# Researching artificial intelligence language models for developing the virtual language learning assistant

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**Abstract**

The article discusses the possibilities of using artificial intelligence language models to develop a virtual assistant for learning languages. Analysis of modern trends in mobile learning and the integration of artificial intelligence into educational processes shows the promise of using neural networks to personalize the learning experience. Research and comparative analysis of three AI models – GPT-4o, GPT-3.5-turbo and Gemini 1.5 Flash – were conducted to assess their effectiveness in processing Ukrainian-language content, generating texts and providing contextual understanding of queries. Based on the results obtained, a mobile application for learning languages was developed that uses GPT-4o as the main language model. The cross-platform mobile application provides interactive learning, including adaptive tasks, automatic exercise checking, real-time feedback and game elements. The results confirm the feasibility of using AI assistants in language education and open up prospects for further research in the field of automated learning.

**Keywords**

learning foreign languages, artificial intelligence applications, large language models (LLM), GPT-4o, virtual assistant, mobile application

## 1. Introduction

The modern pace of life and constant changes in the labor market require people to continuously learn and improve their skills. Economic globalization, international cooperation and cultural exchange create a growing demand for effective methods of learning languages [1, 2].

The widespread use of smartphones, tablets and other mobile devices allows learning anywhere, which significantly expands access to learning. Therefore, today there is a growing demand for distance learning, online learning and mobile learning. This is also especially relevant in the context of military action, when many are forced to change their country of residence [3]. This also applies to the need to learn languages. All this creates additional demand for effective tools for learning languages.

Today, the application of mobile learning principles to language learning (Mobile-Assisted Language Learning, MALL) is a popular approach Kumar [4], Chuah [5], Levkivskyi[6]. The review by the authors [4] shows that mobile language learning is a new area of research, but there are already many developments. The authors note that gamification technologies are widely used. The authors of the work [5] note that not all mobile applications for language learning use the pedagogical theories necessary for this. According to studies [4, 5], mobile technologies provide continuous access to educational content, adapting it to the needs of the user and allowing interactive interaction in real time. In addition, the work [6] notes that the use of mobile applications contributes to the flexibility of the learning process, allowing users to complete tasks in a place and time convenient for them. This makes mobile learning an ideal choice for developing a system aimed at a large segment of users.

*STEM@ICon-MaSTEd 2025: 4th Yurii Ramskyi STE(A)M Workshop co-located with XVII International Conference on Mathematics, Science and Technology Education, May 14, 2025, Ternopil, Ukraine*

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In parallel, the rapid development of technologies in the field of artificial intelligence and natural language processing opens up new opportunities for the creation of intelligent learning systems [7]. The integration of AI into the learning process opens up new opportunities for personalizing the educational experience [6, 8, 9, 10, 11, 12, 13]. Artificial intelligence is able to analyze the individual needs of the user, track their progress and adapt educational content to the level of knowledge and the pace of assimilation of the material [10, 11].

Therefore, the development of learning systems with artificial intelligence support has begun to develop actively [1, 14, 15, 16, 17, 18]. Thus, a review of Son's publications [14] shows that the use of AI in language education is growing. This concerns natural language processing, automated written assessment, automatic speech recognition, chatbots, etc. The analysis of the authors [19] confirms that the introduction of artificial intelligence in language learning programs helps to increase the motivation of adult learners, but there are certain risks. Language learning using mobile devices with built-in artificial intelligence by students was studied in the work [20]. The authors note that students significantly improved their listening and reading test results. The positive impact of using artificial intelligence in language learning is also noted in the work of Wei [17]. Their analysis showed that students not only improved their English learning results, but also had greater motivation. According to the work [15], artificial intelligence technologies are promising for improving language learning. His research has shown that the implementation of artificial intelligence has so far yielded results for writing exercises, assessment accuracy, and student engagement. However, the author believes that teacher intervention is still necessary because proper pedagogical input is required. Meanwhile, artificial intelligence offers unique opportunities for personalized learning.

The combination of artificial intelligence methods and mobile technologies also takes place. Thus, in the work [6] the authors propose the use of machine learning algorithms to create a mobile application for learning a foreign language. Thanks to this, their development allows for the creation of unique and personalized settings for each user based on their personal data and preferences. The proposed application has various exercises, but there are no game elements.

