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Micro:Bit Immplementation in ICT Education

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Abstract: Our civilization has moved deep into the computer society. Unlike the economy, schools very slow carry out the necessary transformations. The application of different technologies in the educational process, on the one hand, accelerates the teaching process while on the other hand it makes it more interesting and acceptable to participants. Therefore, various initiatives have been launched aiming at a faster transformation of the school system. With an ubiquitous trend of accent on the STEM area, the logical way of solving problems is the foundation of development. Programming logic is recognized as a tool that will be the basis for any business. In search of affordable solutions, in order to cover as many of today's pupils as possible, Micro:bit are selected. Micro:bit can also be used to enhance computational thinking, learning, and problem-solving across disciplines. More than 30 countries around the world began to use Micro:bits in their education systems. In Croatia, this was accomplished through various projects involving almost all school institutions and spreading across libraries across the country. The aim of this paper is to show that projects with a high impact on education can be realized with a small amount of funds. We will show some of the started projects, the correlation they have created among subjects in school and generations of children. The impact that a Micro:bit has on education in Croatia is indisputable and therefore we will try to give examples of good practices described in the projects for future use of this technology in teaching.

Keywords: Micro:bit, STEAM education, School, Programming

Introduction to Micro:Bit

The Micro Bit (also referred to as BBC Micro Bit, stylized as Micro:bit) is an open source hardware ARM-based embedded system designed by the BBC for use in computer education in the UK in 2015. The device is described as half the size of a credit card and has an ARM Cortex-M0 processor, accelerometer, magnetometer and temperature sensor, Bluetooth and USB connectivity, a display consisting of 25 LEDs (5x5 matrix), two programmable buttons, and can be powered by either USB or an external battery pack. The device inputs and outputs are through five ring connectors that form part of a larger 23-pin edge connector (Figure 1.).

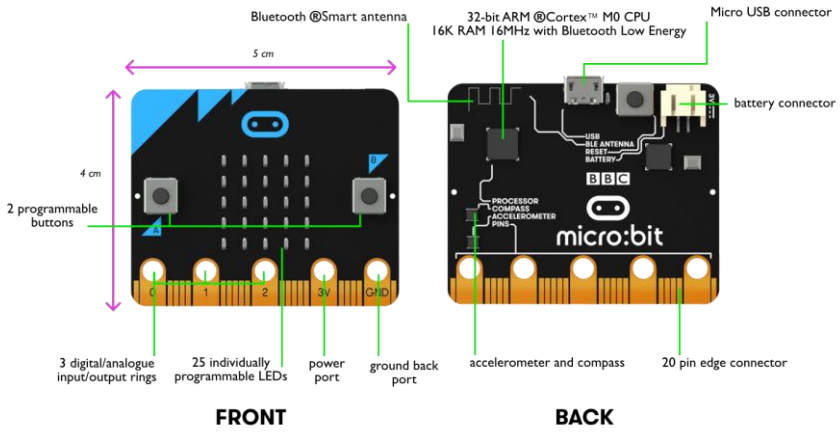

Figure 1. Hardware description of Micro:Bit (Source: https://microbit.org/hr/guide/features/)

Micro:bit can be coded in any web browser with Blocks, Javascript, Pyton, Scratch ect. respectively no specialized software installation is required on any OS platform.

It is not necessary to own the microcontroller itself, since the web editor in which it is programmed has a Micro:bit, so it can be tested any time whether the script is written or not. Different microbial sensors allow children and teachers to spread their imagination and use them in many different ways. Using Micro:bits makes it very easy for every child to learn the basics of coding very quickly, so they can quickly create their own, simple games, develop problem solving skills, and become interested in STEM.

