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Pilot Testing the Methodology for Developing High School Students' English Lexical Competence Using Ai Tools: Content, Organization, and Stages

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Abstract: The article describes the content, organization, and procedure of a pedagogical experiment designed to determine the effectiveness of a methodology for developing senior students' English lexical competence with artificial intelligence (AI) tools. The experiment follows the sequence "diagnosis → AI-based intervention → ongoing monitoring → final diagnosis → statistical analysis." The article substantiates a five-stage model of an AI-integrated lesson and a five-strand intervention: contextual vocabulary instruction, semantic networks and concept mapping, word formation and collocations, communicative vocabulary use, and cognitive-creative lexical activity. Lexical competence is diagnosed across receptive, productive, collocational, creative, and cognitive components, each assessed through specific task types. The teaching in the experimental and control groups is compared, and methodological recommendations for using AI tools are proposed.

Keywords: Lexical competence, artificial intelligence, senior students, pedagogical experiment, collocational competence, semantic network, contextual instruction, diagnostics.

1. Introduction

In foreign language teaching methodology, lexical competence is regarded as a foundational component of communicative competence. As I. S. P. Nation notes, knowing a word entails knowing its form, meaning, and use — that is, its grammatical functions, collocations, and constraints on use [1]. N. Schmitt, substantiating the graded nature of lexical knowledge, demonstrates that a learner may know a given lexical item to differing degrees across its various components [2]. It follows that lexical competence cannot be adequately measured merely by the number of memorized words: a learner's ability to select a word appropriately in context, to establish its semantic connections, and to employ it independently in productive speech must also be assessed.

In the senior grades of general secondary schools, accomplishing this task by traditional means proves difficult. Although the lexical repertoire of students within a single class differs considerably, they work with the same word lists and the same exercises; new words are most often learned through translation and rote memorization,

within a single context. As a result, a student may recognize a word yet be unable to use it in a natural combination or in an authentic speech situation.

In contemporary pedagogy, artificial intelligence technologies are regarded as a promising means of resolving this contradiction. M. Warschauer and C. Chapelle emphasize that digital and intelligent technologies serve to develop learners' autonomous-learning skills, to ensure an individualized approach, and to deepen language competencies [3], [4]. According to R. Ellis and D. Nunan, the effective acquisition of vocabulary requires that learners not merely memorize words but apply them in authentic speech situations [5], [6]. R. Luckin, interpreting AI as an "intelligent assistant," notes that it optimizes instruction by analyzing the learner's level of knowledge, identifying errors, and offering individualized recommendations, while not fully replacing the teacher [7], [8].

At the same time, the effectiveness of AI in education is determined not by the technology itself but by the pedagogical rationale underlying its application [9]. L. Kohnke, B. L. Moorhouse, and D. Zou show that the didactic value of generative tools is realized only within the framework of a task clearly defined by the teacher [10]. A systematic review by O. Zawacki-Richter and co-authors notes that most research on AI in education is focused on technological aspects, while pedagogical and methodological grounding remains insufficient [11]. In practice, too, tools such as Quizlet and Wordwall are frequently applied episodically, without being systematically integrated into the instructional process.

In the Republic of Uzbekistan, the improvement of foreign language teaching and the introduction of digital technologies into education have been established at the level of state policy. The "Digital Uzbekistan – 2030" strategy [12], Resolution No. PQ-5117 on popularizing foreign language learning [13], and the Strategy for the Development of Artificial Intelligence Technologies until 2030 [14] constitute the legal framework for this direction.

The purpose of this article is to substantiate the content, organizational principles, and stages of a pedagogical experiment aimed at piloting a methodology for developing senior students' English lexical competence on the basis of AI tools.

2. Research methodology

The following methods were used in the study:

- theoretical analysis and generalization — scholarly sources on lexical competence, context-based vocabulary teaching, and the use of AI in education were analyzed;
- didactic modeling — an AI-integrated lesson model and intervention system were developed;
- pedagogical experiment — the diagnostic, formative, and final stages were planned with the participation of experimental and control groups;
- diagnostic testing, rubrics, and pedagogical observation — instruments for measuring the components of lexical competence were determined;
- comparative analysis and mathematical-statistical processing — the procedure for comparing the groups' results was established.

3. Results and Discussion

In developing the experimental procedure, communicative, cognitive, integrative, individual-differentiated, and technological approaches were combined. The use of AI technologies was directed toward transferring students' existing receptive knowledge into productive speech activity, acquiring new lexical units in context, understanding semantic relations, and applying them independently in speech. In doing so, the following didactic requirements for integrating information and communication technologies into English language teaching were taken into account: compliance with language norms; the integration of listening, speaking, reading, and writing skills; the use of new lexical units

in communicative situations; consideration of students' individual psychological and intellectual characteristics; the encouragement of autonomous learning; and the provision of prompt feedback and diagnostic assessment.