The author of the work [16] developed the AIELL system, which is a mobile learning system supported by artificial intelligence. The proposed system is designed to learn vocabulary and grammar of English as a second language. The results of the authors' evaluation study showed that their system meets the needs of students well. In the work [1], the authors conducted a study and found gaps in programming artificial intelligence for language learning. They note that when implementing technologies, various types of instant feedback of language skills should be taken into account to support independent learning. The authors believe that it is necessary to study the ways of organizing feedback, including with the help of artificial intelligence. Therefore, its potential should be explored further. The author of the work [18] also comes to this conclusion. As a result of his study, he concludes that mobile programs based on artificial intelligence for teaching foreign languages are still at the initial level.

Therefore, to improve intelligent language learning systems, more attention should be paid to paid to natural language processing technologies (NPL) and large language models (LLM), their research and debugging. In the work [21] the authors argue that social interaction via mobile apps significantly increases users' motivation to learn a language, and NLP helps automate these processes by providing dialogues and assessing the quality of the response. Using language models and interactive scenarios is especially useful for learning new vocabulary and grammatical constructions. Using NLP methods, the system will be able to assess the quality of the user's responses, track errors, and suggest corrections.

The combination of artificial intelligence and mobile learning technologies has made the development of virtual assistants for language learning relevant. Virtual assistants can provide personalized and adaptive language learning, which is especially relevant in the context of the growing need for individualization of the learning process. At the same time, Natural language processing is an integral part of virtual assistants.The use of NLP algorithms will allow the system to understand, analyze and generate responses in natural language, which will significantly increase the efficiency of speech interaction.

As stated earlier, providing timely and objective feedback is a very important aspect of the learning process. Providing feedback during learning significantly increases the efficiency of learning. In the case of a mobile assistant for learning languages, this feedback can be implemented through automated

assessment of the performance of exercises, tests or interactive tasks. Using NLP technologies, the system can automatically evaluate the correctness of the entered answers, provide comments and offer additional exercises to improve the result.

Thus, the development of a virtual assistant for language learning is a relevant scientific task, the solution of which can significantly affect the effectiveness of language education, make it more accessible and personalized. The successful creation of such an assistant will not only solve a specific problem in the field of language learning, but will contribute to the development of innovative approaches in education in general, opening up new opportunities for personalized, effective and accessible learning in the digital age. The success of a virtual assistant depends on the quality of the language model used.

Learning English with the help of the developed application in the STEM context promotes critical thinking and problem solving, as it requires students to use logical analysis and a creative approach to interpreting data from the AI model. This is due to the integration of STEM elements such as programming, mathematics and science. It is due to the interactivity of the developed program, which combines natural language and technology, that English language learning occurs within the framework of STEM education.

This paper describes the study of modern language models and the development of a virtual assistant for learning a foreign language, implemented as a cross-platform mobile application.

## 2. Research methodology

To develop a mobile application for learning foreign languages, it was necessary to integrate a language AI model that would provide high-quality text generation, translation, and contextual understanding of user requests. In the process of selecting the best model, three modern LLM (versions of November 2024) were tested:

- GPT-4o is an improved version of GPT-4 optimized for use in web and mobile applications. This model is designed to solve complex problems that require a high level of contextual understanding, logic, and creative thinking. GPT-4o is suitable for tasks that require analytical skills, such as text generation, coding, content creation, and professional technical support.
- GPT-3.5-turbo is a simplified version of GPT-4 that focuses on faster response generation. It offers high speed, making it ideal for real-time applications such as chatbots, customer service automation, answering user queries, and basic text generation. This model is less computationally intensive, but may be inferior in accuracy and ability to perform deep contextual analysis.
- Gemini 1.5 Flash is the latest development from Google.Gemini 1.5 Flash is an AI model designed to quickly perform a wide range of tasks focused on text creation and data analysis. It is characterized by high processing speed and efficiency in tasks with a medium level of complexity. Gemini 1.5 is best suited for projects where speed and simplicity are important, such as business process automation, medium-complexity text generation, and basic data analysis.

Each of them has its own strengths and weaknesses, which influenced the final decision. Therefore, the following studies were conducted. All requests to the models were in Ukrainian.

The objective of the first experiment is to evaluate the ability of three different models – GPT-4o, GPT-3.5-turbo, and Gemini 1.5 Flash – to perform grammar tests that simulate real-life tasks in a mobile language learning app. Each model was tested on different types of grammar tasks, including choosing the correct option, correcting errors in a sentence, and explaining grammar rules.

