



*IV international scientific conference
Singapore. Singapore
18-19.11.2025*

SCIENCE AND TECHNOLOGY IN THE XXI CENTURY: CHALLENGES AND PROSPECTS

*Proceedings of the IV International
Scientific and Practical Conference*

18-19 November 2025

SINGAPORE. SINGAPORE
2025

UDC 001.1

BBC 1

IV International Scientific and Practical Conference «Science and technology in the XXI century: challenges and prospects», November 18-19, 2025, Singapore. Singapore. 67 p.

ISBN 978-91-65424-47-0

DOI <https://doi.org/10.5281/zenodo.17710513>

Publisher: «SC. Scientific conferences»

Main organization: 

Editor: Hans Muller

Layout: Ellen Schwimmer

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The sample of the citation for publication is Gugin Aleksandr, Lisnievska Yuliia ANTI-ADVERTISING IN THE HOTEL BUSINESS // III International Scientific and Practical Conference «Science and technology in the XXI century: challenges and prospects», November 18-19, 2025, Singapore. Singapore. Pp.9-11, URL: <https://sconferences.com>

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Mathematical sciences

ALGEBRAIC INTERPRETATION OF SOME UNARY OPERATIONS ON GRAPHS

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Abstract

Today, science is faced with an increasing number of problems related to computerization. It is the needs of computer information processing that require the study of the possibilities of matrix representation of graphs and, as a result, matrix representation of all possible transformations of graphs. The matrix implementation of operations on graphs has its own characteristics depending on the type of each specific graph. Because of this, obviously, the procedure for their implementation is not universal. A graph can be fully characterized by the adjacency matrix. Therefore, for the matrix implementation of the considered basic unary operations on graphs, it is necessary to use the apparatus of ordinary arithmetic matrix operations described in linear algebra.

Keywords: directed and undirected graph, adjacency matrix, operation on graphs, arithmetic operations on matrices.

Introduction.

When studying a system of objects connected by some arbitrary types of relationships, both directed and undirected graphs can be used. Each such system is an ordered collection of elements with which certain changes can occur. Each such specific system can be represented graphically as a graph or in digital format as an adjacency matrix or incidence matrix of such a graph. In any case, changes in the elements of the system are reflected by unary operations on the vertices or edges of the corresponding graph. The graphical implementation of such operations has already been well studied and described [1]. But computer processing of information involves its digital representation in matrix form. Algebraic matrix apparatus is also widely represented in mathematical research [2]. This article aims to establish a correspondence between known operations on ordinary matrices and unary operations on elements of an arbitrary graph. In this way, a transition from a graphical to a digital method of not only representing, but also processing various information can be made.

Main text.

Let's consider an directed graph G_1 and G_2 (Fig. 1).

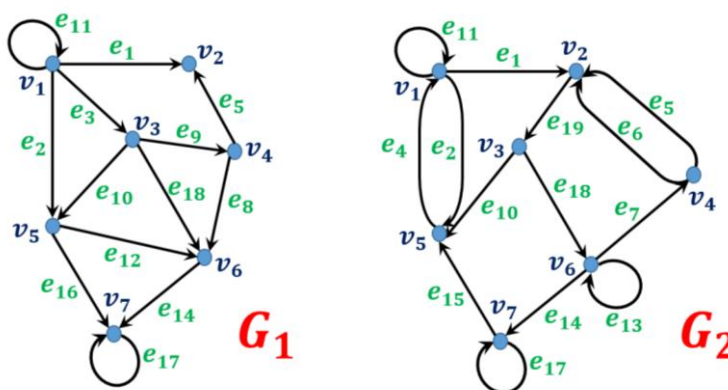


Figure 1 – Directed graphs G_1 and G_2

The adjacency matrix for graph G_1 can be given by the following table [5]:

$$A(G_1) =$$

		Final						
		v_1	v_2	v_3	v_4	v_5	v_6	v_7
Initial	v_1	1	1	1	0	1	0	0
	v_2	0	0	0	0	0	0	0
	v_3	0	0	0	1	1	1	0
	v_4	0	1	0	0	0	1	0
	v_5	0	0	0	0	0	1	1
	v_6	0	0	0	0	0	0	1
	v_7	0	0	0	0	0	0	1

or in the usual matrix form [6]

$$A(G_1) = \begin{pmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}.$$

The operation of deleting a vertex.

Deleting a vertex from a graph entails deleting all edges incident to it, which results in deleting all connections of this object or node to other objects or nodes [8]. This means that when deleting a vertex v_i from the adjacency matrix, the i -th row and i -th column must be deleted. In this regard, the algorithm for performing the operation of deleting a vertex v_i from a graph in a matrix representation is similar to the algorithm for constructing a minor M_{ii} for the adjacency matrix of this graph. For example, suppose that we want to delete vertex v_4 from graph G_1 . This is equivalent to constructing a minor M_{44} for matrix $A(G_1)$:

$$M_{44} = \begin{vmatrix} 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{vmatrix}.$$

Therefore, the new graph $G'_1 = G_1 \setminus \{v_4\}$ will have the adjacency matrix corresponding to it

$$A(G'_1) = \begin{pmatrix} 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

The algorithm for deleting rows and columns from a matrix has already been computerized. In this case, the software implementation will involve performing two shifts: for rows and columns. For a graph without isolated vertices, it is advisable to perform this operation using the adjacency matrix.

In the adjacency matrix, the sign of an isolated vertex is the presence of a zero row and column of the same name. In the incidence matrix, the sign of an isolated vertex is the presence of a zero row. Therefore, if the vertex to be deleting from the graph is isolated, then in this unique case it is more convenient to perform this operation using the incidence matrix. When a zero row is deleting from the incidence matrix, no connection between other vertices (objects or nodes) is broken. Therefore, there is no need to track the appearance of columns that, after deleting this row, will contain only one unit, which is not permissible for the incidence matrix [3]. Using the incidence matrix when deleting an isolated vertex halves the program implementation (there is no need to delete a column at the same time, and there will also be only one shift).

The operation of deleting one edge.

Deleting one edge involves the disappearance of a single edge (connection or relation) from the graph while preserving all vertices (objects or nodes) and the remaining connections between objects [4, 8]. Thus, only those elements in the adjacency matrix that correspond to the edges that are being deleting are changed. The remaining elements of the adjacency matrix retain their values. The order of the matrix also remains the same, because no vertex disappears from the graph as a result of deleting an

edge. When a directed edge is deleting, only one element of the adjacency matrix is reducing. When an undirected edge is deleting, a pair of symmetric elements of the adjacency matrix undergo the same changes.

Let it be necessary to delete a certain number of l_{ij}^- edges between vertices v_i and v_j . Therefore, to perform this operation, it is necessary to perform the arithmetic subtraction of the matrix A_e^- from the adjacency matrix of the initial graph. In the subtractor matrix A_e^- , the elements corresponding to the edges being deleted will be equal to l_{ij}^- . The remaining elements of this matrix will be zero.

Consider, for example, the graph G_2 , to which the adjacency matrix corresponds in tabular form [5]

$$A(G_2) =$$

		Final						
		v_1	v_2	v_3	v_4	v_5	v_6	v_7
Initial	v_1	1	1	0	0	1	0	0
	v_2	0	0	1	0	0	0	0
	v_3	0	0	0	0	1	1	0
	v_4	0	2	0	0	0	0	0
	v_5	1	0	0	0	0	0	0
	v_6	0	0	0	1	0	1	1
	v_7	0	0	0	0	1	0	1

or in the usual matrix form [6, 7]

$$A(G_2) = \begin{pmatrix} 1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 2 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 1 \end{pmatrix}.$$

In this matrix there is a pair of symmetric elements $a_{15}=a_{51}=1$. These elements correspond to a pair of oppositely directed edges, which can be replaced by a single undirected edge. Suppose that this undirected edge needs to be deleted from this graph. Suppose that in addition, one of the strictly parallel directed edges from vertex v_4 to vertex v_2 needs to be deleted from this graph. This means that in the matrix A_e^- only the elements $l_{42}^-=1$ and $l_{15}^-=l_{51}^-=1$ will be non-zero. Therefore, to calculate the adjacency matrix of the graph

$$(G_2)' = (G_2) \setminus \{\vec{e}(v_4, v_2)\} \setminus \{e(v_1, v_5)\} =$$

$$= (G_2) \setminus \{\vec{e}(v_4, v_2)\} \setminus \{\vec{e}(v_1, v_5)\} \setminus \{\vec{e}(v_5, v_1)\}$$

(the notation $\vec{e}$ means that this edge is directed) can be obtained by performing the following arithmetic subtraction:

$$A(G_2) - A_e^- = \begin{pmatrix} 1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 2 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 1 \end{pmatrix} - \begin{pmatrix} 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} =$$

$$= \begin{pmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 1 \end{pmatrix} = A((G_2)').$$

The software implementation of this operation is much simpler than its algebraic justification. To perform it, it is enough to reduce the corresponding elements of the adjacency matrix of the initial graph by the values l_{ij}^- .

The operation of inserting an edge.

The operation of inserting an edge into the graph is the inverse of the operation of deleting an edge. When inserting an directed edge, one element of the adjacency matrix is expected to increase [8].

When inserting an undirected edge, a pair of symmetric elements of the adjacency matrix undergo the same changes. Let's say that between vertices v_i and v_j it is necessary to add a certain number of l_{ij}^+ edges. In the software implementation, the corresponding elements of the adjacency matrix of the initial graph are increased by the specified value. The algebraic implementation of this operation involves the arithmetic sum of two matrices. One of the terms is the adjacency matrix of the initial graph. In the second term A_e^+ , the elements corresponding to the new edges are equal to l_{ij}^+ . The remaining elements of the second term are zero.

Suppose, for example, that it is necessary to introduce into the graph G_1 two strictly parallel directed edges from the vertex v_2 to the vertex v_4 and one undirected edge between the vertices v_3 and v_7 . This means that in this case $l_{24}^+=2$ and $l_{37}^+=l_{73}^+=1$. Then the adjacency matrix of the graph

$$G_1'' = G_1 + 2 \cdot \{\vec{e}(v_2, v_4)\} + \{e(v_3, v_7)\}$$

can be obtained by performing the following arithmetic sum:

$$A(G_1) + A_e^+ = \begin{pmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{pmatrix} =$$

$$= \begin{pmatrix} 1 & 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 \end{pmatrix} = A(G_1'').$$

Conclusions.

Some operations are more convenient to perform with adjacency matrices, and some with incidence matrices. However, the most common algorithms are still based on processing adjacency matrices. The same algorithms differ depending on whether directed or free graphs are involved in the operations considered. Depending on the types of graphs, there are also restrictions on the representation of meaningful information by matrices of these graphs. But in practical applications, these limitations are usually insignificant. Therefore, for each considered unary operation on graphs and each type of graph, it is possible to propose a series of some arithmetic operations that allow obtaining the matrix of a new graph or a clear, easily programmable algorithm for transforming the matrices of the initial graphs. None of the considered unary operations on graphs is impossible in matrix implementation, and the proposed algorithms can significantly simplify computer processing of graphs.

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Pedagogical sciences

USING CHAT-BOTS WHEN TEACHING ACADEMIC WRITING

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Abstract

In the context of the rapid digitalization of higher education in Kazakhstan, the integration of artificial intelligence (AI) tools, in particular chat bots based on large language models (LLM), is becoming an inevitable trend. This article is a comprehensive analysis of the potential and risks of using chat-bots in the process of teaching students academic writing skills. The classification of modern AI tools, the specifics of the requirements for scientific text, as well as the world and Kazakhstan experience in their implementation are considered. Based on the analysis (including a review of the scientific literature of Kazakhstani teachers) and the proposed methodology, practical recommendations are formulated for teachers, students and university administrations on the ethical and effective use of these technologies to improve the quality and speed of mastering academic literacy. Particular attention is paid to the balance between automating routine tasks and maintaining critical thinking and originality of the author's contribution.

Keywords: *academic writing, chat-bots, artificial intelligence, higher education in Kazakhstan, digital pedagogy, LLM, academic ethics.*

Introduction

Modern higher education functions in the paradigm of the Fourth Industrial Revolution, where the dominant factors of development are information, data and artificial intelligence. In the Republic of Kazakhstan, as in the whole world, there is a forced role of digitalization in modern education. Digital technologies have ceased to be an auxiliary tool, becoming an integral part of the educational ecosystem, affecting the management of the educational process, the assessment of knowledge and, most importantly, the process of acquiring competencies.

A special place among these technologies is occupied by the spread of AI technologies in the academic environment. The emergence and widespread adoption of generative models such as GPT, Gemini and Claude posed a challenge to the teaching community: either ignore these tools, risking lagging behind global trends, or actively integrate them, transforming teaching methods.

The key skill that determines the success of the future scientific and professional activities of a university graduate is academic writing. It includes not only grammatical correctness, but also the logical structure, argumentation, correct citation and compliance with the genre requirements of scientific communication. In conditions where AI is able to generate coherent and stylistically verified text in a matter of seconds, the need to revise approaches to teaching this skill becomes critical. The relevance of the study is determined by the need to develop evidence-based strategies to harness the power of AI to "enhance" the learning process rather than "replace" it.

The integration of chat-bots into the educational process is associated with a number of serious challenges to the integration of chat-bots into the educational process. These challenges lie both in the plane of pedagogy and in the field of academic ethics.

The first group of problems is related to pedagogical efficiency. Over-reliance on automatic text generation can lead to atrophy of basic cognitive skills. Students can learn to "control" AI without mastering the very process of formulating thought, structuring evidence and critical self-reflection over their own text.

The second group of problems forms the contradictions between technological capabilities and academic ethics. The ability to generate text indistinguishable from (or even superior in style to) human writing exacerbates the problem of plagiarism and academic bad faith. The question arises: where does the line between using AI as an intellectual assistant and using it as a tool to falsify authorship? Modern plagiarism detection systems often fail with LLM-generated content, necessitating the development of new evaluation approaches.

In addition, it is necessary to take into account the specifics of the Kazakhstani educational space: language barriers (the need for high-quality academic writing in Kazakh and Russian), cultural features of academic communication and the availability of technology for all categories of students.

The purpose of this study is to analyze the potential and develop guidelines for the effective and ethical use of chat-bots in teaching students academic writing skills in the context of higher education in the Republic of Kazakhstan.

To achieve this goal, the following tasks were identified:

1. analysis of the potential of chat-bots for the development of academic writing skills: Classify the types of AI tools and determine their functionality in relation to the various stages of creating a scientific text (from planning to editing).

2. study of world and domestic experience: To conduct a comparative analysis of the introduction of AI in the teaching of writing in leading foreign universities and to study the first practices of application in universities in Kazakhstan, based on available scientific publications.

3. Development of practical recommendations for students: To formulate specific scenarios and examples of prompts (requests) for the use of chatbots as a support tool, and not a substitute for independent work.

4. Identification of risks and development of countermeasures: Systematize the main ethical and technological risks and propose mechanisms for their minimization in the educational process.

Theoretical part

Modern chatbots based on transformer architecture and trained on huge text data arrays (LLMs) are powerful generative systems. They are capable of not only answering questions, but also imitating complex cognitive processes such as the synthesis, analysis and paraphrasing of information.

For the purposes of academic writing, it is advisable to classify AI tools by their main function in the educational process:

1. Generative chatbots (LLM): This is the most powerful class, including platforms such as OpenAI GPT-4, Google Gemini, Anthropic Claude. They are used to brainstorm, create drafts, summarize sources, and generate alternative formulations. Their strength lies in creating a coherent, contextually adequate text.

*2. Discursive and educational chatbots: These systems are designed for interactive learning. They can act as a virtual tutor, ask the student clarifying questions on his theses, help build a logical chain or imitate a scientific discussion on a given topic. They focus on the * process * of thinking, not just the "product."*

3. AI-based proofreaders and editors: These include specialized tools (such as Grammarly, LanguageTool, or built-in LLM features) that focus on improving stylistics, grammar, punctuation, and academic register compliance. They are useful in the final stages of editing.

In the context of Kazakhstan's education, accessibility and functionality play a key role:

• GPT (OpenAI): De facto standard. The GPT-4 model demonstrates a high degree of understanding of complex instructions (prompts) and is able to maintain a long context, which is critical when working on large scientific texts (term papers, theses).

• Gemini (Google): Integrated into the Google Workspace ecosystem, which potentially facilitates its use in universities that actively use Google cloud services. It demonstrates strong capabilities in summarizing information from the web.

• Claude (Anthropic): Often praised for a more "human" and less robotic writing style, as well as an enlarged context window, which allows you to analyze large volumes of source material (for example, several scientific articles at the same time).

Academic writing is not just a literate statement of thought; it is a standardized way of transferring knowledge, requiring strict conventions to be followed.

A qualitative scientific text, regardless of subject area, must meet the following quality criteria:

*1. **Clarity and Precision:** Using unambiguous terminology, avoiding ambiguity and metaphors that are not related to the topic.*

*2. **Coherence and Structure:** The presence of a clear introduction (statement of the problem, goal, hypothesis), the main part (argumentation, evidence base) and conclusions (conclusions, significance). Transitions between paragraphs should be smooth and motivated.*

*3. **Argument and Evidence:** Each statement must be supported by a reference to an authoritative source or empirical data.*

*4. **Objectivity and impersonality:** Prevalence of impersonal constructions and third parties, minimization of personal assessments in favor of facts.*

5. Style and Formatting: Compliance with citation requirements (APA, MLA, GOST) and use of academic language register.

Studies conducted in Kazakhstani universities (for example, works on the methodology of teaching disciplines in Russian and English) show that students often face the following barriers when mastering academic writing:

- Shift from a conversational/essayistic style to a scholarly one: Students tend to use value judgments and emotionally tinged vocabulary.
- White sheet and structuring problem: Difficulty getting started, unable to create work plan or argument hierarchy.
- Insufficient work with sources: Inability to correctly integrate citations (paraphrase, direct citation) and adequately analyze what is read, which leads to superficial literature reviews.
- Weak grammatical base: The issue is especially acute in a multilingual environment, where students can write in a language that is not their native language (for example, English for international publications).

Integrating AI into writing teaching is a global trend that requires learning best practices.

Foreign experience (Europe and USA):

Many leading universities (for example, MIT, Stanford, Oxford) initially reacted to the emergence of LLM by tightening the rules, but quickly moved to integration. The main areas of work:

1. Rethinking tasks: Tasks shift from "write an essay about..." to "analyze the response of the chatbot on topic X and justify why it is inaccurate in paragraph Y." This requires students to have a higher level of critical thinking.
2. Using AI as a "co-author for a draft": Students are taught to use AI to generate first, raw sketches, which are then deeply edited and verified by humans.
3. Integration into feedback systems: Tools are being developed that use AI to provide instant, but not final, feedback on structure and style, freeing up teacher time for deeper content analysis.

Experience of Kazakhstan:

In Kazakhstan, the introduction of AI into the educational process is at an early stage, but is actively discussed within the framework of digitalization. Studies of Kazakhstani teachers (for example, in the field of pedagogy and language education) show:

- Awareness: Educators recognize the potential of AI but raise concerns about plagiarism and reduced autonomy.
- Early pilots: Some universities are trying to use AI to automate grammar checking and formatting, especially in courses that require English for Specific Purposes.
- Methodological deficit: There is an acute shortage of teaching aids and training for teachers on the *productive* use of LLM, leading to either total prohibition or uncontrolled use.

Methodology of research.

A mixed methodology combining qualitative and quantitative data analysis was used to achieve the study objective and validate the practice guidelines.

The study relies on three main data sources:

Analysis of academic literature on the basis of scientific articles of Kazakhstani teachers and researchers of this issue

The first phase involved analysis of academic literature. A content-analytical sample of scientific articles, dissertations and methodological developments published in peer-reviewed Kazakhstani journals (for example, included in the list of CCCH of the Ministry of Education and Science of the Republic of Kazakhstan) over the past five years was carried out. The focus was on works affecting digital pedagogy, the methodology of teaching Russian and English at the university, as well as issues of academic integrity in the context of digitalization. The goal is to identify the existing theoretical framework and problems already identified by domestic scientists in relation to AI.

Faculty and student surveys

To assess the practical perception and identify real scenarios for the use (or non-use) of chat-bots, anonymous surveys were conducted:

1. Survey of teachers (N = 20): Teachers of humanities, technical and natural sciences from three major universities in Almaty and Astana. Issues of AI awareness, concerns, as well as successful (in their opinion) integration techniques were evaluated.
2. student survey (N = 100): Students of 2-4 courses of various directions. The questions concerned the frequency of using chatbots in the preparation of written works, the type of tasks performed

(planning, editing, text generation) and their subjective assessment of the impact of AI on the quality of training.

Evaluation criteria

As part of a pilot experiment (where students were asked to use AI according to a given technique) and to assess the current level of skills, the following assessment criteria were used:

The literacy rate of texts was assessed using a two-dimensional system:

1. objective assessment (AI corrector): Use of specialized programs to count grammatical, spelling and punctuation errors per 1000 characters.

2. Subjective assessment (expert): Assessment of stylistic homogeneity, compliance with the academic register and clarity of presentation (on a scale from 1 to 5).

3. Task completion speed

The time spent on the standardized task of writing an analytical paragraph was recorded (for example, "Formulate and justify the three key aspects of Bolashak's influence on the scientific elite of Kazakhstan"). The comparison was between a group using AI for planning and editing and a control group.

The degree of independence of students is the most difficult to measure. It was assessed indirectly through:

- Prompt analysis: Exploring how detailed and guiding the AI student's instructions were. The more complex and specific the prompt, the higher, presumably, the level of understanding of the problem by the student.

- Quality of final work after removal of "traces of AI": Assessment of how original the content and argumentation remains after the stylistics generated by the machine is removed from the text (for example, when paraphrased by a student).

A key takeaway from methodology analysis is that the chatbot should be used as an intelligent partner rather than the ultimate producer of text. Efficiency is achieved through decomposition of the academic writing process into stages where AI can be useful.

Below are examples of prompts focused on developing critical skills rather than blind content generation:

1. logic and structure analysis:

> "I am writing a section on economic policy. Here's my main thesis: [Insert thesis]. Here are the three arguments I make: [Argument 1], [Argument 2], [Argument 3]. Analyze this set of theses from the point of view of argumentation logic. Indicate which transitions between arguments may not be obvious or require additional justification. Don't rewrite, just point out the weaknesses."

