

# Opportunities for block programming in STEM education

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## **Abstract**

STEM education seeks to build foundational skills that may be applied in emergency situations, apply knowledge acquired, encourage a passion for work, and lay the foundation for creative thinking. Block programming can benefit a learner's development by fostering enthusiasm, persistence, and advancement in the field of programming. Learning basic algorithms and applying them to real-world, practical tasks and projects motivates the present novice programmer to seek out and find new solutions to his issues.

**Subject Codes:** 97P20, 97B20.

**Keywords:** STEM, block programming, micro:bit, arduino, robotics.

## **1 Introduction**

Interactive learning methods occupy an increasingly large part in the educational process, which is why a number of changes in the educational system are required. Introducing new teaching methods, techniques, and approaches, renewing the old technique with a new one in order to improve the quality of the learning environment.

## **2 Results and Discussion**

Interactive learning methods occupy an increasingly large part in the educational process, which is why a number of changes in the educational system are required. Introducing new teaching methods, techniques, and approaches, renewing the old technique with a new one in order to improve the quality of the learning environment.

One of these methods is the STEM model of learning, which was developed in the 1990s. The term STEM originates from the English words for Science, Technology, Engineering, Math (Mathematics). This method of training is widespread in the USA, and in recent years it has also been popularized in European countries.

To form algorithmic thinking and basic programming knowledge, visual programming environments are used, where the child immediately sees the result of his program [2]. Block programming makes it possible to learn different types of algorithms in an accessible way that learners can quickly and easily apply. Code implemented in the form of visual-colored blocks

has a strong impact on understanding code and increasing programming skills.

### **Opportunities for STEM block learning grades 5-7 (micro:bit)**

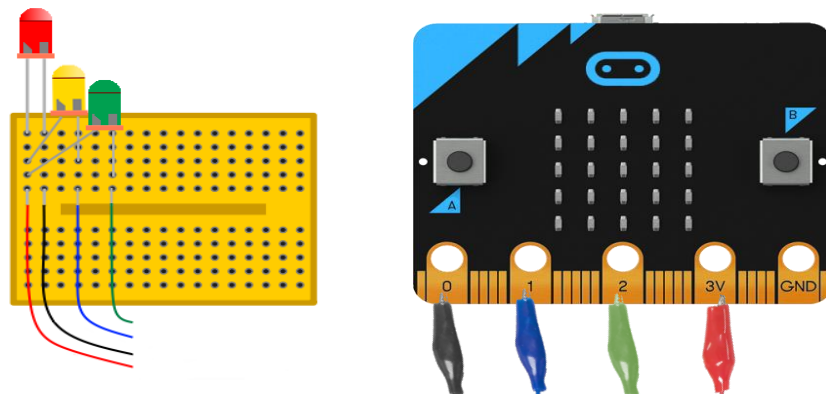
The Micro:bit is a small programmable computer designed to encourage children to get actively involved in writing code and creating various projects [1]. It features 25 LEDs, motion, touch, pressure, temperature and light sensors, making it very convenient for developing small and medium-sized projects in a learning environment.

#### *Project "Traffic Light"*

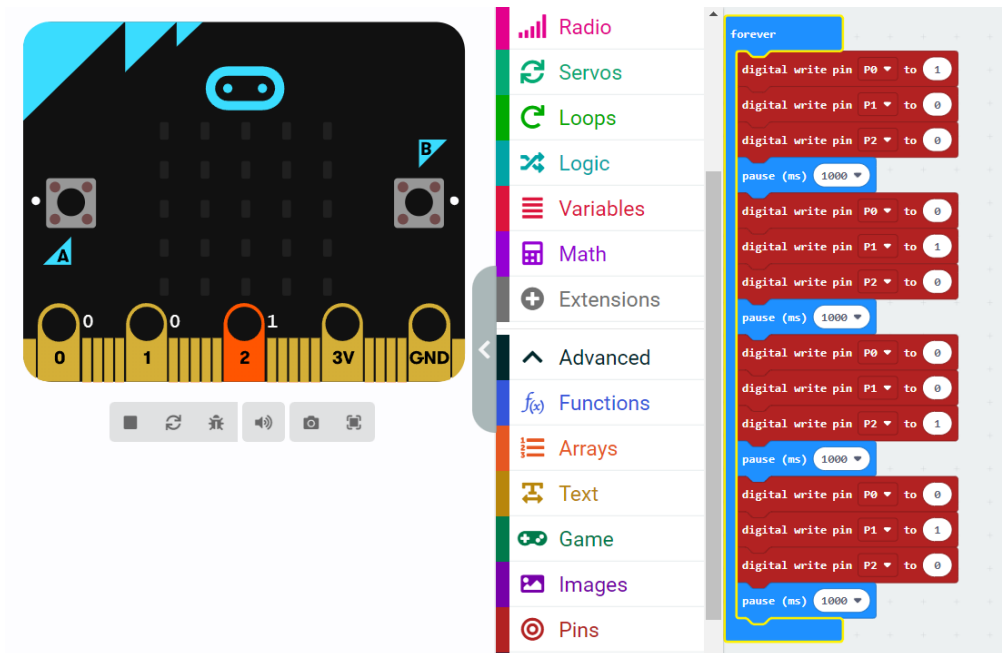
The goal of this project is for students to develop and build skills to implement a looping algorithm that is applied to start the lights of a streetlight. Knowledge from Physics and Road safety lessons is used.

