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EXPERIENCE WITH USING BBC MICRO:BIT IN TEACHING

Summary: *Micro: bit is a new learning device that makes it easy to learn programming and electronics. This device enables the development of logical thinking, problem solving skills and digital literacy in students in general. Using the micro: bit enables relatively easy programming in different programming environments on different computers and mobile phones. Additional functionalities of the micro: bit are achieved by extending it with special elements. The research was conducted in a primary school in the Republic of Serbia. The pupils were divided into a control and an experimental group, with the students in the experimental group using the micro: bit device. The results of the work show that the use of the micro: bit in class has a positive effect on the students performance in the subject „Technique and Technology" for the lesson „Managing processes and things remotely using information and communication technologies". In addition, the students thoughts about the use of the micro: bit in class were revealed.*

Key words: *micro: bit, children education, ICT technology, computer science, education research.*

INTRODUCTION

The way of life has changed rapidly with the development of science and technology, industry and society, so there is a need for multidisciplinary education (Kim and Lee 2022). In the teaching process, information and communication technologies (ICT) can be

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used as a tool for communicating and selecting teaching content, as a tool for creating teaching content, as a tool for improving the teaching process, as a research tool and as a tool to support evaluation (Medar and Ratković 2021: 110), and according to the study cited in the paper (Papić et al. 2015: 591), 86% of teachers from Europe say that pupils are more motivated and attentive when computers and the internet are used in class. Computational thinking is increasingly recognised as a set of essential skills to nurture, equip and inspire the next generation for the digital age workforce.

Researchers and practitioners are increasingly interested in designing learning environments that provide opportunities for young learners to learn and develop computational thinking concepts and practises by working on problems that are authentic and relevant to their lives and interests (Shahin et al. 2022). The article (Mitrohina and Šajhislamova 2020: 165) explored the issues related to the use of computer-based testing in computer science as a method for assessing the quality of students' knowledge.

Educational software and hardware are being used more and more massively in developed education systems. Instead of closed computer software and hardware, flexible and open modules are increasingly used, integrated into digital educational content or customised. The trends for education in the European Union are: problem-based teaching (instead of a content, the focus is on a problem that students solve through their own activity), lifelong learning, interdisciplinarity and project teaching (Namestovski 2013: 32).

Information and communication technology is emerging as one of the most important subjects for primary schools around the world, playing a key role in educational, economic and social change (Gibson and Bradley, 2017). In many countries around the world, teaching computer science or programming is just becoming a top priority, because they treat these subjects as electives for selected and talented computer science students or are imposed only on those preparing for a job in computer science market (Schmidt 2016: 6).

British Broadcasting Corporation (BBC) started the „Make It Digital initiative“ in 2015, to foster a new era of creativity in young people using programming and digital technology as a medium.

When the project was launched, the BBC spent two years researching previous work and new ideas to get more children programming and improve digital literacy (Austin et al. 2020: 1). The micro: bit (cited as BBC micro bit or as micro bit) initiative was partly motivated by the recent introduction of Computing as a compulsory subject in schools in England (Sentance et al. 2017: 1). The micro: bit is a pocket-sized programmable computing device that allows children to engage with technology and get creative (Ball et al. 2016: 1).

The micro: bit is a small, unhoused circuit board with a display consisting of 25 LEDs, a few buttons and some sensors. The device has a micro-USB socket that allows you to connect it to your computer to power it and send programmes to it (Monk 2018:1). Using the micro:bit in the classroom can help develop the following ICT topics (Stanojević et al. 2021: 16): creating simulations of physical systems; creating algorithms that respond to different inputs and produce different outputs; solving the same problem using different tools and programming languages; storing and manipulating data; introducing Boolean logic and operators to students; interconnecting multiple computer systems; and using technology in the arts. Kalogiannakis et al. (2021) provided a systematic review of the literature on the use of BBC micro: bit in primary education, including twelve empirical studies published between 2016 and 2020. Many different platforms can be used to teach students programming (Scratch, Raspberry Pi or Arduino), but in United Kingdom the micro:bit platform has been used in schools since 2015 (Minić and Kreculj 2019: 51).

The development of smart objects is usually a task reserved for experts with a background in electronics and low-level programming. This situation has changed in recent years thanks to physical computing and microelectronic devices such as Arduino or Micro: bit (Pellegrino et al. 2022). The study by Carlborg et al. (2019) investigates which factors are important when using the micro: bit to teach computational thinking in Swedish schools. Over a period of one year, 21 workshops were conducted in Sweden.

Tan et al. (2021) use a neurophysiological measure to monitor student interest and learning during a micro: bit activity. The technologies and tools associated with the maker movement

are commonly divided into no-tech, low-tech and high-tech categories, with high-tech tools including single-board microcontrollers (e.g. Arduino, micro: bit and Raspberry Pi) and digital fabrication tools (Harron et al. 2022: 3). Micro: bit is present in almost 30 countries around the world (Milić et al. 2018: 129) and according to a survey in the UK, 88% of all respondents (boys and girls) said that the micro: bit made programming seem less difficult than they previously believed.