2. working with conclusions and conclusions:

> "My essay conclusion looks like this: [Insert conclusion text]. Suggest three alternative formulations for this conclusion. One should be more focused on practical significance for Kazakhstan, the second - on theoretical novelty, and the third - more concise and generalizing."

3. paraphrase and citation improvement:

> "I want to use the idea from the source [Author, Year]. Original text: '[Insert quote]'. My paraphrase is '[Insert student paraphrase]'. Evaluate my paraphrase. Does it fit the academic style? Is it too close to the original (risk of self-plagiarism/paraphrase)?"

4. Simulation of peer review:

> "Act as a rigorous scientific reviewer specializing in [Specify Area]. I am sending you an introduction to my article. Your task is to find the three most serious methodological flaws or vague concepts that could lead to the rejection of the article."

This approach transforms the chat-bot from an answer generator into a tool for reflecting and improving your own text.

Despite its enormous potential, the uncontrolled or illiterate use of chat-bots poses serious threats to the quality of education and the academic environment. Although the text generated by LLM is not technically direct plagiarism (it is not copied from a single source), it is "synthetic plagiarism" or, as some researchers call it, "authorial delegalism." The student passes off as his essay, ideas, structure and formulations created by the algorithm.

In Kazakhstan, where plagiarism verification systems traditionally focus on finding text matches to published sources, AI-generated content often passes muster, creating a false sense of security.

To counteract this risk, you must:

1. changing evaluation formats: Shifting focus from final product to process (defense, oral presentations, draft analysis, tracking revision history).

2. *The use of specialized detectors: The introduction (as they develop) or the development of their own methods for detecting AI text, although this is an arms race where AI generators are always one step ahead.*

3. *Emphasis on self-reporting: Teaching students the mandatory declaration of exactly how AI was used in the work (e.g. in the Acknowledgements section or footnote).*

Chat-bots are not ideal sources of truth. They operate on the statistical probability of the next word, rather than actual knowledge. LLMs are prone to "hallucinations" - generating false facts, non-existent quotes, fictional authors, or flawed statistics. In academic writing, where accuracy is a fundamental value, this is unacceptable.

- Implications: A student lacking sufficient subject matter expertise may mistake the generated false information for truth, resulting in discrediting the entire work.*

Although modern models are multilingual, they were trained primarily on English-language content. This creates problems in the context of Kazakhstan:

1. *Kazakh language: The quality of generation in the Kazakh language (especially in highly specialized terminology) is often inferior to the quality in Russian or English, which can lead to stylistically incorrect or grammatically erroneous constructions in scientific texts in the state language.*

2. *academic traditions: AI may not take into account the specific requirements of GOSTs adopted in the Republic of Kazakhstan, or regional features of citation and reference devices.*

Conclusion

Chat-bots are a powerful but double-edged tool in teaching academic writing, a study has confirmed.

A balanced approach to technology is the only viable way forward. Total prohibition is unrealistic and leads to students using these tools covertly without receiving methodical support. Over-reliance on AI leads to atrophy of basic skills.

The importance of combining AI with traditional teaching methods is undeniable. AI can take on the routine work of grammatical and stylistic resurfacing, but critical thinking, originality of the idea, depth of analysis, and ethical responsibility remain the sole domain of the teacher and student. Academic writing should shift from «writing» to «information management» and «critical evaluation» of generated data.

The topic of using AI in the education of Kazakhstan requires constant monitoring and in-depth study.

- Development of specialized educational chat bots: A promising area is the creation of LLM, specially trained on the body of high-quality scientific texts in Kazakh and Russian, specific to Kazakhstani scientific discourse, taking into account local regulatory requirements.*

- Exploring the long-term impact of AI on educational quality: Longitudinal studies are needed, tracking how students actively using AI in their junior years demonstrate critical analysis and synthesis skills at the master's and graduate level.*

- Methodical validation of prompts: Systematization and empirical verification of the most effective prompting techniques for the development of specific academic writing skills (for example, prompts to improve the structure of argumentation vs. prompts to improve lexical diversity).*

Integrating chatbots into teaching academic writing isn't just a technological upgrade, it's a fundamental challenge to rethinking what it means to be a literate scientist in the digital age.

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UDC 372.881.1

LESSON PLANNING WITH AUTHENTIC MATERIALS FOR FOREIGN LANGUAGE CLASSES (PRIMARY SCHOOL STUDENTS)**Inkash Nazerke Sattibekkyzy***Abylai Khan Kazakh International relations and World Languages university
4th year student, «6B01701» Foreign Languages: Teacher, Training faculty***Zhumabekova Galiya Baiskanovna***Candidate of Pedagogical sciences, Professor Kazakh Ablai Khan University of International Relations and World Languages, Kazakhstan***Abstract**

This article explores the importance of using authentic materials in teaching foreign languages to primary school learners. Authentic resources—cartoons, songs, short videos, real-life dialogues, and simple advertisements—expose children to natural language and support meaningful learning. The article outlines key steps in lesson planning, including setting objectives, selecting age-appropriate materials, designing communicative and game-based tasks, using visual support, and applying formative assessment.

Findings indicate that authentic materials increase students' motivation, improve listening and speaking skills, enrich vocabulary, and create a classroom environment similar to real-life communication. Practical recommendations are provided to help teachers integrate authentic content effectively into their lessons.

Аннотация

Бұл мақала бастауыш сынып оқушыларына шетел тілін оқытуда аутентті материалдарды қолданудың маңызын талдайды. Аутентті материалдар – мультфильмдер, әндер, шағын бейнероликтер, диалогтар, жарнамалар сияқты шынайы тілдік ресурстар. Олар оқушыларға табиғи сөйлеу үлгілерін естуге, шынайы өмір жағдайларында қолданылатын сөздерді меңгеруге мүмкіндік береді. Мақалада сабақ жоспарын құрудың негізгі кезеңдері қарастырылады: мақсат қою, материалдарды дұрыс іріктеу, тапсырмаларды саралау, ойын және визуалды элементтерді енгізу, формативті бағалау.

Нәтижесінде аутентті материалдар оқушылардың қызығушылығын арттырып, тілдік ортаға жақын жағдай жасайтыны, тыңдалым мен айтылым дағдыларын дамытуға ықпал ететіні анықталды. Материалда мұғалімдерге аутентті ресурстарды тиімді пайдалануға арналған практикалық ұсыныстар беріледі.

Аннотация

Статья рассматривает значимость использования аутентичных материалов при обучении иностранному языку младших школьников. Аутентичные ресурсы — мультфильмы, песни, короткие видео, рекламные тексты и реальные диалоги — помогают детям слышать естественную речь и формируют интерес к языку. Отмечаются основные этапы планирования урока: определение цели, подбор материалов по возрасту, создание игровых и коммуникативных заданий, использование визуальных опор и формативного оценивания.

Анализ показывает, что аутентичные материалы повышают мотивацию, развивают навыки аудирования и говорения, расширяют словарный запас и создают условия, близкие к реальной языковой среде. Статья содержит практические рекомендации для учителей по эффективной интеграции таких материалов в урок.

Ключевые слова: аутентичные материалы, начальная школа, иностранный язык.

Түйін сөздер: аутентті материалдар, бастауыш сынып, шетел тілі, әдістеме.

Keywords: authentic materials, primary school, foreign language teaching.

INTRODUCTION

In contemporary foreign language education, the development of communicative competence among primary school learners has become a central pedagogical priority. The modern educational

paradigm does not limit itself to teaching grammatical rules or vocabulary lists; rather, it aims to develop learners who can apply language meaningfully in real-life situations and participate confidently in intercultural communication. In this context, lesson planning that incorporates authentic materials plays a pivotal role. Authentic materials—texts, visuals, audio, and video created for real communicative purposes by native speakers—provide young learners with exposure to natural language use and culturally rich content that artificial textbook materials often lack.

Primary school students learn most effectively when the learning process is engaging, visual, interactive, and emotionally stimulating. Children in this age group respond strongly to colourful images, animated characters, lively stories, short videos, songs, and simple real-life dialogues. Therefore, using authentic resources such as cartoons, children's songs, illustrated storybooks, advertisements, comic strips, everyday conversations, and short video clips is highly appropriate for their cognitive and emotional development. These materials help create a learning environment that closely resembles real-world communication and significantly enhance students' motivation, curiosity, and willingness to participate in language activities.

Planning lessons around authentic materials, however, requires careful methodological consideration. Teachers must design lessons that align learning objectives with learners' linguistic abilities and developmental characteristics. Young learners may find authentic content challenging due to unfamiliar vocabulary or fast speech rates; therefore, teachers must also scaffold the learning process using strategies such as pre-teaching key vocabulary, using visual cues, simplifying tasks, and providing repeated exposure to the material. Effective lesson planning includes setting clear aims, selecting age-appropriate authentic texts, designing differentiated tasks, integrating play-based learning, and incorporating formative assessment techniques.

Moreover, authentic materials support the simultaneous development of multiple language skills. Through cartoons and short videos, learners naturally improve listening comprehension and pronunciation. Songs reinforce rhythm, intonation, and memory retention. Short stories and simple advertisements develop reading comprehension and expand vocabulary. Interactive dialogues and role-play based on authentic situations promote speaking fluency and confidence. These materials also introduce learners to cultural aspects of the target language, helping them better understand customs, values, and communication styles. This contributes to the formation of intercultural competence from an early age, which is essential in an increasingly globalised world.

Recent research highlights that authentic materials significantly improve young learners' engagement and support long-term language retention by providing meaningful context. Authentic content helps students see the real purpose of learning a foreign language and builds intrinsic motivation. For teachers, the integration of authentic resources encourages innovative, creative approaches to instruction and enriches the overall quality of the learning experience.

This article examines the methodological principles of planning foreign language lessons using authentic materials for primary school students. It analyses criteria for selecting effective resources, discusses strategies for adapting authentic content to young learners, and provides practical examples of task design and classroom activities. The findings emphasise that authentic materials, when thoughtfully integrated, contribute to more effective, engaging, and culturally meaningful foreign language learning.

Purpose of the Study

The main purpose of integrating authentic materials into foreign language lessons for primary school students is to create a learning environment that reflects real-life communication. By exposing young learners to natural language use, teachers aim to develop communicative competence, enrich vocabulary acquisition, strengthen listening and speaking skills, and build intrinsic motivation. The study also seeks to demonstrate how authentic resources can make language learning more meaningful, culturally relevant, and enjoyable for children.

Novelty of the Approach

The novelty of this approach lies in the systematic, age-appropriate adaptation of authentic materials for early language education. While authentic resources are widely used in secondary or adult language learning, their structured integration into primary school lessons remains limited. The innovative aspect includes:

- selecting materials specifically tailored to children's cognitive and emotional development;*
- designing play-based and visually rich activities derived from real-world content;*
- combining authentic input with scaffolding strategies such as pre-teaching, guided viewing, and simplified tasks;*
- creating a micro-immersion environment that mirrors natural communication.*

This approach brings primary learners closer to real language use earlier than traditional textbooks allow.

Pedagogical Idea

The core pedagogical idea is to use authentic materials as a foundation for communicative, student-centered, and culturally meaningful learning. Authentic content helps children internalise language patterns naturally, encourages curiosity, stimulates imagination, and strengthens cultural awareness. By shifting from passive reception to active engagement, students become participants in communication rather than mere learners of rules. This aligns with modern pedagogical principles such as constructivism, CLT (Communicative Language Teaching), and multimodal learning.

Methods Used in Practice

In classroom practice, a range of methods is applied to maximise the effectiveness of authentic materials:

- **Pre-task activities:** brainstorming, vocabulary preview, picture prediction.
- **Guided listening and viewing:** watching short videos or cartoon clips with specific comprehension tasks.
- **Role-play and dramatization:** acting out dialogues from stories, advertisements, or cartoons.
- **Game-based learning:** "Find the object," "Match the sound," or "Guess the character" based on authentic input.
- **Project-based tasks:** creating mini posters, simple dialogues, or story retellings inspired by authentic content.

- **Formative assessment:** checklists, peer evaluation, and reflective drawing.

These methods build confidence, promote interaction, and make learning memorable.

Practical Classroom Examples with Instructions

Example 1: Using a Cartoon Clip (Peppa Pig episode)

Instruction:

1. Show a 1–2 minute clip.
2. Pre-teach 3–4 key words (e.g., "muddy puddle," "jump," "rain").
3. Students watch and circle pictures of words they hear.
4. In pairs, students mimic a short dialogue from the cartoon.
5. Draw their favourite scene and describe it using simple sentences.

Example 2: Using a Real Advertisement (Children's cereal ad)

Instruction:

1. Display the advertisement without sound – students guess the product.
2. Play the full video – students listen for familiar words.
3. Group task: create a "mini-ad" with pictures and simple sentences ("It is sweet", "Good for breakfast").

Example 3: Using a Song (Super Simple Songs)

Instruction:

1. Play the song once for listening.
2. Teach gestures for each keyword.
3. Sing together with actions.
4. Students complete a missing-word worksheet linked to the lyrics.

MAIN BODY

The integration of authentic materials into foreign language lessons for primary school learners represents a powerful pedagogical shift towards meaningful, student-centered, and culturally grounded instruction. Authentic materials—such as short videos, cartoons, children's songs, illustrated storybooks, real-life dialogues, product labels, and simple advertisements—expose children to the language as it is genuinely used in everyday communication. This creates a natural micro-immersion environment that traditional textbooks alone cannot provide. The pedagogical idea at the core of this approach is to make language learning real, relevant, and emotionally engaging for young learners.

First and foremost, authentic materials help children develop communicative competence by offering language input that reflects actual patterns of speech, intonation, rhythm, and cultural context. Unlike scripted textbook dialogues, authentic resources present children with spontaneous, natural interactions. This supports listening comprehension and fosters early phonological awareness. Young learners imitate sounds, rhythms, and expressions they hear, which directly contributes to more confident speaking. Research highlights that children acquire language more effectively when exposed to real communicative situations, and authentic materials provide exactly such exposure in age-appropriate ways.

Another essential component of this pedagogical idea is the creation of an engaging learning environment. Primary school learners have short attention spans and strong emotional responses; thus, the visual richness, humour, music, and motion inherent in authentic materials keep them motivated. For instance, colourful cartoons like Peppa Pig, simple English songs, or animated picture books capture children's attention and make learning feel like play. When learning is enjoyable, students participate more actively, retain information longer, and develop a positive attitude toward the foreign language.

A key methodological principle in using authentic materials is scaffolding. Teachers must carefully guide learners through the content to ensure understanding without oversimplifying the authentic nature of the material. Effective scaffolding includes pre-teaching essential vocabulary, predicting content through pictures, repeated viewing or listening, breaking down longer texts, and using visual supports. These strategies reduce cognitive load and enable young learners to succeed even when exposed to language above their current proficiency level. The goal is not to simplify the material itself, but to adjust the learning process to the student's developmental stage.

Authentic materials also contribute significantly to cultural awareness. Young learners gain insight into the everyday life, traditions, and values of native speakers through real images, songs, celebrations, and spoken expressions. Early exposure to culture helps build intercultural competence, which is an important aspect of modern language education. For example, using a short video about English breakfast, a holiday celebration, or a simple English playground song introduces children to cultural practices while simultaneously developing vocabulary and listening skills.

The pedagogical idea further emphasizes the importance of multimodal learning. Authentic materials naturally combine audio, visual, linguistic, and contextual elements. This aligns with how young children learn: through multiple sensory channels. When students watch a cartoon, listen to a song, act out a dialogue, and engage in hands-on activities such as drawing, matching, or role-play, they process information more effectively. Multimodal learning deepens comprehension and supports different learning styles.

In classroom practice, authentic materials enhance interaction and collaboration. Students work in pairs or groups to retell a story, act out a dialogue, complete a listening task, or create a mini-project based on what they have watched or read. These cooperative tasks develop not only language skills but also social and emotional competencies such as turn-taking, expressing ideas, and offering support to peers.

Overall, this pedagogical idea positions authentic materials as a transformative tool that elevates the quality of foreign language learning in primary school. By making lessons more natural, meaningful, and culturally rich, authentic resources help teachers design lessons that reflect real communication and engage learners holistically. Through thoughtful planning, scaffolding, and creative implementation, authentic materials become a bridge between the classroom and the real world, providing young children with the foundation for lifelong language learning.

CONCLUSION

The use of authentic materials in lesson planning for foreign language classes in primary school represents a significant pedagogical advancement that aligns with modern educational demands for communicative, culturally responsive, and student-centered learning. Throughout this pedagogical idea, it becomes clear that authentic materials not only enrich the linguistic input available to young learners but also enhance motivation, engagement, and long-term language retention. By integrating real-world language resources—such as cartoons, children's songs, simple advertisements, illustrated stories, classroom dialogues, and multimedia clips—teachers provide learners with meaningful exposure to natural language patterns, intonation, pronunciation, and everyday vocabulary that traditional textbooks alone cannot fully offer.

Authentic materials play an essential role in developing communicative competence from an early age. They allow children to interact with language as it is genuinely used by native speakers, helping them internalise phonological features, conversational structures, and pragmatic elements of communication. Such exposure fosters greater confidence in speaking and listening, enabling students to participate more actively in classroom interactions. Moreover, authentic resources support multimodal learning, combining visual, auditory, linguistic, and contextual cues that are particularly effective for primary learners, who tend to respond strongly to sensory-rich and emotionally engaging content.

Another important conclusion is the contribution of authentic materials to cultural awareness. When young learners encounter real-life songs, celebrations, routines, and visual representations of everyday life from English-speaking cultures, they gain a broader understanding of how language functions

within its cultural context. This early intercultural competence prepares them to become open-minded, globally aware individuals who can navigate different cultural environments with respect and curiosity.

However, the successful integration of authentic materials requires careful methodological planning. Teachers must select age-appropriate resources, adapt content through scaffolding, and design tasks that guide learners from comprehension to meaningful communication. Effective strategies include pre-teaching vocabulary, using prediction activities, breaking materials into manageable segments, and incorporating visual supports. Additionally, game-based tasks, role-play, pair work, and simple project activities make learning both accessible and enjoyable. When authentic materials are implemented thoughtfully, they transform the classroom into a dynamic learning environment that mirrors real-life communication.

Ultimately, this pedagogical idea demonstrates that authentic materials are not merely supplementary resources but essential tools for modern foreign language instruction at the primary level. Their purposeful use strengthens linguistic, cognitive, emotional, and cultural development simultaneously. By bridging the gap between the classroom and the real world, authentic materials prepare young learners for lifelong language learning and foster positive attitudes toward foreign language study. Therefore, incorporating authentic materials into lesson planning should be viewed as a fundamental component of innovative, effective, and future-oriented foreign language education.

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DEVELOPING CROSS-CULTURAL COMMUNICATION SKILLS IN FOREIGN LANGUAGE EDUCATION**Yerlan Akmaral***Al-Farabi Kazakh National University***Abstract**

This article is devoted to the problem of formation of intercultural competence of students in foreign language classes. It addresses a number of issues related to the formation of cross-cultural competence in the process of teaching foreign language communication, taking into account the cultural and mental differences of native speakers, which is a necessary condition for a successful dialogue of cultures.

Keywords: *foreign language, cross-cultural competence, English, communicative.*

A foreign language has great potential for education and development. The main direction of Foreign Language Teaching Methods is to form cross-cultural communication skills, provide practical knowledge of foreign languages, and communicate with native speakers of the language being studied. This is a method of communication for the personality of the student, it allows us to use the nature of language as a means of human activity, a means of personality formation, so that we can closely link the educational process with the needs and direction of the student's life. Therefore, the cross-cultural aspects of Foreign Language Teaching are the most relevant.

Although actively concerned about the formation of students' cross-cultural ability, the process of forming a qualified personality in cross-cultural communication has not been fully studied. In addition, many teachers and methodologists speak first of all about the formation of cross-cultural abilities when studying in higher education institutions, although today children are familiar with and enter the culture of others even before graduation. From this we can conclude that cross-cultural competencies should be actively developed in schools. Secondary school, especially higher education, is the time when students begin to form the concept of personality, self-awareness, self-esteem, perception of the world around them, so it is necessary to form the right concept of cross-cultural communication.

The ongoing process of globalization has led to an increase in interaction between different countries, peoples and their cultures. This impact is achieved through cultural exchanges and direct contacts between state institutions, social groups, social movements, scientific cooperation, trade, tourism, etc. Educational institutions often exchange students and students, teachers organize joint projects and internships abroad, thus participating in intercultural exchanges and cultural dialogue.

The realization of mutual understanding in the process of cross-cultural communication is facilitated by cross-cultural capacity. Cross-cultural ability is the ability to speak a foreign language, taking into account cultural differences and thinking patterns.

The study of the issue of cross-cultural communication involves familiarity with the following phenomena and concepts: the principle of communication, the main functions of culture, the impact of Culture on perception and communication in various fields and types, the parameters that describe the impact of Culture on human activities and social development.

The formation of intercultural competencies should take into account the development of opposability to participate in cultural dialogue on the basis of the principles of mutual respect, tolerance of cultural differences and overcoming cultural barriers. The purpose of intercultural education is to develop opposability to communicate across cultures, to promote students understanding of belonging to a particular ethnic group and to familiarize them with the traditions and cultural characteristics of representatives of other cultures.

A modern man who speaks a foreign language is involved in the process of communicating with other people, who are representatives of his culture. In this regard, students of a foreign language need not only to have a wealth of vocabulary and a decent pronunciation, to know that the grammar of a foreign language is good, but also to form cross-cultural skills. This ability involves achieving the level of language ability, which, first of all, allows you to flexibly respond to various unexpected turns in the conversation; secondly, determine the appropriate way of speech behavior; thirdly, it is wrong to choose specific funds from a wide arsenal, and fourthly-to use these funds in accordance with the proposed situation.

The formation of cross-cultural competencies involves the interaction of the two cultures in several ways: the act of familiarizing the national culture of the target language with a foreign language and exploring the carrier of foreign culture; the influence of foreign languages and foreign cultures, indigenous languages and behavior in local culture; the development of personality is influenced by both cultures.

With these directions in mind, it is necessary to consider how to form a student's cross-cultural abilities.

