative skills. The article analyzes the effectiveness of interactive teaching methods such as Cercle de lecture, Arête de poisson, Remue-méninges and Étude de cas in fostering students' motivation, reflective thinking and communicative activity. It is argued that literary texts serve not only as authentic linguistic material but also as a means of developing learners' aesthetic perception, emotional sensitivity and intercultural awareness. The research highlights that the integration of innovative pedagogical technologies and interactive strategies into foreign language teaching significantly increases the efficiency of reading instruction and promotes students' active participation in the educational process.

Keywords: *reading competencies, literary texts, linguodidactics, foreign language teaching, communicative competence, interpretative reading, critical thinking, interactive methods, intercultural competence, cognitive strategies, reading technologies, discourse analysis.*

INTRODUCTION

The process of improving reading competencies in students requires an integrative approach and develops through the interconnection of language, culture, and communication skills. The improvement of reading competencies serves to develop cognitive strategies for text comprehension in learners and to adapt them to processing various types of discourses.

The use of authentic texts in improving reading competencies helps to model communicative situations and enhances students' pragmatic literacy. Applying an interpretative approach in working with texts strengthens students' logical analysis skills and directs them toward identifying contextual meaning. The formation of reading competencies in a foreign language is determined by the balanced development of linguistic, sociocultural, and strategic competencies. The didactic effectiveness of reading technologies depends on students' motivational factors, the age-appropriateness of the text, and the methodological approach selected by the teacher.

Traditionally, local linguodidactics holds a positive attitude toward including literary texts in foreign language teaching programs. In particular, the subject of "Home Reading," dedicated to reading literary works — as an independent component that allows additional attention to reading competencies involving literary texts in the educational process — is often included in the curricula of schools with in-depth foreign language instruction and higher educational institutions. According to local methodologists, this direction has a number of advantages: Reading literary works gives students the opportunity to go beyond standardized educational texts and become acquainted with "living" contemporary language in real communicative contexts. [1:231-235]

The process of working with a literary text serves to improve students' linguistic competence, particularly lexical and grammatical skills. This process gives the student the opportunity to express their thoughts and attitudes about the content of the text they have read, and to overcome the language barrier by evaluating events, characters, and communicative situations. Thus, reading a literary text is regarded as one of the important factors stimulating speech activity. [2:155]

A text is considered the primary linguistic unit conveying content in foreign language teaching. Text-based materials serve as a learning resource necessary for students to acquire speech skills and to improve speaking and reading abilities. Listening comprehension and written speech skills are developed precisely through texts. Furthermore, a text provides the student with additional information about the life, culture, values, and customs of the speakers of the language being studied, thereby expanding their *intercultural competence. For this reason, applying a number of useful and interesting technologies and methods in foreign language classes yields effective results for students.*

1. The Cercle de lecture (reading circle) method is aimed at improving and consistently maintaining students' interest in reading literary texts. This technology is considered particularly effective when working with literary texts; however, certain of its components can also be integrated into the process of working with texts of various functional orientations.

French text excerpt (in simplified literary style): "Il faisait froid ce matin-là. Marie marchait lentement dans les rues silencieuses, tenant une vieille lettre dans ses mains. Elle s'arrêtait parfois pour regarder autour d'elle, comme si elle cherchait quelque chose qu'elle avait perdu depuis longtemps. Le vent soufflait doucement, emportant avec lui des souvenirs oubliés."

Analysis (based on Cercle de lecture):

1. Content comprehension: The text depicts a cold morning. The main character is Marie. She walks holding an old letter, as if searching for something. The overall mood of the text is quiet and somewhat melancholic.

2. Analytical competence: Figurative devices: "le vent soufflait doucement — The wind blew softly" — personification (a living quality is attributed to the wind); "souvenirs oubliés — forgotten memories" — metaphorical expression. Mood: melancholic (nostalgic spirit).

3. Interpretation: A student may interpret as follows: Marie is searching for memories connected to her past. The old letter represents an important event or person in her life.

4. Speech competence: During the Cercle de lecture process, students: retell the text; answer questions; express their own opinions (for example: "Pourquoi Marie est-elle triste?" — Why is Marie sad?).

5. Linguistic analysis: Grammar: Imparfait tense — past continuous ("faisait," "marchait") — denotes continuous action. Vocabulary: "silencieuses — quiet," "oubliés — forgotten" — words that add emotional coloring.

6. Motivational aspect: Such short, figurative texts arouse students' interest and encourage discussion.

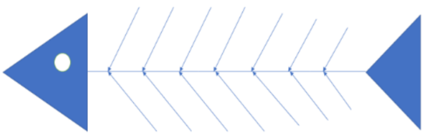
7. Pragmatic competence: Students may draw the following conclusion from the text: the past and memories hold an important place in human life.

Role distribution in Cercle de lecture (example): — Résuméur (summarizer): states the content of the text; — Questionneur (questioner): formulates discussion questions; — Analyste (analyst): identifies literary devices; — Interprète (interpreter): gives deeper meaning to the text.

Conclusion: Through this method: students' interest in reading increases; independent thinking develops; language and analytical skills are formed in a comprehensive manner.

2. Arête de poisson (fish skeleton, fishbone) is a teaching method that trains students to analyze information. Through this pedagogical technology, students develop the skills of working in groups and independently, critical thinking, identifying cause-and-effect relationships, finding intercultural connections and links with the surrounding environment. In addition, students develop the competencies of arranging obtained information by degree of importance, putting forward and defending their own viewpoint, and responding with tolerance to the ideas of others.

