SOME POSSIBILITIES FOR APPLYING THE MICRO:BIT IN STEM EDUCATION GRADES 5-7

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ABSTRACT: *This article examines some possibilities for applying block programming through the use of a Micro:bit programmable board in STEM education classes. Various methods and technologies are presented by which this board can be integrated into the learning process. Attention is drawn to the relationship between block programming and other academic disciplines. Several sample implementations are provided.*

KEYWORDS: *STEM education, Micro:bit, Project-based learning, Middle school, STEM technology*

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Introduction

Education through STEM (Science, Technology, Engineering, Mathematics) is a modern methodology aimed at building knowledge and competences by solving tasks related to life. These tasks are very often developed in multi-component projects in which knowledge from different learning areas is applied. As some authors share "STEM is an approach to learning that is based on the idea of educating students in four specific disciplines - science, technology, engineering and mathematics in an interdisciplinary and applied approach" [1]. According to various sources, STEM was born in the 90s of the last century [3], and its main progress, according to some authors, at the beginning of the XXI century, parallel to the development of information and communication technologies.

The modern teacher is challenged to be competent in these four disciplines and to set tasks whose goals are solutions related to the challenges and problems of the modern world. In this regard, building suitable conditions, such as the construction of a school STEM

environment, provided for by the eponymous NP [8], gives the opportunity for every teacher to construct and model their STEM lessons and projects. The use of various techniques, software and devices such as programmable boards, "microscopes, computers, tablets, robotic devices, etc. Students learn to recognize problems by putting themselves in problem situations and testing" [2], which motivates and stimulates them in classes.

All these disciplines can be united in the following "active activities:

1) Science: observation, comparison, description, experiment, forecasting, asking questions, looking for reasons, creating explanations and drawing conclusions, presenting results.

2) Technology: identifying a problem, exploring possible solutions to achieve something, using tools (from a screwdriver to software applications), looking for improvements, inventing.

3) Engineering: solving real problems, using different materials for construction, design, planning.

4) Mathematics: comparing, measuring, counting, finding models, study of geometric shapes, etc." [5]

What is Micro:bit?

Microbit is a programmable board equipped with an Arm Cortex-M4 32 bit processor with FPU with a speed of 64MHz (Fig. 1). The transfer of information between the computer and the board is realized through a USB cable, and the many sensors and interfaces make it possible to realize a variety of projects[10]. If the holder for battery is used, the board can work autonomously with 2 batteries of 1.5 V each.
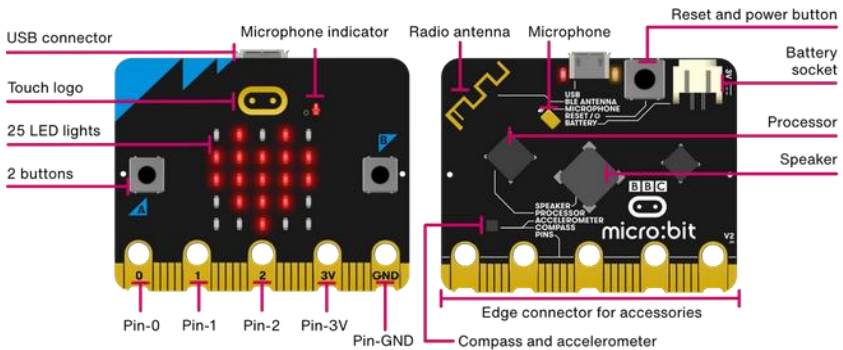
Fig. 1 Device on a micro:bit board [9]

On one side of the board there are two buttons (A and B) that are used to control events in the program code. The light matrix of 25 LEDs allows symbols and diagrams to be visualized, through which feedback is provided to the user. The sensors touch, accelerometer, magnetometer, temperature, as well as Bluetooth, the antenna, microphone and speaker, give great latitude to act in the construction of STEM projects. In order to control other devices or sensors, the micro:bit board has 3 main pins for I/O, 1 main pin each for the transmission of electrical voltage and for GND (ground). The other pins can also be used for this purpose, but they require an additional expansion board.