Necessary resources for the implementation of the project:

- <https://makecode.microbit.org/#editor>.
- BBC micro:bit
- Micro USB cable
- Battery pack with 2 x AAA batteries
- 3 x LED light 5 mm
- Breadboard
- 4 x Alligator Clip to Male Jumper Wire



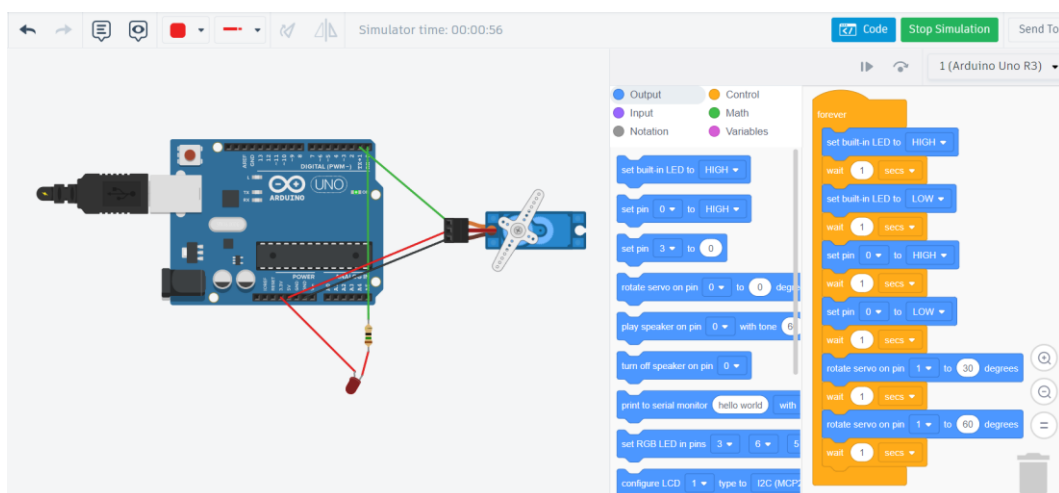
**Figure 1** Technical implementation of the project "Traffic light"



**Figure 2** Code implementation in an online platform [4] for block programming with micro:bit

### STEM block programming opportunities grades 8-10

Arduinos are an open-source microcontroller board that allows the creation of more complex projects and prototypes for hobbyist or educational purposes. Having standard ports makes it very accessible to connect to other systems and interact with various sensors, electric motors, LEDs, LED displays and more.



**Figure 3** Code and simulation in an online platform [5] for c Arduino programming

### *Remote Controlled Car:*

The aim of this project is for the students to develop skills and competences related to building skills of algorithms and conditional transitions, which is applied in the management of the cart. Knowledge from Physics, Mathematics and IT lessons is used.

Necessary resources for the implementation of the project:

- <https://www.tinkercad.com/>
- Arduino UNO
- Micro USB cable
- Battery pack with 2 x AAA batteries
- 4 x LED light 5 mm
- 2x Gearmotor
- 4 x Wheels
- 1 (set) Jumper Wire
- 1 (set) Alligator Clip Wire
- Bluetooth module

The special thing about this project is the choice of working chassis. It can be drawn and made using a 3D printer, thus the project will be most precisely realized, or it can be created from another suitable material (MDF, Plexiglas or cardboard). When designing the car, you will be expected to think about suitable places and ways to attach all the components as well as the Arduino board itself.



**Figure 4.** An example implementation of a cart programmed with Arduino [3].

## **3 Conclusion**

The purpose of STEM training is to form basic skills to be applied in critical situations, application of acquired knowledge, active attitude to the activity performed and laying the foundations of creative thinking.

The use of block programming can influence in a better direction, the development of the learner by causing him interest, persistence, and development in the field of programming. The learning of basic algorithms and their application in real practical tasks and projects motivates the modern novice programmer to search and find new solutions for his challenges.

## References

- [1] Garov, K., Peykova, D., Some aspects of STEM teaching and learning in primary and lower secondary education, Scientific Conference “*Innovative ICT for Digital Research Area in Mathematics, Informatics and Pedagogy of Education*”, 7-8 November 2019, Pamporovo, Bulgaria, 67-76. <https://fmi-plovdiv.org/GetResource?id=3555>.
- [2] Dermendzhieva, L., Papancheva, R. 2017, BLOCK PROGRAMMING FOR TEACHERS AND STUDENTS, *Education and Technologies*, vol. 8, 2017, 367-375. [https://www.edutechjournal.org/wp-content/uploads/2017/09/8\\_2\\_367-375.pdf](https://www.edutechjournal.org/wp-content/uploads/2017/09/8_2_367-375.pdf).
- [3] Mestvirishvili, I., Shapakidze, D., 2020, Nauka za trieneto, Programiraneto v STEM obuchenieto, Science on Stage Deutschland, 2020, 30-35, [https://www.science-on-stage.eu/sites/default/files/material/coding-in-stem-education\\_bg\\_web.pdf](https://www.science-on-stage.eu/sites/default/files/material/coding-in-stem-education_bg_web.pdf).
- [4] <https://makecode.microbit.org/#editor>.
- [5] <https://www.tinkercad.com/>.

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