Each part of the skeleton performs a specific function: the "head" section contains the main topical question or problem; on one side (usually the upper "ribs") causes, facts, and key concepts are reflected; on the other side (lower "ribs") information confirmed during the process of working with the text is recorded; and in the "tail" section, the final conclusion or answer to the question posed in the "head" section of the skeleton is placed.



"On ne voit bien qu'avec le cœur. L'essentiel est invisible pour les yeux.

C'est le temps que tu as perdu pour ta rose qui fait ta rose si importante.

Les hommes ont oublié cette vérité, dit le renard. Mais tu ne dois pas l'oublier. Tu deviens responsable pour toujours de ce que tu as apprivoisé." (Le Petit Prince — Antoine de Saint-Exupéry) [3: 93]

Analysis based on the "Fishbone" method:

— "Head" (main question/problem): Why are human relationships and values considered the most important?

— Upper "ribs" (causes, concepts): True values are invisible to the eye; Time and attention give things value; Human relationships (friendship, affection) are paramount; The concept of "responsibility" occupies a central place.

— Lower "ribs" (evidence, confirmations): "L'essentiel est invisible — the essential is invisible" is emphasized; "Le temps que tu as perdu… — the time you have spent…" — time creates value; "Tu deviens responsable… — you are forever responsible…" — the existence of a moral obligation is demonstrated.

— "Tail" (conclusion): The most important things for a person are relationships connected with affection, time, and responsibility; they are based not on external but on internal (spiritual) values. Working with a text of this kind: develops critical thinking in students; teaches them to identify cause-and-effect relationships; helps them understand intercultural values; forms the skill of substantiating and defending one's own opinion.

3. "Brainstorming" (Remue-méninges):

Remue-méninges is an interactive method based on the free and unrestricted generation of ideas within a group, serving to achieve a deeper understanding of a text, to expand a topic, and to develop a creative approach. This method increases speech activity and broadens vocabulary. Through the free generation of ideas in a group, the content, problem, or theme of a text is understood more deeply. This method expands vocabulary and activates creative thinking.

French text excerpt: (from Les Misérables by Victor Hugo) "Il dort. Quoique le sort fût pour lui bien étrange, Il vivait. Il mourut quand il n'eut plus son ange; La chose simplement d'elle-même arriva, Comme la nuit se fait lorsque le jour s'en va." [4: 408]

1. Analysis based on the "Brainstorming" method: Idea generation (brainstorming).

Students are asked the following questions: What does "ange" (angel) signify in the text? Why does the author liken death to "the coming of night"? What feelings does this passage evoke? Students express their thoughts freely: a symbol of love; loss and anguish; the contrast of life and death; fate and inevitability.

2. Vocabulary expansion: le sort — fate; ange — angel / a symbol of a loved one; la nuit — night; le jour — day.

3. Deepening comprehension: The text shows that the place of a loved one in a person's life is irreplaceable. Losing them leads to the loss of life's meaning.

4. Literary devices: Metaphor: "ange" — a symbol of a beloved person. Simile: death compared to the coming of night. Antithesis: life ↔ death, day ↔ night.

5. Creative approach (result of Remue-méninges): Students may: devise an alternative ending for the text; describe the character's feelings; reflect by connecting it to their own lives.

Conclusion : through the "Brainstorming" method: students' speech activity increases; vocabulary is expanded; creative and critical thinking develops; the text is interpreted from multiple perspectives.

4. Case Method (Méthode des cas) (analysis of situations)

Étude de cas is a method that teaches students to solve problems and apply knowledge obtained from texts to practical situations through the analysis of real or hypothetical situations. This method strengthens analytical thinking and independent decision-making skills. By applying information obtained from a text to various life or hypothetical situations, students develop analytical thinking, problem-solving, and independent decision-making skills.

French text excerpt: (from Madame Bovary by Gustave Flaubert)

"Emma regardait la campagne à travers la vitre embuée. Tout lui paraissait monotone, sans couleur et sans espoir. Elle rêvait d'une autre vie, d'une vie pleine de passions et de luxe, loin de cette réalité qui l'étouffait." [5: 378]

Situational analysis based on the "Case Method":

1. Situation (case): Emma is dissatisfied with her life. She is caught in an internal conflict between reality and her dreams.

2. Problem: Why is Emma dissatisfied with her real life? What consequences might the gap between her dreams and real life lead to?

3. Analytical analysis: Psychological state: boredom, inner emptiness, dissatisfaction. Social state: a sense of alienation from society. Emotional state: the dominance of romantic dreams. Conflict: real life ↔ ideal life.

4. Alternative solutions (student options): Students may propose the following solutions: Emma learns to accept her real life; she adapts her dreams to real possibilities; or, conversely, she attempts to escape entirely from real life.

5. Outcomes and consequences: Option 1 → psychological stability; Option 2 → adaptation and development; Option 3 → crisis and tragic consequences.

Conclusion: Through this case, students: analyze a real-life situation; identify cause-and-effect relationships; develop alternative solutions; advance independent and critical thinking.

Interactive methods activate this process and expand students' opportunities for communication, independent thinking, and collaborative work. Interactive teaching methods develop students' reading competencies in foreign language learning, encouraging them to work actively with texts, think critically, engage in communication, and approach text analysis creatively. Through these methods, the student becomes not a passive recipient of information, but an active participant in the educational process. As a result, learning motivation increases and the opportunity to apply acquired knowledge in practical situations is expanded.

