

MUHANDISLIK

& IQTISODIYOT

*ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

2026-YIL
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- 05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
05.01.03 – Informatikaning nazariy asoslari
05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
05.01.07 – Matematik modellashtirish
05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
05.02.00 – Mashinasozlik va mashinashunoslik
05.02.08 – Yer usti majmualari va uchish apparatlari
05.03.02 – Metrologiya va metrologiya ta'minoti
05.04.01 – Telekommunikatsiya va kompyuter tizimlari, telekommunikatsiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
05.05.05 – Issiqlik texnikasining nazariy asoslari
05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
05.08.03 – Temir yo'l transportini ishlatish
05.08.06 – "G'ildirakli va gusenisali mashinalar va ularni ishlatish" (texnika fanlari)
05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti
08.00.01 – Iqtisodiyot nazariyasi
08.00.02 – Makroiqtisodiyot
08.00.03 – Sanoat iqtisodiyoti
08.00.04 – Qishloq xo'jaligi iqtisodiyoti
08.00.05 – Xizmat ko'rsatish tarmoqlari iqtisodiyoti
08.00.06 – Ekonometrika va statistika
08.00.07 – Moliya, pul muomalasi va kredit
08.00.08 – Buxgalteriya hisobi, iqtisodiy tahlil va audit
08.00.09 – Jahon iqtisodiyoti
08.00.10 – Demografiya. Mehnat iqtisodiyoti
08.00.11 – Marketing
08.00.12 – Mintaqaviy iqtisodiyot
08.00.13 – Menejment
08.00.14 – Iqtisodiyotda axborot tizimlari va texnologiyalari
08.00.15 – Tadbirkorlik va kichik biznes iqtisodiyoti
08.00.16 – Raqamli iqtisodiyot va xalqaro raqamli integratsiya
08.00.17 – Turizm va mehmonxona faoliyati

Ma'lumot uchun, OAK
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MUNDARIJA