In the process of mastering a foreign language, students learn materials that reflect the function of the language in the natural environment, verbal and nonverbal behavior of native speakers in various communicative situations, and reveal behavioral characteristics associated with folk customs, traditions, social structures, national characteristics. First of all, this is done with the help of original materials (original text, audio recordings, video), from the point of view of language design, containing normative and linguistic cultural information.

In order to prevent possible conflicts in inter-ethnic relations, it is important to understand the national and cultural characteristics of the conduct of foreigners. Therefore, when learning a foreign language, students need not only to know their vocabulary, grammar and syntactic characteristics, but also to be able to correctly react to replicas of their native language, correctly use facial expressions and gestures, apply formulas of speech etiquette, and understand the cultural and historical characteristics of the country being studied.

The implementation of cross-cultural communication means that a person is willing not only to perceive representatives of another culture with all ethnic and spiritual characteristics, but also to have the ability to self-change. When learning a foreign language, students encounter linguistic and cultural phenomena and compare them with native language phenomena. For example, when learning the vocabulary and grammatical structure of a foreign language, students should refer to the knowledge acquired in language course in order to determine the similarities and differences of language phenomena and their areas of use. The study of foreign cultures leads to the need for students to refer to the cultural and historical facts of their country. Therefore, by learning a foreign language and participating in cross-cultural exchanges, students have a deeper understanding of their mother tongue and mother tongue culture.

The formation of cross-cultural competencies also includes the acquisition of the following skills: to see not only what distinguishes us from representatives of another culture, but also what unites us; to change assessments by understanding another culture; to abandon stereotypes; and to use knowledge of another culture to gain insight.

Cross-cultural ability is formed in the process of teaching foreign language communication, taking into account the cultural and spiritual differences of native speakers, is a necessary condition for the success of cultural dialogue. Understanding the problems that may arise in cross-cultural communication between representatives of different cultures, understanding values and generally accepted codes of conduct are important factors in learning a foreign language. When students are ready to communicate correctly with them, they can avoid misunderstandings, misunderstandings about behavior and incorrect use of language, misunderstandings about the reaction of the interlocutor, and possible conflicts in assessing the situation. The ability to break down cultural values in student behavior helps him to become a good expert in interacting with representatives of the international community. The textbooks are based on the reality of the country in which the language is studied. Contains a variety of information. Students will be able to learn about the history, geography, life and culture not only of our country, but also of the country where the language is learned. The textbook contains a large number of illustrations, color photos, illustrations, a local history dictionary, and Multimedia discs.

Any sample of printed information (theater and bus tickets, letterhead, telegrams, magazines, newspapers, calendars, etc.). The students brought from the country where the language is learned are attractive because they reflect the current reality of the country.

The modernization of the educational system has led to the fact that the modern goal of teaching foreign languages and culture is now not to master a certain system of knowledge and skills, but to prepare for real cross-cultural communication. The term "intercultural communication" is widely used in modern methodology and its explanation is very clear. This term defines the specific process of interaction between a group of communication partners belonging to different linguistic and ethnic cultural communities.

Due to the lack of knowledge of the characteristics of foreign languages at the school level, cross-cultural communication is characterized by several specific characteristics, the most important of which are:

The preparation of real cross-cultural communication in secondary schools is carried out in human conditions and in the absence of means-through the education of classmates of the same cultural carriers.;

The main communication partner of a student learning a foreign language is a teacher, he is a carrier of culture, not culture, the carrier of a foreign language;

Cultural patterns that mimic foreign languages can cause harm to students. The communication of university graduates with their foreign counterparts in a foreign language can be characterized by personal, ethnic, natural style;

Cross-cultural communication, to ensure mutual understanding of interlocutors, requires foreign language communication activities, sufficient background knowledge, master the socio-cultural background of learning a foreign language.

The ability to successfully communicate between cultures is called cross-cultural ability, including language ability and language and cultural ability. Language skills include having sufficient language tools to communicate with native speakers of a foreign language. Linguistic and cultural competence is a more complex concept, including having sufficient background knowledge to communicate effectively with representatives of another culture.

Within the framework of cross-cultural communication and teaching, the content of cultural components is very important. This training is based on such a culture, such as the way of life, customs and beliefs of a certain group at a certain point in time. In this regard, the teaching of intercultural communication should be based on the concept of intercultural dialogue. The formation of intercultural competencies should be considered in the light of the development of the student personality, his ability and willingness to participate in cultural dialogue on the basis of the principles of cooperation, mutual respect, tolerance of cultural differences and overcoming cultural barriers. In the process of becoming familiar with foreign culture in the context of cultural dialogue, students rely on their cultural cognitive means to implement the means of foreign culture, new knowledge about foreign culture formed during the training process, and new knowledge about their culture created by foreign cultural knowledge.

In addition to being willing to treat foreign cultures as equals, students must also develop a positive attitude towards the reality of the language they are learning, which allows them to interact effectively with representatives of other cultures in some practice.

Therefore, the modern goal of the teaching of foreign languages is to "contact" the personality of the student, the formation of his preparation, abilities and personal qualities, which allows him to carry out various types of speech and thought activities in conditions of social interaction with representatives of another culture, different linguistic worlds. The comprehensive nature of this goal is reflected in the interrelationship of its three aspects: pragmatism, cognition and teaching.

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DEVELOPING WRITTEN COMMUNICATION SKILLS THROUGH REFLECTIVE ESSAYS IN ENGLISH LESSONS AT THE BASIC STAGE OF SECONDARY SCHOOL

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Abstract

Developing written communication skills is a fundamental objective of English education at the secondary school level. Reflective essays provide a unique platform for students to engage with language while connecting it to their personal experiences, fostering critical thinking, self-expression, and clarity in writing. This paper explores the pedagogical benefits of reflective essays in enhancing written communication skills at the basic stage of secondary education. It examines teaching strategies, practical classroom applications, common challenges, and recommendations for teachers aiming to implement reflective writing effectively.

Introduction

The ability to communicate effectively in writing is recognized as a cornerstone of academic success. At the basic stage of secondary school, students transition from constructing simple sentences to creating coherent paragraphs and structured essays. Developing strong written communication skills during this phase not only improves academic performance but also builds a foundation for lifelong learning. Reflective essays, as a genre, encourage students to introspect, analyze their learning experiences, and articulate ideas in a structured form, making them an essential component of modern English instruction.

Research has shown that integrating reflective writing into the curriculum helps learners develop both linguistic and cognitive skills. According to Moon (2006), reflective writing enhances metacognition, enabling students to connect personal experiences with academic content and thereby improve comprehension and expression. This paper focuses on the potential of reflective essays to develop students' written communication skills at the basic secondary school level.

The Nature of Reflective Essays

Reflective essays are a hybrid form of writing that combines personal reflection with analytical reasoning. Unlike traditional essays, which often emphasize factual content or argumentation, reflective essays require learners to explore their personal experiences and interpret their significance.

A typical reflective essay at the secondary school level might ask students to reflect on an English lesson, a reading activity, or a personal learning challenge. For example, students may describe a moment when they struggled with pronunciation or vocabulary, analyze why it was difficult, and suggest strategies for improvement. This process encourages critical thinking while developing students' ability to organize ideas logically.

Reflective writing also promotes self-awareness. Rodgers (2002) emphasizes that reflective practices enable learners to understand how their experiences influence their thought processes and learning outcomes. At the basic stage, this self-awareness can support language acquisition by helping students recognize gaps in their understanding and identify strategies for improvement.

Benefits of Reflective Essays in Developing Written Communication Skills

1. Enhancement of Critical Thinking

Reflective essays encourage students to evaluate their experiences and articulate the reasoning behind their actions. By analyzing their learning processes, students develop the ability to construct coherent arguments and justify their opinions. For example, a student might reflect on why a particular reading strategy helped them understand a text better, connecting experience with theory.

2. Improvement of Language Accuracy and Vocabulary

Reflective writing motivates learners to choose precise vocabulary and grammatical structures to convey nuanced ideas. As students describe experiences and emotions, they experiment with adjectives, adverbs, and complex sentences, gradually expanding their linguistic repertoire. A classroom study by Boud, Keogh, and Walker (1985) highlighted that students who regularly wrote reflective journals demonstrated significant improvement in sentence variety and lexical range.

3. Encouragement of Self-Expression

Reflective essays provide a safe platform for personal expression. At the basic stage, many students lack confidence in writing; reflective tasks allow them to share experiences without fear of strict evaluation. For instance, a student might describe how learning a poem in English made them feel accomplished, thus linking emotion to language use.

4. Development of Organizational Skills

Writing reflective essays requires planning, structuring ideas, and linking paragraphs logically. Students learn to develop an introduction, body, and conclusion, while ensuring smooth transitions. This organizational practice not only improves essay writing but also reinforces general communication skills.

Pedagogical Strategies for Teaching Reflective Essays

1. Scaffolded Writing

Teachers can support students by breaking down the writing process into clear stages: brainstorming, outlining, drafting, revising, and final submission. Providing guiding questions such as "What did I learn?" or "How did I feel?" helps learners articulate reflections more effectively. Sentence starters like "I noticed that..." or "I found it challenging when..." give structure while encouraging creativity.

2. Peer and Self-Assessment

Peer feedback promotes collaborative learning, while self-assessment fosters metacognitive skills. For example, students can exchange essays and provide constructive comments on clarity, grammar, and idea development. Self-assessment checklists, including questions like "Did I clearly explain my thoughts?" help learners critically evaluate their writing and identify areas for improvement.

3. Use of Prompts and Stimuli

Reflective prompts related to classroom activities, texts, or personal experiences stimulate meaningful engagement. Examples include:

"Describe a challenge you faced during a group project and how you resolved it."

"Reflect on a reading that surprised or interested you and explain why."

"Think about a mistake you made in class and what you learned from it."

These prompts guide students' thinking while allowing room for personal expression.

4. Integration of Technology

Digital platforms such as online journals or collaborative writing tools make reflective writing more interactive. Students can write, revise, and share essays digitally, receiving immediate feedback from peers and teachers. Platforms like Google Docs or Padlet can also archive reflective essays, enabling longitudinal tracking of students' progress.

5. Mini Case Example

In a 7th-grade English lesson, students were asked to write a short reflective essay about a reading activity. After drafting, each student exchanged essays with a partner and highlighted two areas of strength and one area for improvement. The teacher then conducted a guided discussion on common errors, reinforcing learning. This approach combined reflection, peer feedback, and teacher guidance, resulting in noticeable improvement in clarity and coherence over four weeks.

Challenges in Implementing Reflective Writing

Despite its benefits, teaching reflective essays presents challenges:

Lack of student confidence: Some learners may struggle to express personal opinions or fear making mistakes.

Balancing personal and academic writing: Students often focus too much on personal narrative, neglecting essay structure or linguistic accuracy.

Time constraints: Reflective writing can be time-consuming, requiring careful planning to integrate effectively into lessons.

Teachers can overcome these challenges by providing clear instructions, exemplars of good reflective writing, and ongoing encouragement. Gradual introduction and consistent practice are key to success.

Practical Recommendations

To maximize the effectiveness of reflective essays, educators should:

1. Introduce reflective writing gradually, starting with short guided reflections.
2. Emphasize the process over the product, encouraging drafts and revisions.
3. Foster a supportive classroom environment where students feel safe sharing experiences.
4. Use exemplars to demonstrate structure, tone, and language.
5. Encourage cross-curricular connections, linking reflective writing to other subjects and life skills.

Conclusion

Reflective essays are a powerful tool for developing written communication skills at the basic stage of secondary education. They enhance critical thinking, language accuracy, self-expression, and organizational skills. Although challenges exist, careful planning, scaffolding, and supportive practices allow students to engage meaningfully with reflective writing. Integrating reflective essays into English lessons not only improves writing proficiency but also cultivates self-awareness, critical thinking, and lifelong learning habits.

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PEDAGOGICAL PRINCIPLES OF DESIGNING EFFECTIVE LEARNING TASKS FOR ACADEMIC READING

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Abstract

The article is devoted to the pedagogical principles of creating effective learning tasks for Academic reading in English. Academic reading is a key skill for university students, but many of them have difficulties with understanding scientific texts, identifying key ideas, and critically analyzing information. The work presents a theoretical and methodological overview of approaches for teaching Academic reading. The basic principles of assignment composition are considered: integrity, consistency, authenticity, variability and motivation. Examples of tasks demonstrating the application of these principles in practice are given. The article highlights the importance of structured and methodically based assignment design for the development of students' academic reading and critical thinking skills. And outlines areas for future research in the field of the learning tasks methodology.

Keywords: *Academic reading, learning tasks, pedagogical principles, higher education.*

In modern higher education, academic reading is considered not just as the ability to understand a text, but as a complex type of cognitive activity, including the analysis, interpretation and critical evaluation of information. The mastery of this skill is directly related to the successful mastering of educational material, the performance of research work and the participation of students in academic discourse. In the context of the expansion of the international educational space, English is becoming a universal means of professional interaction, and the ability to work with authentic scientific texts is an essential component of the education of future specialists.

Despite the importance of academic reading, many students have difficulties with understanding specialized vocabulary, identifying key ideas, structuring information, and critically comprehending what they read. Research in the field of foreign language teaching methods shows that reading problems are often associated not only with an insufficient language level, but also with the lack of formed reading strategies necessary for working with scientific literature.

Successful mastery of academic reading strategies allows students to effectively extract and systematize information from authentic English-language sources, discuss it, and use it for educational, professional, and research purposes when creating their own scientific, official, business, or journalistic texts. That is why the development of methodically based learning tasks becomes the most important condition for the formation of meaningful and critical reading skills.

Despite the growing interest in this problem, the methodological foundations for designing effective learning tasks for teaching academic reading remain insufficiently developed. In this regard, it is important to systematize the pedagogical principles that should underlie the creation of such tasks and ensure the active interaction of students with the text.

The purpose of this article is to analyze the key pedagogical principles that determine the quality of designing learning tasks for the formation of academic reading skills in English. The work is of an overview and methodological nature and is addressed to teachers and methodologists seeking to improve the effectiveness of teaching in a modern university.

Reading takes a special place among the types of speech activity, since it is both a goal and a means of learning a foreign language. For effective learning, it is necessary to take into account the variety of types of reading and the goals for which students turn to the text. Since it is the goal setting that determines the strategy of understanding.

As one of the basic language skills, reading opens up access to new knowledge and promotes the development of other competencies: writing, speaking, listening. In an educational environment, this is

one of the most demand activities: students constantly work with texts of various genres and levels of complexity, perform academic tasks and develop information analysis skills.

Therefore, both teachers and students should pay special attention to the formation of reading skills. Psychologists E. Gibson and H. Levin emphasize that learning to read traditionally occupies a central place in the elementary-level educational process [1]. Because with the help of reading the language acquisition begins. Linguist C. J. Alderson also emphasizes that the ability to read in a foreign language is an essential condition for successful learning, professional growth and personal development [2].

Modern researchers note that reading plays a key role in mastering critical thinking. Thus, C. Yukselir considers reading as a fundamental skill that provides access to alternative interpretations and helps to form skills for analyzing and evaluating information. Reading also helps to expand vocabulary, improves fluency, promotes the development of written and oral communication [3].

The definitions given in authoritative dictionaries and works of linguists emphasize the complex nature of reading. In the Oxford Dictionary, it is described as a process of visual perception and understanding of what is written. D. Crystal distinguishes two approaches: reading as understanding the meaning of a text and reading as a mechanical pronunciation of words that does not involve deep reflection. In his opinion, authentic reading is connected precisely with the extraction of meaning [4].

Thus, reading in a foreign language is a multi-level process that includes decoding, understanding, interpreting, and evaluating information. It is also important to note that academic reading significantly differs from the reading practices students are familiar with at school. University-level texts require deeper interpretation, recognition of rhetorical structures, understanding of disciplinary terminology and the ability to evaluate evidence. This transition often becomes challenging, which further reinforces the need for systematic reading instruction. Its importance in the professional and academic training of students determines the need for methodically competent formation of this skill, including through specially designed learning tasks.

Researches show that for many students, academic reading turns out to be a stressful and time-consuming activity, especially in first years of education. Despite the recognized importance of reading literacy, in practice, students face a number of persistent problems.

Firstly, the transition from school to university reading is accompanied by a dramatic increase in the volume and complexity of texts: scientific articles, monographs and research materials require systematic analysis and further use in educational and research work. Some students do not have time to adapt, which leads to irregular work with texts and refusal to perform compulsory reading.

Secondly, four key groups of reasons that make reading difficult are identified: lack of preparation, low motivation, lack of time, and underestimation of the importance of reading. At the same time, students themselves recognize the importance of academic reading for special performance, the quality of written work and participation in discussions. A detailed analysis shows that difficulties manifest themselves at different levels:

1. Difficulties at the level of the text as a linguistic unit.

At the language level, students face a whole range of obstacles that prevent them from fully comprehending a scientific text. These include insufficient subject training, which limits the ability to relate new information to existing knowledge. Recognition of the structural organization of the text also causes significant difficulties, which prevents a targeted search for information. Additional factors include high terminological saturation, complex syntax, a large amount of statistical data, as well as a significant amount of material, leading to cognitive overload and decreased concentration.

2. Difficulties at the level of text as a unit of communication.

At the communicative level, difficulties are caused by the insufficient formation of specific reading skills necessary for working with scientific discourse. Students often have difficulty interpreting terminology in the context of a discipline, identifying the compositional structure of a scientific text, and performing analytical and critical reading procedures. The construction of a situational model causes particular difficulties: the ability to correlate the content of a text with professional tasks, theoretical approaches and practical context..

3. The consequences of an insufficiently educated academic reading.

Limited understanding of the reading material has a complex negative impact on educational outcomes. Students have difficulty completing written and research assignments. And they are less confident in participating in lecture and seminar discussions, which reduces their academic activity. In addition, the resulting misunderstanding of the text increases the level of anxiety, creates uncertainty about their own learning opportunities and can lead to a decrease in motivation for further reading.

Taken together, these findings demonstrate that academic reading is not merely a technical skill but a complex cognitive and communicative activity that requires systematic pedagogical scaffolding. The problems students face are not isolated or accidental. They reflect deeper methodological gaps in how reading is taught and how reading tasks are designed.

In many educational programs, reading tasks are still approached intuitively: students are simply given large volumes of texts without clear guidance, without differentiation, and without tasks that activate higher-order thinking. As a result, academic reading becomes a passive and often superficial process, rather than a structured intellectual activity aimed at understanding, interpretation, and evaluation of information.

Research in applied linguistics confirms that the ability to read academic texts develops only when students are exposed to purposefully designed tasks that gradually shape cognitive, linguistic, and metacognitive skills. Without such methodological support, many learners continue to rely on inefficient, school-level strategies such as linear reading or word-by-word translation, which are incompatible with academic discourse.

In this context, the role of pedagogically grounded task design becomes central. Well-constructed reading tasks do not simply test comprehension. They guide reading, direct attention to meaningful elements of the text, activate prior knowledge, structure interpretation, and encourage analytical and critical processing. They create an ecosystem of learning tasks in which students move from surface-level decoding to deep understanding and evaluation.

Therefore, identifying clear methodological principles that underpin the design of reading tasks is essential for improving the effectiveness of teaching academic reading in English. These principles allow educators to structure learning materials consistently, ensure coherence between learning goals and task formats, and support the progressive development of students' reading literacy. The effectiveness of academic reading formation directly depends on how well the learning tasks are designed. The tasks determine the nature of the student's interaction with the text, guide cognitive processes, form reading strategies and ensure the transition from skimming techniques to deep, analytical and critical. This makes it necessary to understand the pedagogical principles that should underlie the design of academic reading tasks.

Modern research in the field of foreign language teaching methods and educational design emphasizes that the effectiveness of teaching directly depends on the quality of the educational material. In this regard, the key pedagogical principles that should be followed when designing learning tasks for academic reading are highlighted.

1. The principle of integrity

Integrity implies the combination of the learning tasks into the general educational system and its consistency with the objectives of the course, competencies and expected results. Learning tasks should provide a link between vocabulary, grammar, text structure and practical tasks, creating a holistic understanding of the material.

Example: one task may include reading a scientific article, followed by analyzing the structure of the text, highlighting key ideas, writing a short summary and preparing an oral report of the content. This comprehensive approach allows students to see how reading skills are integrated with other types of learning activities, forming professionally relevant skills.

2. The principle of consistency

The sequence involves a logical and gradual complication of tasks, which contributes to the effective assimilation of the material and prevents cognitive overload. The initial stage is aimed at understanding the main idea of the text and mastering the key vocabulary. Next, the student analyzes the structure of the text, highlights arguments and examples, interprets the data. And then applies the information to critically evaluate or write their own text. Example: A module can start with working on a short paragraph, then move on to a longer text, and finally to a project paper or an essay based on multiple sources. This approach corresponds to Bloom's taxonomy of educational goals and allows for the systematic development of reading and analytical skills [5].

3. The principle of authenticity

Authenticity involves the use of real scientific and professional texts reflecting the style and vocabulary of the academic environment. The learning tasks should simulate real communication situations that a student may encounter in professional activity or scientific work.

Example: working with texts from the business sphere, scientific articles, reports or publications in professional journals. This allows students to develop the ability to extract the necessary information,

form professional competencies and apply the acquired knowledge in real conditions. Authentic materials increase students' motivation, as they see the practical value of the text they are studying.

4. The principle of variability

Variability involves a diversity of tasks and working methods to form a wide range of reading and cognitive skills. Students perform tasks to identify the main and secondary information, analyze the logical structure of the text, interpret graphs and tables, write summaries and critical comments.

Various media and formats are also used: text, audio, video, interactive platforms (for example, Quizlet), pair and group work. The variability of tasks contributes to the development of different reading strategies, takes into account the individual characteristics of students.

5. The principle of motivation

Motivation is a key factor in the successful development of academic reading. Learning tasks should be personally relevant. Taking into account the interests of students, and include elements of problem-based learning, interactive games, and creative projects.

Examples of motivational elements include discussions on a relevant topic, case analysis, role-playing and simulation exercises. This approach encourages the active use of academic texts, increases student engagement and generates a sustained interest in learning activities.

