

# ARTIFICIAL INTELLIGENCE AND ITS APPLICATION TO PERSONALIZATION OF PROGRAMMING LEARNING IN STEAME INTEREST CLUBS

Todorka Glushkova

**Abstract.** *Artificial intelligence is increasingly asserting itself as a powerful tool for organizing the educational process. The term AIEd (Artificial Intelligence in Education) defined in [1] distinguishes two aspects: the development of AI-based learning tools and the use of AI to organize, manage, evaluate and improve learning. AIEd includes both the creation of intelligent school educational cyber-physical platforms [2, 3] and the use of chatbots and other intelligent tools to track and support learning processes and personalization of learning [4]. The article discusses the author's experience with the application of some AI chatbots in programming education in school STEAME interest clubs.*

**Key Words:** AIEd, AI-Chatbots, STEAME education.

## 1. Introduction

Artificial intelligence (AI) can play a key role in personalized programming learning in STEAME (Science, Technology, Engineering, Arts, Mathematics and Entrepreneurship) interest clubs at school, providing innovative methods and tools that facilitate learning and inspire students. The article will mainly focus on the personalization of learning in aspects such as:

- Providing opportunities for personalized learning and providing adapted learning resources and tasks by creating personas to which students associate with similar personal characteristics.
- Providing AI learning assistants to communicate with students, provide additional explanations and support during exercises or project work.
- AI can be used to evaluate and improve program code.

Using AI in STEAME interest clubs can enrich the educational process and inspire students to be excited about the world of programming

and science. However, it is important to emphasize that AI must be used in accordance with ethical standards and pay attention to the protection of personal data and the age of learners.

## 2. AI Chabots in school education

Chatbots used in training are an innovative and effective way to support the learning process. These bots can be used in a variety of educational contexts – in the classroom; in STEAME interest clubs; in out-of-school training centers; in online or blended learning; in lifelong learning etc. Chatbots can be used as an additional didactic tool to support learning in the following areas:

- Providing additional information related to learning content;
- Providing additional, more detailed explanations, resources and examples related to the learning topic;
- Chatbots can generate and provide assignments and exercises for students, according to their personal skills and knowledge.
- Receive feedback on solved tasks with additional comments and explanations, enabling students to understand their mistakes and improve their results.
- Chatbots can provide advice on effective learning strategies and techniques, especially when working on projects.
- Chatbots can make learning more interactive and fun by using games, quizzes, and other interactive activities to engage students and engage them in learning content.

Personalization is one of the key characteristics of successful learning [4]. Chatbots can help achieve this goal in the following aspects:

- They can use machine learning algorithms to adapt their suggestions during collaborative communication based on the students' individual needs and skills.
- They can provide personalized learning materials that are appropriate for the particular student.

On the other hand, AI chatbots can also assist educators and teachers in:

- Development of study programs for study disciplines and interest

clubs;

- The development of lesson plans;
- The creation of tests and questionnaires to measure the knowledge and attitude of students in the class or group;
- The creation of statistics on the progress and development of students;
- The organization of activities related to inclusive education.

Chatbots in education provide both students and educators with a means for more interactive, personalized and effective learning. They can contribute to better assimilation of the material and increase the motivation to learn. Some chatbots that are used or designed for training are:

- **Duolingo**: Duolingo uses a chatbot called “Duobot” that provides students in language courses with the opportunity to practice conversations of new language skills.
- **Squirrel AI**: This tutoring chatbot uses artificial intelligence and machine learning algorithms to deliver personalized math lessons and exercises.
- **Woebot**: This mental health chatbot is used to provide support and advice regarding students’ emotional well-being.
- **EduPal**: a chatbot designed to assist in information technology education. It provides information and resources for students.
- **Busuu**: Busuu uses a chatbot to teach new words and phrases in different languages through interactive dialogues.
- **AdmitHub**: This chatbot is used in the university admissions process, providing information and support to prospective students.

Moreover, chatbots with a more universal application such as ChatGPT [5] and MS GitHub Copilot [6] offer a wide range of capabilities and can be used in different fields. ChatGPT can: generate text in response to asked questions or instructions; to provide information and explanations on various topics using the knowledge with which he has been trained. MS GitHub Copilot is able to support the programming learning process by: providing automatic code suggestions during development; assists students in creating functions, classes, comments, and other parts of program code; provides quick and easy access to code snippets and frequently used

constructs; detects and comments errors in programs, etc. These chatbots are based on large Natural Language Processing (NLP) models and are trained with massive amounts of data. They have the potential to be used in a variety of fields, including education, programming, medicine, content creation, and more. However, the presence of possible limitations and inconsistencies, such as the lack of context awareness and the need for careful processing of the data that can be provided to the models, should be considered.

