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Ivan Pukalsky

ORCID ID 0000-0001-5610-7286

Galina Unguryan

ORCID ID 0000-0002-8687-4504

Bohdan Yashan

ORCID ID 0000-0003-2521-2432

Yuriy Fedkovych Chernivtsi National University

USING CHATGPT ARTIFICIAL INTELLIGENCE IN PROGRAMMING TRAINING

This paper is devoted to the investigating of the possibility of using ChatGPT by students who are beginning to learn the high-level programming language Python and its impact on their learning outcomes.

The main part of this work is divided into five stages. At the first stage, we analysed the problems related to teaching programming to students and identified the main ones, such as frequent power outages and problems with the Internet connection, lack of necessary technical capabilities, and lack of personal communication between students and their classmates and teachers. Next, we analyzed the risks and disadvantages of using ChatGPT when learning programming and highlighted the main ones. This is the inconsistency of the code with the task, the non-optimality of the created code, and the quick detection of plagiarism when students in the class make the same requests. The next step was to analyze the possibilities of using ChatGPT to learn programming. Summing up all the features, it is clear that using ChatGPT as an interactive Python reference is a valuable tool for students to quickly get additional information, and it is also a very useful tool for correcting errors in the student's code. In the fourth stage, we conducted an experiment with 7th grade students on using chat to learn programming. The study found that students who used ChatGPT to learn the Python programming language had an increased level of motivation to learn and achieved much better academic achievement compared to students who did not use chat. At the last stage, we provided recommendations for formulating effective queries in ChatGPT when learning programming.

The results emphasize that the use of ChatGPT in learning programming stimulates students to learn new things and increases their motivation to acquire knowledge. It is also worth remembering the consequences of using artificial intelligence in the educational process and taking various measures to prevent this.

Keywords: artificial intelligence, ChatGPT, Python programming language.

Problem statement. In the modern world, technologies are developing very rapidly and intensively, and the training of specialists in various fields has its own characteristics, so programming is becoming one of the key professional skills in many areas. There is a wide range of methods and approaches to teaching programming, currently. According to UNESCO experts, in order for the qualifications of specialists to meet the requirements of the information society, it is necessary to actively introduce e-learning into the educational process. This contributes to the formation of a new approach to education that develops in students the necessary skills and competencies for further learning throughout life [1].

ChatGPT (Generative Pre-trained Transformer) is a basic natural language processing (NLP) system developed by the research organization OpenAI. It is capable of generating text that sounds natural to a human, making it useful for use in chatbots. In recent years, there have been active discussions about the introduction of artificial intelligence (AI) and chatbots into the field of education. Imitation of dialogues, information search, and its interpretation can serve as effective tools for feedback to students, contributing to better understanding of the material. Using ChatGPT can increase students' interest in learning and keep them motivated to complete the course.

The process of learning programming is accompanied by numerous challenges, in particular due to the different levels of students' training, difficulties in forming algorithmic thinking, and the lack of an individual approach to learning. The use of generative neural networks, commonly referred to as artificial intelligence (AI), opens up new possibilities for overcoming these problems, making the learning process more adaptive, effective, and accessible.

Programming is an important component of the school computer science course, the main goal of which is to develop algorithmic thinking, a logical approach to solving problems, and the ability to apply information technologies. Therefore, teachers are faced with the question of the correct approach to explaining new programming material, taking into account the different levels of students' training and the individual attitude of each student to the learning process. Thus, the use of elements of artificial intelligence in the study of programming will help in solving these problems. On the one hand, artificial intelligence can act as an assistant to a student in acquiring knowledge, and on the other hand, as a means of supporting teachers in classifying learning tasks.

Analysis of recent research and publications. Many scientists have conducted research on the use of ChatGPT in the educational process. The review [2] by the researchers is one of the first peer-reviewed scientific journal articles investigating ChatGPT. The authors have analyzed its main advantages and limitations, and focus on the relevance of ChatGPT for higher education (assessment, learning, and teaching) and formulate recommendations for students, teachers, and higher education institutions regarding its use.