RIVOJLANAYOTGAN MAMLAKATLARDA ESG TAMOYILLARINI JORIY ETISHNING INSTITUTSIONAL TO'SIQLARI VA IQTISODIY OQIBATLARI	10
I. R. Berdikulova	
KIMYO SANOATINING IQTISODIYOTDA TUTGAN O'RNI VA TARMOQ KORXONALARIDA BOSHQARUV HISOBI	14
Onorboev Sh.M.	
A WEEKLY LOGISTICS-CONTROLLING SYSTEM FOR EXPORT SUPPLY CHAINS: CORRIDOR-LEVEL EVIDENCE FROM A TEXTILE EXPORTER.....	26
Mukhammadiyahaminova Shakhzoda Sherzodovna	
FOTOVOLTAIK-TROMBE DEVORI ASOSIDA HAVONI ISITISH, TOZALASH VA ELEKTR ENERGIYASI ISHLAB CHIQRISH JARAYONLARINI INTEGRATSIYALASHNING ILMIY-METODIK TAHLILI.....	36
Rahimova Volida Karim qizi	
XAVFSIZ HAYOT TARZINI SHAKLLANTIRISHDA TA'LIM VA TARBIYANING O'RNI: NAZARIY ASOSLAR VA AMALIY MODEL.....	42
Nigmatjonov Sardor Abdumannovich	
РАЗВИТИЕ МЕТОДОЛОГИИ ВНЕДРЕНИЯ ИННОВАЦИОННЫХ СТРАТЕГИЙ НА ПРЕДПРИЯТИЯХ ПИЩЕВОЙ ПРОМЫШЛЕННОСТИ: КОНЦЕПТУАЛЬНЫЙ ПОДХОД.....	49
Дониёрова Зухрабону Алишер кизи	
KAMBAG'AL OILALARNI TADBIRKORLIKKA JALB QILISHDA DAVLAT TOMONIDAN MOLIVAVIY QO'LLAB-QUVVATLASH VA BOSHQARISH (MENEJMENT) TIZIMINI TAKOMILLASHTIRISH YO'LLARI...53	
Bazarbaeva Asiya Shalkarbaevna	
MOLIVAVIY INKLYUZIVLIK KONSEPSIYASI: BANK XIZMATLARINING KAMBAG'ALLIK DARAJASIGA TA'SIRINING NAZARIY ASOSLARI VA O'ZBEKISTON AMALIYOTI.....	58
Niyozov Zuxur, Abdujalilov Shexroz, Zubaydulloyeva Damira	
KORXONALARNI QAYTA TASHKIL ETISH JARAYONIDA ASOSIY VOSITALAR HISOBI VA BAHOLASHNI TAKOMILLASHTIRISH.....	61
Davletov Ikrom Raximberganovich	
ИОРДАНИЯ КАК ТУРИСТИЧЕСКИЙ ЦЕНТР БЛИЖНЕГО ВОСТОКА.....	67
Салихова Алина Муратовна	
QUYOSH ENERGIYASINI KONVERSIYALOVCHI OPTOELEKTRON GELIOTRANSFORMATORLARNING FIZIK-TEXNIK ASOSLARI	73
Axunov Qambarali, Xomidov Abdullajon, Mashrapova Irodaxon	
XXI ASRDA O'ZBEKISTONDA ELEKTR ENERGIYASINI TEJASHDAGI YANGI TEXNOLOGIYALAR.....	78
Xamrakulova Xilola, Yusupova Sevaraxon	
HUDUDIY IXTISOSLASHUVNING SHAKLLANISH OMILLARI VA MINTAQAVIY RIVOJLANISHDAGI AHAMIYATI	83
Sodiqova Nigora	
BANKLAR TRANSFORMATSIYASI JARAYONIDA AKTIVLAR SAMARADORLIGI TAHLILI.....	89
Muminov Bekzod Polvonovich	
ЧЕЛОВЕЧЕСКИЙ КАПИТАЛ КАК КЛЮЧЕВОЙ ФАКТОР УСТОЙЧИВОГО ЭКОНОМИЧЕСКОГО РАЗВИТИЯ УЗБЕКИСТАНА	95
Садыков Авазбек Мадаминович, Цхай Лана Александровна	
MILLIY KADRLAR ZAXIRASINI SHAKLLANTIRISHNING ILG'OR XORIJ TAJRIBASI.....	103
G'aniyev Elyor Sobirjonovich	
DIGITALIZATION OF INSOLVENCY PROCESSES: THE ROLE OF A UNIFIED ELECTRONIC PLATFORM IN ENSURING TRANSPARENCY AND ECONOMIC EFFICIENCY	110
Damirjon Nurmatovich Soliyev	