Experimental methodology. The experiment consisted of performing typical tasks on English grammar. Each task tested a separate aspect of speech. The results of each model's test performance were assessed according to the following parameters:

- validity of response (Correctness) – whether the answer corresponds to the correct option, was assessed by the relevant expert;
- task completion time (Response Time) – how long it takes for the model to generate a response;

- explanation of the answer (Explanation Quality) – the quality of the explanation of the correct option, if required.

Real examples of tasks and results are given in table 1.

**Table 1**
Examples of grammar test completion.

| Model | Answer | Validity, % | Time, sec | Explanation |
|---|---|---|---|---|
| Request: " _ apple is on the table. Виберіть правильний артикль: 1) a, 2) an, 3) the." | | | | |
| GPT-4o | an | 100 | 0.8 | We use an because the word apple starts with a loud sound |
| GPT-3.5-turbo | an | 100 | 1.2 | Артикль an використовується перед голосними. |
| Gemini 1.5 Flash | a | 0 | 0.7 | a використовується перед будь-якими словами. |
| Request: "Виправте помилку у реченні "I has a dog." | | | | |
| GPT-4o | I have a dog | 100 | 0.6 | Дієслово has використовується з he/she/it. Для I правильне дієслово — have |
| GPT-3.5-turbo | I have a dog | 100 | 0.9 | Помилка в узгодженні дієслова з займенником I. |
| Gemini 1.5 Flash | I has a dog | 0 | 0.5 | - |
| Request: "Вкажіть правильну форму дієслова: 'Yesterday, I (to go) to the cinema." | | | | |
| GPT-4o | went | 100 | 0.7 | |
| GPT-3.5-turbo | went | 100 | 0.8 | |
| Gemini 1.5 Flash | go | 0 | 0.6 | |

The results of the experiment show that GPT-4o significantly outperforms other models in all parameters, demonstrating high answer accuracy, execution speed, and explanation quality. GPT-3.5-turbo also showed good results, but the task execution time and explanation quality were lower compared to GPT-4o. Gemini 1.5 Flash, although it gave answers quickly, often made mistakes in choosing the right options and gave insufficiently detailed explanations.

The purpose of the second experiment is to evaluate the ability of models to generate detailed, accurate and understandable explanations for grammar and vocabulary problems. This aspect is critical for a mobile application aimed at teaching users a foreign language, since it is important for users not only to get the right answer, but also to understand why it is correct.

The models were given a series of questions where they had to not only give the correct answer, but also explain it. Five different types of problems were tested: explanation of choosing the correct article; explanation of the use of tenses; explaining the difference between synonyms; explanation of the use of the passive state; explanation of the structure of a complex sentence. Real examples of tasks and results are given in table 2.

According to the results of this experiment, the GPT-4o model showed the best results, providing detailed and accurate explanations necessary for the learning process. GPT-3.5-turbo showed mediocre results, in particular, insufficient detail of explanations. Gemini 1.5 Flash showed the lowest accuracy and superficial explanations, which may be insufficient for the learning application.

Next experiment aims to test the ability of GPT-4o, GPT-3.5-turbo, and Gemini 1.5 Flash models to correctly understand and respond to queries in Ukrainian, taking into account the context. Given that the Ukrainian language has a complex grammatical structure, the experiment evaluates the accuracy, logic, and relevance of the models' responses in different contexts. Experimental methodology. The models were given a series of test tasks in Ukrainian, which included:

- determining the meaning of a word based on context;
- explanation of homonyms in different contexts;
- eliminating grammatical errors in the text;
- forming a response to a request that requires context based on a preliminary dialogue.

**Table 2**
Examples of forming explanations.

| Model | Answer | Validity,% | Time, sec |
|---|---|---|---|
| Request: "Чому в реченні 'I saw an elephant' використовується артикль an" | | | |
| GPT-4o | Артикль an використовується перед словами, що починаються з голосного звуку. У слові elephant перша літера — e, яка є голосною, тому використовується an. | 100 | 0.9 |
| GPT-3.5-turbo | Тому що слово elephant починається з голосного звуку. | 100 | 1.2 |
| Gemini 1.5 Flash | Артикль an використовується, коли слово починається з голосної букви | 70 | 0.8 |
| Request: "Поясніть різницю між словами big і large" | | | |
| GPT-4o | Слова big і large є синонімами і часто взаємозамінні, але big зазвичай використовується у більш неформальному контексті, тоді як large має більш формальний відтінок | 100 | 0.9 |
| GPT-3.5-turbo | Обидва слова означають щось велике | 70 | 1.3 |
| Gemini 1.5 Flash | Це синоніми | 50 | 0.9 |
| Request: "Поясніть структуру речення: 'I know that he is coming" | | | |
| GPT-4o | Це складнопідрядне речення, що складається з головного речення 'I know' і підрядного речення 'that he is coming', яке виступає в ролі додатку | 100 | 1.2 |
| GPT-3.5-turbo | Це речення, де одна частина пояснює іншу. | 70 | 1.5 |
| Gemini 1.5 Flash | Це складне речення | 40 | 0.9 |