The paper [3] is devoted to research focused on the development of a specialized GPT model aimed at supporting students in learning programming. The model is designed to serve a triple purpose: to assist students in developing specific pieces of code and to guide them through the process of improving and debugging their own programs. The study highlights the importance of maintaining honesty and integrity in the learning process while using cutting-edge technologies to improve students' programming abilities.

The authors of the article [4] conducted a research of the impact of ChatGPT on education in the Java programming language. They tested ChatGPT on students speciality «information systems», who are learning Java using a mixed-methods approach. Quantitatively, researchers assessed constructs such as “ChatGPT Prompting Skills,” “Trust,” “Objective Values” and their relationship to student satisfaction, finding mixed effectiveness. Their conclusions show that while ChatGPT can improve certain aspects of learning, its effectiveness depends on the context and complexity of the tasks. The main positive conclusions of the regression analysis showed that ChatGPT prompting skills positively affected both objective and subjective values, suggesting a significant role in improving students' understanding of and engagement with programming concepts.

The publication [5] analyzes the impact of artificial intelligence and GPT-store on the educational process, highlighting the potential for individualization and efficiency of learning. The benefits, challenges, and recommendations for implementing and safely using AI in education are discussed, with an emphasis on the need for data protection, curriculum updates, and teacher training.

In paper [6], researchers explore the moral choices that arise with the implementation of ChatGPT in higher education, particularly in higher education institutions in Latin America. Researchers Miriam Sullivan, Andrew Kelly, and Paul McLaughlan conducted a content analysis to examine news articles (N=100) about how ChatGPT is disrupting higher education, looking at experiences from Australia, New Zealand, the United States, and the United Kingdom [7]. The paper analyzes several key topics, including the response of universities to academic integrity issues, the limitations and weaknesses of the results of using artificial intelligence (AI) tools, and the possibilities of its application for student learning.

The paper [8] examines the implications of students and universities using ChatGPT by examining the perceptions of chat by academics and students. As a result, future research suggestions were made to examine the ethical implications of artificial intelligence for education, strategies for addressing privacy concerns, and how educational institutions can best prepare for the integration of AI technologies.

Scientist Chung Kwan [9] conducted a rapid literature review to enrich the understanding of ChatGPT capabilities in various specialized fields.

Ukrainian scientists are also participating in the use of ChatGPT in university educational institutions.

Researcher Leontieva I.V. [10] focuses on the theoretical and practical aspects of using ChatGPT in universities using the example of the first level of higher education (bachelor's). The author analyzed the problems of students' use of such technologies and focuses on the feasibility of using a chatbot in the practice of teaching students.

The paper [11] considers the use of artificial intelligence as a tool for analyzing and classifying programming tasks in the educational process. An approach to automating the task classification process that takes into account their complexity, subject matter, and type is proposed. Particular attention is paid to the advantages of using AI technologies to increase the efficiency of programming training, in particular, adapting tasks to the level of students' knowledge.

In the work [12], Goncharova I.P. explores the possible use of AI in the professional activities of a teacher, focusing on the opportunities that AI provides to support a teacher in various aspects of his work.

The article [13] analyzes the impact of artificial intelligence and information technologies on mobile education as an innovative direction in the field of education. The authors emphasized that overall, the impact of artificial intelligence and information technology on mobile education is multifaceted. Artificial intelligence allows you to create personalized learning programs, get answers to questions from students via text or voice interaction, analyze performance data, track student progress in real time, etc. programming and its impact on students.

In [14], authors Y. O. Sisilitsyn and V. V. Osadchyi investigated the possibilities of using ChatGPT in distance learning of programming for students majoring in "Computer Science". The authors investigated the use of artificial intelligence using the C++ programming language as an example. They highlighted both the positive and negative aspects of using ChatGPT in higher education.

The objectives of the article. The purpose of the research is to analyze the possibilities of using ChatGPT in teaching programming in the high-level language Python and its impact on students.