### 3. AI Chatbots and programming education in STEAME interest clubs

In recent years, robotics has entered the STEAME interest clubs as a desired direction. On the one hand, this field combines knowledge of mathematics, physics, mechanics, programming, and on the other hand, it also enables the application of AI tools in education. The first step in the organization of such an interest club is the development of a curriculum tailored to the age group, the learning objectives and the desired skills and competencies. Here the teacher can be supported, for example, by ChatGPT. To the request “Create a curriculum on “Introduction to robotics” for 7th grade students within 30 teaching hours. The main objectives are to acquire knowledge and skills related to programming the movement of robotic devices in Python.” The chatbot offers the curriculum presented in Figure 1.

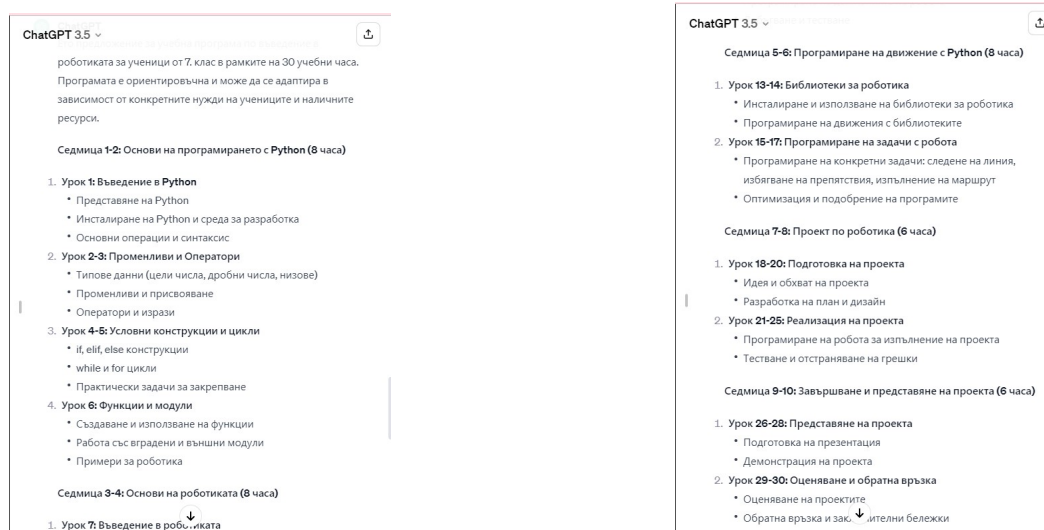


Figure 1. Curriculum for STEAME Interest club “Introduction in robotics”

Preparation for any topic of the syllabus can also be assisted by the AI-bots. For example, for Lesson 15–17 Programming Robot Tasks, chatGPT generated the following lesson plan proposal and short feedback check (Figure 2):

**Урок 2: Практическо програмиране (45 минути)**

- Преговор на предишната седмица (10 минути):**
  - Бърз преговор на материала от предишните уроци, свързан с програмирането на робота.
- Демонстрация (15 минути):**
  - Демонстрация на програмирането на конкретна задача с робота.
  - Обяснение на кода и взаимодействието със сензори или актуатори.
- Практическо упражнение (15 минути):**
  - Учениците да изпълнят същата задача или подобна с робота.
  - Ръководство и помощ от учителя по време на упражнението.
- Обсъждане на резултатите (5 минути):**
  - Споделяне на решения и изживявания от учениците.
  - Анализ на възникнали проблеми и техните решения.

**Урок 3: Заключително обобщение и оценка (45 минути)**

- Преговор на практическите упражнения (20 минути):**
  - Преговор на програмирането на робота и решаването на задачи.
  - Споделяне на добри практики и трудности.
- Оценяване и обратна връзка (15 минути):**

**ChatGPT**

Ето три въпроса от различен тип, които може да използвате за тест във връзка с уроците за "Програмиране на задачи с робота":

**1. Въпрос тип "Множествен избор":**

Какво представлява програмирането на задача с робота?

- Програма за решаване на геометрични задачи.
- Процес на създаване на софтуер за роботи.
- Процес на определяне на цветовете на роботските сензори.

**2. Въпрос тип "Кратък отговор":**

Какво е предимството на използването на сензори при програмирането на робота? Дайте кратък отговор.

**3. Въпрос тип "Практическа задача":**

Използвайки Python, напишете код за програмиране на робот, който трябва да следва черна линия на пода и да избегне препятствия по пътя си.