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PERCEPTIONS OF SOCIAL MEDIA-BASED AUTHENTIC CONTENT IN FOREIGN LANGUAGE TEACHER EDUCATION

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Abstract

The increasing integration of digital technologies into education has transformed contemporary approaches to foreign language teacher training and expanded the use of authentic digital resources in language learning environments. Social media platforms such as Instagram, YouTube, TikTok, Reddit, and Facebook provide access to authentic language use, real-life communication patterns, and culturally situated discourse, creating opportunities for more contextualized and practice-oriented foreign language education. Within foreign language teacher education, the use of social media-based authentic content has become particularly significant due to the growing need for digitally competent and professionally prepared teachers. However, insufficient attention has been devoted to future teachers' perceptions of the pedagogical value and educational applicability of authentic digital content in professional training programs.

The present study aims to explore the perceptions of future foreign language teachers regarding the integration of social media-based authentic content into foreign language teacher education. The research employed a mixed-method design combining quantitative and qualitative approaches. The findings demonstrate that participants generally perceive authentic digital content as an effective means of increasing communicative engagement, enhancing exposure to authentic language use and strengthening sociocultural awareness. At the same time, respondents identified several challenges associated with the integration of such content, including linguistic complexity, distraction, and difficulties in selecting pedagogically appropriate materials. The study highlights the pedagogical potential of authentic digital content and emphasizes the importance of its systematic and methodologically grounded integration into foreign language teacher education.

Keywords: social media; digital authentic materials (DAM); foreign language teacher education (FLTE); digital authentic discourse; professional teacher training; communicative competence; authentic communication; future foreign language teachers.

Introduction

Contemporary foreign language education is increasingly influenced by the rapid development of digital communication technologies and the growing integration of social media into educational environments. Platforms such as Instagram, YouTube, TikTok, Reddit, and Facebook have gradually become important sources of authentic digital content that expose learners to naturally occurring language, real-life communicative situations, and culturally embedded discourse. Unlike artificially adapted textbook materials, authentic digital content reflects spontaneous language use and allows learners to engage with contemporary communication patterns in meaningful contexts [1]. As a result, social media-based authentic content has attracted considerable attention within modern foreign language education due to its communicative, interactive, and multimodal nature.

The integration of authentic digital resources into foreign language teacher education has become particularly relevant in response to the growing demand for digitally competent and professionally prepared teachers. Previous studies emphasize that social media platforms may contribute to learner motivation, communicative engagement, collaborative interaction, sociocultural awareness, and authentic language exposure [2]. In addition, authentic online discourse creates opportunities for future teachers to observe contemporary linguistic practices and develop skills necessary for technology-supported language instruction in modern educational settings [3]. Nevertheless, despite the increasing use of social media in educational contexts, the pedagogical value of authentic digital content in foreign language *teacher education remains insufficiently explored from the perspective of future teachers themselves. Researchers also highlight several challenges related to the educational implementation of social media-based authentic content, including linguistic complexity, distraction, information overload, and difficulties in selecting pedagogically appropriate materials [4].*

Therefore, the present study aims to investigate the perceptions of future foreign language teachers regarding the integration of social media-based authentic content into foreign language teacher education. The study seeks to answer the following research questions:

1. How do future foreign language teachers perceive the educational value of social media-based authentic content?

2. What benefits do students associate with the use of authentic digital content in foreign language teacher education?

3. What challenges do future foreign language teachers experience when using social media-based authentic content for educational purposes?

Literature review

The widespread expansion of online communication platforms has reshaped the ways in which languages are learned, practiced, and taught in contemporary educational environments. Over the last decade, social media has gradually evolved from a tool of interpersonal communication into a significant educational resource actively integrated into foreign language instruction. Researchers commonly define ***social media*** *as digital platforms and web-based applications that allow users to create, share, exchange, and interact with user-generated content within virtual communities and communication networks [3].*

The growing educational value of social media is closely connected with the concept of authentic digital materials. In foreign language pedagogy, ***authentic digital materials*** *are generally understood as digitally mediated resources originally created for real communicative and social purposes rather than for classroom instruction. These materials include social media posts, online videos, podcasts, interviews, comments, blogs, online discussions, digital news reports, and other forms of naturally occurring online discourse [1]. Unlike traditional educational materials adapted specifically for language learners, authentic digital content reflects spontaneous communication, contemporary vocabulary, sociocultural references, pragmatic conventions, and naturally occurring interactional patterns found in real digital environments. Consequently, exposure to authentic digital discourse creates opportunities for learners to engage with language as it is genuinely used in modern communicative contexts.*

Current research emphasizes that social media-based authentic content contributes to the development of communicative competence, learner autonomy, sociocultural awareness, and contextual language understanding [5]. The integration of authentic digital resources also supports learner-centered and interaction-oriented approaches to foreign language teaching. According to N. Brocca, social media technologies correspond with constructivist and connectivist perspectives on learning because they encourage collaborative interaction, participation in discourse communities, and knowledge construction through authentic communication [1]. Previous studies additionally indicate that the use of authentic digital content positively influences students' motivation, communicative participation, intercultural interaction, and willingness to engage in professional and educational communication [6].