Research results. AI-based systems can provide individual tasks to reinforce knowledge, analyze students' progress, and identify their weaknesses. This is especially important in classrooms with multi-level student learning groups, digital divides, and psychological traits. In addition, AI can automatically check the correctness of the task, analyze the effectiveness of algorithms, and provide constructive recommendations. AI can use the gamification mechanism to motivate students and create tasks based on adaptive games and students' knowledge level. Self-education is extremely important. Platforms with AI elements are useful for this type of activity. It is particularly important for areas where access to qualified teachers is limited.

In this article, we want to explore the possibilities of using ChatGPT by students who are beginning to learn the high-level programming language Python and its impact on their learning results.

To do this, let's formulate the steps that need to be taken to achieve this goal:

- Analyze problems related to teaching students programming.
- Conduct an analysis of the risks and disadvantages of using ChatGPT when learning programming.
- Analyze the possibilities of using ChatGPT in programming classes.
- Conduct research on students' use of ChatGPT when debugging programs and analyze its impact on their learning outcomes.
- Provide recommendations for formulating effective queries when learning programming.

Analysis of problems related to teaching students programming.

Scientists Semenykhina O. V. and Rudenko Y. O. [15] conducted research at the ascertaining stage, which involved determining the level of students' interest and desire to learn programming depending on their age. Thus, the analysis showed: the natural interest shown by younger schoolchildren in programming decreases over the years, and during the most productive period of its study, it is minimized. It was found that high school students have: a low level of interest in learning programming; lack of motivation; psychological blocks regarding their own abilities in the context of programming; insufficient level of understanding of computer science.

Researchers in the work [16] conducted an analysis of computer science curricula and indicated that the study of programming languages takes place in the 10th grade both at the standard level and at the profile level, but this section refers to an optional module, that is, not all students (schools, classes) choose this module for study, and therefore in some schools the study of a programming language may not be provided. That is, there is a problem of the lack of study of programming in high school.

In [17], researchers consider the problem of the sequence of learning programming. They found that when moving to learning high-level programming languages after block programming, it is advisable to use a game-based approach to program development, which will ensure the sequence of learning and the relationship with previously studied material.

The article [18] considers some problems of teaching the basics of algorithmization and programming in the school course of computer science. The authors identified and analyzed the following problems: mathematical preparation, continuity of the content line of the basics of algorithmization and programming, choice of programming language, availability of educational and methodological materials, motivation for learning. Each of the above problems is important for teaching the basics of algorithmization. The analysis of problem aspects was carried out for students of grades 5–11.

One important problem may be the lack of necessary technical capabilities, such as the need for specialized laptops or computers or software. The lack of such opportunities can significantly complicate high-quality teaching and learning of programming.

The next problem is the lack of a stable Internet connection, limited Internet traffic quota. This problem is particularly relevant nowadays, when military operations are ongoing in the country and there are frequent problems with electricity and, consequently, with the Internet connection.

Another problem is the lack of personal communication between students and classmates and teachers, which can lead to limited exchange of ideas, impossibility of discussions and mutual support, which can significantly affect the understanding of the material and the importance of learning tasks.

Analysis of the risks and disadvantages of using ChatGPT when learning programming.

Let's analyse the disadvantages and potential risks of using chat as a means of learning programming, which are indicated by the authors of articles [2], [7] – [10].

One of the most important disadvantages of using ChatGPT when learning programming is the desire of students to receive ready-made code for the task using an artificial intelligence system. This way, students can submit the code generated by the chat as their own. In general, a neural network can generate a ready-made code for a certain task, but for this, you need to have the appropriate skills to create queries for artificial intelligence, and you need to be able to configure programming environments.

Let's consider cases where users create requests in the system to receive ready-made code.