О ПРОЦЕССАХ ЦИФРОВИЗАЦИИ В УЗБЕКИСТАНЕ.....	116
Джумаев Аскар Хайдарович	
SOLIQ MA'MURCHILIGI METODOLOGIYASINING HUQUQIY, TASHKILY VA RAQAMLI BAZASINI SHAKLLANTIRISH BILAN BOG'LIQ MUAMMOLAR.....	121
Shamsiev O'ktam Sayfitdinovich	
KO'P XONADONLI UYLARDA KOMMUNAL XIZMATLAR KO'RSATISH SOHASINING INSTITUTSIONAL ASOSLARI VA HOZIRGI HOLATI TAHLILI.....	127
Muminov Obidjon Odilovich	
MINTAQA VA UNING HUDUDLARIDA MEHNAT OMILI HISOBIGA SANOAT SALOHİYATINI OSHIRISH YO'LLARI.....	135
Urazaliyev Bekzod Sultanbayevich	
КЛАССИФИКАЦИЯ ИНСТРУМЕНТОВ ЦИФРОВОЙ ТРАНСФОРМАЦИИ ПРИНЯТИЯ РЕШЕНИЙ С УЧЕТОМ ОПТИМИЗАЦИИ БИЗНЕС ПРОЦЕССОВ.....	141
Джуманов А.А.	
O'ZBEKISTONDA SOLIQ MADANIYATINI SHAKLLANTIRUVCHI OMILLARNI FAKTOR TAHLIL VA KO'P OMILLI REGRESSIYA ASOSIDA BAHOLASH.....	152
V.I. Isroilov, V.B. Ibragimov	
ИСПОЛЬЗОВАНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В РАЗВИТИИ БАНКОВСКИХ УСЛУГ.....	158
Мамутова Айгуль Калмурзаевна	
QUYOSH NOVUZLARIDA SODIR BO'LUVCHI ISSIQLIK JARAYONLARINING BIR O'LCHAMLI MATEMATIK MODEL.....	165
M.M. Maxmudova, J.J. Kamolov	
ФАКТОРЫ, СДЕРЖИВАЮЩИЕ РАЗВИТИЕ БАНКОВСКОГО ОБСЛУЖИВАНИЯ ВНЕШНЕЭКОНОМИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ.....	172
Алиев Али Комил угли, Каримова А.	
ISTE'MOL KREDITLARINING ANAMIYATI VA O'ZIGA XOS JIHATLARI.....	176
S. Qayumov, M. Qurbonov, A. S. Abduraxmanov	
AVTOTRANSPORT XIZMATLARI SAMARADORLIK DARAJASINI OMILLI TAHLILI.....	179
Raximov Azamat Hamroqulovich	
MINTAQA IQTISODIYOTINI BARQAROR RIVOJLANTIRISHDA FIRMALARNING TASHQI BOZORLARGA INTEGRATSIYALASHUV JARAYONLARI: XORIY TAJRIBASI.....	183
Ozodova Farida Zarif qizi	
СОВЕРШЕНСТВОВАНИЕ УПРАВЛЕНИЯ ЗОЛОВОАЛЮТНЫМИ РЕЗЕРВАМИ И ВНЕШНИМ ДОЛГОМ КАК ФАКТОР ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ УЧАСТНИКОВ ФИНАНСОВОГО РЫНКА В УСЛОВИЯХ ИННОВАЦИОННОЙ ЭКОНОМИКИ.....	187
Зайналов Жахонгир Расулович, Алиева Сусанна Сейрановна	
GENERATIV AI ASOSIDAGI ALGORITMIK NARX BELGILASH MEKANIZMLARI: RAQOBAT IQTISODIYOTIDA MONOPOLLASHUV XAVFI, VANO BO'YICHA SOZLASHUV MUAMMOLARI VA ANTIMONOPOL TARTIBGA SOLISH.....	192
Kendjayeva Dildora Xudayberganovna, Abdumannopova Shirin Olamgir qizi	
РАЗВИТИЕ ЗЕЛЁНОЙ ЭНЕРГЕТИКИ В РЕСПУБЛИКЕ УЗБЕКИСТАН КАК ФАКТОР УСТОЙЧИВОГО ЭКОНОМИЧЕСКОГО РОСТА.....	200
Тураева А. И.	
THE ROLE OF ARTIFICIAL INTELLIGENCE IN KNOWLEDGE DELIVERY MODELS.....	204
Daminova Barno Esanovna, Pardayeva Sevinch Sherzod qizi, Inoqov Jasur Komil o'g'li	
СОВЕРШЕНСТВОВАНИЕ ИНСТРУМЕНТОВ ФИНАНСОВОГО АНАЛИЗА ДЛЯ МАЛОГО БИЗНЕСА И СТАРТАПОВ.....	208
Ибрагимов Гайратжон Артикович	
RAQAMLI IQTISODIYOT VA SUN'IY INTELLEKT SHAROITIDA IJTIMOY-IQTISODIY ADOLAT QOIDALARI.....	216
Alimov Nasimjon Hoshimovich	



ЧЕЛОВЕЧЕСКИЙ КАПИТАЛ КАК КЛЮЧЕВОЙ ФАКТОР УСТОЙЧИВОГО ЭКОНОМИЧЕСКОГО РАЗВИТИЯ УЗБЕКИСТАНА	221
Садыков Авазбек Мадаминович, Цхай Лана Александровна	
TURIZMNI RIVOJLANTIRISHDA SUN'IY INTELLEKTDAN FOYDALANISH USULLARI	228
Daminova Barno Esanovna, Abduraimova Aziza Erkin qizi, G'ofurova Anora Zafar qizi	
XALQARO MOLIYAVIY HISOBOT STANDARTLARI (IFRS)GA O'TISH JARAYONIDA ISHLAB CHIQRISH XARAJATLARI HISOBINING MUAMMOLARI.....	233
Ismailov Naufal Nadirovich	
RAQAMLI BANK XIZMATLARINI TAKOMILLASHTIRISHDA SUN'IY INTELLEKT VA BIG DATA TEXNOLOGIYALARIDAN FOYDALANISH ISTIQBOLLARI.....	241
Eshqobulova Charos O'roq qizi	
ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION: A GLOBAL REVIEW OF AI-POWERED TEACHING AND LEARNING	245
Begzod Nishanov	



ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION: A GLOBAL REVIEW OF AI-POWERED TEACHING AND LEARNING

Begzod Nishanov

Senior Lecturer at International School of Finance and Technology

Abstract: Artificial intelligence, and in particular generative AI systems such as ChatGPT, Gemini, and Claude, has moved from the periphery to the mainstream of higher education in less than four years. By 2025, multiple international surveys converge on a single conclusion: AI use among university students is approaching universality, while institutional governance, faculty competence, and pedagogical theory are scrambling to keep pace. This article synthesises peer-reviewed empirical research published between 2020 and 2026, together with reports from UNESCO, the OECD, the Russell Group, the Digital Education Council, the Higher Education Policy Institute, Ellucian, and EDUCAUSE, to present a global, theoretically grounded account of the current state of AI-powered teaching and learning. The article maps adoption trends and key technologies, situates them within established and emerging theoretical frameworks including the Technology Acceptance Model, TPACK and its AI-specific extensions, constructivism, connectivism, and self-regulated learning theory, reviews benefits and challenges, surveys policy responses across multiple jurisdictions, and outlines future directions including AI literacy as a graduate attribute, hybrid human–AI pedagogies, and the redefined role of the educator. The analysis concludes that AI adoption in higher education is no longer a question of trajectory but of governance, and that the pedagogy of integration, not the technology itself, determines whether AI enhances or undermines learning outcomes.

Keywords: artificial intelligence, higher education, generative AI, teaching and learning, Technology Acceptance Model, TPACK, adaptive learning, academic integrity, AI literacy, UNESCO, self-regulated learning.

Annotatsiya: Sun'iy intellekt, xususan ChatGPT, Gemini va Claude kabi generativ AI tizimlari, to'rt yildan kamroq vaqt ichida oliy ta'limning chekkasidan uning asosiy oqimiga aylandi. 2025-yilga kelib, bir nechta xalqaro tadqiqotlar yagona xulosaga keldi: universitet talabalarining AI dan foydalanishi umumiylikka yaqinlashmoqda, shu bilan birga institutsional boshqaruv, professor-o'qituvchilar malakasi va pedagogik nazariya bu tezlikka yetib bora olmayapti. Ushbu maqola 2020–2026-yillarda nashr etilgan ekspert tekshiruvidan o'tgan empirik tadqiqotlarni, shuningdek, UNESCO, OECD, Russell Group, Raqamli ta'lim kengashi, HEPI, Ellucian va EDUCAUSE hisobotlarini sintez qilib, AI asosidagi o'qitish va o'rganishning hozirgi holatining global, nazariy jihatdan asoslangan tahlilini taqdim etadi. Maqolada qabul qilish tendensiyalari, asosiy texnologiyalar, nazariy asoslar, imkoniyatlar va muammolar, siyosat javoblari hamda kelajak yo'nalishlari, jumladan, AI savodxonligi, gibrid inson–AI pedagogikasi va pedagog rolining qayta belgilanishi ko'rib chiqiladi.

Kalit so'zlar: sun'iy intellekt, oliy ta'lim, generativ AI, o'qitish va o'rganish, texnologiyani qabul qilish modeli, TPACK, adaptiv o'rganish, akademik halollik, AI savodxonligi, UNESCO, o'z-o'zini tartibga soluvchi o'rganish.

Аннотация: Искусственный интеллект, в частности генеративные системы ИИ, такие как ChatGPT, Gemini и Claude, менее чем за четыре года переместился с периферии в мейнстрим высшего образования. К 2025 году множество международных исследований приходят к единому выводу: использование ИИ среди студентов университетов приближается к универсальности, в то время как институциональное управление, компетенции преподавателей и педагогическая теория не поспевают за этими темпами. В данной статье синтезируются рецензируемые эмпирические исследования, опубликованные в 2020–2026 годах, а также доклады ЮНЕСКО, ОЭСР, Russell Group, Совета по цифровому образованию, HEPI, Ellucian и EDUCAUSE, чтобы представить глобальный, теоретически обоснованный анализ текущего состояния преподавания и обучения на основе ИИ. В статье обсуждаются тенденции внедрения, ключевые технологии, теоретические основы, преимущества и проблемы, политические ответы в различных юрисдикциях и перспективные направления, включая ИИ-грамотность как ключевую компетенцию выпускника, гибридные человеко–ИИ педагогики и переопределенную роль педагога.

