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ARTIFICIAL INTELLIGENCE IN ENGLISH LANGUAGE TEACHING AT TECHNICAL UNIVERSITIES: INTERNATIONAL PERSPECTIVE

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The integration of artificial intelligence (AI) technologies into English language teaching at technical universities represents a transformative shift in educational practices worldwide. The study examines the current state, opportunities, and challenges of AI implementation in English for Specific Purposes (ESP) and general English teaching within engineering and technical education contexts. Through the analysis of recent research and institutional practices of technical universities across different geographical regions, the paper identifies key applications of artificial intelligence. The research reveals that AI technologies offer substantial benefits for technical students; however, implementation faces significant challenges as well. The study demonstrates that successful integration of artificial intelligence in technical university English programs requires comprehensive institutional frameworks combining clear pedagogical objectives, adequate technological infrastructure, systematic faculty professional development, student digital literacy education, and ongoing evaluation of learning outcomes. Comparative analysis across institutions reveals that technical universities in Asia-Pacific regions show particularly high adoption rates of AI-enhanced English learning platforms, while European and North American institutions emphasize critical evaluation of artificial intelligence outputs and ethical usage principles. The research concludes that artificial intelligence technologies, when thoughtfully implemented, can significantly enhance English language learning outcomes for technical students by providing scalable personalized teaching, facilitating autonomous learning, and preparing students for AI-integrated professional communication contexts. However, effectiveness depends critically on maintaining appropriate balance between technological tools and human pedagogical guidance, ensuring that artificial intelligence serves as complement rather than replacement for skilled language teaching. The findings contribute to emerging scholarship on technology-enhanced language learning.

Key words: artificial intelligence, English language teaching, technical university, English for Specific Purposes, engineering education.

Голуб Тетяна, Коваленко Ольга. Штучний інтелект у викладанні англійської мови в технічних університетах: міжнародна перспектива

Інтеграція технологій штучного інтелекту (ШІ) у викладання англійської мови в технічних університетах являє собою трансформаційний зсув в освітній практиці в усьому світі. У дослідженні розглядається поточний стан, можливості та проблеми впровадження штучного інтелекту у викладання англійської мови для спеціальних цілей і загальної англійської мови в контексті вищої технічної освіти. Завдяки аналізу останніх досліджень та інституційних практик технічних університетів у різних регіонах світу у статті визначено ключові застосування штучного інтелекту. Дослідження показує, що технології ШІ пропонують суттєві переваги для студентів технічних спеціальностей, однак упровадження також стикається зі значними труднощами. Дослідження демонструє, що успішна інтеграція штучного інтелекту

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в програми англійської мови технічних університетів потребує комплексних інституційних рішень, що поєднують чіткі педагогічні цілі, адекватну технологічну інфраструктуру, систематичний професійний розвиток викладачів, навчання цифровій грамотності студентів і постійну оцінку результатів навчання. Порівняльний аналіз між установами показує, що технічні університети Азіатсько-Тихоокеанського регіону демонструють особливо високі показники впровадження платформ для вивчення англійської мови на основі штучного інтелекту, тоді як європейські та північноамериканські установи наголошують на критичній оцінці результатів ШІ та етичних принципах його застосування. У дослідженні зроблено висновок, що технології штучного інтелекту за умови продуманого впровадження можуть значно покращити результати вивчення англійської мови для студентів технічних спеціальностей, забезпечуючи персоналізоване навчання, сприяючи автономному навчанню та готуючи студентів до контекстів професійного спілкування, інтегрованих зі ШІ. Однак ефективність критично залежить від підтримки належного балансу між технологічними інструментами та педагогічним керівництвом викладача, що дає можливість штучному інтелекту слугувати доповненням, а не заміною кваліфікованого викладання мов. Результати дослідження сприяють розвитку наукових досліджень щодо технологічно вдосконаленого вивчення мов.

Ключові слова: штучний інтелект, викладання англійської мови, технічний університет, англійська мова для спеціальних цілей, інженерна освіта.