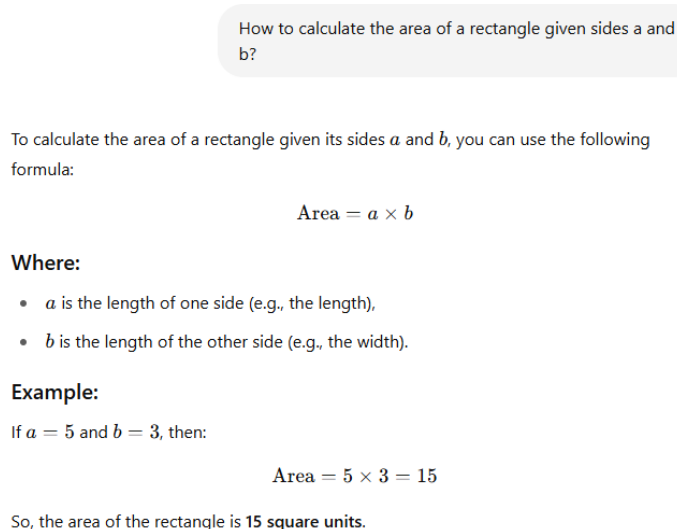


Fig. 1. Request to solve a programming problem using ChatGPT

What we can see from the response is that the artificial intelligence did not fully understand what it needed to do. Then the user rewrites the query as follows: "Write a program in the Python

programming language to calculate the area of a rectangle given sides a and b?". As a result, we will get code written in the Python programming language:

```
# Input: sides a and b
a = float(input("Enter the length of side a: "))
b = float(input("Enter the length of side b: "))

# Calculate the area
area = a * b

# Output the result
print(f"The area of the rectangle is {area}")
```

Fig. 2. Request to solve a programming problem using ChatGPT

This is the standard code for solving such a problem using Python. Thus, continuing to experiment with various queries on using ChatGPT to teach programming in Python, we can draw the following conclusions:

- the code written with the help of artificial intelligence may not be suitable for the task at hand;
- writing a good query requires the student to have basic knowledge of a particular programming language;
- code created by artificial intelligence is not always optimal;
- if multiple users make a request with a specific task, the program written using ChatGPT will have similar characteristics, thus making it easy to identify plagiarism.

Analysis of the possibility of using ChatGPT in programming classes.

At the moment, it is impossible to solve the problem of lack of technical capabilities using ChatGPT, so we will pay more attention to the neural network as a way for students to learn the material independently. There are times when a student was absent from a computer science class when new programming material was being explained. Of course, at such moments it may be difficult for a student to understand even basic concepts such as "loop", "variable", "condition", so ChatGPT can be used as an additional reference tool with various tasks.

Here are some examples of queries for basic concepts in the Python programming language.

We ask the following query: "Give a visual example of a "variable" in Python's language".

The chat produces a text message, code sample, and visualisation: *A variable in Python is like a labeled box that stores a value. You can "put" something into it, and "use" it later by referring to its name.*

Python code:

```
python Копіювати Редагувати

length = 5      # A variable named 'length' stores the value 5
width = 3       # A variable named 'width' stores the value 3

area = length * width # 'area' now stores the result of length * width

print(area)     # Output: 15
```

Visualization:

```
arduino Копіювати Редагувати

length → 5
width → 3
area → length x width = 15
```

Fig. 3. Visualizing the concept of "variable" in Python using ChatGPT

To the query "Give a visual example of a "condition" in Python," ChatGPT provided an answer in the form of a code example of a condition (i.e., an **if** construct), as well as a graphical representation of the concept: *A **condition** in Python is a statement that checks whether something is true or false, and based on that, the program decides what to do next.*