In the context of foreign language teacher education, the pedagogical role of authentic digital content has become especially important due to the growing need for digitally competent and professionally prepared teachers capable of functioning effectively in technology-mediated educational environments. Authentic social media discourse enables future teachers to observe contemporary linguistic practices, analyze real communication patterns, and develop skills related to the pedagogical integration of digital resources into language instruction [7]. At the same time, researchers identify several challenges associated with the educational implementation of social media-based authentic content, including information overload, distraction, linguistic complexity, informal language structures, and difficulties in selecting pedagogically appropriate materials for educational purposes [4].

Although the relationship between social media and language learning has been widely explored in recent years, considerably less attention has been devoted to future foreign language teachers' perceptions of authentic digital content within teacher education programs. Therefore, further investigation is required to better understand how future teachers evaluate the communicative, pedagogical, and professional value of social media-based authentic content in the process of foreign language teacher training.

Methods

1. Research design*: the present study employed a predominantly* ***quantitative research design*** *aimed at investigating future foreign language teachers' perceptions of social media-based authentic* *content in FLTE. Quantitative data were obtained through structured closed-ended questionnaire items designed to identify common tendencies, attitudes, and patterns related to the educational use of authentic digital content. In addition, several open-ended questions were incorporated to obtain more detailed insights into students' personal experiences and recommendations concerning the pedagogical integration of authentic digital materials into professional teacher training.*

*2. **Participants** of the study consisted of approximately **40 undergraduate students** majoring in foreign language teacher education. The participants were selected through purposive sampling, as the research specifically targeted future foreign language teachers who regularly engage with digital technologies and online educational resources.*

*3. **Instrument:** the questionnaire consisted of 10 items divided into two sections.*

*· **Closed-ended questions** included multiple-choice and five-point Likert-scale items intended to identify students' attitudes, frequency of use, perceptions of educational value and opinions regarding the role of social media-based authentic content in FLTE.*

*· **Open-ended questions** focused on participants' personal experiences, perceived benefits, difficulties, and suggestions concerning the educational integration of DAM.*

*4. **Data collection procedure:** the online questionnaire was distributed electronically through digital communication platforms commonly used by university students. Before completing the questionnaire, respondents were informed about the academic purpose of the study, the voluntary nature of participation, and the anonymity of the collected responses. The questionnaire required approximately 5–7 minutes to complete.*

*5. **Data analysis:** the quantitative data were analyzed using descriptive statistical methods, including percentage distribution and comparative analysis of participants' responses. The qualitative responses obtained from the open-ended questions were analyzed using thematic analysis in order to identify recurring opinions, perceptions, and challenges associated with the use of social media-based authentic content in foreign language teacher education.*

Results

The findings demonstrate that authentic digital materials positively influence students' communicative engagement, motivation, exposure to real-life language use, and professional language development. At the same time, several challenges related to the educational integration of authentic digital content were identified, including linguistic complexity, distraction, and difficulties associated with selecting pedagogically appropriate materials.

1. To the question "How often do you use social media-based authentic content (e.g., YouTube, Instagram, TikTok, Reddit) during foreign language learning activities?"

- ***Very often** – 17 participants (42.5%) reported that they regularly use social media-based authentic content during foreign language learning.*
- ***Often** – 12 respondents (30%) stated that they frequently incorporate authentic digital platforms into their language learning activities and academic preparation.*
- ***Sometimes** – 8 students (20%) indicated that they occasionally use social media-based authentic materials for educational purposes, mainly as supplementary learning resources.*
- ***Rarely** – 3 participants (7.5%) selected this option, demonstrating limited use of authentic digital content in their language learning process.*
- ***Never** – none of the respondents selected this option, which suggests that all participants had at least some experience using social media-based authentic content in learning.*

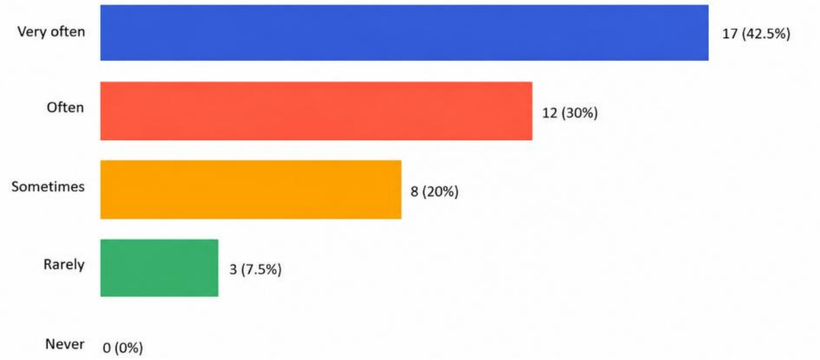

Figure 1. Frequency of students' engagement with social media content in language learning

2. To the question "Which social media platforms do you consider the most effective for foreign language learning?"

– ***YouTube*** – *14 participants (35%) identified YouTube as the most effective platform due to its wide variety of authentic videos, interviews, and real-life communicative content.*

– ***Instagram*** – *9 respondents (22.5%) selected Instagram, emphasizing its usefulness for learning contemporary vocabulary, authentic expressions and visual language content.*

– ***TikTok*** – *7 participants (17.5%) reported that TikTok contributes to language learning through short-form authentic videos and interactive communicative content.*

– ***Reddit*** – *4 students (10%) considered Reddit effective because it provides opportunities to observe authentic online discussions and naturally occurring written communication.*