As a result of the study, a model of an AI-integrated experimental lesson, a five-strand intervention system, and instruments for diagnosing lexical competence were developed. The components of the lesson model are summarized in Table 1.

Table 1. General model of the AI-integrated experimental lesson.

Component	Content
Aim	Developing senior students' lexical competence with the aid of AI tools
Form of instruction	AI-integrated practical lesson
Methodological approaches	Communicative, cognitive, integrative, individual-differentiated, and adaptive
Main tools	ChatGPT, Quizlet, Wordwall, LearningApps, and multimedia resources
Main activities	Recognizing words, understanding their meaning, using them in context, identifying semantic connections, and using them in productive speech
Assessment	Diagnostic test, ongoing assessment, rubric, final test, and statistical analysis

Source: compiled by the author.

The instructional aim of the lesson is to teach the meaning, pronunciation, grammatical properties, and use of new lexical units, to connect them with previously acquired material, and to expand active and potential vocabulary. The educational (values-related) aim is directed at fostering responsible and purposeful use of digital technologies, critical evaluation of information, and academic integrity, while the developmental aim is directed at developing speech activity, analytical and logical thinking, the ability to compare alternative variants, and the ability to monitor one's own learning independently. By the end of the lesson, the student is expected to recognize new units, determine their meaning from context, use them correctly in sentences and dialogues, distinguish synonyms, antonyms, and collocations, and complete independent practice with the aid of AI. Each lesson is organized in five stages (Table 2).

Table 2. Stages of the AI-integrated lesson.

Stage	Time	Main content
1. Organizational part	3–5 min	Announcing the topic and aim, motivation, explaining the rules for using AI tools
2. Presentation of new lexical material	10–15 min	Presentation in the context of text, image, audio, and video; generating examples of usage with AI; identifying synonymic, antonymic, derivational, and collocational relations
3. Consolidation	15–20 min	Matching, gap-filling, word formation, restoring collocations, inferring meaning from context, building semantic networks, and constructing dialogues
4. Assessment and feedback	5–7 min	Automatic AI feedback as a supporting tool; final pedagogical assessment by the teacher
5. Closing part	3–5 min	Summarizing, self-assessment, reflection; homework on AI platforms and composing 5–7 sentences with the new words

Source: compiled by the author.

At the assessment stage, account is taken not only of correct answers but also of the learner's ability to use a lexical unit in context, to identify semantic connections, and to express an independent opinion. This approach ensures that feedback does not become

reduced to merely supplying ready-made answers: according to the involvement-load hypothesis of B. Laufer and J. Hulstijn, the more strongly a task activates a learner's need, search, and evaluation components, the more firmly the lexical unit is retained in memory [9].

In the experimental group, the content of the intervention was organized around five interconnected methodological strands (Table 3).

Table 3. Methodological strands of the AI-based intervention.

Strand	Content	Example
1. Contextual vocabulary instruction	AI generates texts adapted to the learner's level; meaning is determined not through translation but on the basis of context, syntactic structure, and synonymic relations	Adapting text complexity to the learner's individual capability
2. Semantic networks and concept mapping	Systematizing synonymic, antonymic, hyponymic-hyperonymic, and thematic relations around a central concept	"Environment": pollution, climate change, wildlife, recycling, renewable energy
3. Word formation and collocations	Identifying derivational forms, building word families, using natural combinations	depend – dependent – dependence – independence; make a decision, take responsibility
4. Communicative vocabulary use	Generating topic-based dialogues, monologues, and communicative situations with AI	Independent use of new units in an authentic situation
5. Cognitive and creative lexical activity	Semantic categorization, metaphor analysis, creating new contexts	"Time is a river," "Knowledge is light": source and target domain

Source: compiled by the author.

The theoretical grounds of the intervention strands are clearly defined. Work with collocations is based on M. Lewis's lexical approach, according to which language consists of "grammaticalized lexis," with word combinations forming the central part of lexical knowledge [15]. The analysis of conceptual metaphors is grounded in the theory of G. Lakoff and M. Johnson, according to which metaphor is a fundamental mechanism of thought [8]. Contextual instruction and semantic networks, in turn, implement the principle – noted by I. S. P. Nation – of encountering a word repeatedly and in varied contexts [16].

The lexical competence developed during the experiment encompasses five components. A separate set of task types was defined for diagnosing each component (Table 4).

Table 4. Components of lexical competence and diagnostic tasks.