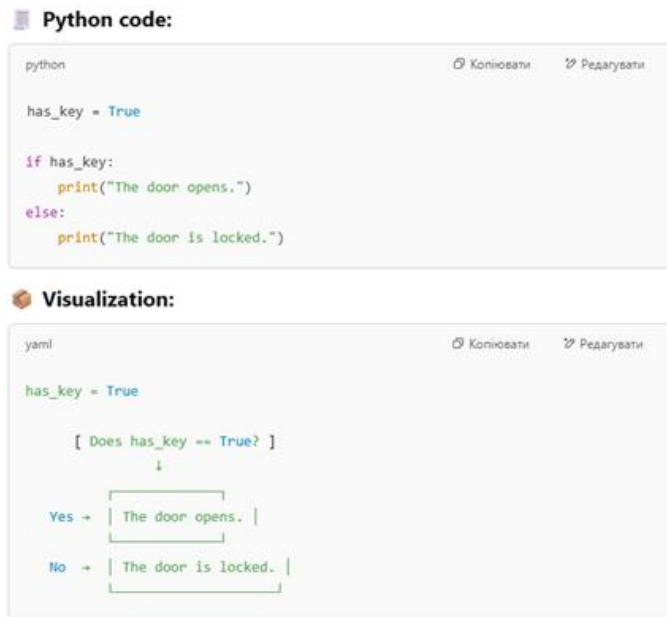


Fig. 4. Visualizing the concept of "condition" in Python using ChatGPT

The query "visualization of the concept of "for loop" in Python" received a response in the form of a definition of the for loop, a code example, a visual diagram, and a flowchart: *Let's visualize the concept of a for loop in Python — it's like repeating the same task for each item in a sequence (like a list or range of numbers).*

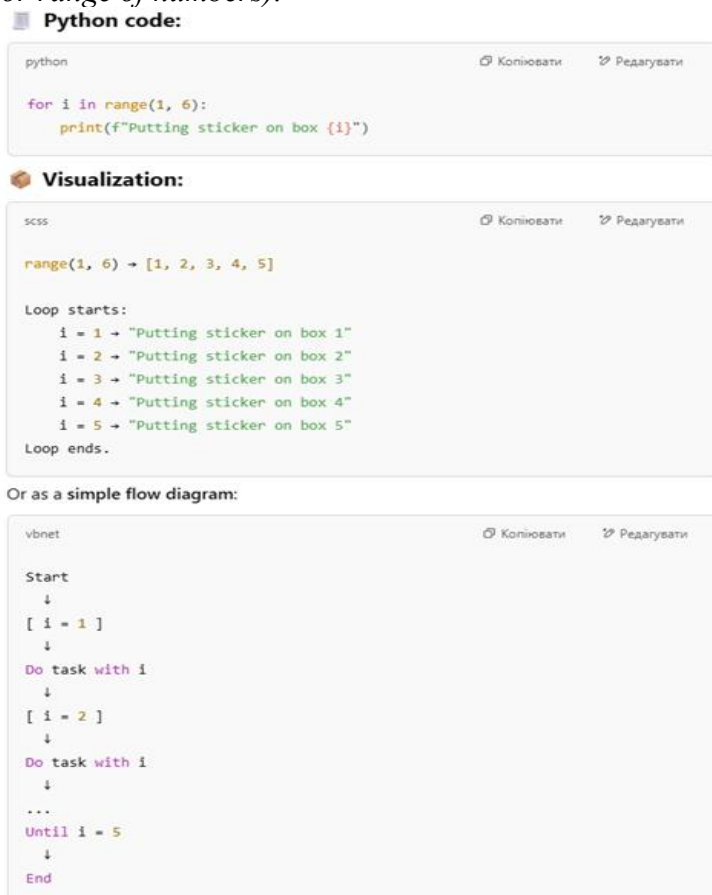


Fig. 5. Visualizing the concept of a "for loop" in Python using ChatGPT

Of course, if a student needs additional explanation of the topic "loops in Python", he has the opportunity to contact ChatGPT with a corresponding request. Thus, ChatGPT provides a piece of code that shows how to use a for loop in Python and also explains how it works.

In general, we can conclude that using ChatGPT as an interactive Python language reference is a necessary tool for students learning the Python programming language to quickly obtain additional information. An important use of ChatGPT is to correct errors in the student's code. Because when students first start learning a programming language, they make mistakes in their code. There are situations when a student cannot find an error in their code, then the chat's ability to check the code comes in handy.

Conducting a study on students using ChatGPT when debugging Python programs and analyzing its impact on their learning outcomes.