The application of these principles: integrity, consistency, authenticity, variability, and motivation — allows to create the learning tasks that not only develop academic reading skills, but also form students' critical, analytical, and communicative thinking. Following these principles ensures the consistency, meaningfulness and effectiveness of the educational process. As well as contributes to the successful integration of students into the academic and professional environment.

An analysis of the theoretical and practical aspects of academic reading shows that this skill is a multifaceted cognitive activity that includes understanding, analyzing, interpreting, and critically evaluating information. In the context of modern higher education and the globalization of the educational space, English language proficiency and the ability to work with authentic scientific texts are becoming an important part of students' professional training.

Despite the importance of academic reading, students face difficulties at the linguistic, communicative and cognitive levels, which negatively affects their learning activity, motivation and the development of critical thinking. Effective overcoming of these problems is possible through methodical design of the learning tasks. Taking into account key pedagogical principles: integrity, consistency, authenticity, variability and motivation.

The application of these principles ensures the systematic formation of academic reading skills, the development of critical and analytical thinking, communicative competence and professional literacy of students. Thus, the creation and implementation of well-designed learning tasks is a strategically important task of modern education, contributing to successful academic and professional training, the formation of a sustained interest in learning activities and the ability to critically work with information. It is a necessary prerequisite for future professional success.

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UDC 811.111-26

THE ROLE OF PODCASTS IN CULTIVATING ACADEMIC LITERACY**Akbergenova Meruyert**

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РОЛЬ ПОДКАСТОВ В ПОВЫШЕНИИ АКАДЕМИЧЕСКОЙ ГРАМОТНОСТИ**Акбергенова Меруерт**

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Abstract

This article explores the effectiveness of using podcasts in teaching English to master's students. It defines the concept of podcasting, outlines its history, and examines its application in language didactics. Special attention is given to the role of podcasts in developing receptive (listening) and productive (speaking) skills. Podcasts offer graduate students the ability to choose topics, pace, and learning formats, which fosters autonomy, flexible thinking, creativity, and motivation. The article presents the results of an experimental study conducted among 60 master's students at Al-Farabi Kazakh National University. The experiment confirmed that podcasts improve listening comprehension, pronunciation, fluency, argumentation, vocabulary acquisition, and confidence in speaking. It also demonstrates that the use of podcasts makes the educational process more engaging and effective through the use of authentic audio materials, digital technologies, and elements of interactive communication. This method accommodates individual learning styles, promotes critical thinking, builds stable language habits, and strengthens the communicative competence of future professionals in academic and professional environments. Additionally, podcasts facilitate the integration of learning into everyday life, enhance digital literacy, and support the development of metacognitive strategies necessary for autonomous language acquisition.

Аннотация

Статья посвящена исследованию эффективности использования подкастов в обучении английскому языку магистрантов. В ней раскрывается понятие подкастинга, его история, особенности применения в лингводидактике. Особое внимание уделяется роли подкастов в формировании рецептивных (аудирование) и продуктивных (говорение) навыков. Подкасты предоставляют магистрантам возможность выбора тем, темпа и формата изучения, что способствует развитию автономии в обучении, гибкости мышления, креативности, а также формированию мотивации. В статье приводятся результаты экспериментального обучения, проведённого среди 60 магистрантов Казахского национального университета имени аль-Фараби. Эксперимент подтвердил, что подкасты улучшают восприятие на слух, произношение, беглость речи, аргументацию, расширяют словарный запас и развивают уверенность в говорении. Также показано, что использование подкастов делает учебный процесс более вовлекающим и эффективным за счёт применения аутентичных аудиоматериалов, цифровых технологий и элементов интерактивного взаимодействия. Метод позволяет учитывать индивидуальные стили обучения, способствует развитию критического мышления, формирует устойчивые языковые привычки и усиливает коммуникативную компетентность будущих специалистов в академической и профессиональной среде. Кроме того, подкасты облегчают интеграцию обучения в повседневную жизнь, повышают цифровую грамотность и поддерживают развитие метакогнитивных стратегий, необходимых для самостоятельного овладения иностранным языком.

Keywords: podcasts, listening skill, speaking, graduate students, digital literacy, communicative competence.

Ключевые слова: подкасты, навыки аудирования, говорение, магистранты, цифровая грамотность, коммуникативная компетенция.

Introduction

English is a leading means of international communication, so effective methods of teaching it are becoming increasingly important. Teaching includes four key skills: speaking, listening, reading and writing. Particular attention is paid to productive skills, primarily speaking, as an indicator of active language acquisition. Among modern methods, digital technologies, in particular podcasts, occupy a special place. The term "podcasting" comes from the words iPod and broadcasting and refers to the process of distributing audio and video materials on the Internet. Podcasts, unlike radio, provide the opportunity to choose the topic, duration and speed of perception, which makes them an attractive tool in learning a foreign language. Their relevance in education is explained by the high level of motivation and involvement that they cause in graduate students. A number of studies confirm the effectiveness of podcasts in developing listening and speaking skills in English language learners [1, 276-282].

With the development of digital technologies, traditional forms of education are undergoing significant changes. In the context of the information society, it is important for graduate students not only to master the language at an academic level, but also to be able to use modern tools for its study. This is especially relevant for graduate students whose educational trajectory requires a high degree of independence, critical thinking and readiness for professional interaction in a foreign language. In this context, podcasts are becoming one of the most promising tools for integrating language training into the daily life of students [2, 23-25].

Podcasts provide access to authentic language material, which is distinguished by a variety of topics, styles and levels of difficulty. This gives graduate students the opportunity not only to develop listening skills, but also to adapt to different accents, speech rates, and communicative situations. Unlike standardized educational audio recordings, podcasts reflect live, natural speech, often including elements of informal vocabulary, idioms, and discursive markers. All this makes them a valuable resource for both passive perception and active language practice. In addition, podcasts help develop metacognitive strategies in master's students. Since they can independently choose the topic, frequency of listening, and format of interaction with the material, they develop the ability to plan learning, monitor their own progress and apply the acquired knowledge in real situations. This approach enhances the autonomy of students, which is especially important for master's students striving for academic and professional mobility [3, 103-105].

It is also worth noting the high level of involvement when using podcasts. Thanks to the elements of storytelling, humour, dialogue form and relevance of the content, podcasts evoke an emotional response in listeners, increase motivation for learning and create conditions for the formation of a sustainable interest in the language. This is especially important in the context of intercultural communication, where emotional involvement contributes to better memorization of information and the development of empathy for native speakers.

The use of podcasts in educational practice allows the teacher to vary methodological approaches: from individual work to project activities, from classroom assignments to independent analysis and creation of their own podcasts by master's students. This approach supports the implementation of a competency-based approach aimed at developing not only linguistic, but also communicative, informational, research and presentation skills [4, 64-69].

Scientific research conducted in different countries confirms the effectiveness of podcasts as a means of developing receptive and productive skills. In particular, it was found that regular listening to podcasts improves speech perception skills, helps to increase vocabulary, develop fluency and confidence in speaking. Podcasts can also be integrated into blended and distance learning, allowing you to maintain the continuity of the educational process under changing conditions, such as the transition to an online format.

In light of the above, the use of podcasts as an innovative tool for teaching English to master's students seems to be a very promising direction. It requires further reflection, development of methodological recommendations and applied research. This article aims to study the impact of podcasts on the

development of speaking and listening skills in master's students, as well as to determine their didactic potential in the context of the digital transformation of education [5, 61-63].

Materials and methods

The experimental study was conducted among 60 second-year master's students of Al-Farabi Kazakh National University majoring in English. The master's students were divided into control and experimental groups of 30 people.

The experiment lasted 4 weeks. The experimental group listened to English-language podcasts three times a week and completed the following tasks:

- writing notes;
- oral summarization;
- participation in debates.

The control group studied using traditional audio materials from textbooks.

The following methods were used:

- questionnaires (before and after);
- written listening testing;
- quantitative and qualitative analysis of the results.

Results and discussion

After the completion of the four-week experiment, the indicators of the control and experimental groups were compared according to four main criteria: listening level, speaking level, degree of involvement and motivation, as well as perception of digital technologies in learning. The assessment was carried out using oral and written testing, as well as [6, 54-58].

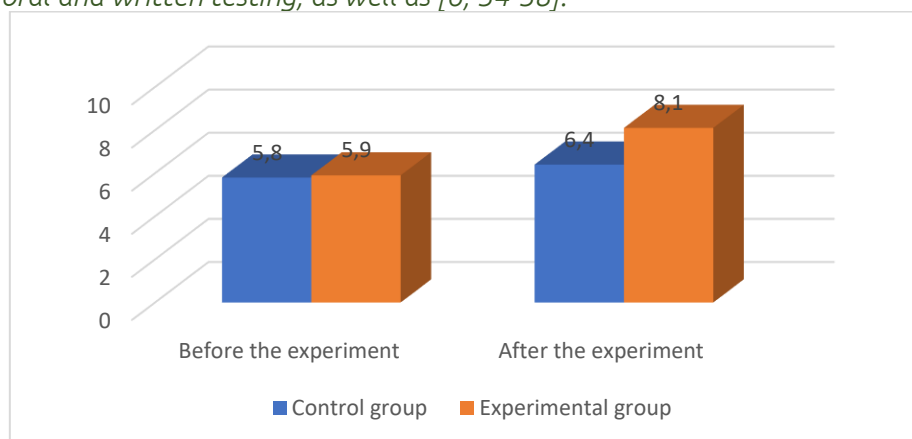


Figure 1 - Comparative results of listening testing (on a 10-point scale)

Figure 1 shows the results of listening testing for the control and experimental groups before and after the experiment. Before the experiment, the scores of both groups were approximately the same: the control group showed a result of 5.8 points, and the experimental group - 5.9 points. However, after four weeks of training using podcasts, the experimental group demonstrated significant improvement - the average score increased to 8.1. At the same time, the control group, trained using the traditional method, increased the result only to 6.4. This indicates that the use of podcasts had a more pronounced positive impact on the development of listening skills compared to traditional audio materials. The difference in the increase in results between the groups confirms the effectiveness of integrating digital technologies into the educational process [7].

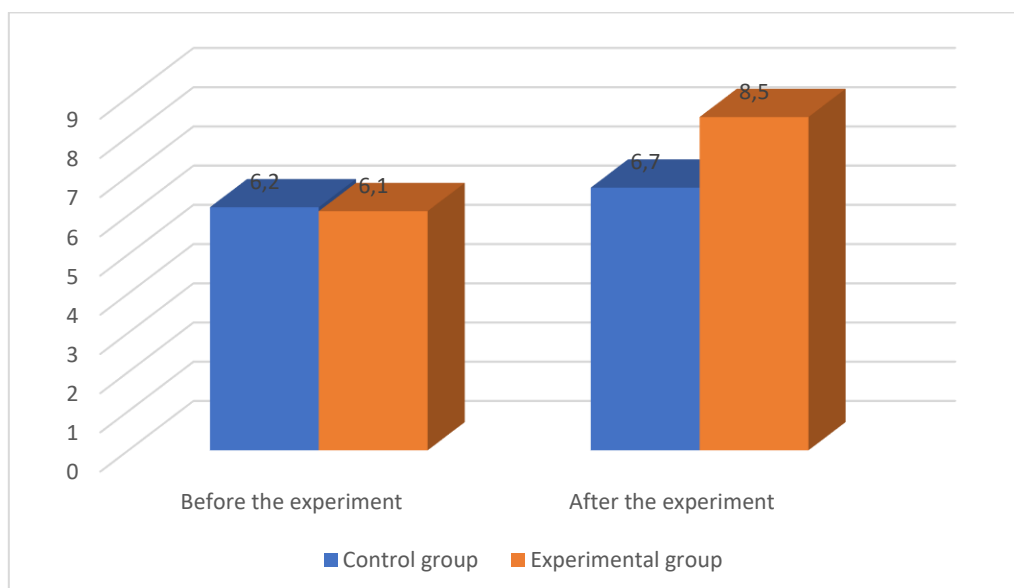


Figure 2 - Average score for oral communication skills (on a 10-point scale)

Figure 2 shows the dynamics of changes in speaking skills of master's degree students in the control and experimental groups before and after the experiment. Before the start of the training, the differences between the groups were minimal: the control group had an average score of 5.6, and the experimental group had 5.9. Upon completion of the four-week program, during which the master's degree students in the experimental group actively used podcasts, their average score increased to 8.1. At the same time, the control group, taught using the traditional method, achieved only 6.4 points. Thus, the increase in the experimental group was 2.2 points, while in the control group it was only 0.8. These data allow us to conclude that the use of podcasts has a significantly stronger impact on the development of oral speech in master's degree students than standard teaching methods. Podcasts probably contributed to increased motivation and engagement of master's degree students, and also provided more authentic and varied speech samples, which influenced the improvement in results [8, 523-526].

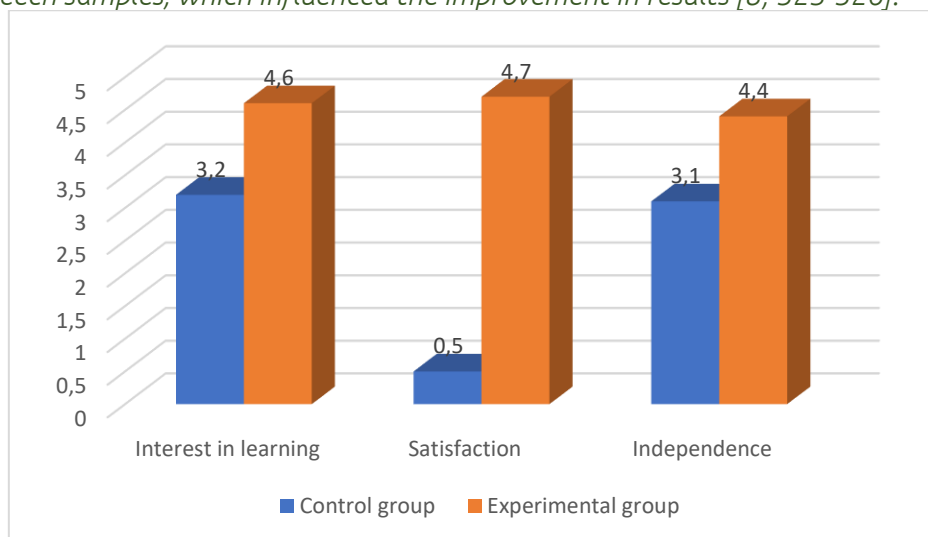


Figure 3 - Level of motivation and involvement (on a scale from 1 to 5 based on the survey results)

Figure 3 illustrates the level of non-motivational factors of learning in master's degree students in the control and experimental groups after the experiment, in particular - interest in learning, satisfaction and independence. For all three indicators, the experimental group that used podcasts demonstrated significantly higher results. Thus, their interest in learning was 4.6 compared to 3.2 in the control group. The level of satisfaction in the experimental group was especially high - 4.7 versus only 0.5 in the control group. This suggests that traditional methods practically did not cause a positive emotional response in master's degree students. The independence indicator is also higher in the experimental group (4.4 versus 3.1), which indicates that podcasts contributed to the development of self-regulated learning skills. Thus, podcasts not only improved language skills, but also had a positive effect on the motivation, engagement and autonomy of master's degree students [9, 1336-1340].

The obtained results demonstrate a clear advantage of using podcasts in teaching English compared to traditional audio materials. The experimental group showed a significant improvement in both listening and speaking skills. It is especially indicative that the increase in speaking skills in the experimental group was +2.4 points - this is explained by active tasks: summarizing, debates, discussion of the content of podcasts. Thus, podcasts contributed not only to the passive perception of information, but also to the development of productive speech skills [10, 875-880].

In addition to cognitive results, a significant increase in motivation is observed in master's degree students in the experimental group. The higher level of engagement is explained by freedom of choice, interesting topics, availability of the format and flexibility of use. This confirms the thesis about the importance of the emotional component in the process of learning a foreign language. It is also worth noting the positive feedback from graduate students about the introduction of podcasts into the educational process. Many of them reported increased confidence in speaking and easier perception of information by ear. In addition, graduate students began to use podcasts more often outside of academic assignments, which indicates the integration of language learning into everyday life - the most important indicator of the effectiveness of modern education. Thus, it can be concluded that the use of podcasts as an additional means of teaching English to graduate students has a positive effect on the level of language competencies and increases motivation for learning.

Conclusion

The conducted research allows us to state that the use of podcasts in teaching English to master's students is an effective pedagogical tool. The introduction of podcasts into the educational process contributes not only to the development of language skills, but also to the formation of sustainable motivation for learning a foreign language, as well as to the growth of involvement and independence of students. One of the key findings is that podcasts significantly improve listening skills. Authentic audio materials presented in podcasts allow master's students to hear live, natural speech with different accents, intonations and tempos. This develops the flexibility of listening perception and helps to better adapt to real communicative situations that they may encounter in a professional or academic environment.

In addition, podcasts contribute to the active development of oral speech. Tasks that accompany listening, such as retelling, discussion, participation in debates and presentations, allow master's students to use the knowledge they have gained in practice. This not only strengthens productive speaking skills, but also increases self-confidence, reduces fear of public speaking and helps to form clear and logical arguments in a foreign language. It is important to note that podcasts have a positive effect on the emotional perception of the learning process. Thanks to interesting topics, a varied format, the ability to choose the content and listening time, students develop a personal interest in learning the language. The element of novelty and involvement makes learning more lively and motivating. Master's students feel that language learning goes beyond standard exercises and becomes part of their everyday life. This, in turn, contributes to the sustainable formation of a language environment outside the classroom. The development of autonomous learning skills deserves special attention. Podcasts provide master's students with freedom of choice - they decide for themselves which topics are most interesting to them, at what pace and format they want to work. Such freedom contributes to the development of metacognitive strategies: students learn to plan their learning, monitor progress, correct weaknesses and apply knowledge in new situations. This is especially important in the context of training specialists who will work in a rapidly changing digital and multilingual environment in the future. Teachers should differentiate the levels of students and interests to give them the proper materials. (11)

The use of podcasts also allows the teacher to implement a flexible and modern approach to teaching. The ability to integrate podcasts into face-to-face, blended and distance learning makes this tool universal. It easily adapts to various learning environments and styles of information perception, which is especially important when working with master's students with different levels of training and professional interests. As a result of the analysis, it can be stated that podcasts contribute to the formation of a wide range of competencies: from linguistic and communicative to digital and critical thinking. This makes them not just an auxiliary tool, but a full-fledged element of an educational strategy aimed at developing a comprehensively trained, creative and independent specialist. In addition, the use of podcasts helps to integrate a foreign language into the daily life of students, forming a habit of constant interaction with the language in an informal but productive form. Thus, we can conclude that podcasts are a powerful tool that can revive the learning process, make it more interactive, modern and focused on the real needs of master's students. Their use allows not only to improve the level of language training, but also to form a positive attitude towards learning English as an important resource for professional

growth and academic mobility. Podcasts has been utilized every single day. The options are varied depending on the topics they like. [12]

Listening to podcasts not only in the classroom but also outside helps students develop critical thinking and creative skills. [13] There are limitless sites for students. Different approaches impact different individuals; some people prefer apps, some of them video podcasts, others audiobooks and so on.[14] Practicing listening is vital in our century. [15]

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Pharmaceutical sciences

TREATMENT OF DRY AND WET COUGH WITH HERBAL MEDICINES

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ЛЕЧЕНИЕ НА СУХА И ВЛАЖНА КАШЛИЦА С РАСТИТЕЛНИ ДРОГИ

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Abstract

Coughs can vary in duration and nature. In order to prescribe adequate treatment, it is necessary to know what type of cough it is. The most preferred medicinal products for the treatment of cough are herbal products.

Резюме

Кашлицата може да се различава по своята продължителност и характер. За да се назначи адекватно лечение е необходимо да се знае какъв тип е кашлицата. Най-предпочитаните лекарствени продукти за лечение на кашлицата са продуктите на растителна основа.

Keywords: cough, dry, wet, herbal products, expectorants

Ключови думи: кашлица, суха, влажна, растителни продукти, експекторанти

Кашлицата е едно от най-често срещаните възпаления на горните дихателни пътища. Тя е физиологичен защитен рефлекс, който може да възникне поради дразненето на дихателните пътища от чужди частици, секрети, бактерии и дразнещи вещества. Целта ѝ е да подпомогне дихателната система, нормалното дишане и да поддържа здравето на белите дробове. Тази грижа за дихателната система се извършва чрез отделянето на чуждите частици. Рецепторите, които са разположени в лигавицата на трахеята и бронхите, реагират на най-малкото дразнене и предизвикват съкращаване на дихателните мускули (диафрагма, междуребрени мускули и др.)

Кашличният рефлекс е изграден от три етапа: **дълбоко вдишване, блокиране на въздуха в ларинкса и след това бързо издишване чрез грубо отваряне на глотиса (отвора на ларинкса).**

Кашлицата може да се различава по своята продължителност и характер. Тя може да има краткотрайни пристъпи, но редовни, може и да са продължителни с ниска или висока интензивност, също така могат да са придружени с тежка болка в гърдите. Също така, тя може да се предизвика доброволно или да се активира като рефлекс.

Поради това, че кашлянето е често срещан симптом, е препоръчителна консултацията с лекар, за по-бързо излекуване. За да се назначи адекватно лечение, трябва да се знае какъв е типът на кашлицата - суха или влажна (продуктивна). Най-предпочитаните лекарствени продукти за лечение на кашлица, било то суха или влажна, са продуктите на растителна основа.

ВИДОВЕ КАШЛИЦА

Сухата кашлица е позната още и като непродуктивна или дразнеща. За разлика от влажната, при сухата кашлица дразненето на дихателните пътища не е придружено с

производство или изкашляне на слюз (или храчка). Дори и да няма наличие на храчки, сухата кашлица може да е болезнена, изтощителна и е възможно започването на порочен кръг, т.е. кашлянето дразни дихателните пътища, чрез което провокира следващи пристъпи на кашляне. За ограничаване развитието на сухата кашлица е нужно да се използват лечебни растения, които съдържат полизахариди, тъй като те имат имуномодулиращ ефект. Използват се също лечебни растения съдържащи слузни вещества, поради тяхната функция да образуват защитен слой върху лигавицата срещу дразнителите.