Ключевые слова: искусственный интеллект, высшее образование, генеративный ИИ, преподавание и обучение, модель принятия технологий, TPACK, адаптивное обучение, академическая честность, ИИ-грамотность, ЮНЕСКО, саморегулируемое обучение.

INTRODUCTION

The integration of artificial intelligence into higher education represents one of the most significant transformations in the history of university teaching and learning. Universities, as institutions that produce

knowledge, shape public discourse, and prepare future professionals, occupy a central role in determining how societies adopt, govern, and benefit from AI technologies. Yet the speed at which AI tools have entered academic life has outpaced the capacity of institutions, educators, and policymakers to respond with adequate governance, pedagogical frameworks, and ethical guidelines.

The public release of ChatGPT in November 2022 marked a watershed moment. Within twenty-four months, generative AI had become a routine feature of undergraduate study across all major world regions. By 2025, surveys across sixteen countries indicated that approximately 86 percent of university students were using AI tools in their studies, with comparable figures emerging from the United Kingdom, where usage among full-time undergraduates rose from 66 percent in 2024 to 95 percent in 2026 (Freeman, 2025; Stephenson and Armstrong, 2026). This near-universal adoption has generated both extraordinary pedagogical opportunities and profound challenges related to academic integrity, equity, faculty preparedness, and the very purpose of higher education.

There is a notable absence of comprehensive, theoretically grounded reviews that synthesise the rapidly accumulating evidence base while attending to the global diversity of institutional responses. This article seeks to address that gap by presenting a structured global review of AI-powered teaching and learning in higher education, drawing on peer-reviewed empirical research published between 2020 and 2026, together with reports from UNESCO, the OECD, the Russell Group, the Digital Education Council, the Higher Education Policy Institute, Ellucian, and EDUCAUSE.

The article is organised as follows. Section 2 reviews the relevant literature across five theoretical traditions. Section 3 describes the research methodology. Section 4 presents the analysis and results, structured around adoption trends, benefits, challenges, empirical findings, and policy responses. Section 5 offers conclusions and recommendations for future research and practice.

REVIEW OF LITERATURE ON THE SUBJECT

Davis's (1989) Technology Acceptance Model, with its core constructs of perceived usefulness and perceived ease of use, remains the most widely applied framework in studies of student and faculty adoption of generative AI. A systematic literature review examining 54 empirical studies on ChatGPT acceptance in higher education confirmed perceived usefulness and perceived ease of use as the most robust predictors of behavioural intention to use, often mediated by trust, self-efficacy, and perceived risk. Extensions include Venkatesh's Unified Theory of Acceptance and Use of Technology (UTAUT and UTAUT2), which incorporates performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, and habit. Strzelecki (2024), Habibi et al. (2023), Yildiz Durak and Onan (2024), and Acosta-Enriquez et al. (2024) have applied UTAUT2 to ChatGPT adoption across European, Turkish, Latin American, and Asian samples, generally finding hedonic motivation and habit to be powerful predictors of sustained use.

Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge framework has been the dominant lens for analysing teacher technology integration for nearly two decades. Mishra, Warr, and Islam (2023) explicitly applied TPACK to ChatGPT, arguing that generative AI's autonomy, opacity, and capacity to generate plausible content challenge the framework's assumption that technology is a neutral tool. Three significant AI-specific extensions have followed: Celik's (2023) Intelligent-TPACK (i-TPACK), which adds AI-specific ethical knowledge as a core domain; the AI-TPACK model proposed by Ning et al. (2024) and elaborated by Meng et al. (2026), which decomposes the framework into seven AI-related components; and a 2026 Human-Centric AI Pedagogy (HCAP) framework integrating AI-Technological, AI-Content, AI-Pedagogical, Human-AI Collaborative, and Ethical Knowledge domains, validated through a Delphi study (Karataş and Ataç, 2026).