We conducted an experiment with students in grade 7-A at Chernivtsi Multidisciplinary Lyceum № 4. In 7th grade, students begin to learn programming in Python in the "Algorithms and Programs" section. The students in the class are divided into two groups, with 17 students in Group I and 16 students in Group II. When studying the section "Algorithms and Programs", students in the first group studied the Python programming language using ChatGPT, while students in the second group used only the textbook and the teacher's presentation. The first group used ChatGPT to explain loops, conditions, to show specific examples of code, and to explain that code. Thus, during the lessons in the first group, the students had an increased interest in studying this topic, they were active in the lessons, answered questions well, and gave specific examples, unlike the students in the second group. This is evidenced by the results on this topic, which are presented in the figures below.

The results of both groups are presented in the diagrams (Fig.6 and Fig.7).

■ quantity 10, 11, 12: ■ quantity 7, 8, 9: ■ quantity 4, 5, 6: ■ quantity 1, 2, 3:

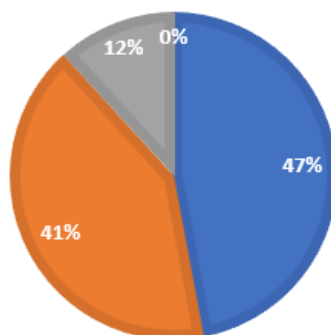


Fig. 6. Results of thematic assessment of the 1st group

■ quantity 10, 11, 12: ■ quantity 7, 8, 9: ■ quantity 4, 5, 6: ■ quantity 1, 2, 3:

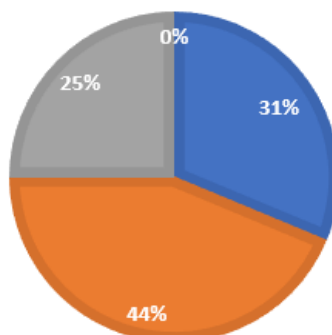


Fig. 7. Results of thematic assessment of the 2nd group

The quality of knowledge of students in the first group is 88%, and in the second group - 75%, and in the quantitative ratio of excellent grades (grades 10, 11, 12) students in the first group - 8, and in the second group - 5. Thus, using ChatGPT when learning programming in a computer science class helps students better understand and assimilate the educational material, and demonstrate creativity and imaginative thinking.

Therefore, encouraging students to experiment with code is an important step in learning programming, and ChatGPT is a valuable resource in this process. By experimenting with code and trying different approaches, students develop programming skills and gain a deep understanding of programming concepts. After conducting such an experiment, we can say that students' motivation to learn programming is increases.

Recommendations for formulating effective queries when learning programming.

Creating the right ChatGPT queries is a real art, especially if you are learning programming. Here are some tips on how to formulate effective queries to better learn Python:

1. *Be specific.* The clearer the request, the more accurate the answer. Instead of asking "Teach me Python", write "Explain how a for loop works in Python with an example".

2. *Take small steps.* Ask for a small snippet or concept to be explained, then move on. For example: "What is a variable in Python?", "How does the if conditional statement work?", "Give an example of a function that takes two numbers and returns their sum."

3. *Ask for an explanation in simple words.* Use phrases like: "Explain in terms of a beginner," "Can you give an example and a comparison with real life?"

4. *Ask for examples with explanation.* The code + explanation = the best combination for learning. For example: "Give an example of a function with parameters in Python and explain how it works."

5. *Use your examples.* Show the code you've already written and ask: "Why doesn't this code work?", "How can I improve this piece of code?", "How can I change this while loop so that it doesn't end up infinite?"

6. *Ask for practical tasks.* Ask: "Give a simple task using conditional operators", "A task for training functions in Python".

7. *Learn through mistakes.* You can even write intentionally "bad code" to have ChatGPT explain the errors. For example: "What's wrong with this code?", "Why is there a TypeError?"

8. *Request a comparison.* To better understand the difference between things, for example, you can ask: "What is the difference between a list and a tuple in Python?", "Which is better to use - for or while?"

9. *Learn step by step.* You can ask: "Teach me Python from scratch: step 1 — variables." Give the task", "Let's move on to step 2 - conditions", (And so on). I can accompany you as a "tutor", guiding you through the topics.

10. *Don't be afraid to ask "stupid" questions.* Because issues of this nature are often the most important!