Figure 2. Lesson plan and feedback test (in Bulgarian)

Personalization is a key feature of successful learning in both classroom work and STEAME interest club activities. The teacher, based on his/her experience, customizes the learning tasks, but also in this process teacher can get the assistance of the AI bots. According to [7] Personas are profiles of a group of students with similar personal characteristics. If we make a request to ChatGPT to generate several Personas and then join the specific students to the Persona with the closest characteristics, we will be able to customize the learning tasks (Figure 3).

**ChatGPT**

Персона 1: Александър - Страстият Програмист

- Възраст: 14 години
- Характеристики:
  - Обича програмирането и е ентузиазен от новите технологии.
  - Винаги носи със себе си лаптоп и е вълнуван от създаването на нови софтуерни приложения.
  - Участва активно в състезания и хакатони, където развива своите умения в програмирането на роботи.

Персона 2: Мария - Теоретичен Дизайнер

- Възраст: 14 години
- Характеристики:
  - Харесва дизайн и творческо решаване на проблеми.
  - Занимателна е от изграждането на иновативни роботи с уникални външни видове.
  - Участва в състезания, свързани с дизайн на роботи, и съчетава програмирането с изкуствен дизайн.

Персона 3: Николай - Инженерът на Бъдещето

- Възраст: 14 години
- Характеристики:
  - Обича инженерството и механиката на роботите.
  - Всеки свободен момент го използва за конструиране и подобряване на роботи.
  - Участва в състезания за роботи със сложни механични изисквания и създава уникални решения.

**ChatGPT**

Задача за програмиране на робот за Александър: "Следвай Линията"

**Задача:**

Александър трябва да напише програма за робот, която ще следва черна линия на пода. Роботът е оборудван със сензор, който отчита цвета на пода. Целта е да се програмира роботът да следва черната линия и да прави завои, когато срещне кръстовище или завиваща линия.

**Изисквания:**

- Роботът трябва да стартира движението си, когато бъде стартиран програмата.
- При засичане на черната линия, роботът трябва да следва посоката на линията.
- Ако роботът достигне кръстовище, трябва да реши дали да завие наляво, надясно или да продължи напред.
- Роботът трябва да може да прави корекции по време на движение, за да остане върху линията.
- Програмата трябва да се завърши, когато роботът достигне предварително зададено място или след определен брой движения.

Figure 3. Creating Personas and appropriate tasks for them (in Bulgarian)

Programming the robot motion task following a black line as well as pathfinding in lability can be part of a project-based learning mission. After completing the work on the implementation of the project, the teacher can analyze the program implementations (Figure 4). MS Copilot can assist him/her in this direction. The chatbot suggests the program constructs, detects errors or the use of inefficient methods, comments the code and explains in detail the algorithms used. This chatbot can be used by the teacher both at the stage of preliminary preparation and during the lesson when working with students.

In the last year, an experimental study was conducted on the application of AI chatbots in programming education in the STEAME interest club at the school in Brezovo, region of Plovdiv. The results show that over 60% of teachers consider the use of chatbots useful, although they need additional information and support; 90% of students find it motivating to use chatbots to support project work within interest clubs. In the conducted survey among students, over 90% expressed a desire to use AI technologies to solve specific problems, while over 75% of parents expressed concerns about their children's independent use of these technologies.

```

python
from ev3dev2.motor import LargeMotor, OUTPUT_A, OUTPUT_B, SpeedPercent
from ev3dev2.sensor.lego import ColorSensor
from time import sleep

# Инициализиране на моторите
left_motor = LargeMotor(OUTPUT_A)
right_motor = LargeMotor(OUTPUT_B)

# Инициализиране на цветния сензор
color_sensor = ColorSensor()

# Настройка на скоростта на моторите
left_motor.on(SpeedPercent(50))
right_motor.on(SpeedPercent(50))

while True:
    # Проверка на цвета на левата (например, черно)
    if color_sensor.color == ColorSensor.COLOR_BLACK:
        # Роботът се движи напред
        left_motor.on(SpeedPercent(50))
        right_motor.on(SpeedPercent(50))
    else:
        # Роботът завива надясно, за да се върне към левата
        left_motor.on(SpeedPercent(0))
        right_motor.on(SpeedPercent(50))

# Можете да добавите други условия и логика за коригиране на посоката на движение

# Проверка на цвета на левата (например, черно)
if color_sensor.color == ColorSensor.COLOR_BLACK:
    # Роботът се движи напред
    left_motor.on(SpeedPercent(50))
    right_motor.on(SpeedPercent(50))
else:
    # Роботът завива надясно, за да се върне към левата
    left_motor.on(SpeedPercent(0))
    right_motor.on(SpeedPercent(50))