Vygotskian and Piagetian constructivism continues to provide the dominant pedagogical rationale for AI-supported learning, particularly when generative AI is positioned as a Vygotskian "more knowledgeable other" that scaffolds within a student's zone of proximal development. Recent scholarship argues that ChatGPT can support active knowledge construction when used dialogically, while warning that uncritical answer-seeking collapses learning into shallow information transfer (Chan and Hu, 2023; Lodge et al., 2023).

George Siemens's (2005) connectivism, originally formulated for the Web 2.0 era, has been revisited as a framework for understanding learning in AI-saturated networks. Connectivism's emphasis on knowledge as distributed across nodes—people, databases, algorithms—fits the reality of students whose study practices now include continuous interaction with large language models. Recent scholarship in tertiary education argues that connectivism remains useful for theorising learning ecologies in which AI agents function as non-human nodes in knowledge networks.

Zimmerman's (2000, 2011) cyclical model of self-regulated learning—forethought, performance, and self-



reflection—has become a central reference point for the most pedagogically sophisticated AI scholarship. Chiu (2024) and Chiu and Rospigliosi (2025) argue that generative AI can either foster or hinder self-regulated learning depending on metacognitive support: tools that prompt goal-setting, monitoring, and reflection scaffold autonomy, while answer-on-demand interaction undermines it. Xu et al. (2025) demonstrated experimentally that metacognitive prompts embedded in generative AI environments significantly enhance self-regulated learning and learning experience. A growing methodological consensus across these frameworks suggests that no single existing theory is sufficient, and hybrid models combining multiple lenses are emerging as the standard for empirical work.

RESEARCH METHODOLOGY

This article employs a narrative synthesis methodology, integrating evidence from multiple sources to construct a comprehensive global review. The methodology involved a systematic search of peer-reviewed databases including Scopus, Web of Science, PubMed, and ERIC for empirical studies on AI in higher education published between 2020 and 2026, using search terms including “artificial intelligence,” “generative AI,” “ChatGPT,” “higher education,” “teaching and learning,” “adaptive learning,” and “academic integrity.” This was supplemented by analysis of policy documents and institutional reports from UNESCO, the OECD, the Russell Group, EDUCAUSE, the Digital Education Council, the Higher Education Policy Institute, and Ellucian. The review synthesises findings across five thematic domains: adoption trends and technologies, theoretical frameworks, benefits and opportunities, challenges and barriers, and policy and institutional responses. The analysis attends to both quantitative evidence from surveys and meta-analyses and qualitative findings from institutional case studies.

ANALYSIS AND RESULTS

Artificial intelligence is not new to higher education. Intelligent tutoring systems such as AutoTutor, Cognitive Tutor, and ALEKS have been studied in college settings since the 1990s, with meta-analyses reporting moderate-to-large positive effect sizes on academic learning (Steenbergen-Hu and Cooper, 2014; Kulik and Fletcher, 2016; Ma et al., 2014). What is genuinely new is the speed and breadth of diffusion that followed the public release of ChatGPT in November 2022.

The Digital Education Council’s Global AI Student Survey 2024, covering 3,839 students across 16 countries, found that 86 percent of students use AI in their studies, 54 percent on a weekly basis, and 24 percent daily. In the United Kingdom, the HEPI/Kortext Student Generative AI Survey tracked usage among full-time undergraduates from 66 percent in 2024 to 92 percent in 2025 to 95 percent in 2026, with use for assessed work climbing from 53 percent to 88 percent to 94 percent over the same period (Freeman, 2025; Stephenson and Armstrong, 2026). A 109-country PLOS ONE study with 23,218 respondents remains the largest global empirical study of student perceptions to date (Ravšelj et al., 2025).

Institutional adoption is also accelerating. Ellucian’s 2025 State of AI in Higher Education survey reports that institution-wide AI adoption jumped from 49 percent in 2024 to 66 percent in 2025, with 43 percent of institutions now including AI in their strategic plan. However, the Digital Education Council’s 2025 Global AI Faculty Survey shows that while 61 percent of faculty have used AI in teaching, 88 percent have done so only minimally—evidence that faculty integration trails student uptake by a wide margin (Table 1).