Micro:Bit Usage

Micro:Bit Usage Worldwide

Today, Micro:bit is represented in nearly 30 countries of the world, including Canada, Norway, Singapore, China, Swedish, USA, etc. The first massive use of Micro:bit in schools was in UK, two years ago. It was difficult to assume that two years later it would be used by nearly a million students. Such a growth of users, implies a bigger need for support for both teachers and students. "A Discovery Research report for BBC Learning showed genuine behavioural change: before using Micro:bit 23% of girls said they would definitely take up computer science as an option, after using the Micro:bit for the first time that number increased up to 39%. Elsewhere, 88% of all respondents – boys and girls – said the Micro:bit made coding seem less difficult than they previously believed." (Martin, 2016). Teachers covered by this change may vary significantly according to age and education as well as the way of use of technology. In the United Kingdom, everyone has a unique need to quickly adapt to the new curriculum. According to Sentance (2017.), some schools do not use Micro:bit only in the STEM field, but in other subjects such as textiles and art. In textiles the Micro:bit was programmed to light up and then sewed into clothes. They need fast and comprehensive support. It is estimate that Micro:bit users will create satisfying apps in less than 50 lines, according to Ball (2016).
Different movements for support are being initiated in this period. Some of them are: Fab Lab, Croatian Manufacturers, Techshop, Maker Schola, Digitalverkstan …

Micro:Bit Usage in Croatia

Micro:Bit Competition| Profil Klett

One of the projects that had the most significant impact is the project of the company Profil Klett.The aim of the competition was to demonstrate how to apply ICT in teaching and at the same time to develop the social and ecological awareness of students as well as actively encourage students to apply Micro:bit in irrigation sets and their integration into the teaching of different subjects and grades. The main goal of the project is to achieve co-operation between classroom and subject teaching, teamwork, develop a sense of responsibility in the proper use of equipment, develop creativity in the use of computer in teaching, develop students' ability to observe and measure, develop a positive and conscientious attitude toward work and ecological awareness.

A plant watering set that consisted of a soil moisture measuring sensor and water pumps was donated to schools. The set was planted alongside the plant.

Also, as a support for the development of ideas, a digital manual for teachers was developed. "Examples of microbial integration in teaching with different interpersonal contents - exercises and tasks with Python on Micro:bit".

The framework of activities that most students did can be represented as follows:

1. To set hypotheses of research work
2. Established stages of research work
3. Picking seedlings
4. Learning about the germination process and planting conditions
5. Performing an experimental part of the research work
    a. Programming Micro:bit
        i. Generating code
        ii. Setting the moisture sensor
        iii. Adjusting the amount and speed of water flow
    b. Manual watering of seedlings
6. Data collection
    a. Height of the plant
    b. Number of flowers / leaves
    c. Amount of water used
    d. Amount of electricity consumed
    e. The amount of light received
    f. Temperature
    g. Plant mass
7. Data processing
8. Dissemination of results

The main research question was: Which plant will grow better?
The schools that participated in the competition had experiments with different hypotheses:
H1: The Plant I manually pump.
H2: The Plant that has automatic irrigation with a Micro:bit.
Some schools conducted additional experiments with amount of (artificial) light and the release of different types of music.

The research was mostly attended by 3rd and 4th grade or 5th and 6th grade students. They were lead by teachers of class teaching, biology and CS.

Research work was largely organized so that lower grade students were given the task of making pots, creating visual arts and literary works and creating posters and comics. Senior class students programmed Micro:bit, adjusting sensors, manually pumping plants, and taking care of the accuracy of the circuit.

Among the seedlings used in the project tomatoes, peas and wheat dominated, but we also encountered a wide range of plants used in schools. Vegetables including radish, spinach, young onions, tomatoes, wheat, barley, etc. Some used zumbulas and African purples, lemons, cucumbers, cherries, cherries, cocoa.
Depending on the seedlings used, germination times were different, but most schools were careful to expose the seedlings to enough light.