```

```

python
from robobo import Robobo
import time

# Инициализиране на робота
robobo = Robobo()
robobo.connect()

# Преместете робота напред
robobo.move(50) # Променете скоростта и времето според нуждите си

while True:
    # Проверка на разстоянието до стената в предния сензор
    distance = robobo.readSensor("front", "distance")

    if distance < 10: # Адаптирайте стойността на разстояние според лабиринта
        # Завъртете робота надясно
        robobo.turnLeft()
    else:
        # Роботът се движи напред
        robobo.move(50) # Променете скоростта и времето според нуждите си

    # Проверка за достигане на цвета (катола от лабиринта)
    if robobo.readSensor("front", "color") == "green":
        robobo.stop()
        break

# Разключване на робота
robobo.disconnect()

```

Figure 4. MS GitHub Copilot Suggestions

## 4. Conclusions

The use of AI in education has many advantages, but also certain challenges. AI can improve learning outcomes, productivity and student

engagement by opening new avenues for personalized education, feedback, collaboration and support. However, it was found that during training the chatbots provided sometimes detailed but incomplete information, as well as some poor programming advice and solutions. This was successfully used by teachers to draw students' attention to the need for critical reception of information.

Teachers are largely reserved and pay more attention to the problems and challenges of using these technologies. Parents are cautious and worried about the rapid introduction of new and insufficiently tested technologies in education. All this determines the need for joint efforts by teachers, researchers, scientists and policy makers to ensure the ethical and responsible use of AI in education.

### Acknowledgments

This study is financed by the European Union-NextGenerationEU, through the National Recovery and Resilience Plan of the Republic of Bulgaria, project No. BGRRP-2.004-0001-C01 and partially supported by the project FP23-FMI-002 "Intelligent software tools and applications in research in mathematics, informatics and teaching pedagogy" at the Plovdiv University "Paisii Hilendarski".

### References

- [1] F. Ouyang, P. Jiao, Artificial intelligence in education: The three paradigms, *Computers & Education: Artificial Intelligence*, 2021, 2, 100020, <https://doi.org/10.1016/j.caeai.2021>.
- [2] J. Todorov, I. Krasteva, V. Ivanova, E. Doychev, BLISS-A CPSS-like Application for Lifelong Learning, *IEEE International Symposium on Innovations in Intelligent Systems and Applications (INISTA)*, Sofia, BG, 2019 b, 1–5, doi: 10.1109/INISTA.2019.8778363, ISBN: 978-1-7281-1862-8.
- [3] A. Rahnev, N. Pavlov, V. Kyurkchiev, Distributed Platform for e-Learning – DisPeL, *European International Journal of Science and Technology (EIJST)*, 2014, Vol. 3, No. 1, 95–109, ISSN:2304-9693, Corpus ID: 111412863.
- [4] T. Noskova, E. Smyrnova Trybulska, N. Morze, T. Hug, T. Glushkova, K. Gurba, New Technologies in Personalization of STEM and STEAM Education – International Context, *International Journal of Con-*

- tinuing Engineering Education and Life-Long Learning*, 2021, 1 (1), doi:10.1504/ijceell.2022.10037158, ISBN: 1741-5055.
- [5] K. Quibeldey-Cirkel, Disrupting stem education: the game-changing impact of ChatGPT and ChatGPT codex, *EDULEARN23 Proceedings*, IATED, 2023, pp. 220–228, ISBN: 978-84-09-52151-7, ISSN: 2340-1117, doi: 10.21125/edulearn.2023.0106.
- [6] B. Puryear, G. Sprint, Github Copilot in the classroom: learning to code with AI assistance, *Journal of Computing Sciences in Colleges*, 2022, 38 (1), 37–47, ISSN: 1937-4771.
- [7] L. Nielsen, K. Nielsen, J. Stage, J. Billestrup, Going Global with Personas, 2013. In: P. Kotzé, G. Marsden, G. Lindgaard, J. Wesson, M. Winckler, (eds) *Human-Computer Interaction – INTERACT 2013*. Lecture Notes in Computer Science, Vol. 8120, Springer, Berlin, Heidelberg. [https://doi.org/10.1007/978-3-642-40498-6\\_27](https://doi.org/10.1007/978-3-642-40498-6_27), Print ISBN: 978-3-642-40497-9, Online ISBN: 978-3-642-40498-6

Todorika Glushkova, Paisii Hilendarski University of Plovdiv,  
Faculty of Mathematics and Informatics,  
236 Bulgaria Blvd., 4003 Plovdiv, Bulgaria,  
email: [glushkova@uni-plovdiv.bg](mailto:glushkova@uni-plovdiv.bg)