According to the results of the experiment, the GPT-4o model demonstrates the best ability to understand the context of the Ukrainian language, providing detailed and logical answers. GPT-3.5-turbo shows average results, often offering basic or general answers. Gemini 1.5 Flash shows the worst results, often not taking into account the context or providing superficial answers. The general conclusions of the study results are presented in the table 3.

The first model, GPT-4o, demonstrated the ability to retain context in long dialogues during testing, which is critical for an educational application. The model provided a high level of understanding of queries and the ability to adapt responses to the specifics of the educational content. The average response time was 800 ms, which is acceptable for an interactive mobile application. Due to its adaptability and ability to process complex language structures, GPT-4o became the main candidate for implementation in the project.

The second model, GPT-3.5-turbo, has a high query processing speed with an average response time of about 600 ms, which is 25% faster than GPT-4o. However, the quality of translation and text generation was slightly lower, especially for complex phrases and long dialogues. The model handled simple queries and short answers well, but often lost context in long interactions, which reduced its effectiveness for educational use. Due to its lower resource requirements, GPT-3.5-turbo is a good choice for applications with simple tasks, but for a project with an emphasis on complex context and multi-step interactions, it was less suitable.

The third model, Gemini 1.5 Flash, is the latest development from Google and was tested as one of the possible options for integration into the application. Its main advantage was the speed of query processing, which was 500 ms, which is the best result of all the tested models. The model showed good results when processing short texts and simple translations, but when working with highly specialized content and complex language structures, the quality of its responses was inferior to GPT-4o.

Thus, it was decided to use the GPT-4o model further. Before implementation, a process was carried outfurther training of the GPT-4o model using the Fine-tuning mechanism, which is a key stage in adapting the system to the specific tasks of a mobile application for learning foreign languages. At the initial stage, a data set for training was prepared. This set contained various examples of text queries

that model real-life scenarios for using the application, as well as the corresponding expected answers. All data was formatted as a JSONL file, which makes it easier for the OpenAI system to process them when training the model.

