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AI-ASSISTED ADAPTIVE ENGLISH LEARNING MODEL FOR DEVELOPING AGRICULTURAL TERMINOLOGY COMPETENCE AMONG UZBEK AGRARIAN UNIVERSITY STUDENTS

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Abstract: In the modern globalized economy, mastering specialized professional terminology is crucial for agricultural graduates in Uzbekistan to participate in international scientific collaborations and modern agro-technological advancements. However, traditional English for Specific Purposes (ESP) pedagogy often struggles to address individual learning paces, resulting in uneven terminology retention. This study proposes and evaluates an AI-Assisted Adaptive English Learning Model (AA-AELM) designed specifically to foster agricultural terminology competence among students at Tashkent State Agrarian University. Utilizing a comparative experimental design, students were divided into an experimental group using the AA-AELM platform (which integrates personalized spaced repetition, contextual algorithmic vocabulary feedback, and local agricultural task frameworks) and a control group taught through traditional ESP methods. Qualitative and comparative analysis of pre- and post-tests indicated a significant improvement in the experimental group's vocabulary retention, usage accuracy, and reading comprehension of technical texts. Qualitative feedback revealed high student engagement and reduced cognitive load. The paper concludes with actionable recommendations for integrating AI-driven adaptive methodologies into the agrarian higher education curriculum of Uzbekistan.

Keywords: AI-assisted learning, Adaptive learning, ESP, Agricultural terminology, Pedagogical innovation, Uzbekistan higher education.

Introduction

With the rapid modernization of agriculture in Uzbekistan, driven by digital transformation, resource-saving technologies, and international trade, the demand for highly skilled agrarian specialists who can communicate fluently in English has risen exponentially. English has established itself as the global lingua franca of agricultural sciences, biotechnology, water management, and soil science. Consequently, agrarian universities in Uzbekistan are tasked with cultivating not just general language proficiency, but highly specific communicative competence centered on agricultural terminology.

However, developing agricultural terminology competence presents unique pedagogical challenges. Agronomy, veterinary medicine, agricultural engineering, and biotechnology contain dense, multi-morphemic, and conceptually complex lexicons. Traditional English for Specific Purposes (ESP) classrooms in non-philological universities often employ a standardized approach, which ignores the highly diverse linguistic backgrounds and varying learning paces of students (Saydamatova, recently). Traditional rote memorization lacks context, leaving students unable to apply terminology dynamically in professional and academic settings (Saydamatova, recently).

Artificial Intelligence (AI) and adaptive learning technologies offer a paradigm shift to resolve these limitations. By leveraging machine learning algorithms, natural language processing (NLP), and neural networks, adaptive systems can analyze student responses in real-time, diagnose individual strengths and weaknesses, and deliver custom-tailored learning pathways.

While general AI-assisted language learning platforms exist, they lack the specialized, domain-specific vocabularies and context-based task structures necessary for professional fields like agriculture. There is a prominent research gap concerning the design, implementation, and empirical validation of an AI-assisted adaptive English model tailored specifically to the localized agrarian curriculum in Central Asia.

This study aims to bridge this gap by establishing and testing the efficacy of an **AI-Assisted Adaptive English Learning Model (AA-AELM)**. Built on theories of scaffolding, spaced repetition, and context-based language teaching, the model was tested with undergraduate students at Tashkent State Agrarian University (TSAU). The research addresses the following questions:

- To what extent does the AA-AELM improve agricultural terminology acquisition and retention compared to traditional ESP methodologies?
- How does the adaptive pathway affect student engagement and cognitive load during the learning process?

Literature Review

The integration of technology in language pedagogy has progressed from simple Computer-Assisted Language Learning (CALL) to complex, algorithm-driven Intelligent Computer-Assisted Language Learning (ICALL). Research indicates that personalized learning environments significantly lower language anxiety and bolster learner autonomy.

Historically, terminology acquisition has been viewed as a major bottleneck in ESP. Cognitive load theory suggests that processing complex technical terms simultaneously with foreign grammatical structures quickly overburdens working memory. To combat this, researchers suggest scaffolded delivery. Saydamatova in her study on gamification emphasized the massive potential of gamification and structured interactive models in diminishing affective filters and boosting vocabulary retention in general English classrooms.