Table 1. AI Adoption Rates in Higher Education¹ (Selected Surveys, 2024–2026)

Survey / Source	Sample	AI Usage Rate	Year
DEC Global AI Student Survey	3,839 students, 16 countries	86%	2024
HEPI/Kortext (UK undergrads)	Full-time UG	66% → 92% → 95%	2024–2026
Chegg Survey	11,706 students, 15 countries	80%	2024
Ravšelj et al. (PLOS ONE)	23,218 students, 109 countries	Widespread	2025
Ellucian (institutional)	HE institutions	49% → 66%	2024–2025

Five clusters of benefit recur in the 2020–2026 peer-reviewed literature. First, AI-enabled adaptive learning systems modify content, pacing, and assessment to the individual learner, with a 2024 meta-analysis by Wang

1 Source: Compiled from DEC (2024); Freeman (2025); Stephenson and Armstrong (2026); Ravšelj et al. (2025); Ellucian (2025).

et al. reporting medium-to-large positive effects on cognitive outcomes. Second, automated formative feedback has demonstrated measurable gains: a four-week randomised controlled trial with 259 Chinese undergraduates found significant writing-quality improvements over instructor feedback alone, with the strongest effects on organisation and argumentation. Third, faculty workload reduction is substantial: Google’s Generative AI for Educators programme reports that 83 percent of completers expect to save two or more hours weekly. Fourth, AI-powered predictive analytics and chatbots for advising have been deployed at scale, with documented improvements in retention and student satisfaction. Fifth, genuine accessibility gains have been achieved through AI-powered captioning, audio description, real-time translation, and text simplification for students with disabilities and non-native speakers.

The same speed of adoption that produces benefits has generated a parallel set of risks. Academic integrity is the most widely discussed concern: the proportion of UK undergraduates directly inserting AI-generated text into submitted work rose from 3 percent in 2024 to 12 percent in 2026, and AI-related academic misconduct incidents increased nearly 400 percent in UK institutions between 2022–23 and 2024–25 (Cotton, Cotton, and Shipway, 2023; Stephenson and Armstrong, 2026). AI-detection technologies remain unreliable, with documented high false-positive rates particularly against non-native English speakers.

The digital divide represents a second major concern. HEPI’s 2025 survey documented a widening divide along gender, socioeconomic, and disciplinary lines, with premium AI subscriptions creating an additional “paywall divide.” Ethical challenges extend to algorithmic bias, privacy invasion, and the risk of surveillance-oriented classrooms. Multiple studies report negative correlations between high-frequency uncritical AI use and student performance, raising concerns about cognitive erosion and over-reliance. Faculty resistance persists: only 42 percent of UK students in 2025 considered staff well-equipped to help with AI. Finally, institutional policy development has lagged behind adoption, with only approximately 39 percent of higher education institutions having comprehensive AI policies as of 2025.

A rich empirical evidence base has emerged with extraordinary speed. The largest cross-national survey remains Ravšelj et al.’s (2025) 109-country study, which found students primarily use ChatGPT for brainstorming, summarising texts, and finding research articles. Systematic reviews and meta-analyses published between 2023 and 2026 consistently report generally positive effects of AI tools on academic achievement, higher-order thinking, and writing outcomes, with feedback-based interventions producing the largest gains. However, subgroup analyses reveal substantial variation across countries, disciplines, and intervention designs. A 2026 meta-analysis in Nature Humanities and Social Sciences Communications concluded that generative AI interventions tend to outperform traditional approaches, while noting that methodology—not technology—drives engagement and learning outcomes (Table 2).