**Table 3**
Results of comparison of models.

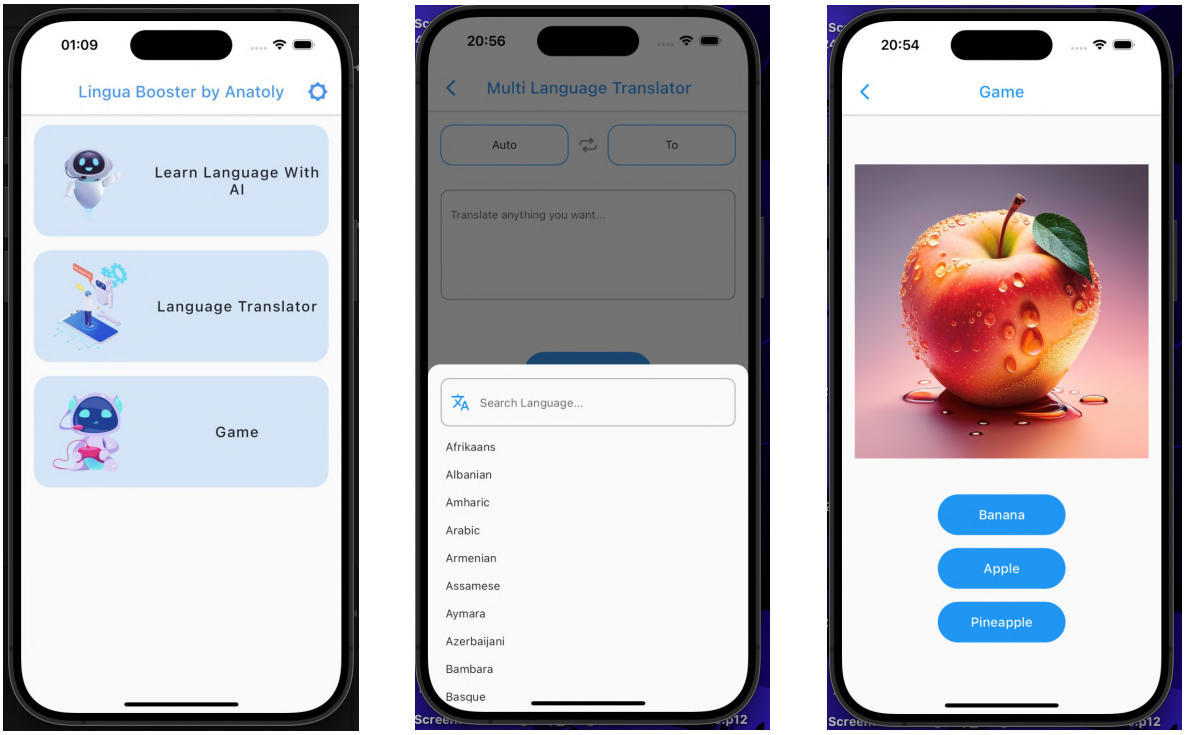
| Parameter | GPT-4o | GPT-3.5-turbo | Gemini 1.5 Flash |
|---|---|---|---|
| Response generation time (ms) | 800 ms | 600 ms | 500 ms |
| Content of context in multi-step tasks | High: correct choice in 5 consecutive queries | Medium: context loss after 3 requests | High: correct choice in 4 consecutive queries |
| Logicality of translation options | High: options are accurate and relevant | Average: several options are illogical | Average: sometimes there are incorrect options |
| Adaptability to user errors | High: able to account for erroneous input and offer clarification | Average: sometimes returns the wrong answer without further clarification | Low: rarely offers error correction |
| Sensitivity to language context (Ukrainian) | High: takes into account context and grammar | Average: errors in complex phrases | Intermediate: difficulties with grammatical nuances |
| Sensitivity to language context (English) | High: handles complex structures perfectly | High: has a good understanding of basic grammar | High: handles standard designs |
| Adaptability to changes in the subject matter of the task | High: quickly adapts to changing context | Low: often need to restart the dialogue | Medium: adaptation to new topics requires additional clarification |
| Taking grammar tests | 95% correct answers | 80% correct answers | 85% correct answers |
| Correctness of generation of educational materials | High: creates detailed examples with explanations | Medium: offers only basic examples | Low: examples are often superficial. |
| Working with erroneous variants | High: explains the reasons for the error and suggests the correct solution | Average: rarely explains errors | Low: only indicates incorrect answer |
| Working with multilingual queries | High: switches between languages well | Average: mixed queries issues | Average: sometimes confuses languages |

Once prepared, the data was uploaded to the OpenAI service using the OpenAI CLI. This initiated a fine-tuning process, where the model adapted to the new dataset. Initially, GPT-4o retained the general language capabilities of the base model. It then gradually adapted to more application-specific tasks, such as translating words, choosing the correct option from multiple options, and providing explanations of grammatical constructions.

## 3. Results

To implement a virtual assistant for learning languages, a modern technology stack was used, including the Flutter framework with the Dart language for creating a cross-platform mobile application, Firebase-Firestore for storing user data, lessons and progress, and the OpenAI API for integrating text generation functions or hints for students. Additionally, the GeminiDeveloper API is used to obtain educational materials from external sources. The application interface is designed taking into account the principles of UI/UX design, which ensures intuitive navigation and convenient use. Adaptive design allows the application to function equally well on different types of devices with different screen sizes. The main window of the application is shown in figure 3 a). The application offers users several key features:

- AI teacher is a virtual mentor that supports dialogue learning of a foreign language. Users can communicate with the AI teacher, ask questions and receive answers in real time. The teacher adapts to the user's level of knowledge, providing an individual approach to learning. An example of the application window is shown in figure 3 a) and figure 3 b).
- Translator is a tool for instant translation of words, phrases and sentences between different languages. The translator is based on AI algorithms, which ensures translation accuracy and contextual understanding of the text. An example of the program window is shown in figure 3 b).
- Interactive game – an educational game that helps you memorize new words.The main goal of the game is to improve vocabulary and develop associative thinking in users. As part of the game, a map with an image generated by the OpenAI DALL E AI model is displayed on the screen, creating unique illustrations based on specified keywords. Along with the image, the user is offered several translation options for the name of an object in a foreign language. The user sees the image and must choose the correct word in a foreign language corresponding to the image. This component combines elements of gamification, making learning interesting and effective. An example of the program window is shown in figure 3 c).




a) b) c)

**Figure 1:** Examples of mobile application operation.


a) b)

**Figure 2:** Example application with dialog window.

From a technical point of view, the application uses cloud infrastructure for storing and processing data. This ensures the scalability of the system, stable operation even under heavy load, as well as the security and privacy of user data.