The experimental part consisted of for steps:

- planting two plants (usually) of the same type
- connecting the plant with the Micro:bit (water pump, water tank, irrigation hose, soil moisture sensor etc.).
- Programming Micro:bit for optimum watering of the plant (amount of water, frequency of watering depending on sensor sensitivity)
- Recording results and planting seedlings manually.

During the project in some schools the water pump failed. They decide to continue with manual watering of the plants.

Data collection was periodic. The most commonly collected data was measuring the difference in height of the irrigation seedlings compared to manual irrigation. Schools that chose crops with multiple seeds, eg wheat yields, have results which generally show manual irrigation as better because all plants had the same amount of water. Unique distribution and growth of all plants was evident, as opposed to automatic irrigation, where plant growth was in the narrow circle around the pump, and the rest of the grain grew later. It was obvious even when it later grew. Schools that have decided on individual seedlings eg tomato, show better results with automatic irrigation compared to manual. Some schools still - depending on the chosen plant - counted the leaves on the plants, measured temperature and room lighting, soil moisture, the amount of electricity and water used, etc.

Results

The progress of using Micro:bit in Croatia started by IRIM a year ago. IRIM is a privately-funded Croatian nonprofit organization. All educational institutions are called to respond to the equipment of their school with BBC Micro:bit. In that period, over of 20,000 Micro:bit are deployed in over 1,000 elementary schools and secondary schools, universities and libraries.
All universities joined and acquired Micro:bit well as the vast majority of elementary schools (Figure 2).

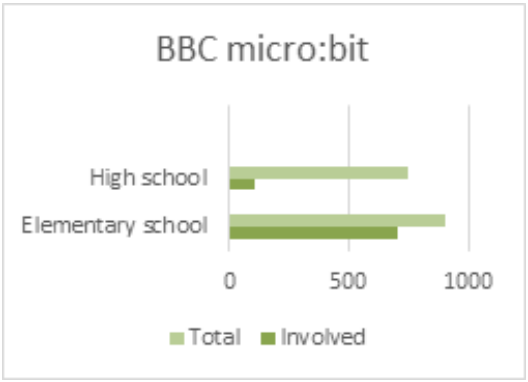

Figure 2. Involved schools in BBC micro:bit (Source: http://croatianmakers.hr/hr/ustanove-stem-revolucije/)

The teacher's response to this, suggests that teachers are interested in projects. According to Bakić (2017), a majority of teachers are interested in taking part in more advanced workshops with Micro:bit (Figure 3).

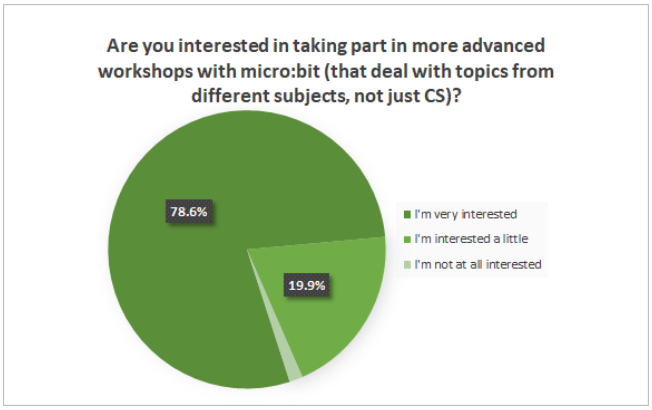

Figure 3. The teachers' interest in the application of Micro:bit in different areas

It is noted that more than 78% of teachers are very interested, while only 1.5% are not interested in applying Micro:bit in teaching of other topics. For teachers, Micro:bit has proven to be an excellent motivational tool.

In the project Profil Klett there were 200 sets available in the schools. 148 schools (74%) have completed the task with more than 450 teachers and 5,000 students (Figure 4.).