Introduction. The rapid development of artificial intelligence (AI) technologies has boosted huge transformation in educational practices across disciplines and institutional contexts. Within technical universities, institutions primarily focused on engineering, technology, applied sciences, and related fields, the integration of artificial intelligence into English language teaching represents particularly significant development with the implications for student learning outcomes and professional preparation. Technical university students face distinctive English language learning challenges because of their need to master both general academic English proficiency and highly specialized technical vocabulary, develop communication skills for international professional contexts, balance language learning with demanding technical coursework, and prepare for careers characterized by AI-integrated communication technologies.

Nowadays, English language proficiency has become essential competency for technical professionals in globalized world where international collaboration, cross-border projects, technical documentation, and multinational corporate environments demand effective communication skills. Engineering and technology graduates must navigate complex communication scenarios including presenting technical information to diverse audiences, collaborating with international teams, producing technical documentation meeting international standards, and adapting communication styles across cultural and professional contexts. Traditional English language teaching at technical universities has struggled to adequately address these multifaceted requirements within constraints of limited contact hours, large class sizes, diverse student proficiency levels, and the need to balance linguistic development with technical content mastery.

Artificial intelligence technologies offer potential solutions to these persistent challenges through capabilities that enable personalized adaptive teaching responsive to individual learner needs, scalable delivery of language practice opportunities beyond classroom constraints, immediate automated feedback on linguistic performance, authentic simulation of professional communication contexts, and data-driven insights into learning progress and outcomes. The emergence of sophisticated AI applications including large language models like ChatGPT, intelligent tutoring systems, adaptive learning platforms, automated writing evaluation tools, and conversational AI agents has created unprecedented opportunities for enhancing English language education at technical universities worldwide.

However, AI integration into language teaching also raises important questions and challenges requiring careful consideration. Concerns include maintaining appropriate pedagogical balance between technological tools and human teaching, ensuring equitable access across students, addressing academic integrity issues related to AI-assisted work, developing faculty capacity for effective AI

integration, and evaluating actual learning outcomes versus technological enthusiasm. Understanding both the opportunities and challenges of AI implementation in technical university English programs is essential for institutional leaders, language teachers, and policymakers seeking to implement these technologies effectively while avoiding potential pitfalls.

The research examines the current state of AI usage in English language teaching at technical universities in different countries and regions. The study aims to provide insights that can inform institutional decision-making and guide effective AI integration strategies tailored to distinctive contexts and needs of technical higher education institutions.

Analysis of Research and Publications. The scholarly literature on AI in English language teaching at technical universities has expanded significantly in recent years, reflecting both growing institutional adoption and increasing research attention to this phenomenon. The research indicates that AI-powered tools enhance personalized learning by adapting content and pacing to individual student performance, improving vocabulary acquisition, pronunciation, and learner motivation [9; 14]. Studies in various countries, including Nepal, Azerbaijan, India, and Nigeria, reveal positive impacts on learner autonomy and proficiency while highlighting concerns related to ethical implications, job displacement fears, and digital literacy gaps [10; 12]. Comprehensive reviews underscore scepticism about AI adoption but recognize its potential to transform EFL teaching by offering real-life simulation environments and interactive practice [1; 2; 6]. Recent advancements also integrate data science and IoT technologies, enhancing adaptive feedback and improving English classroom engagement and fluency [8; 13].

Recent research has focused particularly on generative AI applications following the release of ChatGPT and similar large language models. Chugai O. and Havrylenko K. [3] investigated attitudes of technical university students and teachers at National Technical University of Ukraine toward ChatGPT usage in English for Engineering classes. Their study revealed that students exhibited predominantly positive attitudes toward ChatGPT as learning tool. Teachers demonstrated more neutral stance, acknowledging potential benefits while expressing concerns about academic integrity and appropriate pedagogical integration. This attitudinal divergence between students and faculty represents common pattern across multiple studies, suggesting need for aligned expectations and clear guidance regarding AI tool usage.

Research by Zawacki-Richter [15] and colleagues conducted systematic review of AI applications in higher education, identifying that adaptive learning systems represent particularly prevalent implementation in language education contexts. Their analysis documented various AI-powered platforms designed specifically for language learning including intelligent tutoring systems providing personalized feedback, adaptive content delivery systems adjusting difficulty based on learner performance, and automated assessment tools evaluating written and spoken language production.