Even more, language instruction must connect with the physical reality of the student. In her context-based pedagogical research, Saydamatova highlighted that integrating local agricultural practices, regional ecological realities, and traditional Uzbek agrarian systems into English lessons makes the foreign vocabulary cognitively accessible and culturally relatable. Linking local farming concepts (such as traditional irrigation or specific cotton-growing phases) to English technical terms creates a bridge of familiarity.

To operationalize this, modern pedagogy utilizes Task-Based Language Teaching (TBLT). As demonstrated by Saydamatova in her research on task-based frameworks, designing multi-stage task cycles (consisting of pre-task, task cycle, and language focus stages) specifically for agricultural scenarios ensures that vocabulary is not just passively recognized, but actively integrated into productive skills.

However, implementing these localized, task-based, and highly interactive approaches manually across large, heterogeneous university classrooms is extremely labor-intensive for educators. This is where AI-driven adaptive technologies become crucial. Adaptive learning algorithms can dynamically adjust the difficulty of tasks, space out the review of specialized terms based on individualized forgetting curves, and provide instant contextual feedback. Combining local agricultural contexts and task-based pedagogical frameworks with AI's adaptive efficiency forms the theoretical backbone of the AA-AELM evaluated in this paper.

Methodology

Research Design

This study utilized a mixed-methods quasi-experimental design. Over an entire academic semester, the experimental group utilized the AA-AELM platform, while the control group

followed the conventional, textbook-centered ESP syllabus. Both groups were evaluated via pre-tests, post-tests, and delayed post-tests to measure both short-term acquisition and long-term retention of target agricultural terminology.

Participants

The participant pool consisted of undergraduate students majoring in Agrobiology and Plant Protection at Tashkent State Agrarian University. The students were divided into two parallel, equal-sized groups:

- **Experimental Group (EG):** Students exposed to the AA-AELM platform.
- **Control Group (CG):** Students taught using traditional teacher-led, textbook-based materials.

A pre-intervention assessment was administered to ensure that both groups possessed homogenous general English proficiency (at basic and intermediate language proficiency levels) and equivalent baseline knowledge of agricultural terminology.

The AA-AELM Architecture

The proposed **AI-Assisted Adaptive English Learning Model (AA-AELM)** is structured around several core algorithmic components:

1. **Diagnostic & Profiling Module:** Determines the student's initial vocabulary breadth and cognitive style.

2. **Adaptive Engine (Spaced Repetition & Level Tuning):** Uses modified SuperMemo spaced repetition algorithms combined with natural language processing to deliver personalized vocabulary drills. If a student struggles with terms like agrochemicals, soil salinity, or photosynthesis, the system automatically breaks down the terms, offers morphological definitions (prefixes/suffixes), and increases their frequency in subsequent sessions.

3. **Context-Based Generative Module:** Based on the student's performance, the AI engine dynamically generates reading passages and interactive scenario-based tasks containing the target vocabulary, drawing on localized Uzbek farming scenarios (such as drip irrigation in the Fergana Valley or salinity management in the Karakalpakstan region) to align with context-based learning paradigms (Saydamatova, recently).

Target Vocabulary and Instruments

A comprehensive corpus of specialized agricultural terms was selected from standard international textbooks, divided into various thematic modules: Soil Science, Crop Production, Plant Protection, Agricultural Machinery, and Agrobiotechnology.

Data was gathered through:

- **Vocabulary Knowledge Scale (VKS):** To measure self-reported and demonstrated knowledge of target terms.
- **Reading Comprehension & Term-in-Context Tests:** To evaluate active usage competence.
- **Likert-Scale Survey & Semi-Structured Interviews:** To capture the experimental group's feedback on user experience, perceived cognitive load, and engagement.

Results

Terminology Acquisition and Retention

Comparative analysis of the pre-test, post-test, and delayed post-test (administered several weeks after the intervention ended) scores demonstrated that the AI-Assisted Adaptive model significantly outperformed the traditional method.

At the beginning of the research, the initial assessment confirmed that both groups started with an equivalent baseline of terminology knowledge. However, by the end of the semester, the

Experimental Group achieved a substantially higher performance level in terminology acquisition than the Control Group.

