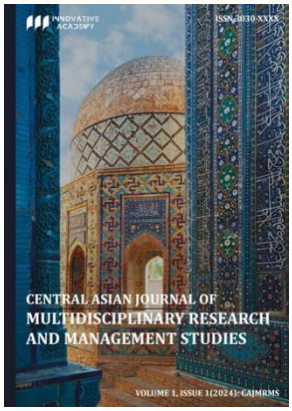

DEVELOPING LEARNER AUTONOMY IN ENGLISH FOR PHARMACY STUDENTS THROUGH AI-POWERED EDUCATIONAL TECHNOLOGIES

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ABSTRACT

As pharmaceutical education becomes increasingly English-mediated, pharmacy students need not only language knowledge but also the ability to manage their own learning beyond the classroom. This paper explores how AI-powered educational technologies — adaptive learning platforms, AI chatbots, automated feedback tools, and gamified applications — can be used to foster learner autonomy in English for Specific Purposes (ESP) courses for pharmacy students. The discussion is grounded in the classical theory of learner autonomy developed by Holec (1981), Little (1991), and Benson (2001), and is combined with a synthesis of recent empirical and review studies (2022–2026) on artificial intelligence in language education, together with the authors' own classroom observations while teaching English for pharmaceutical purposes. The paper identifies four key mechanisms through which AI supports autonomous learning: personalized progression through pharmaceutical vocabulary, instant individualized feedback on professional writing, chatbot-based simulation of pharmacist–patient interactions, and motivation-sustaining gamified self-tracking. It further discusses the documented risks of over-reliance on AI tools and the resulting erosion of critical thinking, arguing that AI applications are most effective when they support, rather than replace, teacher guidance. Building on this evidence, the paper proposes a three-pillar framework — terminology mastery, professional simulation, and self-assessment — for integrating AI

into pharmacy ESP curricula, together with a concrete design for a small-scale classroom pilot study. The paper concludes by calling for further longitudinal, classroom-based research to measure the long-term effect of such integration on learner autonomy and professional language competence.

Introduction

The globalization of the pharmaceutical industry has made English proficiency an indispensable professional skill for future pharmacists, who must independently read drug documentation, follow international research, and communicate with foreign colleagues and patients. However, English for Specific Purposes (ESP) instruction at many pharmaceutical higher education institutions continues to rely on teacher-centered, uniform materials that leave little room for students to take charge of their own learning process. As a result, learners often depend heavily on the instructor for guidance, correction, and motivation, and rarely develop the habit of managing their own study strategies once formal classes end. Given that pharmacy graduates are expected to keep updating their professional knowledge throughout their careers, cultivating learner autonomy during their student years is not a secondary goal but a core professional competence.

Over the past several years, the rapid spread of artificial intelligence (AI) tools in education has opened new possibilities for addressing this gap. Adaptive learning platforms, AI-based writing checkers, conversational chat bots, and gamified applications are increasingly available to language learners, and a growing body of international research (2022–2026) has begun to document their effects on learner engagement, motivation, and self-regulation. At the same time, this literature has also raised concerns about the risk of students becoming overly dependent on AI-generated answers, which may weaken rather than strengthen independent learning skills if such tools are not integrated thoughtfully. For ESP instruction in pharmaceutical higher education, where the language content is highly specialized and professionally consequential, understanding both the opportunities and the risks of AI integration is therefore essential.

Theoretical Framework: Learner Autonomy

The concept of learner autonomy that underlies this paper originates in the work of Holec (1981), who defined it as the learner's ability to take charge of his or her own learning — that is, to set personal objectives, select learning content and methods, and monitor and evaluate progress independently of the teacher. Little (1991) extended this definition by emphasizing its psychological dimension, describing autonomy as a capacity for critical reflection, decision-making, and independent action that develops gradually through guided practice rather than emerging spontaneously. Benson (2001) further distinguished several interconnected dimensions of autonomy — technical, psychological, and political — arguing that genuine learner autonomy requires not only the opportunity to make choices but also the metacognitive skills needed to make those choices productively.

These classical definitions remain directly relevant to AI-supported ESP instruction. Adaptive platforms and chatbots can provide the technical opportunity for self-directed practice — flexible pacing, unlimited repetition, and instant feedback — but, following Little's and Benson's arguments, opportunity alone does not guarantee autonomy. Students also need to develop the reflective and evaluative skills to interpret AI feedback critically, set realistic goals, and monitor their own progress. This distinction between the technical availability of

self-access tools and the psychological capacity to use them autonomously provides the theoretical lens for the discussion that follows.

Aim of the Study

This thesis aims to examine how AI-powered educational technologies — including adaptive learning platforms, AI chatbots, automated writing feedback tools, and gamified applications — can be pedagogically integrated into ESP courses to foster learner autonomy among pharmacy students, and to propose a practical framework for such integration within the specific context of pharmaceutical vocabulary and professional communication. A secondary aim is to outline a concrete, replicable design for a classroom-based pilot study that could be used by ESP teachers at pharmaceutical higher education institutions to evaluate the framework in practice.