The application has feedback mechanisms for users. AI analyzes the errors made by the user and provides recommendations for their elimination. This contributes to a deeper assimilation of the educational material and increases the effectiveness of the educational process.

Thus, the mobile application for learning foreign languages acts as a comprehensive solution for interactive, personalized and adaptive learning. It combines modern technologies and teaching methods to provide a quality educational experience.

## 4. Conclusions

In the modern world, the relevance of using mobile applications for learning foreign languages using artificial intelligence is rapidly growing. This problem arises at the intersection of technological progress and the social need for accessible, flexible and personalized learning. In the context of globalization, knowledge of foreign languages is becoming critical for academic, professional and personal development, which leads to the need to develop effective tools for their mastery. One of the key reasons for the relevance of this problem is the growing need for alternative forms of learning

that go beyond traditional education. Mobile applications allow people to study at any time and place convenient for them, which is especially important in the fast pace of life in modern society. This makes interactive platforms for learning languages a necessary component of the educational space. In addition, the rapid development of technologies requires constant improvement and adaptation of mobile applications to new standards and capabilities. Thus, the integration of AI into the learning process opens up new opportunities for personalization of the educational experience. Natural language processing technologies and modern AI language models help analyze the individual needs of the user, track their progress and adapt the educational content to their level of knowledge and the pace of assimilation of the material. This allows for more effective learning compared to traditional methods.

The paper examined different AI language models in the context of learning English while communicating in Ukrainian. The GPT-4o model was chosen for implementation in the mobile application of a virtual assistant for learning languages, providing a high level of understanding of queries and the ability to adapt responses to the specifics of the learning content. The average response time was 800 ms, which is acceptable for an interactive mobile application.

As a result, a prototype of a mobile phone was developed language learning application that integrates interactive learning functionality, providing users with access to an adaptive, personalized environment to improve their language skills.

The mobile application was developed using the Flutter platform, which ensured cross-platform compatibility and high performance. Integration with the Gemini Developer API and OpenAI API provided the ability to create dynamic educational content and provide adaptive feedback.

The implementation of the GPT-4o language model in a mobile application made it possible to implement natural language processing and obtain a virtual assistant for language learning. A virtual assistant for language learning can provide a flexible and accessible way of learning that can be easily integrated into a daily schedule. A virtual assistant can adapt the learning process to each user's pace, style, and goals, which significantly increases the effectiveness of learning.

The development of a virtual assistant for language learning contributes to the development of innovative educational technologies that can be applied in other areas of education. This opens up broad prospects for innovation in educational technologies in general. From an economic point of view, a virtual assistant can significantly reduce the cost of language education, making it more accessible to a wide range of users.

Finally, the interactive and personalized approach of a virtual assistant can significantly increase learners' engagement and motivation, making the language learning process more interesting and effective. This is especially important in the context of long-term learning, where maintaining motivation is a key factor for success.

The introduction of modern APIs such as Gemini Developer API and OpenAI API has increased the functionality of the application, but it also creates new challenges related to optimization of work, data security and scalability of the system. These issues will be addressed in our next work.

## Author Contributions

Conceptualization – O. Ye. Piatykop, A. O. Yeva; literature review – O. Ye. Piatykop, E. Yu. Balalayeva; software – A. O. Yeva; research, methodology – A. O. Yeva, O. I. Pronina; original draft writing – A. O. Yeva, O. I. Pronina, E. Yu. Balalayeva; review and editing – O. Ye. Piatykop. All authors have read and agreed to the published version of the manuscript.

## Funding

This research received no external funding.

## Data Availability Statement

No new data were created or analysed during this study. Data sharing is not applicable.

## Conflicts of Interest

The authors declare no conflict of interest.

## Declaration on Generative AI

The authors have employed X-GPT-4 for grammar and spelling checks.

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