– ***Facebook*** – *3 respondents (7.5%) indicated that Facebook supports communication and participation in language-related groups and educational communities.*

– ***Blogs/online forums*** – *3 participants (7.5%) selected blogs and online forums as useful sources of authentic written discourse and contextual language exposure.*

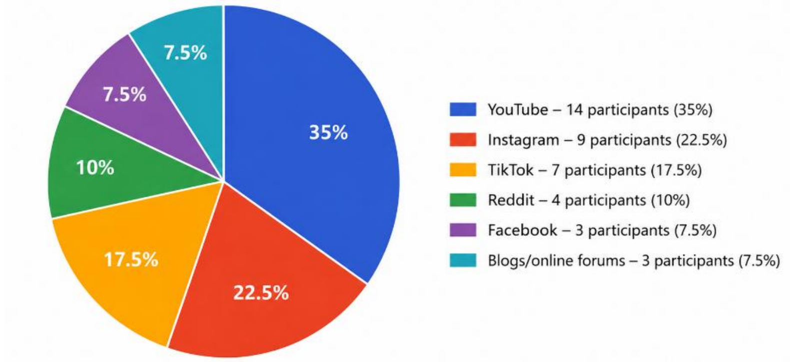

Figure 2. Social media platforms perceived as the most effective for foreign language learning

3. To the question "To what extent do you agree that authentic digital content helps you understand real-life language use and communication?"

· ***Strongly agree*** – *16 participants (40%) indicated that authentic digital content significantly improves their understanding of real-life communication and language use.*

· ***Agree*** – *14 respondents (35%) reported that social media-based authentic materials positively contribute to contextual language comprehension.*

· ***Neutral*** – *7 students (17.5%) selected this option, demonstrating a moderate perception of the educational value of authentic digital content.*

· ***Disagree*** – *2 participants (5%) stated that authentic digital materials do not substantially influence their understanding of real-life language use.*

· ***Strongly disagree*** – *1 respondent (2.5%) selected this option.*

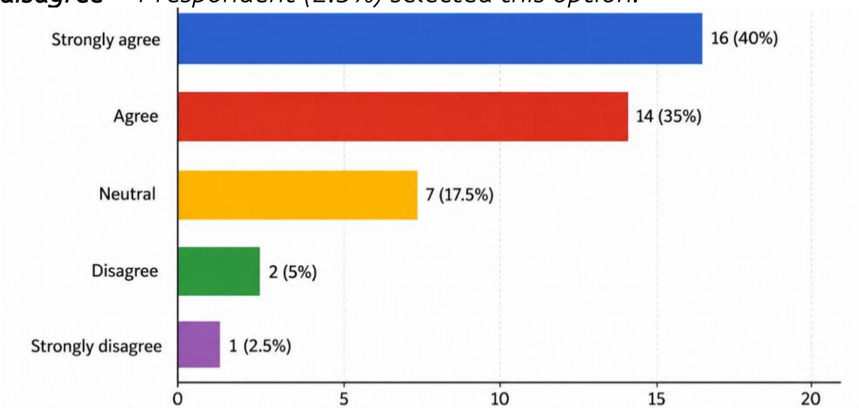

Figure 3. Students' attitudes toward the educational value of authentic digital content

4. To the question "Which aspects of language learning are most positively influenced by authentic digital content?"

· ***Speaking skills*** – *13 participants (32.5%) identified speaking skills as the aspect most positively influenced by DAM due to increased exposure to real-life communication.*

· ***Listening skills*** – *11 respondents (27.5%) reported that DAM significantly improve listening comprehension and understanding of naturally occurring speech.*

· ***Vocabulary development*** – *8 participants (20%) indicated that social media-based authentic content contributes to the acquisition of vocabulary and expressions.*

· ***Pronunciation*** *– 3 students (7.5%) selected pronunciation as the primary area positively affected by authentic digital resources.*

· ***Sociocultural awareness*** *– 5 respondents (12.5%) emphasized the role of authentic digital content in developing understanding of cultural diversity and communication practices.*

· ***Communicative confidence*** *– 6 participants (15%) stated that authentic online interaction increases confidence in using a foreign language in communicative situations.*

· ***Critical thinking*** *– 4 students (10%) reported that authentic digital discourse encourages analytical thinking and interpretation of online information.*

· ***Professional communication skills*** *– 7 respondents (17.5%) indicated that authentic digital materials contribute to the development of professionally oriented communication skills necessary for future foreign language teachers.*

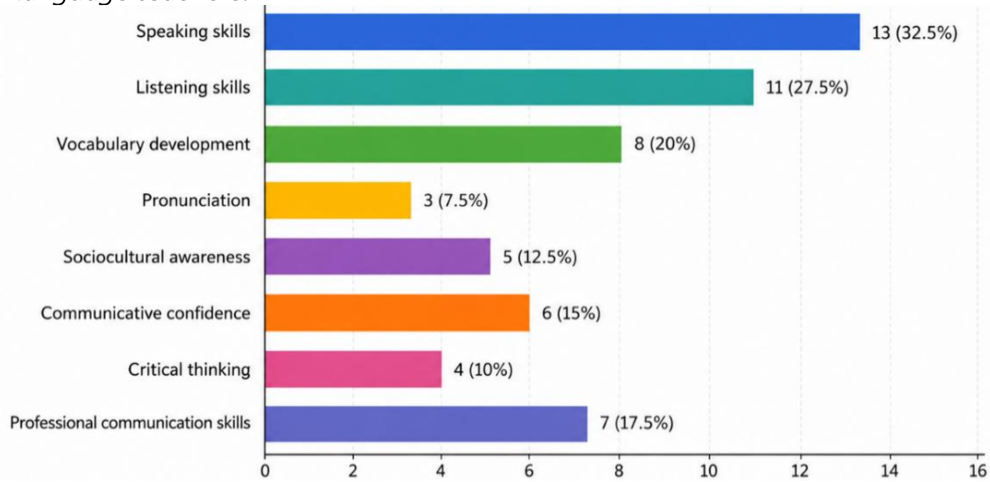

Figure 4. Aspects of language learning are most positively influenced by authentic digital content