Component	Content	Diagnostic tasks
Receptive lexical competence	Recognizing units in text, audio, and other sources; understanding their general and contextual meaning	Word Recognition, Meaning Recall, "Odd one out"
Productive lexical competence	Using units independently and purposefully in oral and written speech	Contextual Usage, composing sentences and dialogues (rubric)
Collocational competence	Using units in natural and normative combinations (strong tea, but not *powerful tea)	Collocations (make, do, take, get)
Lexical creativity	Creating new, meaningful combinations from existing units	Word Formation (educate – education – educational)

Component	Content	Diagnostic tasks
Cognitive competence	lexical understanding word meaning on the basis of semantic, conceptual, and associative relations	Concept Mapping, Semantic Network

Source: compiled by the author.

The pilot experiment was conducted in three stages. At the **diagnostic stage**, the initial lexical competence of the experimental and control groups was determined by means of a diagnostic test. The test covered word recognition, understanding of meaning, word formation, collocations, contextual use, and lexical activity in productive speech; the results provided a basis for establishing the groups' initial state and for subsequently comparing the effects of the intervention. At the **formative stage**, the AI-based methodological system was systematically implemented in the experimental group: contextual instruction, concept mapping, semantic networks, word formation, collocations, metaphor analysis, communicative dialogues, and gamified tasks were differentiated according to students' language level and needs. At the **final stage**, lexical competence was re-assessed by means of a final test equivalent in content and complexity to the initial test, which made it possible to compare the changes objectively.

The teachers who conducted lessons in the experimental group were provided with methodological guidance on presenting new units with the aid of AI, creating concept maps and semantic networks, working with synonyms, antonyms, and collocations, analyzing metaphorical units, creating contextual sentences and dialogues, and organizing lexical tasks based on elements of problem-based learning (PBL) and project-based learning (PjBL). The main differences in teaching between the experimental and control groups are presented in Table 5.

Table 5. Comparative characteristics of teaching in the experimental and control groups.

Parameter	Control group	Experimental group
Presenting a new word	Explanation through translation, writing it in a vocabulary notebook	Presentation in several AI-generated contexts
Consolidation	Memorization, question-and-answer work on the text, traditional exercises	Adaptive, interactive, and cognitive exercises, semantic networks
Differentiation	The same task for all students	Tasks adapted to language level and need
Feedback	Delayed, mostly general	Prompt AI feedback combined with the teacher's pedagogical assessment
Student's role	Recipient of ready-made knowledge	Active subject who searches for, analyzes, and applies material
Monitoring	Pre-test and post-test, in-class activity, autonomy, use in context, lexical activity in productive speech	The same diagnostic criteria

Source: compiled by the author.

Thus, the principal methodological difference between the groups lies in the systematic use, in the experimental group, of an AI-based system of adaptive, interactive, and cognitive exercises, while monitoring is conducted in both groups according to the same criteria. The reliability of the data obtained is determined by means of mathematical-statistical methods. Overall, the pilot experiment was organized according to the sequence "diagnosis → AI-based intervention → ongoing monitoring → final diagnosis → statistical analysis."

An important feature of the experimental design developed is that it assesses lexical competence through qualitative rather than quantitative indicators. What is measured is not how many words a student knows, but whether the student understands the acquired units, connects them semantically, selects them appropriately for context, and uses them independently in productive speech. This is consistent with N. Schmitt's principle that lexical knowledge must be measured as a multicomponent phenomenon.

In the model, AI is regarded not as a tool that fully replaces traditional lexical exercises, but as a pedagogical technology that individualizes and differentiates instruction and provides prompt feedback. The teacher remains the subject who organizes, supervises, and methodologically directs the use of AI tools: automatic feedback serves as a supporting tool, while final assessment remains within the teacher's authority. This constitutes a methodological response both to R. Luckin's conclusion that AI does not replace the teacher but enhances the teacher's practice, and to the problem of "teacherless technology" noted by Zawacki-Richter and co-authors [17].

At the same time, certain limitations must be taken into account when implementing the model. First, materials generated by AI may sometimes be more complex than the learner's level or stylistically imprecise, and must therefore undergo methodological review by the teacher. Second, the model requires a stable internet connection and the availability of devices. Third, cultivating in students a culture of using AI within the bounds of academic integrity remains a distinct pedagogical task.

4. Conclusion

As a result of the study, an integrated system for a pedagogical experiment aimed at piloting a methodology for developing senior students' English lexical competence on the basis of AI tools was developed. It comprises a five-stage lesson model, a five-strand intervention, a five-component diagnostic system, and diagnostic, formative, and final stages. On the basis of the pilot experiment, the following methodological recommendations were developed: planning the use of AI tools in accordance with instructional objectives; differentiating tasks according to students' individual language level; subjecting AI-generated materials to methodological review by the teacher; combining automatic feedback with pedagogical assessment; gradually moving lexical units from receptive activity to productive speech; and giving priority to developing students' independent and critical thinking. The statistical analysis of the pilot experiment's results constitutes a separate research topic. In the future, it would be advisable to test the developed methodology in various regions and types of educational institutions, and to study the long-term retention of lexical knowledge.

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