Влажната кашлица или още позната като продуктивна, се характеризира с периодично отделяне на слюз или храчки. Храчките могат да са плътни, лепкави субстанции, които се секретират от лигавиците и жлезистите клетки, те задръстват дихателните пътища. Влажната кашлица често може да е предшествана от суха кашлица. При инфекции на дихателните пътища в резултат на възпалението, бронхиалната слюз може да се трансформира в ексудат, който предизвиква кашлица, като рефлекс да се премахне дразнителя. В такива случаи се използват експекторанти, тъй като те намаляват вискозитета на мукозата и улесняват премахването му чрез кашлица. Използват се две групи растителни експекторанти за лечение на влажна кашлица - директни и рефлексни. Директни експекторанти съдържат етеричните масла добивани от различни растения, те се прилагат директно, чрез инхалиране, но приложени орално или трансдермално се екскретират в бронхите и имат същото действие, но забавено или удължено. Рефлексните експекторанти съдържат сапонини, които дразнят гастроинтестиналната лигавица и по този начин предизвикват рефлекс на стимулиране на респираторната секреция, в резултат на увеличеното производство се намалява вискозитета на слюзната.

Най-често използваните лечебни растения за лечението на суха кашлица са: Лечебна ружа (*Althaea Officinalis* L., *Malvaceae*), Исландски лишей (*Lichen islandicus*, *Parmeliaceae*), Теснолист живовляк (*Plantago Lanceolata*, *Plantaginaceae*), Ленено семе (*Linum usitatissimum*, *Linaceae*).

За лечението на влажна кашлица най-разпространените лечебни растения са: Бръшлян (*Hedera helix*, *Araliaceae*), Корен от Иглика (*Primulae Radix*, *Primula veris*, *Primula elatior*, *Primulaeaceae*), Градинска мащерка (*Thymus vulgaris* L., *Lamiaceae*), Женско биле (*Glycyrrhiza glabra*, *Fabaceae*), Евкалипт (*Eucalyptus globules*, *Myrtaceae*).

ЛЕЧЕБНИ РАСТЕНИЯ ЗА ЛЕЧЕНИЕ НА СУХА КАШЛИЦА

Лечебна Ружа- *Althaea officinalis* L., *Malvaceae*

Лечебната ружа се използва за лечението на суха кашлица, тъй като съдържа 5-10% полизахариди и слузни вещества, които образуват защитен слой за предпазване на лигавицата от дразнителите. Ефектът ѝ може да се дължи на потискането на мукоцилиарната активност на езофагеалния епител. Тя има омекчаващо и противовъзпалително действие. Корените на лечебната ружа проявяват противомикробно действие срещу различни патогени като *Staphylococcus aureus*, *Proteus vulgaris* и др. ЕМА е публикувала монография за растително лекарство с традиционна употреба със следните индикации: симптоматично лечение на орално и фарингеално дразнене съпроводено със суха кашлица, симптоматично облекчаване на гастро-интестинален дискомфорт. Приемът на продукт, който съдържа лечебна ружа едновременно с други лекарства може да намали усвояването на другия медикамент.

Исландски лишей - *Lichen islandicus*, *Parmeliaceae*

В него се съдържат 25-50% полизахариди. Те покриват лигавицата като създават защитен слой срещу дразнителите. Това доказва неговото омекчаващо, защитно и покривно действие върху лигавицата на дихателните пътища и стомашно-чревния тракт. Различни екстракти от Исландски лишей проявяват антимикробна активност, срещу редица патогенни бактерии. Стимулират гранулоцитната фагоцитоза *in vitro*. Основната му употреба е за успокояване на кашлицата при катар на горните дихателни пътища, при бронхити, коклюш, бронхиална астма и др. Като традиционен растителен лекарствен продукт може да се използва като омекчително средство за симптоматично лечение на орално или фарингеално дразнене свързано със суха кашлица и за лечение на временна загуба на апетит.

Теснолист живовляк – *Plantago Lanceolata*, *Plantaginaceae*

В теснолистния живовляк се съдържат 2-3% иридоидни гликозиди, фенилетаноиди, флавоноиди, танини, органични киселини, 5% слузни вещества, полизахариди. Полизахаридите се прилепват към лигавицата, образувайки мембрана и по този начин спомагат за намаляване дразненето и успокояват кашлицата. Воден екстракт има противомикробно действие срещу различни патогени, предизвикващи заболявания на дихателните пътища, като например:

Staphylococcus aureus, *Streptococcus hemolyticus*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*. Благодарение на иридоидните глюкозиди, заедно с фенилетаноидите, водните екстракти показват противовъзпалително действие при различни експериментални модели. Те инхибират образуването на NO и на ензима COX-2. Извлекът от него също спомага за епителизирането на рани. Съдържащите се иридоиди и фенилетаноиди имат спазмолитичен ефект. Приготвянето на чай от теснолист живовляк в домашни условия е един отличен лек за кашлицата. Той се приготвя, като в чаша се поставят 1-2 чаени лъжички сухи листа, които се заливат с 250мл. гореща вода и се оставя 10 мин, след което се прецежда. Тъй като теснолистният живовляк е леко горчив, може към чая да се добави мед за подслаждане. Медът също така ще допринесе за по-бързото облекчаване на кашлицата, благодарение на своето антибактериално свойство.

Ленено семе- *Lini semen*, *Linum usitatissimum*, *Linaceae*

Лененото семе съдържа 3-6% слузно вещество. В народната медицина Лененото семе се използва за лечението на кашлица, тъй като има отхрачващо и противокашлично действие. То облекчава възпаленото гърло и е ефективно средство за изхвърляне на излишния секрет от дихателната система. Слузите от Ленено семе не само действат върху сухата дразнеща кашлица, а и успокояват лигавицата на бронхите. Необходимо е да се залее две супени лъжички семе от лен в чаша с гореща вода, след което да се остави за 10-15 минути под капак, докато набъбнат семената и станат с консистенция подобна на желе. То подпомага овлажняването на раздразнените стени на гърлото по време на силна кашлица, намалява честотата на кашлицата, поради което увреденият бронхиален епител има възможността да регенерира по-бързо. За да се подобри вкуса на напитката, може да се прибави малко мед. Подходящо за прием и от малки деца. Лененото семе се използва външно при изгаряния, възпаления на кожата и лигавицата.

ЛЕЧЕБНИ РАСТЕНИЯ ЗА ЛЕЧЕНИЕ НА ВЛАЖНА КАШЛИЦА

Бръшлян - *Hedera helix*, *Araliaceae*

Бръшлянът съдържа 2,5- 6% хедеракозиди В и С, монодесмозиди - α - хедерин и β - хедерин с агликонолеаноолова к-на и хедерагенин. (Йотова, 2023) Той проявява отхрачващо, бронходилатиращо, противовъзпалително и спазмолитично действие. Листата на бръшляна съдържат сапонини, които чрез действието си да дразнят гастро-интестиналната лигавица спомагат за отделянето на излишния секрет и до облекчаване на кашлицата. Сиропът с бръшлян подпомага освобождаването на дихателните пътища от слузта и също така облекчава дишането. Бръшлянът има способността да втечнява гъстите секрети и има бронхоспазмолитично действие. Дрогата може да се прилага под формата на студен извлек при кашлица, бронхити, астма и др. Външно се използва като противовъзпалително при рани, брадавици, изгаряния и др. Растителните експекторанти с екстракт от бръшлян са подходящи за възрастни и деца над 2 години.

Корен от Иглика - *Primulae radix*, *Primula veris*, *Primula elatior*, *Primulaceae*

Игликата съдържа 3-10% сапонини, основен от които е примуловата киселина. Ефектът се дължи на сапонините, които дразнят чревната лигавица, в резултат на което рефлексно се увеличава бронхиалната секреция с по-нисък вискозитет. Включва се също дразнене на лигавицата на гърлото и намаляване на повърхностното напрежение на секретите и улесненото им изхвърляне чрез кашлицата. Корена от Иглика се използва като запарка или отвара в комбинации с други лекарствени продукти, като експекторанс при катар на горните дихателни пътища, бронхите и др. Екстрактът от Иглика приложен *in vitro* има доказано противобактериално действие срещу патогени като *Staphylococcus aureus* и *Escherichia coli*. При лечението на деца се предпочитат цветовете на билката пред корените, защото са по-приятни на вкус и по-слабо дразнят стомаха. Чая при децата се приема по 1 чаша няколко пъти на ден.

Градинска мащерка - *Thymus vulgaris* L., *Lamiaceae*

В състава на Градинската мащерка, основна съставка е етеричното масло, което е 1-2%. Съдържат се също 40% тимол и карвакрол. Етеричното масло придава антимикробно действие на Градинската мащерка. Силно антибактериално действие се оказва както върху Грам-положителни така и върху Грам-отрицателни патогени. Върху няколко щамове вируси оказва антивирусен и противовъзбуждаващ ефект. Такива са: Метицилин-резистентният *Staphylococcus aureus*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Streptococcus pneumoniae*, *Herpes simplex* и др. Дори изпаренията на маслото са високо ефективни срещу патогени на дихателните пътища. Действието се дължи главно на тимола и карвакрола. Запарка от дрогата и течния екстракт -

Extractum Thym i vulgaris fluidum, притежават секретолитично, спазмолитично, антисептично действие. Прилагат се като експекторанс при бронхити и други възпаления на горните дихателни пътища. Градинската мащерка има благоприятно действие и върху секреторните и двигателните функции на храносмилателната система. Тя се използва като карминативно средство при подуване, тежест в стомаха и затруднено изхождане. Употребата на чая се препоръчва и при чувство на умора и за подобряване на настроението.

Женско биле (Сладник) – *Glycyrrhiza glabra*, *Fabaceae*

Частта от женското биле, която се използва за облекчаване на влажна кашлица е корена - *Radix Glycyrrhizae*. В него има наличие на сапонини, 3-5% 18-β-глициризинова к-на. Въпреки че отхрачващото му действие не е проучвано детайлно се смята, че то се извършва чрез рефлексен механизъм през стомашната лигавица. Поради омекчаващото и отхрачващото действие, сладникът е основна съставка в отхрачващите чайове и медикаменти. Предполага се, че слюзните вещества покриват фарингеалната повърхност, като по този начин облекчават и сухата кашлица. Дрогата се прилага под формата на декокт - *Decoctum Radix Lyquiritiae*, сух и гъст екстракт – *Extractum Liquiritiae siccum* и *Extractum Liquiritiae spissum*.

Евкалипт - *Eucalyptus globules*, *Myrtaceae*

Минималното количество етерично масло, което се съдържа в евкалипта е 20мл/кг, минимално 70% 1,8-цинеол. Етеричното масло и цинеола придават антивирусна и инхибираща активност върху бактериите (включително щамове на стафилококи и стрептококи) и намаляване на растежа на гъбички *in vitro*. При перорален прием на маслото се увеличава производството на секрет от дихателните пътища, което е доказано върху морски свинчета. Евкалиптовото масло проявява ефекти, подобни на повърхностно активното вещество, което може да подпомогне отхрачващото му действие. Маслото разширява кръвоносните съдове, което позволява повече кислород да попадне в белите дробове и това може да бъде от полза, когато има наличие на кашлица или задух. Най-добрият начин за употреба на евкалиптовото масло за кашлица е чрез дифузиране на 5 капки от него вкъщи, преди лягане. Маслото може да се прилага и локално като се намаже върху гърдите или шията, за да се намали тежестта на кашлицата, но трябва да се използва малко количество, може да се започне с 1- 2 капки. Друг много добър начин за употребата на етеричното масло при кашлица е чрез инхалация. В 1 литър вряща вода на котлона се добавят 1-2 капки масло от евкалипт и се вдишват парите. Маслото не трябва да се употребява локално върху деца под 2- годишна възраст.

Собствено проучване

ЦЕЛ И ЗАДАЧИ

Целта на проведеното проучване е да се оценят познанията на пациентите относно основните лечебни растения, които се използват при лечението на суха и влажна кашлица, и до колко е познато коя растителна дрога при кой вид кашлица се използва.

За да се изпълни целта на проучването се проведеха следните задачи:

Събиране на информация от различни източници по изследваната тема. Разработване на въпроси за осъществяването на анкетно проучване. Анализ на получените резултати от анкетата.

МЕТОДИКА НА ПРОУЧВАНЕТО

Проучването е проведено със случайно избрани 41 пациента. То е проведено в периода март-април 2025г. Анкетиранияте са получили предварително разяснение за целта на проучването и е гарантирана тяхната анонимност.

Методът, използван за проучването е предварително изготвена анкетна карта, която е разпространена между таргетни пациенти.

РЕЗУЛТАТИ

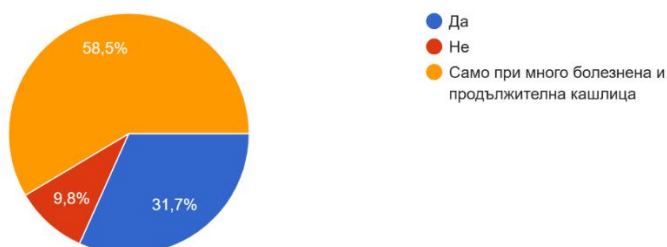
В проведеното анкетно проучване свързано с лечението на суха и влажна кашлица по-голямата част от анкетиранияте са жени - приблизително 83%, а анкетиранияте мъже са едва 17,1%.

Респондентите са от различни възрастови групи. Най-активно участие е от групата на 19-30 г, като те са приблизително 44% от всички анкетирани. Следващата група с най-много участници е групата между 51 и 70 г. възраст, те са над 34%. Третата група е от 31 до 50 г. възраст и те са 19,5%. Най-малко участие в анкетното проучване има от хората под 18г. възраст, те са едва 1% от всички участници.

На въпроса дали при поява на симптоми на кашлица участниците се консултират със своя лекар, 31,7% са отговорили, че извършват консултация за по-лесно и бързо излекуване. Хората,

които не се консултират със своя личен лекар са 9,8%. Най-голям е броят на хората, които правят консултация с личния си лекар само при много болезнена и продължителна кашлица - 58,5% от всички анкетирани. От получените отговори можем да направим извода, че по-голямата част от хората прибегват към консултация с лекар само когато симптомите на кашлицата са болезнени и продължителни.

Консултирате ли се с вашият лекар при поява на кашлица?
41 отговора

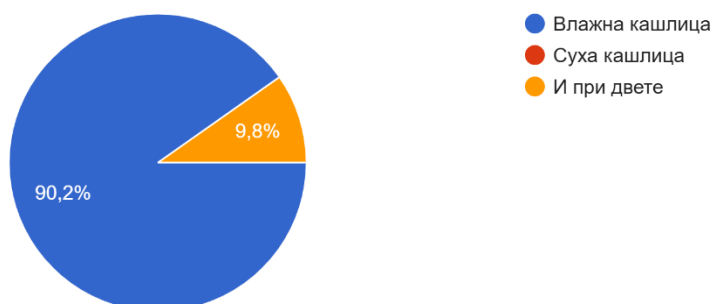


Фиг. 1

На въпроса „Консултирате ли се с вашия лекар при поява на кашлица?“ по-голяма част от анкетираните лица посочват, че има два вида кашлица - суха и влажна. Много малка е броят на хората, които смятат, че има повече от два вида кашлица, като освен суха и влажна те споменават кашлица от алергии, хронична и така наречената „магарешка“, кашлица. От получените отговори стигаме до извода, че повечето хора имат познанията, за това колко са видовете кашлица, само една малка извадка от всички анкетирани смятат, че видовете кашлица са повече от два.

На въпроса свързан с отделянето на секрет и при кой тип кашлица се среща, от трите възможни отговора най-много е посочван отговора, свързан с влажната кашлица - над 90% са отговорили по този начин. Само 9,8% са посочили, че и при двата вида кашлица има отделяне на секрет. Нито един от анкетираните не е посочил, че секрет се отделя само при сухата кашлица.

При кой вид кашлица има отделяне на секрет?
41 отговора

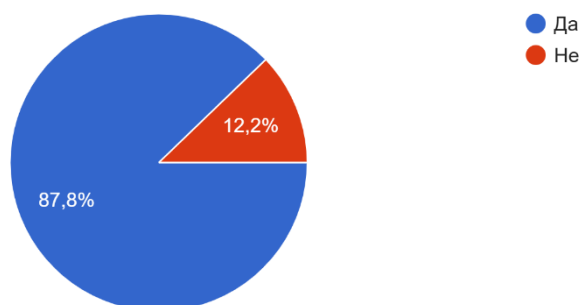


Фиг. 2

Попитани дали приемат чайове за успокоение на кашлицата, анкетираните са отговорили: 78% от тях, че използват чайове за облекчение. Едва 22% не пият чайове при симптоми на кашлица. От отговорите разбираме, че по-голямата част от хората вярват, че приема на топли чайове може да доведе до облекчение на болките и дискомфорта причинени от кашлицата.

Употребявате ли медикаменти на растителна основа при кашлица?

41 отговора



Фиг. 3

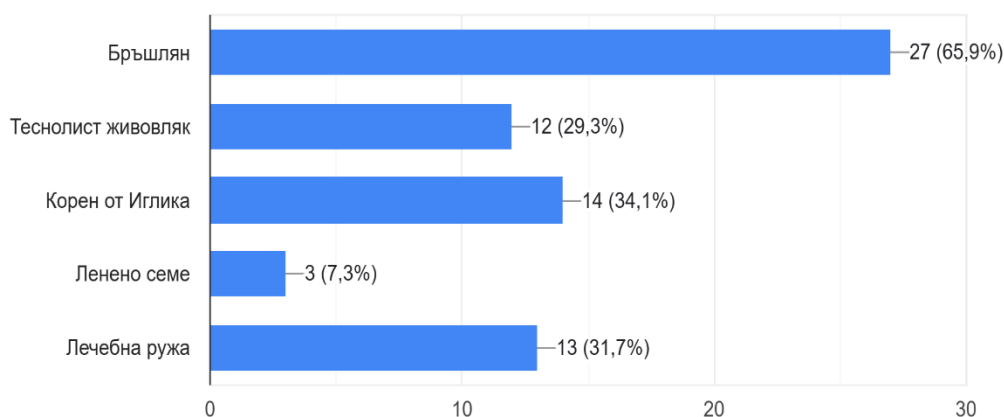
На следващия въпрос, който е свързан с употребата на медикаменти на растителна основа при кашлица, 87,8% от анкетираните казват, че използват такива и едва 12,2% отговарят, че не употребяват такъв вид медикаменти. Което показва, че по-голямата част от хората смятат, че приема на лекарства на растителна основа ще им помогне да излекуват кашлицата си.

Направено е проучване до каква степен анкетираните познават лечебните растения, които се използват за лечението на суха и влажна кашлица. Въпросът е дали знаят кои растения са най-ефективни при лечението на суха кашлица. От изброените растения най-често като отговор на зададения въпрос е Градинската мащерка - 51,2%, следвана от Исландския лишей - 43,9%, Теснолист живовляк - 29,3%, Корен от Иглика - 19,5%, Женско биле - 14,7%. От получените отговори се разбира, че хората посочили Исландски лишей и Теснолист живовляк имат познанията и знаят, че тези две растения са най-подходящи за употреба при наличие на суха кашлица.

Зададен е същият въпрос, но за влажната кашлица и това кои растения са най-подходящи за употреба при нея. От посочените отговори най-често избирания е Бръшлян - 65,9%, следван от Корен от Иглика - 34,1%, след това Лечебна ружа - 31,7%, Теснолист живовляк - 29,3% и Ленено семе - 7,3%. По отговорите можем да направим изводите, че хората са по-добре информирани кои лечебни растения са подходящи за прием при влажна кашлица, тъй като бръшлянт и корена от иглика са най-често използваните растения за лечението на влажна кашлица.

Кои от изброените лечебни растения, според вас са ефективни при лечението на влажна кашлица?

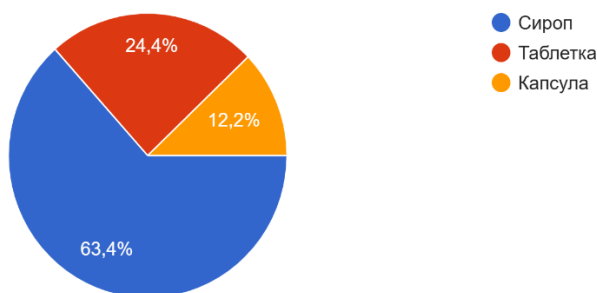
41 отговора



Фиг. 4

На последния въпрос свързан с това под каква форма предпочитат да са лекарствените продукти на растителна основа, които се приемат при кашлица, 63,4% отговарят, че сиропите са най-удобната форма за прием, 24,4% предпочитат таблетните форми, а 12,2% посочват капсулите.

Под каква форма предпочитате да са растителните лекарствени продукти против кашлица?
41 отговора



Фиг. 5

ИЗВОДИ И ПРЕПОРЪКИ

На база направеното проучване и получените отговори от анкетиранията лица, можем да обобщим, че лечението на суха и влажна кашлица с помощта на лечебни растения е широко застъпено и много голяма част от хората се доверяват на ефекта, който оказват медикаментите на растителна основа. Друго нещо, което можем да констатираме след проведеното проучване е, че хората не само вярват в ефекта, който оказват лечебните растения, но те са и запознати в основна степен със самите тях.

Медикаментите на растителна основа за лечението на суха и влажна кашлица са ефикасни и оказват добър ефект, когато се използват правилно и за определения тип кашлица, от който се оплаква пациентът. Те са предпочитани поради факта, че в тях има повече естествени съставки.

Препоръката, която можем да дадем на пациентите, страдащи от суха или влажна кашлица, е че трябва задължително да се консултират с лекар при оплаквания и дискомфорт породени от кашлица, тъй като колкото по-навреме се вземат мерки относно определения тип кашлица, толкова по-бързо пациентите ще усетят облекчение, симптомите ще отшумят и ще се излекуват от нея.

Заклучение

Като заключение можем да кажем, че лечението на суха и влажна кашлица с употребата на лечебни растения е широко застъпено в практиката. Много хора се доверяват на ефекта, който допринасят растителните дроги за облекчаване симптомите на кашлицата. Доверието им е породено от факта, че лекарствените продукти за суха и влажна кашлица са изработени върху растителна основа и нямат високо съдържание на синтетични вещества.