Table 2. Summary of Key Empirical Findings² (2023–2026)

Study / Source	Method	Key Finding
Ravšelj et al. (2025)	Survey, N=23,218, 109 countries	Students use ChatGPT primarily for brainstorming and summarisation; rate accuracy lower for classroom use
Wang et al. (2024)	Meta-analysis, 2010–2022	Medium-to-large positive effects of AI adaptive learning on cognitive outcomes
Wu, Dang, and Li (2025)	Systematic review, 99 papers	Positive attitudes among students and teachers; persistent ethics and accuracy concerns
Xu et al. (2025)	Experimental (BJET)	Metacognitive prompts in GenAI environments significantly enhance self-regulated learning
HEPI/Kortext (2024–2026)	Annual survey, UK UG	AI usage for assessed work rose from 53% to 94%; direct text insertion from 3% to 12%

Policy responses have progressed through three identifiable phases: initial bans and reactive concern (late 2022–mid 2023), the issuance of high-level principles (mid 2023–2024), and operational policy development with curriculum integration (2024–2026). At the international level, UNESCO has produced the most influential body of guidance, including its landmark Guidance for Generative AI in Education and Research (Miao and Holmes, 2023) and the AI Competency Frameworks for Teachers and Students released in September 2024. The OECD’s Digital Education Outlook 2023 and 2026 editions, together with its Reimagining Teaching in an Accelerating World report (2026), provide comprehensive cross-national analysis.

At the national and institutional level, the Russell Group’s 2023 Principles on Generative AI in Education deliberately rejected outright bans in favour of literacy-based integration, setting out five principles endorsed

2 Source: Compiled by the author from cited studies.



by all 24 leading UK universities. The European Union's AI Act classifies certain educational AI applications as high-risk. China issued the world's first national generative AI regulation in 2023. In the United States, no federal framework exists, and institution-by-institution policy variation is the norm. The Digital Education Council's 2024 student survey found that only 5 percent of students felt fully aware of comprehensive AI guidelines at their institution—an indication that communication remains a significant weakness even where policies exist.

CONCLUSIONS AND SUGGESTIONS

The evidence assembled in this review supports four overarching conclusions for the current moment in global higher education.

First, AI adoption is no longer a question of trajectory but of governance. With 92–95 percent of UK undergraduates and 86 percent of students across sixteen countries already using AI routinely, the policy question has shifted from whether AI should be allowed to how it can be used pedagogically, ethically, equitably, and sustainably. Bans are demonstrably ineffective; literacy-based integration, exemplified by the Russell Group and UNESCO frameworks, is the emerging international consensus.

Second, the theoretical foundations of the field are pluralising. The Technology Acceptance Model and UTAUT2 remain indispensable for explaining adoption, TPACK and its AI extensions for explaining teacher competence, constructivism and connectivism for explaining knowledge-in-network, and self-regulated learning theory for explaining the difference between AI-enhanced and AI-substituted learning. Hybrid frameworks combining these lenses are likely to dominate the next generation of research.

Third, the empirical record is cautiously positive but contingent. Meta-analyses consistently report moderate-to-large positive effects, particularly for feedback-rich applications, accessibility, and lower-stakes formative work. But the same record documents over-reliance, cognitive erosion, integrity breakdowns, and a digital divide that runs along gender, socioeconomic, disciplinary, and infrastructure lines. The pedagogy of integration, not the technology itself, determines which outcome prevails.

Fourth, the role of the educator is being redefined rather than dissolved. UNESCO's framing of a teacher–AI–student triad, the OECD's emphasis on relational and ethical work that remains irreducibly human, and the converging recommendations of policy documents from Paris to London to Beijing all point to a future in which educators are required to do more pedagogical design, more ethical scaffolding, and more authentic assessment—even as AI takes on more routine cognitive labour.

The framework presented in this review generates several key recommendations for future research and policy. Empirical studies should prioritise longitudinal designs that track the effects of sustained AI use on critical thinking, metacognition, and disciplinary expertise. Comparative cross-national research should examine how cultural, institutional, and policy differences shape AI integration outcomes. Institutions should invest systematically in AI literacy programmes for both faculty and students, redesign assessment for AI-saturated environments, and build equitable access to AI tools to mitigate the paywall divide. Finally, governance frameworks should treat ethical oversight not as a brake on innovation but as the condition for responsible, sustainable, and educationally meaningful AI integration.

Achieving the full pedagogical potential of AI in higher education will require more than technological adoption. It will demand systematic attention to pedagogical design, investment in professional development, cultural change within university governance, and a recognition that the diverse contexts of global higher education require differentiated, evidence-informed approaches. The next five years will determine whether AI fulfils its promise as the most powerful pedagogical accelerator since the printing press, or whether it deepens inequalities and erodes the very capacities universities exist to cultivate.

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