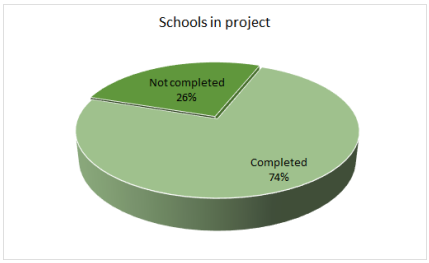

Figure 4. Schools in the Profil Klett project

After the first workshops with teachers and two months of using Micro:bit in classrooms, it can be said that the benefits are multiple. Students are advancing many competencies, including digital literacy and creativity.

Data processing was most often done by manually filling the tables, and later the data was transferred to a digital format. The output project at most schools is a video consisting of images obtained during the implementation of the project, while some schools have also made a presentation and provided a written description of the project and images. PowerPoint (Figure 5.) proved to be the dominant type of materials generated by students during the project (67%) while the least of the schools used the web site as a dissemination tool (7%).

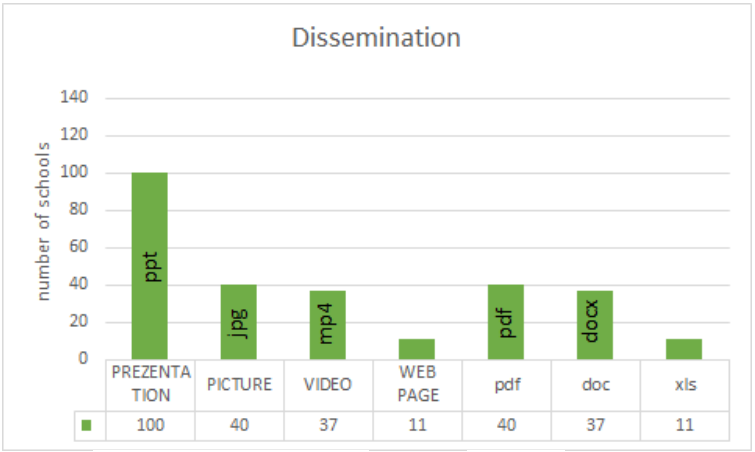

Figure 5. Digitals type of obtained materials

If we look at how many different types of material a school has used, we note that most of the schools (26%) used only PowerPoint for project presentation, while 3 or more types of materials used 17% of schools (Figure 6.).

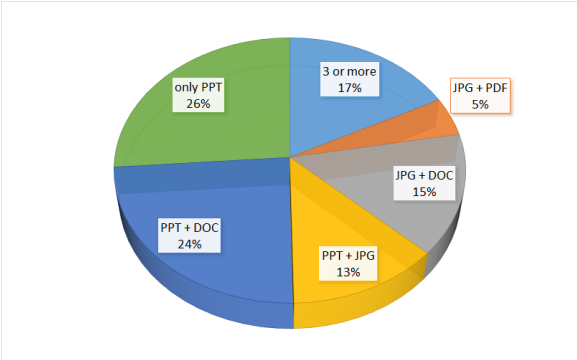

Figure 6. Digitals type of obtained material – more type of materials

Conclusion

Benefits of using Micro:bit are unquestionable. With use of Micro:bit, students enhance their computational thinking, deeper learning, problem-solving and collaboration skills. Concurrently, they develop an interest in

coding and ICT education because Micro:bit makes coding easier and interesting. A large number of registered schools and a response rate of 74% indicate that teachers and students are interested in implementing projects with Micro:bit. From this example of a successful project it is evident that some improvements need to be implemented in the future: A well-designed and elaborated Project; Providing specific technical assistance; Providing support to teachers; Project monitoring at all stages; Repository of supporting documents and phases.

When launching future projects, it is advised to create unique inputs as well as project tracking materials. Given that most schools continue to use only one type of dissemination, it is recommended to set up and follow many different forms of dissemination in future projects. According to Carlborg, (2017.) it is beneficial to always provide same scope of autonomy in exercises.

Since most of the schools used only PPT or only one tool for result tracking, it would be of benefit to assign more assessment tools.

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