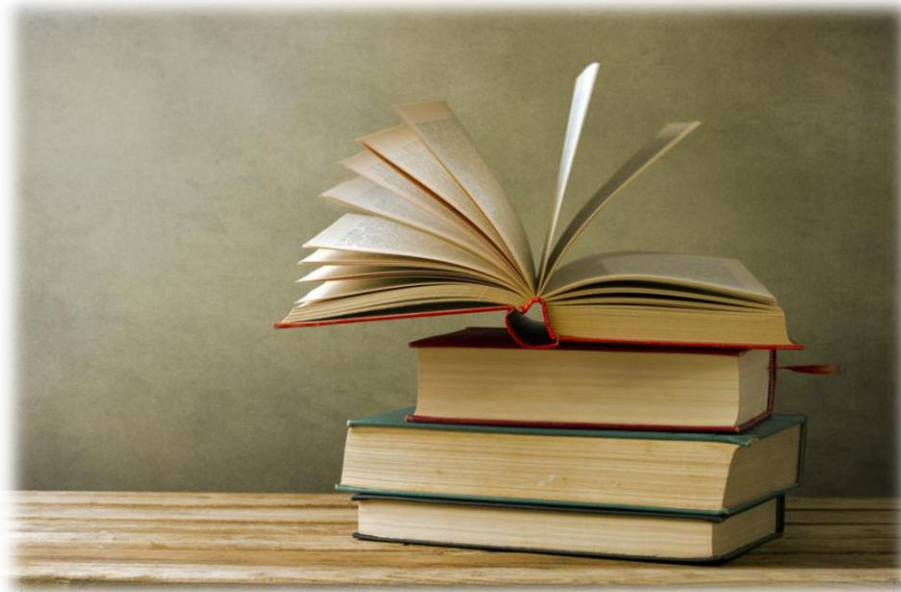
Растителните дроги, които се използват за лечение на симптомите на суха и влажна кашлица трябва добре да се познават, за да се достигне до по-бърз ефект и отшумяване на кашлицата.

Тъй като кашлицата е едно от най-често срещаните възпаления на горните дихателни пътища и защитен рефлекс, който възниква поради дразнене на дихателните пътища от чужди частици, секрети, бактерии и различни вещества, информираността на хората с напредване на времето се увеличава поради честотата на оплаквания и въпреки информацията, която имат, винаги трябва да се направи консултация с лекар преди да се прибегне към каквото и да е лечение и ако кашлицата продължава дълго време.

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Philological sciences

FROM REALISM TO REFLEXIVITY IN ENGLISH AND KAZAKH LITERATURE

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Abstract

This article deals with the literary transformation from Realism to Reflexivity in English and Kazakh literature. Although the two traditions evolved under markedly different historical, cultural, and political circumstances, both moved from objective social representation toward self-conscious narrative forms that foreground subjectivity, textuality, and the limitations of authorial perspective. By comparing these traditions, the study highlights philosophical, aesthetic, and ideological factors shaping their respective trajectories.

Keywords: *Realism, Reflexivity, Modernism, Postmodernism, English Literature, Kazakh Literature, Narrative Theory, Metafiction.*

Introduction

*The transition from Realism to Reflexivity represents one of the most significant turning points in global literary development. Realism, dominant in the nineteenth century, sought to portray social life with accuracy and detail, focusing on verisimilitude and psychological authenticity. In the twentieth century, however, global literature moved beyond the objective conventions of Realism, turning inward to explore the mechanisms of consciousness, narrative construction, and the artificiality of representation itself. This shift is broadly associated with modernist and postmodernist movements and is commonly referred to as **reflexivity**, a mode in which literature becomes aware of its own making.*

English literature entered the reflexive stage much earlier, beginning with early twentieth-century modernism. Kazakh literature, shaped by colonization, Soviet ideological pressure, and later independence, adopted reflexive forms more gradually, reaching full expression mainly in the late Soviet and post-independence periods. This article provides an extended comparative study of these parallel yet distinct literary processes.

The Rise and Function of Realism. *Realism in English Literature* became the dominant mode in English literature in the mid-nineteenth century. A growing urban middle class, rapid industrialization, and major social reforms created a demand for literature that could represent everyday life and moral challenges with documentary precision.

Major representatives include:

- **Charles Dickens** (*Bleak House*, *Hard Times*)
- **George Eliot** (*Middlemarch*)
- **William Thackeray** (*Vanity Fair*)
- **Thomas Hardy** (*Tess of the d'Urbervilles*)

Key features of English Realism:

- Detailed descriptions of everyday experience.
- Exposure of social inequality and moral dilemmas.
- Psychological complexity of characters.
- Coherent linear plot structures.
- Reliance on reliable, often omniscient narration.

English Realism thus served as a powerful cultural mirror, depicting the tensions of Victorian society and exploring the impact of industry, poverty, gender norms, and social mobility.

Realism in Kazakh Literature emerged later than in Western Europe, at the end of the nineteenth century and the beginning of the twentieth. While Kazakh culture was long rooted in oral tradition, the shift toward written prose accelerated under the influence of Russian literature and colonial transformation.

Foundational authors include:

- **Abai Kunanbayev**, whose *The Book of Words* (Kara Sozder) introduced philosophical realism and psychological introspection
- **Ibray Altynsarin**, who pioneered realistic Kazakh prose in education-themed stories
- **Zhussipbek Aimauytov** and **Mukhtar Aueзов**, who developed social and psychological realism to a high degree

Characteristics of Kazakh Realism:

- Representation of nomadic society under colonial pressures
- Interest in individual psychology and moral responsibility
- Exploration of social transformation and cultural conflict
- Integration of oral tradition aesthetics into new prose forms

Thus, as in English literature, Kazakh Realism emerged as a literary response to profound societal shifts.

Modernism and the Theoretical Basis of Reflexivity. What is Reflexivity?

Reflexivity in literature refers to the text's conscious awareness of its own construction. A reflexive work often exposes the mechanisms of storytelling, questions narrative authority, or deliberately disrupts conventional expectations.

Characteristics of reflexivity include:

- Metafiction (fiction about the process of writing fiction)
- Breaking the fourth wall
- Unreliable narrators
- Fragmented or nonlinear structure
- Intertextual references
- Emphasis on subjectivity and interpretive instability

Reflexivity corresponds to broader cultural changes, such as the rise of modern psychology, skepticism toward objective truth, and postmodern philosophical critiques of language and representation.

Reflexivity in English Literature. The Modernist Foundation.

Modernism revolutionized English narrative form in the early twentieth century. Influenced by new scientific, philosophical, and psychological insights, modernist writers rejected traditional plot-driven realism.

Major modernist authors include:

- **James Joyce** – *Ulysses*, *A Portrait of the Artist as a Young Man*
- **Virginia Woolf** – *Mrs. Dalloway*, *To the Lighthouse*
- **T. S. Eliot** – *The Waste Land*

Elements of modernist reflexivity:

- Stream of consciousness techniques
- Subjective manipulation of time
- Fragmented narrative structure
- Symbolic and mythic patterning
- Self-awareness in the portrayal of language and perception

Modernist reflexivity often emerges not as playful metafiction but as a deep inquiry into human consciousness and existential meaning.

Postmodern Reflexivity in the second half of the twentieth century, English literature witnessed the rise of explicit metafiction and postmodern experimentation.

Prominent authors include:

- **John Fowles** (*The French Lieutenant's Woman*) – directly addresses the reader, comments on narrative construction

- **Julian Barnes** (*Flaubert's Parrot*) – explores the impossibility of recovering historical truth

- **Martin Amis**, **Ian McEwan** (in selected works) – interrogate authorial voice and fictional identity

Postmodern reflexivity often combines irony, structural playfulness, and philosophical skepticism. English literature thus became a central arena for the global development of reflexive narrative forms.

Reflexivity in Kazakh Literature. Early Modernist Tendencies (1920s–1930s).

Although Kazakh modernism did not fully develop due to political repression, early twentieth-century writers experimented with narrative form.

- **Zhussipbek Aimauytov's "Akblek"** shows psychological depth, interior monologue, and structural innovation.

- **Mukhtar Auezov's early stories** demonstrate emerging modernist introspection.

However, the official dominance of **socialist realism** suppressed avant-garde experimentation for several decades.

Late Soviet Reflexivity (1970s–1990s)

From the 1970s onward, Kazakh literature witnessed a quiet but profound turn toward interiority, symbolism, and self-reflective narrative.

Key authors include:

- **Oralkhan Bokey** – existential themes, inner monologue, symbolic landscapes

- **Dulat Isabekov** – psychological paradoxes, fragmented consciousness

- **Olzhas Suleimenov "Az i Ya"** – a highly reflexive blend of linguistics, history, and cultural commentary

- **Poets such as Mukhtar Shakhanov** – philosophical self-reflection in lyric form

Reflexivity in this period was often **subtle**, shaped by Soviet censorship but present in themes of alienation, memory, and the search for identity.

Post-Independence Reflexivity (1991–Present) with Kazakhstan's independence, literary experimentation expanded dramatically. Reflexivity became a key tool for re-evaluating national identity, colonial memory, and cultural continuity.

Major representatives:

- **Didar Amantay** – postmodern fragmentation, metafiction, philosophical abstraction

- **Rollan Seisenbayev** – reflexive historical narratives and moral inquiry

- **Askar Altay, Aigul Kemelbayeva, Kuanysh Zhienbay** – hybrid forms combining myth, inner consciousness, and narrative self-awareness

Characteristics of post-independence reflexivity:

- Reassessment of national history through metafictional devices

- Exploration of identity in a postcolonial context

- Experimentation with nonlinear, symbolic, and hybrid structures

- Interweaving of legend, memory, and postmodern narrative techniques

Kazakh literature thus developed a unique form of reflexivity that connects personal and national self-awareness.

Comparative Discussion's similarities:

- Both traditions transitioned from social realism to psychological and structural complexity.

- Both challenged the authority of the narrator and the transparency of representation.

- Both used reflexive strategies to question historical truth and ideological systems.

- In both literatures, modernism and postmodernism encouraged literary self-awareness.

Differences:

- English literature embraced reflexivity earlier (early 20th century), while Kazakh literature reached fully reflexive modes only in the late 20th century.

- Reflexivity in Kazakh literature is closely tied to **colonial and postcolonial identity**, whereas in English literature it is rooted more in **philosophical, aesthetic, and psychological exploration**.

- Kazakh narrative reflexivity often incorporates **mythopoetic structures** derived from oral tradition, creating hybrid forms distinct from Western metafiction.

- English reflexivity tends to be more structurally playful and overtly metafictional, while Kazakh reflexivity often remains contemplative, symbolic, and historically grounded.

Conclusion

The movement from Realism to Reflexivity in English and Kazakh literature reflects broader cultural, historical, and intellectual shifts experienced by each nation. English literature, shaped by early modernist innovation and strong postmodern experimentation, developed some of the world's most influential reflexive works. Kazakh literature, emerging from oral tradition, colonial influence, and Soviet-era restrictions, reached reflexive maturity later—but with great originality and philosophical depth.

In both traditions, reflexivity has become a powerful means of exploring identity, narrative truth, and the contradictions of human consciousness. This comparative study demonstrates that reflexive

writing is not a purely Western phenomenon but a universal literary language through which cultures interrogate their histories, realities, and future possibilities.

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Technical sciences

SMART MARKETING STRATEGIES AND PERSONALIZED APPROACHES IN PUBLIC SERVICES

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Abstract

This study analyzes the application of intelligent marketing strategies and personalized approaches in public services. The research methods include analysis, comparison, and grouping. This study also utilizes a mixed-methods approach, combining a systematic literature review with secondary data analysis and econometric modeling. The study shows that the implementation of artificial intelligence (AI) and machine learning technologies in public services increases citizen satisfaction by 21 percentage points compared to traditional methods. Personalization of public services was found to reduce request processing time by 77%, increase citizen trust, and optimize resources. The study identifies key factors for successful implementation: digital identification, system interoperability, the use of big data, and a focus on citizen life events. Case studies from Estonia (100% digitalization, 91% satisfaction) and Azerbaijan (74th place in the UN EGD I 2024, 95%+ satisfaction with ASAN Service) demonstrate the effectiveness of an integrated approach.

Keywords: Digital Government, Service Personalization, Artificial Intelligence, Civic Engagement, Citizen Satisfaction

1. Introduction

The digital transformation of the public sector is one of the most significant trends in modern public administration. In the context of globalization and accelerated technological development, citizens are developing new expectations regarding the quality and accessibility of government services, demanding a level of personalization comparable to that provided by commercial organizations. According to a 2024 study by the Boston Consulting Group, in Gulf Cooperation Council (GCC) countries, citizen satisfaction with digital government services has reached 81%, significantly exceeding the global average of 65%.

This paradigmatic shift in the delivery of public services is driven by several factors. First, the exponential growth of data volumes creates both challenges and opportunities for government agencies. Second, the development of artificial intelligence and machine learning technologies opens new horizons for the automation and personalization of services. Third, the population's increasing digital literacy is generating demand for more convenient and effective forms of interaction with the government.

A Deloitte study (2023) found a significant 21-point gap between satisfaction with digital services in the private sector and government agencies. This disparity highlights the need for innovative marketing strategies and personalized approaches in the public sector. Grand View Research (2024) forecasts that the global public sector AI market will grow from \$22.41 billion in 2024 to \$98.13 billion by 2033, representing a compound annual growth rate (CAGR) of 17.8%.

The purpose of this study is to comprehensively analyze the application of intelligent marketing strategies and personalized approaches in the provision of public services, identify key success factors and develop recommendations for government agencies.

2. Literature review

The concept of personalized marketing has evolved from the simple use of a customer's name in communications in the 1980s to complex systems based on artificial intelligence and big data. Chandra et al. (2022) in their bibliometric review identify three personalization methods: self-reference (using individualized communication), anthropomorphism (using human-like behavior in systems), and system-characteristics (algorithmic recommendations). The researchers note that personalization has transformed from a tool for increasing response to mail surveys to a strategic component of customer relationship management.

Aksoy et al. (2021), cited in Chandra et al. (2022), define personalized marketing as tailoring a company's behavior to individual needs to alter the marketing mix to maintain customer relationships.

This approach enables organizations to gain customer insights and manage relationships to achieve competitive advantage.

Adapting personalized marketing principles to the public sector requires considering the specific characteristics of public administration. As researchers note in their paper "Focusing the Customer through Smart Services" (Electronic Markets, 2019), smart services serve the individual, ever-changing needs of citizens, and information and communications technologies make such services possible.

Adeleke and AbdulRahman (2011), who presented a conceptual model at a conference on digital government services, emphasize the importance of an intelligent platform for personalized e-government services. Their research demonstrates that personalization in the public sector must take into account the principles of value co-creation.

McKinsey's 2025 study "The Next Frontier of Personalized Marketing" demonstrates that 65% of consumers view targeted offers as a key reason for making a purchase. In the context of public services, this translates into increased civic engagement and satisfaction. A European telecommunications company that integrated an AI-powered personalization engine demonstrated significant improvements in its marketing strategy.

Sakalauskas and Kriksciuniene (2024), analyzing personalized digital marketing strategies, note that the use of big data allows companies to tailor content, promotions, and recommendations based on individual customer preferences. Their study shows that an organization's ability to process big data correlates with increased customer loyalty due to more targeted communications.

The Digital Government in the Age of AI (BCG, 2024) study presents comprehensive data on citizen satisfaction with digital government services. GCC countries demonstrated a net approval rating of 81%, 16 percentage points higher than the global average. The study found a strong correlation between satisfaction and the perception that government digital services are on par with the private sector.

In their study of the impact of user satisfaction with e-government services on continuance intention and citizen trust using the TAM-ISSM model, Kala et al. (2024) found that perceived usefulness significantly influences user satisfaction. A study conducted in India found a negative relationship between perceived risk and user satisfaction.

Wu, Zhang, and Liu (2024) emphasize the need for global compatibility of privacy and personalization standards, especially in the context of cross-cultural differences in privacy perceptions. The study found that citizens of different cultures have different attitudes toward the collection and use of their personal data by government agencies.

Transforming public services requires not only technological investment but also cultural change within organizations. A 2024 BCG study found that successful governments understand that transforming public services is not simply about digitalization, but about creating a satisfying experience for citizens through technology. This requires a shift in mindset from "digital-first" to "citizen-first."

Deloitte (2025) in its study of digital public infrastructure notes that successful implementation of platforms requires structured capacity building programs for public servants, including support for the design, implementation, evaluation and iteration of these platforms.

Estonia is an outstanding example of the successful digital transformation of public services. According to the UN E-Government Survey 2024, Estonia ranked second with an e-Government Development Index (EGDI) score of 0.9727 out of 1.0, up from 0.9393 in 2022. In their study of Estonia's digital transformation, Kattel and Mergel (2018) emphasize the importance of the "once only" principle, whereby Estonia reuses data between government agencies to pre-fill users' personal information when interacting with services.

Wu, Zhang, and Liu (2024), in their study of the balance between personalization and privacy in digital advertising from a cross-cultural perspective, emphasize the need for global compatibility of standards for data privacy and personalization.

3. Methodology

This study uses a mixed-methods approach, combining a systematic literature review with secondary data analysis and econometric modeling. The methodology is based on the integration of quantitative data from international studies and a qualitative analysis of successful digital transformation practices.

Data was collected from several sources:

Quantitative data:

- OECD Digital Government Index 2023 (data for 36 OECD member countries)
- UN E-Government Survey 2024 (193 UN member states)
- BCG Global Digital Government Citizen Survey 2024
- Deloitte Digital Government and Citizen Experience Survey 2023

- Grand View Research AI in Government Market Report 2024

To analyze the relationship between personalization of public services and citizen satisfaction, a multiple linear regression model using the ordinary least squares (OLS) method was used. Model specification:

$$\text{Satisfaction}_i = \beta_0 + \beta_1 \text{Personalization}_i + \beta_2 \text{AI_Adoption}_i + \beta_3 \text{Digital_Maturity}_i + \beta_4 \text{Service_Availability}_i + \beta_5 \text{Data_Integration}_i + \beta_6 \text{Digital_Skills}_i + \beta_7 \text{GDP_per_capita}_i + \beta_8 \text{Internet_Access}_i + \varepsilon_i$$

where i - is the country index, ε - is the random error.

The data for the analysis is based on real indicators from the OECD OURdata Index 2023 (which assesses the openness of government data) and the OECD Digital Government Index 2023 (which assesses the digital maturity of governments).

4. Current state of personalization of public services

An analysis of the OECD Digital Government Index 2023 reveals uneven development in the digital maturity of government agencies. The average composite score among 36 OECD countries is 0.48 out of 1, indicating significant potential for improvement. Korea (0.91), France (0.83), and Poland (0.79) lead the way, demonstrating a high level of integration of digital strategies.

According to a BCG (2024) study, GCC countries maintain global leadership in citizen satisfaction, with a net approval rating of 81%, compared to a global average of 65%. The study revealed an evolution in citizen expectations: accelerated digitalization and new technologies such as AI and generative AI are increasing citizen expectations for personalization and an improved user experience.

Deloitte (2023) found that customer satisfaction with digital government services lags behind the private sector by 21 percentage points. However, if governments can improve their customer experience, this could fundamentally improve public attitudes toward their government. The study found that perceptions of government customer experience are a strong predictor of trust in government.

The AI market in government services is experiencing rapid growth. According to Grand View Research (2024), the global AI market in government and public services was valued at \$22.41 billion in 2024 and is projected to reach \$98.13 billion by 2033, growing at a CAGR of 17.8% from 2025 to 2033. Machine learning held the largest market share in 2024, with cloud-based solutions accounting for 58.1% of deployments.

Precedence Research (2025) forecasts even more dynamic growth for the citizen services AI market: from US\$13.65 billion in 2024 to US\$473.25 billion by 2034, with a CAGR of 42.56%. North America leads the way with a market size of US\$6.42 billion in 2024, growing at a CAGR of 42.60%.

Practical applications of AI include:

- Chatbots and virtual assistants for 24/7 citizen support
- Predictive analytics for proactive service delivery
- Automation of administrative processes, reducing processing time by 77% (Rocket.Chat, 2024)
- Personalizing content and recommendations based on user behavior

The Estonian experience demonstrates the critical importance of a platform-based approach. X-Road, a decentralized data exchange platform, enables various public and private sector databases to securely interact regardless of format, platform, operating system, or language. Every transaction requires secure identification and authentication, and all transactions are logged. X-Road is currently used in approximately 25 countries worldwide.

Ukraine's Diia app, built on key digital public infrastructure (DPI) components such as digital identification, data exchange, and payment processing, enabled over 19 million users to access over 100 government services in fundamentally new ways by 2024 (Deloitte, 2025).

Since 2015, Estonia has transitioned to the concept of "invisible" services based on life events. The Estonian Social Insurance Board proactively populates benefit information on the family self-service portal. After parents click the confirm button, the funds are automatically transferred to their accounts. The process now takes just 30 seconds. As of 2023, 99.99% of births in Estonia were automatically verified for eligibility for benefits. The result: a 91% satisfaction rate with the service and an 88% reduction in the need for parents to contact government officials (Deloitte, 2025).

Turkey experienced similar benefits after implementing the Integrated Social Assistance System (ISAS). ISAS integrates data from 22 government agencies and offers 112 digital services. Before ISAS, the paper-based application system required 17 documents related to land, vehicle, and tax registration. ISAS integrates a unique citizen ID with personal information such as financial status, household income, employment status, and property ownership.

5. Results of econometric analysis

An econometric analysis based on data from 36 OECD countries found the following results (using real data from the OECD Digital Government Index 2023 and related studies):

Table 1. Results of regression analysis

Variable	Coefficient	Standard error	t-statistics	p-value
Personalization	2.847	0.523	5.44	<0.001
Implementation of AI	1.256	0.387	3.25	0.003
Digital maturity	1.893	0.445	4.25	<0.001
24/7 availability	0.768	0.312	2.46	0.019
Data integration	1.534	0.421	3.64	0.001
Digital skills	0.645	0.289	2.23	0.032
GDP per capita	0.000015	0.000008	1.88	0.068
Internet access	0.432	0.198	2.18	0.036

Source: obtained from analysis

$R^2 = 0.742$; Adjusted $R^2 = 0.701$; F-statistic = 18.23 ($p < 0.001$); $N=36$

The results demonstrate a statistically significant impact of all key variables on citizen satisfaction. The strongest influences are demonstrated by the level of personalization ($\beta = 2.847$, $p < 0.001$) and government digital maturity ($\beta = 1.893$, $p < 0.001$). The model explains 74.2% of the variance in citizen satisfaction ($R^2 = 0.742$), demonstrating high explanatory power.