5. To the question "What challenges do you most frequently experience when using authentic digital content for educational purposes?"

– ***Linguistic complexity*** *– 12 participants (30%) identified complex vocabulary and unfamiliar language structures as one of the main difficulties when working with DAM.*

– ***Fast speech rate*** *– 10 respondents (25%) reported difficulties understanding naturally occurring speech due to the rapid pace of authentic audio and video materials.*

– ***Informal language/slang*** *– 8 students (20%) indicated that slang expressions and informal communication styles complicate comprehension of authentic online discourse.*

– ***Information overload*** *– 6 participants (15%) selected excessive amounts of online information as a challenge affecting concentration and effective learning.*

– ***Distraction*** *– 5 respondents (12.5%) stated that social media environments may reduce focus during educational activities.*

– ***Difficulty selecting appropriate materials*** *– 9 students (22.5%) emphasized challenges related to identifying reliable and pedagogically suitable authentic digital resources.*

– ***Cultural references*** *– 4 participants (10%) reported difficulties understanding culturally specific expressions and references encountered in authentic digital communication.*

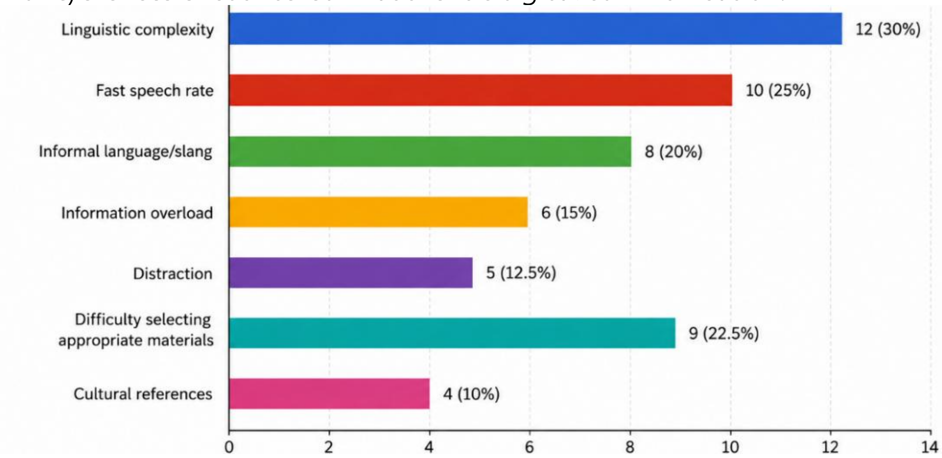

Figure 5. Challenges associated with the use of DAM for educational purposes

6. To the question "What recommendations would you suggest for improving the use of authentic digital content in foreign language teacher education programs?"

The qualitative responses demonstrated that the majority of participants support a more systematic and methodologically organized integration of authentic digital content into foreign language teacher education programs. Many students emphasized the importance of selecting reliable, pedagogically appropriate, and level-oriented digital materials that correspond to learners' linguistic abilities and professional needs. Participants additionally recommended incorporating a wider variety of authentic digital resources, including educational videos, podcasts, interviews, online discussions, and social media platforms, in order to increase communicative engagement and exposure to real-life language use. Several respondents also highlighted the necessity of providing methodological guidance on how to effectively use authentic digital content in classroom activities and professional teacher training contexts.

Discussion

The findings of the present study demonstrate that social media-based authentic content occupies an increasingly important position within contemporary foreign language teacher education. The results indicate that the majority of future foreign language teachers regularly use authentic digital resources during language learning activities and generally perceive such materials as educationally valuable, communicatively meaningful, and professionally relevant. These findings support previous research emphasizing the pedagogical potential of authentic digital environments in promoting communicative interaction, learner engagement, and exposure to naturally occurring language use in foreign language education [1].

One of the most significant findings of the study is the strong preference for video-oriented and interactive social media platforms, particularly YouTube, Instagram, and TikTok. Participants associated these platforms with authentic communication, contextual language exposure, and increased learning motivation. This tendency may be explained by the multimodal nature of social media-based authentic content, which combines visual, auditory, textual, and interactive components within meaningful communicative contexts. Such findings correspond with contemporary communicative and constructivist approaches to language learning, according to which authentic interaction and participation in digital discourse environments contribute to more effective language acquisition and learner-centered educational experiences [5].