Comparative research reveals significant variation in AI adoption patterns across different geographical and institutional contexts. Studies indicate that technical universities in Asia-Pacific regions, particularly China, South Korea, and Singapore, demonstrate high levels of AI integration in English programs driven by governmental policies promoting educational technology, substantial infrastructure investments, and cultural comfort with technology-mediated learning [7]. Research from these contexts emphasizes AI's role in addressing large class sizes and enabling personalized teaching at scale.

European technical universities show more cautious adoption patterns with emphasis on critical evaluation of AI outputs, ethical considerations in AI usage, and maintaining human-centered pedagogy. This approach reflects European regulatory frameworks on AI [4] including concerns about data privacy and algorithmic accountability.

North American technical institutions demonstrate varied adoption with some universities (particularly larger research universities) implementing comprehensive AI-enhanced language programs while others maintain traditional approaches [11]. Research from North American contexts empha-

sizes importance of academic freedom allowing individual faculty to determine appropriate AI integration for their courses rather than mandated institutional approaches.

These cross-cultural variations suggest that effective AI integration must be contextualized to institutional missions, regional regulatory environments, available resources, and cultural norms regarding technology in education rather than applying universal models across diverse contexts.

Materials and Methods. This research employed a mixed-methods approach combining the literature review, and synthesis of empirical findings to examine AI usage in English language teaching at technical universities in different countries and regions. The search strategy encompassed multiple academic databases including Scopus, Web of Science, ERIC (Education Resources Information Centre), IEEE Xplore (for technical education research), and Google Scholar. Search terms combined variations of “artificial intelligence”, “AI”, “intelligent tutoring systems” with “English language teaching”, “English for Specific Purposes”, “ESP”, “language learning”, “technical university”, “engineering education”, “technical students”, and related terms.

Inclusion criteria specified peer-reviewed journal articles, conference proceedings, and institutional reports published between 2013 and 2025 (focusing on recent developments while capturing pre-ChatGPT baseline and post-generative-AI developments), focusing on higher education contexts particularly technical universities or engineering programs, addressing English language teaching specifically rather than general educational AI applications, and providing empirical data, theoretical frameworks, or substantive analysis.

Several methodological limitations warrant acknowledgment. The rapid pace of AI technological development means that findings represent snapshot of current state that will require updating as technologies and practices evolve. The literature search was limited to English-language publications, potentially missing relevant research published in other languages particularly from non-English-speaking countries with high AI adoption. Publication bias toward positive findings may mean that unsuccessful implementations or negative outcomes are underrepresented in available literature. The comparative institutional analysis relied on publicly available information and published research rather than comprehensive internal evaluation data from institutions.

Despite these limitations, the methodology provides robust foundation for understanding current state of AI in technical university English programs and identifying trends, opportunities, and challenges relevant to institutional practice and policy development.

Discussion. The analysis of the studied literature and institutional practices’ research reveals the picture of AI integration in technical university English study programs characterized by substantial potential alongside significant challenges. Perhaps the most compelling opportunity offered by AI in technical English education is capacity to provide personalized teaching. Technical universities typically enrol students with widely varying English proficiency levels ranging from near-beginner to advanced, diverse educational backgrounds in language learning, different technical specializations requiring distinct specialized vocabularies, and varying motivations and career goals affecting their engagement with language study.

Traditional classroom teaching struggles to effectively address this heterogeneity within typical constraints of large class sizes, limited contact hours, and single teacher responsible for all students. AI technologies enable differentiation that would be impractical for human teachers alone through adaptive content delivery adjusting difficulty based on real-time performance assessment, personalized practice recommendations targeting individual students’ specific weaknesses, flexible pacing allowing students to progress at appropriate speed rather than uniform class pace, and customized vocabulary development aligned with students’ specific technical fields.

Research evidence suggests that this personalization yields measurable benefits. Studies document that students using adaptive AI platforms show greater improvement in targeted skills compared to students receiving undifferentiated teaching, report higher engagement and motivation when receiving

appropriately challenging content, and demonstrate better retention of material learned through personalized spaced repetition algorithms. However, effectiveness depends critically on quality of the adaptive algorithms, appropriateness of the content database from which personalized materials are drawn, and integration of adaptive technology within broader curriculum rather than as isolated supplementary tool.