A block environment for working with micro:bit

In order for micro:bit to be used by students who have not yet worked with a scripting text language, the online block environment makecode.microbit.org (Fig. 2), analogous to the familiar block programming environment Scratch, can be used. The environment features a board simulator as well as a coding area. In the middle area are the coding categories from which the required blocks can be selected. In addition to the standard categories for variables, math and logic operations, the environment also has categories to serve the

built-in sensors, the LED matrix and additionally added sensors and devices.
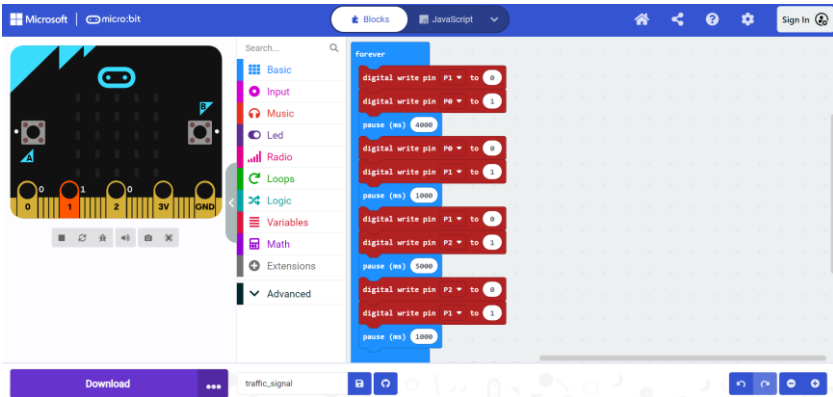
Fig. 2 Work screen of makecode.microbit.org [11]

Any ready code can be stored both in the online environment itself and on the local computer.

Applying project-based learning through Micro:bit

In the implementation of the projects using the micro:bit board, a variety of household materials (paper, wood, cardboard, plastic straw) can be used, as well as additional components such as prototype breadboard, servo motors, alligator clip, jumper wires, water pumps, edge connector breakout board, color LEDs, sensors[7] and etc. With their help, students can create small fun projects that they can easily create even at home. The basic principle that is applied is the use of an infinite loop in which the status of a selected sensor is tracked. If the sensor value changes, then a certain action occurs.

Some of the most popular projects are: watering system, seismograph, step counter, traffic light, etc.

Fig. 3 Example for seismograph [13] and watering system [12]

Another possibility for the creation of projects is the integration of the circuit board and Lego constructors. This type of project is very widespread in STEM education, mainly because of the many products that are available on the market. The use of this type of constructors, according to some authors, "are fascinating and interactive, through which various scientific and engineering experiments are carried out to help them find solutions independently" [4]. From one such constructor, different types of mechanized projects can be created, depending on the number of sensors and the variety of blocks.

Some of them, such as the Inverter Kit [6], allow to realize up to 12 projects described in a separate manual. These projects are implemented using various modular sensors, electric motors and cables connected to each other by means of magnets. Some of the more famous projects are: Automatic Door, Line Patrol Car, Gesture Control Car (Fig. 4). This kind of STEM kits can practically be used daily and by every student without the need to use additional equipment or renew any consumables.

Fig. 4 Invertor Kit and project Gesture Car

Conclusion

The application of the STEM approach at an early age for learning gives the opportunity to develop the personal and professional skills of students. Creating an educational STEM environment in every school will enable every teacher to work and develop both their professional skills and those of their students. The challenge of exactly what resources to use in a particular lesson or project is a problem that many teachers experience. The lack of sufficient literature in Bulgarian, as well as a description of example technologies that would be useful in teaching, makes the preparation of such lessons difficult and uncertain.

With the introduction of a number of operational programs and projects, the Ministry of Education and Science aims to create conditions for the STEM approach to be permanently integrated in every school. Time will tell to what extent the new STEM challenge will be part of the daily learning process.

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