The results additionally demonstrate that authentic digital content is primarily perceived as beneficial for the development of speaking skills, listening comprehension, vocabulary acquisition, communicative confidence, and professionally oriented communication skills. Exposure to authentic online discourse appears to create opportunities for future foreign language teachers to engage with contemporary language practices, observe real communicative patterns, and develop greater sociocultural awareness. However, the findings reveal several challenges associated with the educational use of authentic digital materials. Participants frequently identified linguistic complexity, fast speech rate, informal language structures, and difficulties related to selecting pedagogically appropriate resources as significant obstacles. These results suggest that the integration of authentic digital content into teacher education programs requires careful methodological organization and pedagogical guidance. Without appropriate instructional support, DAM may create cognitive overload and reduce the effectiveness of the learning process.

Overall, the study highlights the necessity of systematically integrating social media-based authentic content into foreign language teacher education programs. The findings indicate that authentic digital resources possess substantial pedagogical value for developing communicative competence, sociocultural understanding, and professionally oriented language skills. Consequently, foreign language teacher education should place greater emphasis on preparing future teachers to critically select, analyze, and pedagogically implement authentic digital content within modern language learning environments.

Conclusion

The present study examined future foreign language teachers' perceptions of social media-based authentic content in the context of foreign language teacher education. The findings demonstrate that authentic digital resources are widely used by students and are generally perceived as effective tools for enhancing communicative engagement, exposure to real-life language use, motivation, and professionally oriented communication skills. The results additionally indicate that video-oriented and interactive platforms such as YouTube, Instagram, and TikTok are considered the most beneficial sources of authentic digital content in contemporary language learning environments. At the same time, the study revealed several challenges associated with the educational integration of authentic digital materials, including linguistic complexity, fast speech rate, informal language structures, and difficulties related to *selecting pedagogically appropriate resources. These findings emphasize the importance of methodological guidance and systematic instructional support when incorporating authentic digital content into foreign language teacher education programs.*

The integration of authentic digital resources may contribute not only to the development of communicative competence and sociocultural awareness, but also to the professional preparation of future teachers capable of functioning effectively in digitally mediated educational environments. Therefore, foreign language teacher education programs should place greater emphasis on the purposeful and methodologically grounded use of authentic digital content in professional language training.

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Technical sciences

URBAN FLOOD PREDICTION HYDROLOGICAL MODEL BENCHMARKING: A COMPARATIVE STUDY OF SWMM AND MACHINE LEARNING APPROACHES

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БЕНЧМАРКИНГ ГИДРОЛОГИЧЕСКИХ МОДЕЛЕЙ ДЛЯ ПРОГНОЗИРОВАНИЯ ГОРОДСКИХ НАВОДНЕНИЙ: СРАВНИТЕЛЬНОЕ ИССЛЕДОВАНИЕ SWMM И ПОДХОДОВ МАШИННОГО ОБУЧЕНИЯ

Гусейнзаде Гюльбахар Гусейн гызы
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Abstract
This article presents a comparative analysis of traditional hydrological models and machine learning approaches used in urban flood prediction. The main objective of the study is to evaluate the effectiveness, accuracy, and applicability of the SWMM (Storm Water Management Model) and various machine learning methods. Rapid urbanization and climate change have significantly increased the risks of urban flooding, which highlights the relevance of this topic. Previous scientific studies were reviewed, and the advantages and limitations of hydrological models were identified. The comparison revealed that although SWMM provides more reliable simulations of physical hydrological processes, machine learning models offer faster and highly accurate predictions when trained on large datasets. The findings of this study are important for urban flood management and the development of early warning systems.
Аннотация
В статье проведен сравнительный анализ традиционных гидрологических моделей и подходов машинного обучения, используемых для прогнозирования городских наводнений. Основной целью исследования является оценка эффективности, точности и применимости модели SWMM (Storm Water Management Model) и различных методов машинного обучения. Ускоренная урбанизация и изменение климата значительно увеличили риски городских наводнений, что подчеркивает актуальность данной темы. В статье проанализированы предыдущие научные исследования, а также выявлены преимущества и ограничения гидрологических моделей. Сравнение показало, что SWMM обеспечивает более надежное моделирование физических процессов, тогда как модели машинного обучения способны обеспечивать быстрые и высокоточные прогнозы при работе с большими объемами данных. Результаты исследования имеют важное значение для управления городскими наводнениями и разработки систем раннего предупреждения.

Keywords: *Urban flooding, SWMM, machine learning, hydrological modeling, flood prediction, benchmarking, climate change.*
Ключевые слова: *городские наводнения, SWMM, машинное обучение, гидрологическое моделирование, прогнозирование наводнений, benchmarking, изменение климата.*

Introduction. *In the modern era, rapid urbanization and global climate change have led to a significant increase in the frequency and intensity of urban floods. The expansion of asphalt and concrete surfaces in urban areas limits the infiltration of rainwater into the soil, resulting in the rapid formation of large volumes of surface runoff within a short period of time. This process creates serious risks, particularly in large cities, including disruptions to transportation systems, damage to infrastructure, economic losses, and threats to human safety.*

Effective management and mitigation of urban flood risks require the development of reliable forecasting systems. Among traditional hydrological models, the Storm Water Management Model (SWMM) is widely used for simulating rainfall–runoff processes. In recent years, the rapid advancement of Big Data and artificial intelligence technologies has accelerated the application of machine learning–based approaches. Machine learning models are capable of analyzing complex hydrological relationships and *nonlinear processes, thereby providing more accurate and efficient prediction results. Therefore, the integration of traditional hydrological models with artificial intelligence approaches is considered a promising direction for urban flood management.*

Relevance of the Topic*. As a result of climate change, the frequency of intense precipitation events has been increasing worldwide. At the same time, the aging of urban drainage systems and the rapid pace of urbanization have significantly increased flood risks in cities. According to reports by the World Meteorological Organization, urban floods have become one of the natural disasters causing the greatest economic damage over recent decades.*

Although traditional hydrological models consider physical processes and hydrological principles, their development and calibration require substantial time, computational resources, and large amounts of data. In contrast, machine learning approaches are capable of providing faster and more adaptive predictions based on large-scale datasets. Therefore, the comparative analysis of SWMM and machine learning models represents one of the most aкmyal and promising scientific directions in modern hydrological research.