Methodology

The study is based on a qualitative synthesis of recent research (2022–2026) on artificial intelligence in ESP and language education more broadly, combined with the authors' own classroom observations while teaching English for pharmaceutical purposes at Tashkent Pharmaceutical Institute. The literature search covered peer-reviewed journal articles, systematic reviews, and meta-analyses addressing AI chatbots, automated writing evaluation, adaptive vocabulary systems, and gamification in both general ESL/EFL and medical or pharmacy-specific contexts, so that the discussion could draw on evidence from the closest available disciplinary parallels where pharmacy-specific ESP research remains limited.

In addition, a small-scale pilot is proposed in which a group of pharmacy students would use an AI chatbot and an adaptive vocabulary application over a period of several weeks. Autonomy levels would be assessed before and after the intervention through a short self-report questionnaire adapted from established learner-autonomy scales, together with reflective learning logs kept by the students throughout the study period. Pre- and post-intervention vocabulary and writing tasks would provide a complementary measure of language gains, allowing the relationship between reported autonomy and observed performance to be examined descriptively, given the small anticipated sample size typical of a single-institution pilot.

Discussion

Recent literature identifies several distinct but complementary ways in which AI tools can support autonomous language learning. The following subsections examine each mechanism in turn, drawing on evidence from general ESL/EFL research as well as studies conducted specifically in medical and pharmacy education contexts.

1. Adaptive Platforms and Personalized Vocabulary Progression

Adaptive learning platforms adjust the difficulty and sequencing of exercises to each learner's current proficiency level, allowing pharmacy students to progress through pharmaceutical terminology at their own pace rather than following a fixed class schedule. A recent systematic review of AI-driven personalization in language learning found that such adaptive systems, when grounded in theories of self-determination, tend to improve vocabulary retention and learner motivation, although the review also noted persistent challenges such as unequal access to digital tools and insufficient teacher training in how to interpret adaptive-system data (Forum for Linguistic Studies, 2025). Applied to a pharmacy ESP context, this suggests that adaptive vocabulary systems built around pharmacological and clinical terminology could allow stronger and weaker students to work through the same core

content at genuinely different paces, addressing one of the central practical constraints of teacher-centered ESP classes.

2. AI-Based Automated Feedback on Professional Writing

AI-based feedback tools such as automated grammar and writing checkers give instant, individualized correction, which lets students revise their own written work — for example, drug information summaries or patient-counseling scripts — without waiting for teacher input. Research on Grammarly, one of the most widely studied automated writing evaluation tools, has found that its feedback on grammatical and mechanical errors can reach a high level of precision, though its usefulness for higher-order concerns such as organization and idea development remains more limited (Hoang & Van, 2025). Similarly, comparative studies of Grammarly and generative chatbot tools among EFL learners have reported measurable gains in grammatical accuracy following sustained use, while also cautioning that automated feedback tools work best as a supplement to, rather than a replacement for, teacher feedback, since teacher input continues to shape content and organization more effectively than automated systems (Comparing Grammarly and ChatGPT for Automated Writing Evaluation of ESL Learners, 2025). For pharmacy ESP writing tasks, this implies that automated checkers are well suited to correcting surface-level grammatical accuracy in drug-related documentation, while teacher feedback should remain central to evaluating clinical clarity, tone, and professional register.

3. Chatbot-Based Simulation of Professional Interactions

Conversational AI chatbots can simulate realistic professional situations, such as a pharmacist consulting a patient or a researcher describing a clinical trial, giving students a private, low-pressure space to practice speaking and to notice and correct their own mistakes. A systematic review of AI-powered chatbots used for EFL speaking practice concluded that such tools can meaningfully strengthen speaking fluency, confidence, and willingness to communicate, particularly because they lower the anxiety associated with speaking in front of peers or an instructor (Du & Daniel, 2024). A more recent meta-analysis of chatbot effectiveness across comparative studies likewise found that generative-AI-powered chatbots tend to produce larger learning gains than earlier rule-based systems, attributing this partly to the greater conversational agency such tools give learners, who can direct the interaction toward topics and phrasing relevant to their own needs (Lyu, 2025). In the pharmacy ESP context, this points to the value of scenario-based chatbot dialogues modeled specifically on pharmacist–patient and pharmacist–physician interactions, rather than generic conversational practice.