More importantly, the delayed assessments highlighted a crucial gap in long-term retention. The Control Group showed a significant decline in terminology recall, indicating that traditional rote learning leads to rapid forgetting once active instruction ceases. In contrast, the Experimental Group maintained a consistently high level of terminology retention with only a minimal decrease in performance. This outcome validates the efficacy of the AI platform's adaptive spaced repetition engine in helping students transition vocabulary from working memory into long-term cognitive storage.

Statistical tests verified that the differences between the two groups were highly significant, confirming a distinct advantage for the adaptive model.

Student Engagement and Adaptive Pathways

System tracking data showed that the adaptive engine successfully adjusted the difficulty and delivery rate of terminology based on individual student performance.

- **High-proficiency students** were automatically fast-tracked to advanced activities, including reading authentic scientific abstracts and resolving complex agricultural scenarios (such as analyzing genetic modifications in drought-resistant crops).
- **Lower-proficiency students** received scaffolded root-word breakdowns, interactive terminology association games, and localized contextual texts before advancing to complex tasks.

This individualized pacing was highly praised in the qualitative feedback. A vast majority of the experimental group reported that the system's adaptivity reduced their learning frustration and cognitive anxiety. Furthermore, almost all participants highly appreciated the integration of local Uzbek agricultural themes, stating that studying professional terminology in familiar regional contexts made the technical language far easier to conceptualize, process, and remember.

Discussion

The empirical findings of this research confirm that the **AI-Assisted Adaptive English Learning Model (AA-AELM)** is a powerful tool for accelerating terminology competence. The model's success lies in its capability to resolve the main limitations of traditional ESP instruction.

One key factor is that the integration of adaptive spacing algorithms successfully prevents the cognitive decay of complex vocabulary. In traditional classrooms, once a topic (such as "Soil Erosion") is completed, the teacher moves to the next chapter, and the vocabulary is rarely reinforced. AA-AELM, however, ensures that terms are systematically re-introduced right at the moment the student's personal learning curve indicates a drop in recall. This explains the high retention rates observed in the delayed assessment.

Another significant element is that the system successfully combined structural adaptivity with localized context-based pedagogy. As advocated by Saydamatova, when Uzbek agrarian students interact with texts that describe real geographical, climatic, and farming conditions of their own country—such as water scarcity in the Aral Sea basin or crop rotation in the Tashkent province—their cognitive schema is already fully formed. They do not have to struggle to understand both a foreign cultural concept and a foreign technical word simultaneously. The AI system automates this by adapting the reading difficulty of these localized scenarios to the linguistic level of each student.

Furthermore, integrating task-based components (Saydamatova, recently) through conversational AI chatbots embedded in the platform allowed students to apply their newly learned terminology in active dialogue (such as simulating a professional discussion with a foreign agricultural technology supplier). This interactive output transformed passive recognition into active professional competence.

Pedagogical Implications

For agricultural universities in Uzbekistan, the implementation of AA-AELM suggests several shifts in language planning:

1. **Blended Learning Integration:** AI systems should not replace English teachers, but serve as powerful auxiliary tools. Teachers can allocate vocabulary drills and personalized reading to the AI platform, freeing up classroom time for active debates, projects, and presentation of scientific papers.

2. **Curriculum Customization:** ESP departments should collaborate with agrarian science departments to continually feed local research data, scientific problems, and agricultural terminology corpora into the AI system's database.

Conclusion

Developing professional terminology competence is a critical requirement for prospective agrarian scientists and agro-technologists in Uzbekistan. The empirical results of this study show that the **AI-Assisted Adaptive English Learning Model (AA-AELM)** yields superior outcomes in both terminology acquisition and long-term retention compared to traditional teacher-led instruction. By combining the personalized power of AI algorithms with localized context-based reading and task-oriented frameworks, the model reduces cognitive overload, sustains motivation, and develops genuine communicative competence.

Future research will focus on expanding the model's speech recognition capabilities to evaluate students' pronunciation of complex terminology, and integrating the platform into the broader digital university ecosystem across all regional branches of Tashkent State Agrarian University.

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