Characteristics of the SWMM Model*. The Storm Water Management Model (SWMM) is a hydrological–hydraulic model developed by the United States Environmental Protection Agency. The model is widely used for simulating rainfall–runoff processes in urban drainage systems. SWMM considers various hydrological and hydraulic parameters, including rainfall intensity, infiltration, evaporation, and the hydraulic characteristics of pipe networks (Rossman, 2015).*

The main advantages of the SWMM model include:

- *Detailed modeling of physical hydrological processes;*
- *Realistic simulation of urban drainage systems;*
- *Capability to analyze different flood scenarios;*
- *Suitability for urban planning and water management applications.*

However, the model also has several limitations. Its primary disadvantages are the high computational time required for simulations and the need for extensive and high-quality datasets for calibration and validation.

Machine Learning Approaches*. Machine learning models enable the identification of nonlinear relationships within hydrological datasets. The most commonly applied methods include Random Forest, Support Vector Machine (SVM), Artificial Neural Network (ANN), and Long Short-Term Memory (LSTM) networks.*

Among these approaches, LSTM models are widely used in urban flood forecasting because they demonstrate high performance in time-series analysis and sequential data prediction (Kratzert et al., 2019). The main advantages of machine learning approaches include:

- *High prediction accuracy;*
- *Rapid processing of large-scale datasets;*
- *Capability for real-time forecasting;*
- *Adaptive learning ability.*

Despite these advantages, machine learning models also have certain limitations. In many cases, they cannot fully explain the underlying physical hydrological processes and are highly dependent on the availability of high-quality training data.

- *Urbanizasiya səthi axınların həcmini artırır (Məmmədov & Əliyev, 2021).*
- *SWMM modeli drenaj sistemlərinin simulyasiyasında geniş tətbiq edilir (Yılmaz & Kaya, 2019).*
- *LSTM əsaslı modellər yüksək proqnoz dəqiqliyi təqdim edir (Demir & Arslan, 2022).*
- *İqlim dəyişiklikləri urban daşqın risklərini artırır (Həsənov, 2020).*

Literature Review. *In recent years, numerous studies have been conducted on the comparative analysis of hydrological models. Lewis A. Rossman (2015) stated that the SWMM model demonstrates high reliability in the simulation of urban drainage systems. Salvadore and colleagues (2015) emphasized the importance of high-resolution digital elevation models in urban flood modeling.*

In the field of machine learning, Mosavi and colleagues (2018) demonstrated the effectiveness of artificial intelligence methods in flood forecasting. Similarly, Frederik Kratzert and colleagues (2019) found that LSTM models achieve better performance than classical approaches in forecasting hydrological time-series data.

Several studies have also shown that hybrid approaches can provide more effective results. In particular, the integration of the physically based SWMM model with machine learning methods improves both interpretability and prediction accuracy (Chen et al., 2020).

In Azerbaijan and Türkiye, a number of studies have recently focused on urban flood modeling and the management of hydrological processes. Azerbaijani researchers Mammadov and Aliyev (2021) investigated the impact of urbanization on surface runoff intensity in the city of Baku and highlighted the importance of applying hydrological models. In addition, Hasanov (2020) showed that climate change has increased urban flood risks in Azerbaijan.

Among Turkish researchers, Yılmaz and Kaya (2019) examined the application of the SWMM model to the drainage systems of Istanbul and concluded that the model produces highly accurate results. Furthermore, Demir and Arslan (2022) analyzed the effectiveness of machine learning methods in flood forecasting and reported that the LSTM approach outperforms classical statistical models.

***Methodology**. Within the framework of this study, the SWMM model and machine learning approaches were evaluated through a comparative analysis. The following stages were carried out during the research process:*

1. *Collection of rainfall and surface runoff data;*
2. *Calibration and simulation of the SWMM model;*
3. *Training of machine learning models;*
4. *Comparison of model performance indicators.*

For the evaluation process, the Nash-Sutcliffe Efficiency (NSE), Root Mean Square Error (RMSE), and Mean Absolute Error (MAE) metrics were used.

The SWMM model provided more interpretable results in terms of simulating physical hydrological processes. In contrast, the LSTM-based machine learning model demonstrated higher accuracy in short-term forecasting tasks.

***Conclusion**. The comparative analysis conducted in this study indicates that both SWMM and machine learning approaches possess significant advantages for urban flood forecasting. The SWMM model is considered more suitable for the detailed analysis and interpretation of physical hydrological processes. Meanwhile, machine learning models provide rapid and highly accurate predictions based on large-scale datasets.*

The results of the study suggest that the most effective approach is the application of hybrid models. Such an approach preserves the interpretability of physical hydrological processes while simultaneously benefiting from the high computational capabilities of artificial intelligence. Future studies should focus on the development of intelligent real-time hydrological forecasting systems for urban flood management.

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