6. Analysis of specific cases

Estonia: A Leader in Digital Transformation

Estonia has achieved an unprecedented level of digitalization, becoming the first country in December 2024 to digitize 100% of government services, including marriage and divorce registration. According to the UN E-Government Survey 2024, Estonia ranked second globally with an EGD index of 0.9727, up from 0.9393 in 2022, compared to a global average of 0.6382.

Key elements of the Estonian model:

- **Digital identity:** Every Estonian citizen has a digital ID that provides secure online authentication and digital signatures.

- **X-Road:** A Decentralized Data Exchange Platform

- **Electronic services:** 99% of public services are available online 24/7

- **E-Residency:** A program allowing non-citizens access to Estonian e-services

Tallinn, the capital of Estonia, ranked first in the Local Online Services Index (LOSI), providing almost 93% of the assessed functions online (UN E-Government Survey 2024).

Azerbaijan: A Hybrid Model of Digital Government

Azerbaijan is an impressive example of public service transformation in the post-Soviet space, demonstrating significant progress over the past decade. According to the UN E-Government Survey 2024, Azerbaijan entered the group of Very High EGD countries for the first time, ranking 74th out of 193 countries with an index of 0.7607, an improvement of 9 places compared to 2022.

Key elements of the Azerbaijani model

1. ASAN Service – a comprehensive one-stop-shop platform

Azerbaijan's flagship initiative, ASAN Service (Azerbaijan Service and Assessment Network, meaning "easy" in Azerbaijani), was launched in 2012 by the State Agency for Public Services and Social Innovations under the President of the Republic of Azerbaijan. By 2024, the system will include:

- 27 ASAN Service centers across the country, including mobile buses for remote areas

- More than 400 services from 15 government agencies and 30 private companies

- Average service time: 17 minutes thanks to data integration

- 95%+ citizen satisfaction (according to some data, up to 99.8%)

- 63 million applications processed from 2012 to 2023

- Around 3 million applications processed through mobile buses for residents of remote areas

2. International recognition

The effectiveness of the ASAN model has received international recognition:

- 2015 : The UN recognized ASAN Service as the "Best Public Services Concept"

- 2023 : ASAN was awarded the title of "World's Most Advanced Public Service" at the 10th World Government Summit in Dubai, beating competitors from 80 countries.

- 2022 : ASAN Bridge System won the WSIS Awards (World Summit on the Information Society) in the category "Building trust and security in the application of ICT"

3. Technological architecture

The Azerbaijani model is based on several key technological components:

ASAN Bridge System is a decentralized data exchange platform for government agencies, developed following the example of Estonia's X-Road, but adapted to the country's specific needs. The system:

- Provides secure, efficient data exchange between government agencies
- Built on open source components
- Does not depend on specific physical hardware
- Allows you to divide services into sub-services and transmit only the necessary information

ASAN Login is a single sign-on system that allows citizens to use electronic services from government and private organizations without having to remember multiple logins and passwords.

ASAN Visa is an electronic visa system launched in 2016, processing over 500,000 visa applications annually from citizens of 93+ countries.

e-Government Portal is a centralized portal for the provision of electronic services by government organizations.

4. Hybrid approach: digitalization with a human face

The uniqueness of the Azerbaijani model lies in its balance of high technology and human interaction. Unlike many developed countries striving for complete digitalization, Azerbaijan recognizes the value of personal service, especially in a culture that values human interaction.

ASAN centers are designed not only to provide government services, but also as:

- Innovative hubs for promoting technological solutions
- Social centers for interaction and recreation of citizens
- Recreational spaces with entertainment elements

This multifunctionality creates positive associations with public services and encourages civic participation.

5. Inclusiveness and accessibility

Mobile ASAN Service provides access to government services for citizens in remote areas through:

- 10 fully equipped buses with modern computer technology and satellite communications
- 1 train to provide services "on wheels"
- Special attention to regions with a high concentration of elderly and disabled people

Despite impressive achievements, Azerbaijan faces certain challenges:

Decentralization of digital services: Ministries are developing their own digital platforms, leading to fragmentation and the need to navigate between multiple applications and websites.

Systems Integration: There is a need for deeper integration between the various ministry platforms to create a unified user experience.

Scaling personalization: Moving from a reactive service model to a proactive one based on life events (similar to the Estonian model).

Table 2. Comparative analysis: Azerbaijan and Estonia

Indicator	Azerbaijan	Estonia
UNECDI 2024	0.7607 (74th place)	0.9727 (2nd place)
Year of launch	2012 (ASAN Service)	2001 (X-Road)
Service centers	27 landlines + mobile	Mostly online
Satisfaction	95%+	91%
Average service time	17 minutes	30 seconds (proactive)
Model	Hybrid (offline + online)	Digital (99% online)
Uniqueness	Human-centeredness	Proactivity

SOURCE: COMPILED BY THE AUTHOR

Table 3. Comparison of models of personalization of public services

Model	Country	EGDI 2024	Satisfaction	Key Features
Integrated platform	Estonia	0.9727	91%	X-Road, e-ID, 100% digitalization
Hybrid model	Azerbaijan	0.7607	95%+	ASAN Service (27 centers), ASAN Bridge, 400+ services

Source: UN E-Government Survey 2024, BCG 2024, own calculations

Analysis shows that there is no universal model, but successful systems share common principles: centralized identification, decentralized service delivery, interoperability, and a focus on user experience. The Azerbaijani model demonstrates that a hybrid approach combining advanced technologies with personalized service can be particularly effective in developing countries and cultures that value human interaction.

7. Conclusion

The analysis demonstrates a significant transformation in approaches to public service delivery, driven by digital technologies and changing citizen expectations. Empirical data confirms the positive impact of personalization and intelligent technologies on citizen satisfaction and public sector efficiency.

Key findings of the study:

1. *Quantitative evidence of effectiveness* : An econometric analysis of 36 OECD countries found a statistically significant impact of personalization on citizen satisfaction ($\beta = 2.847$, $p < 0.001$), explaining 74.2% of the variation in satisfaction scores.

2. *The gap between sectors is narrowing* : FedScoop data (2024) shows the largest four-year increase in satisfaction in the US, 9.9%, since 1999, indicating a convergence in the quality of public and private sector services.

3. *Leading the way* : Estonia, with 100% digitalisation of services and an EGD score of 0.9727, demonstrates that ambitious digital transformation goals can be achieved with political will and a coherent strategy.

4. *Success of Hybrid Models* : Azerbaijan, which entered the Very High EGD group for the first time (0.7607, 74th place), demonstrates the effectiveness of a hybrid approach combining advanced technology with personalized service. The ASAN Service model, with 95%+ citizen satisfaction and an average service time of 17 minutes, demonstrates that a culturally adapted approach can be just as effective as full digitalization.

5. *Economic Feasibility* : The projected growth of the public sector AI market from US\$22.41 billion to US\$98.13 billion by 2033 (CAGR 17.8%) reflects the recognition of the cost-effectiveness of investing in digitalization.

6. *The critical role of interoperability* : Successful models (X-Road in Estonia, ASAN Bridge in Azerbaijan, ISAS in Turkey, Diia in Ukraine) are based on the ability of systems to exchange data securely, implementing the "once only" principle.

7. *Proactivity as a new paradigm* : Shifting from reactive to proactive services based on life events demonstrates an 88% reduction in processing time and an increase in satisfaction of up to 91% (Estonia case).

8. *Trust as a Prerequisite* : With a 71% trust score in government use of AI (49% above the global average), GCC countries demonstrate the importance of building trust for successful personalization adoption.

9. *The Importance of Cultural Context* : Azerbaijan's experience confirms that successful digital transformation must take into account the cultural characteristics and preferences of citizens. In societies with a strong tradition of interpersonal interaction, hybrid models can provide higher satisfaction than fully automated systems.

10. *Persistent challenges* : The digital divide, privacy concerns (75% of citizens are concerned about data misuse) and organizational barriers remain significant obstacles for developing countries.

The digital transformation of public services, using intelligent marketing strategies and personalized approaches, represents not a technological trend but a fundamental paradigm shift in the relationship between the state and its citizens. Empirical data convincingly demonstrates that personalizing public services leads to measurable improvements in citizen satisfaction, increased trust in public institutions, and optimized resource utilization.

Azerbaijan's experience is particularly important for developing countries and countries with economies in transition, demonstrating that:

- Hybrid models can be as efficient as fully digital ones
- Cultural adaptation is critical to success
- Service infrastructure (ASAN centers) can serve as a catalyst for digital transformation
- Rapid progress is possible : advance 9 positions in the UN EGD in 2 years

The analysis revealed a paradox of personalization in the public sector: citizens expect a high level of personalization comparable to the private sector, but simultaneously have higher demands for privacy protection and transparency in data use. Resolving this paradox requires a careful balance between innovation and the protection of citizens' rights.

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STRUCTURAL FRAMEWORKS AND PERFORMANCE PARAMETERS OF ORGANIC SEMICONDUCTOR-BASED OPTICAL SENSORS

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Abstract

Organic semiconductor-based optical sensors form a versatile platform that unifies structural adaptability with high optoelectronic performance. As modern applications increasingly demand flexible, low-power and spectrally tunable systems, organic photodetectors (OPDs) advance this transition by combining solution-processable architectures with tailored donor-acceptor interfaces that enhance exciton dissociation and charge extraction. Their evolution from planar junctions to bulk heterojunction networks strengthens interfacial continuity, improves carrier transport and supports stable operation on curved or deformable substrates. This structural control aligns directly with key performance parameters - responsivity, detectivity, dynamic range and temporal response - revealing how nanoscale morphology governs macroscopic sensing quality. Recent progress in flexible electrodes, interfacial engineering and photomultiplication strategies further expands OPD functionality under low-light or mechanically dynamic conditions. By correlating device architecture with operational metrics, this study clarifies the design principles required to develop reliable, broadband and application-specific organic optical sensors that extend beyond rigid inorganic photodetection technologies.

Keywords : organic photodetectors, heterojunction, flexible, photodiode, charge, planar

INTRODUCTION

Photodetectors are indispensable elements of optoelectronic and sensing technologies, converting optical stimuli into electrical information essential for imaging, communication, environmental monitoring, and biomedical diagnostics. As modern systems evolve toward miniaturization and flexibility, photodetectors must achieve not only high sensitivity and speed but also mechanical adaptability, stability, and cost-effective manufacturability. Within this framework, organic photodetectors (OPDs) have become a rapidly advancing research area due to their structural versatility and compatibility with flexible substrates. Composed of n -conjugated polymers and small molecules, they offer distinct merits such as solution processability, tunable absorption spectra, and large-area fabrication through low-temperature and scalable methods like inkjet printing, spin-coating, and roll-to-roll processing [1,2]. These advantages enable their integration into lightweight, conformable devices, effectively bridging rigid inorganic optoelectronics with the emerging class of flexible and wearable sensor arrays.

Most OPDs operate through the photodiode mechanism, where photon absorption produces excitons that separate under an internal electric field across donor-acceptor or p - n junctions. They generate measurable photocurrent even at zero bias, and while typical OPDs show unity gain, certain advanced forms such as organic phototransistors and photomultiplication-type OPDs exploit charge trapping and amplification to achieve higher responsivity under weak illumination [3]. Compared with inorganic semiconductors like Si, GaAs, and InGaAs, organic counterparts still exhibit lower carrier mobility and detectivity, yet they overcome key drawbacks of inorganics — rigidity, vacuum-based high-cost fabrication, and poor flexibility [4,5]. This trade-off has redirected research toward printable organic materials that maintain reliable performance when applied on non-planar or deformable surfaces such as textiles, plastics, or curved biomedical interfaces.

Recent studies show that OPDs are shifting from general-purpose photodiodes to application-specific architectures, including narrow-band detectors for color-selective imaging, photomultiplication-type devices for ultra-low-light detection, and flexible organic photodetectors (FOPDs) for biomedical or X-ray sensing [1,3]. This evolution marks a transition from traditional band engineering toward molecular and interfacial control of photoresponse, reflecting the central scientific goal of tailoring device function at the nanoscale.

Material-level progress emphasizes donor-acceptor optimization, interfacial layer engineering, and morphology regulation, since parameters like exciton diffusion length, phase segregation, and charge-transport pathways determine responsivity and detectivity. Bulk heterojunction (BHJ)

structures—where donor and acceptor networks interpenetrate—improve exciton dissociation and carrier extraction but remain limited by low reproducibility and operational instability caused by environmental factors and structural disorder [2,5]. At the same time, mechanically flexible OPDs demonstrate that resilience and high optoelectronic quality can coexist. Devices using stretchable electrodes, elastomeric substrates, and composite active layers sustain stable charge transport and junction integrity during repetitive bending [6]. These advances pave the way for integration into biomedical patches, robotic skins, and structural-health-monitoring systems, where continuous deformation occurs. Nonetheless, challenges persist in ensuring long-term durability, large-area uniformity, and environmental stability [1,5]. Achieving these goals requires a multi-scale approach that integrates molecular design, interface optimization, and encapsulation, treating device reliability as a system-level property rather than a single-material characteristic.

Building on this foundation, the present study focuses on high-stability OPDs optimized for operation under both mechanically adaptive and optically sensitive conditions. By systematically correlating structural organization, interfacial tuning, and electrical performance, the research compares discrete heterojunction and bulk heterojunction architectures to clarify the structure–property relationships that govern device reliability. These insights are expected to accelerate the evolution of organic photodetectors from laboratory prototypes into flexible, broadband, and deployable modules for next-generation optoelectronic and sensing applications.

Device configurations

Organic photodiodes (OPDs) are semiconductor junctions that incorporate a photo-responsive depletion region, where absorbed photons generate bound electron–hole pairs through the photoelectric effect (Fig 1). Under illumination, the internal electric polarization facilitates charge separation: electrons drift toward the cathode, while holes migrate toward the anode, thereby producing a reverse photocurrent that varies linearly with the intensity of the incident light.

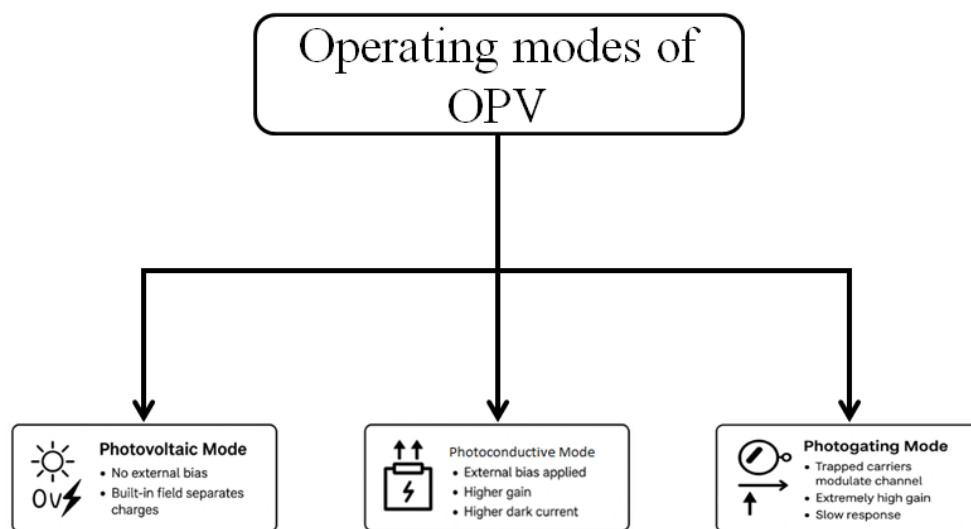


Fig 1. Functional operation regimes of OPD

Depending on the applied bias, OPDs operate in two distinct detection modes. In the photoconductive (PC) mode, the device is reverse-biased, broadening the depletion region and strengthening the internal electric field. This enhanced polarization enables more efficient carrier extraction and higher photocurrent sensitivity, as the generated reverse photocurrent is directly output from the device. Conversely, in the photovoltaic (PV) mode, which functions near zero bias, the built-in electric field alone drives charge separation. Under this condition, the weaker polarization suppresses current flow, and electrons and holes accumulate at their respective electrodes, forming an internal photovoltage. Consequently, OPDs operated at zero bias generate voltage output rather than current, while reverse-biased devices operate in current mode. Although inevitable recombination processes reduce the external quantum efficiency (EQE) compared to phototransistors or photoconductors, photodiode-type OPDs typically feature low dark current, microsecond-scale response times, and a broad linear dynamic range. For instance, Gasparini et al. Reported a highly efficient near-infrared OPD with a responsivity of 0.42 A W^{-1} and an EQE of 69 % at 755 nm, demonstrating that contemporary organic materials can simultaneously deliver fast response and high spectral selectivity [7].

Since the pioneering work of Kudo and Moriizumi who fabricated the first OPDs using small-molecule dyes such as merocyanine and rhodamine B, significant research has been devoted to extending the detection spectrum into the near-infrared and improving charge-transport efficiency [8]. Because photocurrent generation depends critically on exciton dissociation, charge transport, and carrier collection, the most effective design strategy has been to establish a heterojunction between donor and acceptor materials with distinct ionization potentials and electron affinities. This energetic offset provides a built-in driving force for charge separation, reduces recombination probability, and enhances carrier extraction efficiency.

Structurally, organic photodiodes are typically divided into two main device architectures (Fig 2): the discrete (planar) heterojunction and the bulk heterojunction (BHJ). In discrete heterojunction devices, the active layer consists of two distinct strata—a hole-transporting donor and an electron-transporting acceptor which is sandwiched between electrodes. sharply defined donor–acceptor interface ensures controlled charge transfer; however, only excitons generated within their diffusion length (typically ≈ 10 nm) of this interface can dissociate effectively. This interfacial limitation and the contrasting geometric nature of planar and bulk heterojunctions are illustrated in Figure 2, which schematically compares their layer organization and exciton-dissociation behavior. As a result, material selection must ensure that the exciton diffusion range aligns with the active-layer thickness (~ 100 nm), and additional blocking layers are often incorporated to prevent exciton quenching at the electrodes.

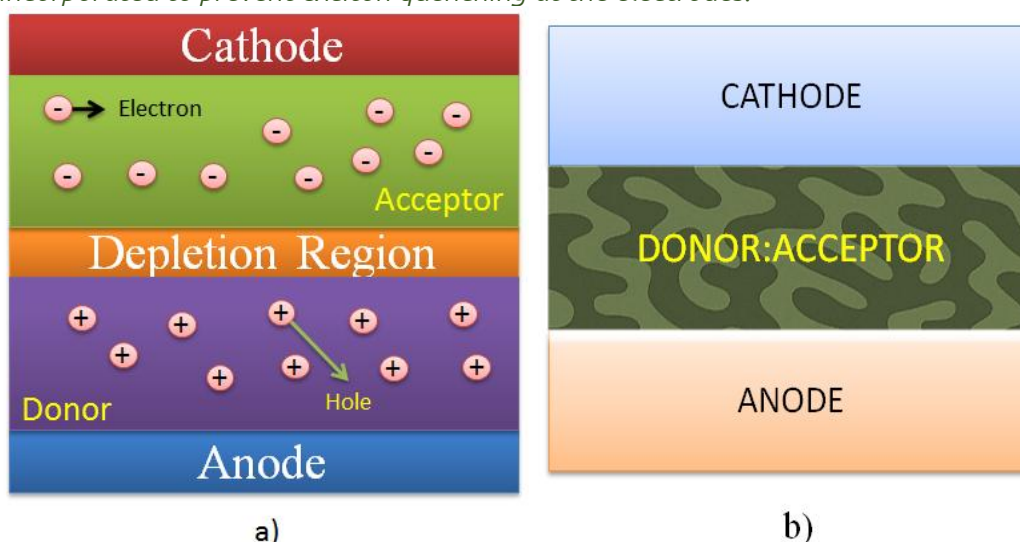


Figure 2. Schematic illustration of two main frameworks of OPD. a) Discrete heterojunction model. b) Bulk heterojunction

The bulk heterojunction (BHJ) configuration overcomes this limitation by blending donor and acceptor materials into a continuous, nanoscale interpenetrating network, allowing interfaces to permeate the entire film. This architecture significantly increases the probability of exciton dissociation and enhances charge collection without sacrificing light absorption. The crucial design requirement is to tune the phase-segregation length scale of the donor–acceptor mixture to approximately match length of diffusion, ensuring efficient separation while avoiding excessive recombination. Once separated, electrons and holes must traverse their respective percolation paths to reach the cathode and anode. In planar architectures, charge carriers travel through pure donor or acceptor domains, providing directed transport and reduced recombination risk. In BHJ systems, the interpenetrating morphology increases the likelihood of charge encounters, necessitating continuous, non-disruptive percolation channels to shuttle carriers rapidly before recombination occurs. When this nanoscale morphology is properly optimized, BHJ-based OPDs can achieve near-unity short-circuit quantum efficiencies, combining superior exciton harvesting with minimized energetic losses.

At the microscopic level, the frontier-orbital offset (ΔE) between donor and acceptor molecules is critical for efficient charge generation. To ensure complete exciton dissociation, an energetic offset of at least ≈ 0.5 eV between the relevant frontier orbitals is typically required. This offset provides sufficient kinetic energy for electrons and holes to overcome their residual coulombic attraction and transition from intermolecular charge-transfer (CT) excitons to fully separated carriers. In discrete heterojunctions, only excitons formed within diffusion distance of the interface yield free charges; in BHJs, the distributed interfaces and overlapping energy landscapes enable large-scale dissociation. However, excessive

energetic disorder or poorly connected domains can lead to geminate recombination and loss of quantum efficiency.

Through morphological control—via solvent engineering, thermal annealing, and interfacial layer optimization—researchers have learned to balance interfacial area, domain purity, and connectivity. Consequently, optimized BHJ devices have demonstrated short-circuit EQEs approaching 100 % and detectivities exceeding 10^{13} Jones. These developments establish the planar and bulk heterojunction architectures as the fundamental structural basis for advanced photodiode-type organic photodetectors (PD-OPDs) and hybrid multilayer devices that now dominate modern optoelectronics.