4. Gamification and Motivation-Sustaining Self-Tracking

Gamified elements such as progress tracking, badges, points, and adaptive quizzes have been shown to sustain motivation over longer, self-directed study periods. Evidence from general English vocabulary instruction shows that gamified applications reliably increase engagement and motivation, with feedback mechanisms identified as the single most influential gamification element across the reviewed studies (PMC scoping review, 2024). Findings from medical education are consistent with this pattern: a classroom study using Kahoot and Quizlet to teach specialized medical vocabulary at a university of medicine and pharmacy reported improved engagement, better vocabulary recall, reduced learning anxiety, and increased peer interaction among second-year medical students (Tran, 2026). Broader reviews of gamification in pharmacy clinical-skills training similarly report gains in learner motivation and knowledge retention when game elements are combined with structured

feedback and realistic simulation, though they caution that gamification is most effective when tied to clear learning objectives rather than used as entertainment for its own sake (Implementation Strategies for Gamification in Pharmacy Clinical Skills Education, 2026). Taken together, this evidence suggests that gamified self-tracking tools are well suited to sustaining pharmacy students' engagement with terminology practice across a full semester, provided the game mechanics are explicitly linked to measurable vocabulary or communication goals.

5. A Three-Pillar Framework for Pharmacy ESP

For pharmacy ESP specifically, these four mechanisms can be organized around three practical pillars. The first pillar, terminology mastery, uses adaptive vocabulary systems built around pharmacological and clinical vocabulary, allowing students to progress through core drug names, dosage forms, and clinical terminology at an individualized pace. The second pillar, professional simulation, uses chatbot-based dialogues modeled on pharmacist–patient or pharmacist–physician interactions, giving students repeated, low-pressure opportunities to rehearse professional communication before they must perform it in real clinical or workplace settings. The third pillar, self-assessment, combines AI-generated writing feedback with simple digital portfolios that let students track their own progress over a semester, encouraging the habits of planning, monitoring, and evaluation that Holec (1981) and Little (1991) identify as central to genuine autonomy. Structuring AI integration around these three pillars, rather than adopting individual tools in an ad hoc manner, allows an ESP course to address vocabulary, spoken interaction, and written communication as complementary strands of the same competence.

6. The Continuing Role of the Teacher and the Risk of Over-Reliance

At the same time, the literature consistently cautions that AI tools should support rather than replace the teacher. A systematic review of over-reliance on AI dialogue systems found that excessive dependence on such tools is associated with reduced critical thinking and weaker independent decision-making, a phenomenon researchers describe as cognitive offloading, in which students transfer mental effort to an external tool rather than developing their own reasoning (Zhai, Wibowo, & Li, 2024). Related studies on generative AI use in higher education report similar patterns, noting that students who accept AI-generated answers without questioning them tend to show measurable declines in analytical performance, and that younger learners appear particularly susceptible to this effect. For pharmacy ESP, where inaccurate interpretation of drug information could have real professional consequences, this risk is especially significant: guidance from the teacher remains necessary to help students interpret AI feedback critically, avoid uncritical acceptance of machine-generated answers, and set realistic personal learning goals — the very skills that distinguish autonomous learning from simple unsupervised tool use. In practice, this suggests that AI-based activities should be paired with periodic teacher-led review sessions in which students are asked to justify, correct, or extend what the AI tool produced, rather than being left to work with the tool entirely unsupervised.

Limitations

This paper is based primarily on a synthesis of existing literature and classroom observation rather than on original experimental data, and pharmacy-specific ESP research remains considerably less developed than research on general EFL or broader medical English contexts; several of the studies cited above therefore concern adjacent fields such as general ESL writing, medical terminology instruction, or pharmacy clinical-skills training

rather than pharmacy ESP specifically. The proposed three-pillar framework and pilot design should accordingly be understood as a starting point for empirical testing rather than as a validated instructional model. In addition, most of the AI tools discussed were developed for general language learning rather than for pharmaceutical content specifically, so their terminology coverage and domain accuracy would need to be verified before large-scale classroom use.

Conclusion

AI-powered educational technologies hold considerable potential for developing learner autonomy in pharmacy-focused ESP instruction, provided they are integrated purposefully rather than used as a simple replacement for classroom teaching. Evidence from adaptive learning platforms, automated writing feedback tools, conversational chatbots, and gamified applications converges on a consistent conclusion: these technologies can meaningfully support personalized progression, individualized feedback, low-pressure professional practice, and sustained motivation, but their benefits depend on deliberate pedagogical design and continued teacher guidance. A curriculum that combines adaptive vocabulary practice, chatbot-based professional simulations, and structured self-assessment — organized around the three-pillar framework proposed here — can help pharmacy students take ownership of their English learning while building the specific communicative competence their future profession demands, without exposing them to the documented risks of uncritical over-reliance on AI-generated content. Further empirical, classroom-based research, including controlled pilot studies of the kind outlined in this paper, is needed to measure the long-term impact of such integration on learner autonomy and professional language outcomes, and to determine how the framework should be adapted for pharmacy programs operating in different national and institutional contexts.

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