AI technologies, particularly conversational agents and intelligent tutoring systems, enable practice opportunities and immediate feedback that complement and extend what human teachers can provide. For technical students needing to develop professional communication competence, AI offers several distinctive advantages.

Thus, conversational AI agents allow students to practice professional English communication without fear of judgment or embarrassment that may inhibit participation in classroom settings. Students can make mistakes, receive feedback, and try again repeatedly without social consequences, that is particularly valuable for students from cultures where saving face is important or for students with high language anxiety. Research indicates that students report feeling more comfortable practicing speaking with AI than with human conversation partners, leading to increased practice time and corresponding skill development.

The immediate feedback capability of AI systems addresses significant limitation of traditional teaching where students often receive delayed feedback on assignments, potentially reinforcing errors. AI-powered writing evaluation tools can provide instant feedback on grammar, vocabulary usage, organization, and style, enabling students to revise and improve their work in real-time rather than waiting days or weeks for teacher evaluation. Similarly, pronunciation feedback systems can immediately identify specific phonological errors and provide targeted practice, accelerating spoken English development.

However, research also documents important limitations of current AI feedback systems. AI evaluation sometimes focuses excessively on surface-level features, like grammar or vocabulary, while missing higher-order issues of argumentation, coherence, or rhetorical appropriateness. In technical writing contexts, AI systems may misunderstand domain-specific terminology or conventions, providing inappropriate feedback. Students may over-rely on AI feedback without developing their own self-assessment capabilities. These limitations suggest that AI feedback should complement rather than replace human teacher feedback, with clear guidance to students about each feedback source's strengths and appropriate uses.

For English for Specific Purposes teaching in technical universities, AI tools offer significant potential for addressing challenge of developing appropriate materials. ESP requires content that combines appropriate linguistic difficulty with relevant technical subject matter, addresses specific vocabulary and communication patterns of particular professional fields, and remains current with evolving technical developments and professional practices. Traditional ESP materials development is time-intensive and requires both language teaching expertise and technical domain knowledge.

AI content generation tools enable ESP teachers to more efficiently create customized materials by adapting authentic technical texts to appropriate language levels, generating practice exercises targeting specific linguistic features, creating simulated professional communication scenarios, and developing vocabulary lists tailored to students' technical specializations. Research indicates that AI-generated ESP materials, when appropriately reviewed and adapted by human teachers, can significantly reduce preparation time while maintaining or improving material quality and relevance.

However, important warnings emerge from implementation experiences. AI-generated technical content requires careful expert review for accuracy, generative AI systems sometimes produce plausible-seeming but technically incorrect information that could mislead students. Cultural appropriateness of AI-generated scenarios should be evaluated, as AI training data may reflect cultural assumptions not applicable to specific student populations. Over-reliance on AI-generated materials risks

homogenization of curriculum, potentially losing valuable diversity that comes from teachers' varied approaches and perspectives.

Results. The synthesis of research literature and institutional practices brought us to several key findings regarding AI usage in English language teaching at technical universities worldwide.

Thus, it was found out that AI integration in technical university English programs shows widespread growth globally but with significant variation across regions and institutions. Asian-Pacific technical universities, for instance, demonstrate highest adoption rates driven by governmental policies and infrastructure investments. At the same time, European institutions show more measured adoption emphasizing ethical considerations. North American institutions display varied patterns with elite research universities leading adoption while others maintain traditional approaches.

As for the factor of diversity of AI applications, it was discovered that technical universities implement wide range of AI applications in English programs including adaptive learning platforms (most mature and widely adopted), conversational AI agents for speaking practice (rapidly growing but with acknowledged limitations), automated writing evaluation (established but requiring human complement), intelligent tutoring systems (promising but requiring substantial institutional investment), and generative AI for content creation (newest and most controversial). Each application type demonstrates distinct strengths, limitations, and use cases.