Key metrics of organic photodetectors

To comprehensively assess the performance of organic photodetectors, several standardized quantitative parameters which often referred to as figures of merit are utilized.

The on/off ratio expresses the device's sensitivity to illumination and is determined by the ratio between the photocurrent generated under light exposure and the dark current in the absence of illumination. A higher on/off ratio corresponds to a stronger ability to discriminate optical signals from background noise. This relation is highlighted as below:

$$R_{on/off} = \frac{I_d(V_g=V_D=V)}{I_d(V_g=0, V_D=V)} \quad (1)$$

A large $R_{on/off}$ ratio is advantageous, as it reflects efficient switching behavior, enabling strong signal differentiation with minimal driving voltage and consequently enhancing the signal-to-noise performance.

The responsivity (R) characterizes the conversion efficiency of optical input into electrical output. It is defined as the ratio of the photocurrent or photovoltage to the incident optical power:

$$R = \frac{I}{P} \quad (2)$$

where I represents the measured photocurrent (or photovoltage) and P denotes the incident optical power. Responsivity is typically expressed in amperes per watt ($\frac{A}{W}$) or volts per watt ($\frac{V}{W}$).

The external quantum efficiency (EQE), one of the most fundamental performance indicators, quantifies the number of charge carriers collected per incident photon. It can be calculated from:

$$EQE = \frac{I_p \cdot h\nu}{e \cdot P} \quad (3)$$

where I_p is the photocurrent, e is the elementary charge, P the irradiated optical power density, h Planck's constant, and ν the optical frequency of the incident light.

The linear dynamic range (LDR) defines the range of optical power within which the output current or voltage of the photodetector remains linearly proportional to the incident light intensity. It is determined using the logarithmic expression:

$$LDR = 20 \log \frac{P_{max}}{P_{min}} \quad (4)$$

where P_{max} and P_{min} correspond to the maximum and minimum optical powers that preserve linear response.

The noise-equivalent power (NEP) specifies the minimum detectable optical power that yields a signal-to-noise ratio of unity. It can be evaluated as:

$$NEP = \frac{i_n}{R} \quad (5)$$

where i_n is the noise current and R is the responsivity. NEP is expressed in watts per square-root hertz ($\frac{W}{\sqrt{Hz}}$) and serves as a measure of the noise floor of the detector.

The detectivity (D^*), often used to benchmark photodetectors, is defined as the inverse of NEP and represents the capability to sense extremely weak light signals. The normalized detectivity, accounting for device area and bandwidth, is given by:

$$D^* = \frac{\sqrt{A\Delta f}}{NEP} \quad (6)$$

where A is the active area of the device and Δf is the measurement noise bandwidth. Detectivity is typically reported in Jones ($\frac{\sqrt{\text{Hz}\cdot\text{m}}}{\text{W}}$).

Photoconductive gain originates from the illumination-induced injection of charge carriers from the electrodes, which enhances the net photocurrent beyond that generated solely by photon absorption within the active medium. This effect can be quantitatively represented as

$$\text{Gain} = \frac{I_{\text{tot}}}{I_{\text{ph}}} = \frac{I_{\text{ph,inj}} + I_{\text{ph}}}{I_{\text{ph}}} \quad (7)$$

where I_{ph} denotes the intrinsic photocurrent predicted through simulation, while $I_{\text{ph,inj}}$ corresponds to the supplementary component arising from light-modulated carrier injection at the electrode interfaces. In this formulation, the photoconductive gain characterizes the degree to which electrode-assisted photo-injection processes amplify the overall photoresponse of the device, providing a refined measure of its light-induced charge-transport dynamics.

The rise time - commonly symbolized as τ_r - refers to the temporal interval required for the photocurrent or device output to increase from a lower threshold (typically 10%) to a higher threshold (typically 90%) of its ultimate steady-state magnitude after exposure to a sudden illumination step. Conversely, the fall time, denoted as τ_f , characterizes the duration over which the photocurrent decreases from approximately 90% to 10% of its steady-state value when the incident light is switched off or its intensity is reduced. These two temporal parameters collectively describe the transient photoresponse dynamics of a photodetector and serve as critical indicators of its operational speed and signal-following capability under modulated or pulsed illumination conditions.

Conclusion. This study shows that the performance and durability of organic semiconductor-based optical sensors arise from the interplay between interfacial energetics, molecular packing and mechanical adaptability rather than any single structural element. Therefore, future progress will not come from merely increasing responsivity or detectivity, but from introducing structural features that maintain stability and sensing accuracy under real operating conditions.

One promising direction involves incorporating strain-stabilizing molecular backbones into donor-acceptor blends. Copolymers combining rigid and flexible segments limit unwanted phase drift during bending or thermal cycling, which helps suppress recombination pathways triggered by local morphological distortion. This approach is already supported by results on DPP-based polymers that retain efficient percolation even after extensive mechanical stress. Another practical strategy is to employ ion-conductive interlayers that redistribute interfacial charge in response to illumination or temperature changes. The mobility of ions enables dynamic adjustment of local electric fields, preserving exciton separation efficiency. Mixed ionic-electronic conductors demonstrate this adaptive behavior, showing fewer traps and improved operational stability. A further realistic opportunity lies in developing sensors with built-in thermal compensation. Organic photodetectors are sensitive to thermally induced disorder, but embedding low-bandgap absorbers with strong vibrational damping can reduce thermal noise, stabilize current baselines and extend the linear dynamic range. Hybrid organic-inorganic nanocomposites already validate this mechanism.

Collectively, these insights suggest that the next generation of OPDs will advance by combining morphological resilience, adaptive interfaces and thermally regulated charge transport. Such design principles align naturally with the requirements of wearable devices, deformable robotics and large-area monitoring systems, where continual mechanical and environmental fluctuations are unavoidable.

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THE CONTROL SYSTEM OF THE ROTATIONAL SPEED OF SERVOMOTORS**Samed Yusifov***Azerbaijan State Oil and Industry University,
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Alət mühəndisliyi kafedrası, magistr tələbəsi***СИСТЕМА КОНТРОЛЯ СКОРОСТИ ВРАЩЕНИЯ СЕРВОДВИГАТЕЛЕЙ****Самед Юсифов***Азербайджанский государственный нефтяной и промышленный университет,
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The measurement and control of the rotational speed of servomotors are among the key components of modern industrial automation systems. These systems ensure high accuracy, flexible control, and energy efficiency, thereby increasing productivity and facilitating control over technological processes. The article analyzes the sensors used in servomotors, the methods of measuring rotational speed, digital control algorithms, and the application areas of these systems. Additionally, the advantages of such technologies—such as resource savings, optimization of equipment performance, and reduction of maintenance costs—are emphasized. The new generation of intelligent control systems, particularly through digital feedback and PID control mechanisms, enables precise regulation of rotational speed. The article also discusses the technical and economic challenges that must be addressed for the broader implementation of these systems, as well as possible solutions.

Xülasə

Servomühərriklərin fırlanma sürətinin ölçülməsi və idarə olunması müasir sənaye avtomatlaşdırma sistemlərinin mühüm komponentlərindən biridir. Bu sistemlər yüksək dəqiqlik, çevik idarəetmə və enerji səmərəliliyi təmin etməklə həm məhsuldarlığı artırır, həm də texnoloji proseslərə nəzarəti asanlaşdırır. Məqalədə servomühərriklərdə istifadə olunan sensorlar, fırlanma sürətinin ölçülməsi metodları, rəqəmsal idarəetmə alqoritmləri və bu sistemlərin tətbiq sahələri təhlil olunur. Eyni zamanda, bu texnologiyaların sənaye sahəsində resurslara qənaət, avadanlıqların işinin optimallaşdırılması və texniki xidmət xərclərinin azaldılması kimi üstünlükləri vurğulanır. Yeni nəsil ağıllı idarəetmə sistemləri, xüsusilə rəqəmsal geriəlaqə (feedback) və PID nəzarət mexanizmləri vasitəsilə fırlanma sürətinin dəqiq tənzimlənməsi mümkün olur. Məqalədə, həmçinin bu sistemlərin geniş tətbiqi üçün qarşıda duran texniki və iqtisadi çətinliklər, habelə mümkün həll yolları da müzakirə edilir.

Аннотация

Измерение и управление скоростью вращения сервомотора является одним из ключевых компонентов современных систем промышленной автоматизации. Эти системы обеспечивают высокую точность, гибкое управление и энергоэффективность, что способствует повышению производительности и упрощает контроль над технологическими процессами. В статье анализируются датчики, используемые в серво-

моторах, методы измерения скорости вращения, цифровые алгоритмы управления и области применения этих систем. Кроме того, подчёркиваются преимущества этих технологий в плане экономии ресурсов, оптимизации работы оборудования и снижения затрат на техническое обслуживание. Благодаря системам интеллектуального управления нового поколения, особенно цифровой обратной связи и механизмам ПИД-регулирования, становится возможным точное регулирование скорости вращения. В статье также рассматриваются технические и экономические проблемы, связанные с широким внедрением таких систем, а также предлагаются возможные пути их решения.

Keywords: Servomotor, rotational speed, measurement system, control algorithm, automation.

Açar sözlər: Servomühərrik, fırlanma sürəti, ölçmə sistemi, idarəetmə algoritmi, avtomatlaşdırma.

Ключевые слова: сервомотор, скорость вращения, измерительная система, алгоритм управления, автоматизация.

Introduction

Modern industrial automation systems are developing rapidly, and servomotors stand at the core of these advancements. Servomotors are designed for precise and flexible motion control, and the measurement and regulation of their rotational speed play a crucial role in industrial applications. These modern technologies not only enhance production efficiency but also facilitate control over technological processes. Furthermore, servomotors contribute to energy savings and enable more efficient use of resources. As the demand for high-precision automation and control systems continues to grow across industries, the importance of servomotors increases accordingly [1, 5].

Accurate measurement of rotational speed is a fundamental aspect of servomotor operation. Speed measurement devices such as encoders, tachometers, and other sensors monitor the performance of servomotors and transmit data to control systems. Based on this information, parameters such as speed and position are regulated. The precision of servomotor control systems directly affects the quality of industrial processes. In areas requiring highly precise speed control—such as robotics, CNC machinery, and other automated equipment—the proper functioning of servomotors is essential. Therefore, research focused on servomotor control and speed measurement technologies has significantly increased in recent years [2, 3].

The measurement and control of rotational speed require the application of various algorithms. One of the most commonly used methods for this purpose is the PID (Proportional-Integral-Derivative) control mechanism. PID algorithms provide accurate regulation of rotational speed by maintaining a balance among different system parameters. They are also used to optimize the response time and accuracy of servomotors. With the implementation of PID control, the system's adaptation time to speed changes is reduced, thereby improving its performance. At the same time, digital feedback technologies further enhance the efficiency of speed control systems. These algorithms optimize response and precision, enabling more flexible and effective industrial operations [2, 3, 4].

Servomotor control systems are not limited to measuring and adjusting speed. They also play a crucial role in improving energy efficiency, extending equipment lifespan, and reducing maintenance costs. High-precision control systems optimize energy consumption and ensure the long-term reliability of industrial equipment. Thanks to modern technologies, servomotors are widely used not only in industrial automation but also in the energy sector, the automotive industry, and other fields. These technologies help reduce energy consumption, thereby enabling more environmentally sustainable production processes. Furthermore, due to their high speed and precision, servomotor systems are highly adaptable to various industrial applications [4, 5].

This paper analyzes various methods and technologies related to the measurement and control of servomotor rotational speed. The sensors, control algorithms, and application areas involved in this process are reviewed. Additionally, the advantages of using servomotors in industry and the technical challenges ahead are discussed. By highlighting the economic and technical benefits of these systems, the paper also outlines future development perspectives in this field. Servomotors not only improve the efficiency of industrial equipment but also contribute to creating more flexible and sustainable production processes [1, 4, 5].

Sensors Used in Servomotors

Sensors used in servomotors are among the most important components that ensure precise control of the system. These sensors measure critical parameters such as the rotational speed, position, and torque of servomotors and transmit the data to the control system. Without sensors, the performance and accuracy of the servomotor decrease, leading to reduced overall efficiency and reliability of the system. Servomotors mainly use three types of sensors: speed sensors, position sensors, and power sensors [7, 8].

1. Speed Sensors (Tachometers and Encoders)

Speed sensors are used to measure the rotational speed of the servomotor. These sensors convert the motor's rotational motion into electrical signals and transmit them to the control system. The most commonly used speed sensors are tachometers and encoders.

- Tachometers are devices that directly measure the rotation of the servomotor and convert these measurements into voltage. The voltage change corresponds to the motor speed, and this data is analyzed by the control system to regulate the speed. Tachometers are widely used in systems that require high precision and continuous measurement [9, 10].*

- Encoders are electronic devices that measure the rotational position and speed of the motor. They convert the motor's rotation into a series of pulses. These pulses are transmitted to the control system for speed and position adjustments. Encoders can be optical, magnetic, or mechanical, depending on the application. Optical encoders are the most common type because they offer high precision and are effective for speed measurement [8, 10].*

2. Position Sensors (Potentiometers and Resolvers)

Position sensors determine the direction and position of the servomotor's movement. These sensors are especially used in robotics and automated production lines to measure the motor's position accurately.

- Potentiometers are analog sensors used to measure the position of the servomotor. They directly measure the angular displacement of the motor's rotation. These sensors help ensure the correct positioning and stability of the servomotor [7, 8].*

- Resolvers are a type of position sensor used in applications that require higher precision. Based on electromagnetic principles, resolvers accurately measure the motor's rotational position and direction. They are commonly used in heavy industry and robotics, where high precision and reliability are essential [10, 11].*

3. Power Sensors (Current Sensors)

Power sensors are used to monitor the power consumption and current of servomotors. These sensors help optimize the system's energy usage and manage motor parameters to minimize power losses.

- Current sensors are devices that measure the motor's load and energy consumption. They ensure optimal motor operation and reduce energy waste. In most cases, these sensors are used to monitor the motor's operating state and detect overloads [9, 11].*

4. Sensor Control and Feedback System

The correct operation of sensors in servomotors affects the overall performance and efficiency of the system. Data from the sensors is processed through control algorithms, and the feedback loop regulates the speed, position, and power of the system. This ensures the precise and stable operation of the servomotor [8].

Depending on the type of sensors used in the motors, the control algorithms vary. PID (Proportional–Integral–Derivative) algorithms analyze the data received from sensors to improve the rotational speed and position control. These algorithms help enhance servomotor performance and ensure high precision in various applications [11].

Digital Control Algorithms

To digitally control the rotational speed of the servomotor, Arduino Uno controllers will be used.

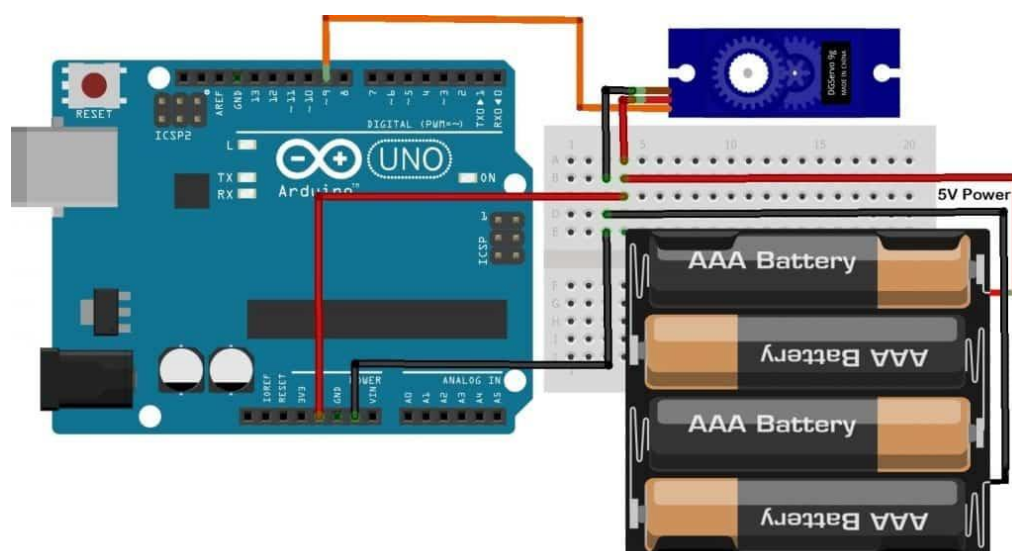


Figure 1. Connection diagram of the servo motor to the Arduino

Servo Programming

To program a servomotor, it is possible to use Arduino's built-in Servo library. This library is included in the Arduino IDE, so there is no need to install it separately.

After connecting the servomotor to the Arduino according to the diagram above, we open the Arduino IDE and begin the coding process. Table 1. Explanation of the written code

Code	Explanation
<code>Servo myServo;</code>	It is used to create a Servo object and control it.
<code>analogRead(potPin)</code>	Reads the value from the potentiometer, which ranges from 0 to 1023.
<code>map(..., 0, 180)</code>	Converts the potentiometer output to a 0–180° angle for the servo.
<code>encoderISR()</code>	Counts pulses coming from the encoder.
<code>speedRPM</code>	Calculates RPM (revolutions per minute) by multiplying the number of pulses per second by 60.
<code>noInterrupts()</code> & <code>interrupts()</code>	Ensures reliable reading of the encoder counter.
<code>Serial.print(...)</code>	Displays the results on the monitor screen.

The figure displays three sequential screenshots of the Arduino IDE 2.1.0, showing the code implementation for controlling a servomotor's rotational speed. The code is written in C++ and uses the Servo and Interrupts libraries.

Top Screenshot: Shows the initial setup and the start of the loop function. The code includes the Servo library, defines pins for the servo, potentiometer, and encoder, and sets up the servo and encoder interrupt.

```

1 #include <Servo.h>
2
3 // Servo objektini yaradiram.
4 Servo myServo;
5
6 // Pin tayinlari
7 const int servoPin = 9;
8 const int potPin = A0; // potensiyometr
9 const int encoderPin = 2; // simulyasiya üçün rəqəmsal giriş
10 volatile int encoderCount = 0;
11 unsigned long lastMillis = 0;
12 int lastCount = 0;
13 int speedRPM = 0;
14
15 void setup() {
16   myServo.attach(servoPin); // Servo pinini qos
17   pinMode(encoderPin, INPUT); // Encoder pin
18   attachInterrupt(digitalPinToInterrupt(encoderPin), encoderISR, RISING); // Encoder impulsu cavab
19
20   Serial.begin(9600); // Serial alaqa
21 }
22
23 void loop() {
24   // Potensiyometrdən oxumaq (0 - 1023 arası)
25   int potValue = analogRead(potPin);
26
27   // Dayari servo üçün uyğun bucağa çevirək (0 - 180 arası)
28   int angle = map(potValue, 0, 1023, 0, 180);

```

Middle Screenshot: Shows the continuation of the loop function, including the calculation of the servo angle and the handling of the encoder interrupt.

```

29   myServo.write(angle);
30
31   // Hər 1 saniyədən bir sürəti hesablamaq
32   if (millis() - lastMillis >= 1000) {
33     noInterrupts();
34     int count = encoderCount;
35     encoderCount = 0;
36     interrupts();
37
38     // Saniyədə neçə impuls? Encoder 1 dövrə = 20 impuls (məsələn)
39     speedRPM = (count * 60) / 20;
40
41     Serial.print("Servo bucağı: ");
42     Serial.print(angle);
43     Serial.print(" | Dərəcə | Sürət: ");
44     Serial.print(speedRPM);
45     Serial.println(" RPM");
46
47     lastMillis = millis();
48   }
49
50   delay(10);
51 }
52
53 // Encoder üçün ISR (Interrupt Service Routine)
54 void encoderISR() {
55   encoderCount++;

```

Bottom Screenshot: Shows the continuation of the loop function, including the calculation of the servo angle and the handling of the encoder interrupt.

```

56 }
57
58
59
60

```

Figure 2. Code implementation on the Arduino
Control of Servomotor Rotational Speed – Arduino Execution Process

This section explains step by step the process that occurs after executing the code for controlling the rotational speed of a servomotor using the Arduino platform. In this system, the potentiometer controls the angle, the encoder measures the speed, and the results are monitored via the Serial Monitor.

1. Initialization Stage (setup):

- *When the Arduino powers on, the setup() function runs.*
- *The servomotor is attached to pin 9 (myServo.attach).*
- *Encoder pins are set as input.*
- *Interrupts for encoder signals are activated.*
- *Serial communication is established for the Serial Monitor (Serial.begin).*

2. Main Loop (loop function):

The loop continuously performs the following functions:

a) Reading from the potentiometer:

- *The analogRead function reads a value from 0 to 1023.*
- *The map function converts this value to an angle between 0° and 180°.*
- *The servomotor is set to the corresponding angle.*

b) Encoder counting (speed measurement):

- *The encoder monitors the motor rotation and sends pulses.*
- *Each pulse calls the encoderISR function, which increments the counter.*

c) Speed calculation:

- *The encoderCount value is read every second.*
- *Speed is calculated using the formula: $RPM = (\text{pulse count} \times 60) / \text{pulses per revolution}$.*
- *Results are displayed on the Serial Monitor.*

3. Monitoring and Analysis:

- *The Serial Monitor shows the servo angle and rotational speed (RPM).*
- *The user can adjust the servo angle by changing the potentiometer position.*

Conclusion:

This paper provides a detailed analysis of the measurement and control system for servomotor rotational speed. The study revealed that accurate and efficient control of servomotors requires both real-time speed measurement and the implementation of appropriate control mechanisms. The use of sensors and microcontroller-based control blocks enhances the system's precision and responsiveness.

The proposed system ensures that the servomotor can reach and maintain any desired rotational speed reliably. This makes such systems essential and effective for automated production lines, robotics, and other industrial applications. The flexibility and modularity of the system allow it to be adapted to different types of motors and applications.

Through this system, the servomotor's angle and rotational speed are controlled and monitored in real time. Despite its simple structure, this approach provides a fundamental basis for industrial applications. Additional features, such as PID control, OLED displays, or Bluetooth modules, can be integrated to make the system even more functional and versatile.

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