Conclusions. We were tasked with analyzing the possibilities of using ChatGPT when learning Python programming and its impact on students, so we can make a brief summary:

1. ChatGPT makes it possible to create both useful and useless code. In order to get the best results, you need to provide clear and detailed instructions.

2. ChatGPT is great for solving specific coding tasks or routines, rather than creating complete programs from scratch.

3. Use ChatGPT to find and select the right coding libraries for specific purposes, and participate in an interactive discussion to voice your choices.

4. Be careful about ownership of the AI code you create and always verify the reliability of the code. Don't trust the results without verification.

5. Think of your interaction with ChatGPT as a conversation. Refine your questions based on the AI's answers to get closer to the desired result.

Also, as a result of the experiment, we can say that ChatGPT helps students understand and assimilate programming educational material and increases students' motivation to learn.

At the moment, ChatGPT has several competitors, so in the future research we plan to involve other generative models and compare the results of their use.

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Пукальський, І., Унгурян, Г., Яшан, Б. Використання штучного інтелекту ChatGPT при вивченні програмування.

Ця робота присвячена дослідженню можливості використання ChatGPT учнями, які починають вивчати мову програмування високого рівня Python та його вплив на результати їх навчання. Основна частина цієї роботи поділена на п'ять етапів. На першому етапі нами було проведено аналіз проблем, які стосуються навчання програмування учнів та виділено основні, такі, як часті відключення електроенергії та проблеми з інтернет-з'єднанням, відсутність необхідних технічних можливостей, а також відсутність особистого спілкування учнів з однокласниками та вчителями. Далі ми проаналізували ризики та недоліки використання ChatGPT при вивченні програмування та виділили основні з них. Це невідповідність коду поставленому завданню, не оптимальність створеного коду та швидке виявлення плагіату при однакових запитах учнів класу. Наступним кроком було здійснено аналіз можливостей використання ChatGPT при вивченні програмування. Підсумувавши всі можливості зрозуміло, що використання ChatGPT у якості інтерактивного довідника мови Python є цінним засобом для швидкого отримання додаткової інформації учнями, а також він є дуже корисним засобом для виправлення помилок у коді учня. На четвертому етапі ми провели експеримент над учнями 7-го класу по використанню чату для вивчення програмування. В результаті дослідження виявлено, що в учнів, які використовували ChatGPT для вивчення мови програмування Python був підвищений рівень мотивації до навчання та вони отримали набагато кращі навчальні досягнення в порівнянні з учнями які не використовували чат. На останньому етапі ми надали рекомендації щодо формулювання ефективних запитів в ChatGPT при вивченні програмування.

Результати підкреслюють, що використання ChatGPT при вивченні програмування стимулює учнів до навчання новому, підвищує рівень їхньої мотивації до у здобутті знань. Також варто пам'ятати про наслідки використання штучного інтелекту в освітньому процесі та проводити різні заходи для запобігання цьому.

Ключові слова: штучний інтелект, ChatGPT, мова програмування Python.

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А. І. Римар

ORCID ID 0000-0001-9077-236X

Криворізький державний педагогічний університет

**ВИКОРСТАННЯ ІКТ ДО ВІЗУАЛІЗАЦІЇ ЧИСЛОВИХ РЯДІВ НА ПРИКЛАДІ
МАТЕМАТИЧНИХ ТРОЯНД**

У статті розглянуто використання інформаційно-комунікаційних технологій для візуалізації та генерування числових рядів, пов'язаних із математичними трояндами Гвідо-Гранді, зокрема трипелюстковою та чотирипелюстковою, на основі їхнього розташування всередині правильного трикутника та квадрата відповідно. Показано, як сучасні цифрові інструменти сприяють осмисленню математичних закономірностей через наочні геометричні форми. Проаналізовано геометричні інтерпретації цих рядів.

Візуалізацію математичних троянд здійснено за допомогою програми GeoGebra, що дало змогу дослідити залежність кількості пелюсток від параметрів рівняння. Візуалізацію рядів і геометричних елементів (довжин сторін, периметрів і площ) виконано у Paint 3D. Для виконання обчислень елементів та частинних сум числових рядів