Also, the research consistently indicates that technical students demonstrate positive attitudes toward AI-enhanced English learning, appreciating immediate feedback, flexibility for self-paced learning, reduced anxiety in practice contexts, and technology-mediated approach aligning with their preferences. The findings demonstrate that AI-powered platforms improve vocabulary acquisition, pronunciation, and learner engagement significantly, with measurable academic outcomes in EFL instruction at technical universities globally [5; 10]. However, students also express concerns about over-reliance, desire for human teacher interaction, and recognition that AI feedback sometimes lacks nuance or cultural appropriateness.

As for the warning, the empirical studies document measurable learning gains associated with well-implemented AI-enhanced English teaching including improved vocabulary acquisition through adaptive platforms, enhanced pronunciation through AI feedback systems, increased writing practice and improvement through automated evaluation, and greater student engagement in self-directed learning. However, effectiveness varies significantly based on implementation quality, most studies examine short-term rather than long-term outcomes.

Despite documented benefits, institutions report consistent challenges including technical infrastructure limitations particularly in resource-constrained settings, pedagogical integration complexity and faculty preparation gaps, academic integrity concerns requiring policy development, equity issues related to differential technology access, and difficulty evaluating actual learning outcomes versus technological enthusiasm. Successful institutions address these challenges through systematic planning rather than ad-hoc adoption.

The research also strongly indicates that effective AI integration maintains appropriate balance between technological tools and human pedagogical guidance. AI assists teachers by automating error detection, plagiarism checking, and providing immediate feedback, improving teaching efficiency. AI proves most effective when complementing rather than replacing skilled language teaching, providing scalable practice and feedback while teachers focus on higher-order skills, complex feedback, and relationship-building.

We must also admit that the strategies that prove effective in one institutional context may not transfer directly to others. Successful AI integration requires attention to specific student populations' needs and preferences, available technical and financial resources, institutional culture and mission, regulatory environment and accreditation requirements, and faculty expertise and readiness. One-size-fits-all approaches prove consistently ineffective.

Besides, AI technologies continue evolving rapidly with new capabilities and applications emerging frequently. Institutions taking rigid approaches to AI integration face obsolescence as technologies advance, while those establishing adaptive governance structures enabling regular evaluation and refinement demonstrate greater sustainability. Effective institutions treat AI integration as ongoing process requiring continuous learning rather than one-time implementation.

These findings suggest that AI technologies offer huge potential for enhancing English language education at technical universities but that realizing this potential requires thoughtful implementation attending to pedagogical principles, equity considerations, and ongoing evaluation rather than simple technological adoption.

Conclusions and Recommendations. The analysis of AI usage in English language teaching at technical universities reveals a field in dynamic transition, characterized by substantial opportunities alongside significant challenges requiring careful institutional navigation. AI technologies have moved beyond experimental status to become established components of language education at technical universities worldwide. The question facing institutions is no longer whether to integrate AI but rather how to do so effectively, equitably, and pedagogically soundly. This shift from optional experimentation to practical necessity reflects both technological advancement and changing expectations of students who increasingly view AI as standard learning tool.

Besides, effective AI integration in technical university English programs requires moving beyond purely technological perspectives to embrace fundamentally pedagogical approaches. The research clearly demonstrates that AI tools themselves are neither inherently beneficial nor harmful, rather, their educational impact depends entirely on quality of implementation, pedagogical design, and integration within broader curriculum. Institutions must therefore prioritize pedagogical planning and faculty development equally with technological infrastructure development.

Furthermore, the distinctive context of technical universities, including students' technical backgrounds, career preparation needs, comfort with technology, and the importance of English for Specific Purposes, creates both unique opportunities and specific challenges for AI integration. Technical students' familiarity with technology and interest in innovation can facilitate adoption, while their need for highly specialized vocabulary and authentic professional communication practice aligns well with AI capabilities. However, ensuring that AI systems adequately address technical domain specificity and professional communication norms requires careful attention and customization.

And at last, equity considerations must remain central to institutional AI implementation strategies. The risk that AI integration could extend existing educational inequalities – between well-resourced and under-resourced institutions, between students with different technology access, between native and non-native English speakers – is substantial and requires proactive mitigation through equitable access policies, comprehensive support structures, and ongoing monitoring of differential impacts.

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