STEAM education is derived from STEM (Science, Technology, Engineering, and Mathematics), with the addition of Arts. Lu et al. (2022) investigated the UN Sustainable Development Goal: Project-Based Learning Oriented STEAM Curriculum with the application of Micro: bit. Nowadays, digital technologies are an everyday part of life and therefore it is important that these technologies are taught at an early age to children. One of the biggest advantages of the micro: bit is that it is a low-cost, highly functional board that supports teaching (Voštinár and Knežník 2020: 2).

MATERIALS AND METHODS

Investigating the effectiveness of using micro: bit in teaching of subject „Technique and Technology“ to primary school pupils is the subject of this research. The aim of this research is to determine the impact of the use of micro: bit on pupils' performance in the teaching of subject „Technique and Technology“ in the second cycle of primary education (from grade 5 to grade 8). The research was conducted in October 2022 in the primary school „Kadinjača” in Loznica, Republic of Serbia. Table 1 shows the structure of the sample of pupils who participated in the research.

Table 1. Research sample - control group

Group type	Number of respondents
Control group	14
Experimental group	14
Total	28

The main task of the research is to determine the students' opinion about the use of micro: bit in the classroom after the experiment conducted.

The dependent variables of the study were:

- the students' performance in the test for the lesson on „Managing processes and things remotely using ICT“ in the control and experimental groups;
- the opinion of the pupils in the experimental group about the use of the micro: bit in the classroom.

The independent variable of the research is the traditional way of processing the lesson using multimedia elements through computers and projectors.

The main hypothesis of the research refers to the assumption that the use of the micro: bit in class has a positive effect on students' performance in the subject „Technique and Technology“ for the lesson „Managing processes and things remotely using ICT“.

The specific hypothesis refers to the assumption that the students in the experimental group evaluate the use of the micro: bit in class positively and that they are interested in its further use.

In this study, the experimental model with parallel groups was applied. Both the control and experimental groups are equivalent in terms of ability and overall success, i.e. they have approximate numbers of excellent, very good and good students. An initial test of the students was conducted using a seven-task test that included didactic problems such as managing things remotely, what are smart cities, the Internet of Things, how do traffic lights work, which programmes have artificial intelligence, which devices are actuators and which are indicators. The control group worked through this lesson in the usual traditional way, while the experimental group had a lesson with the micro: bit. Afterwards, both groups were given the same objective tasks to test their knowledge (knowledge test).

In the second part of the study, a short questionnaire was created to find out what the students thought about the use of micro: bit in the classroom. Descriptive statistics were used to determine the students' initial and final knowledge and their assessment of the interest and usefulness of micro: bit and modern teaching tools.

RESULTS AND DISCUSSION

The initial test of knowledge in the subject „Technique and technology“, which was conducted with seventh grade students in the control group, showed the following results (Table 2).

Table 2. Initial examination of knowledge - control group (14 students)

Number of the task in the knowledge test	1	2	3	4	5	6	7
Number of correct answers	1	2	4	5	6	8	6
Success in %	7	14	28	35	42	57	42

The initial test of knowledge in the subject „Technique and technology“ conducted with the seventh grade students in the experimental group showed the following results (Table 3).

Table 3. Initial test of knowledge - experimental group (14 students)

Number of the task in the knowledge test	1	2	3	4	5	6	7
Number of correct answers	2	1	4	6	5	8	5
Success in %	14	7	28	42	35	57	35

It is clear from both tables (Tables 2, 3) that both the control and the experimental groups obtained approximately equal results in the first test conducted. The control group has 30 correct answers and the experimental group has 31 correct answers.

An experiment was then conducted in which the control group worked on the lesson topic in the traditional way and the experimental group worked on it with the help of micro: bit. A retest was conducted and the following results were obtained (Table 4 and Table 5).

Table 4. Success in solving tasks - control group (14 students)

Number of the task in the knowledge test	1	2	3	4	5	6	7
Number of correct answers	2	5	7	8	9	11	8
Success in %	14	35	50	57	64	78	57

The control group dealt with the lesson topic in the traditional way and the total number of correct answers is significantly higher compared to the first test. The total number of correct answers achieved by the control group in the first test is 32, while this number is 50 in the last test.

Table 5. Success in solving tasks - experimental group (14 students)

Number of the task in the knowledge test	1	2	3	4	5	6	7
Number of correct answers	4	7	9	10	11	13	9
Success in %	28	50	64	71	78	92	64

After dealing with the teaching topic with the help of the micro:bit, the students achieved significantly better results than in the first test. The experimental group achieved a total of 31 correct answers in the first test, compared to 63 in the last test. The results of the study showed that the experimental group achieved better results in the final knowledge test than the control group (Figure 1).

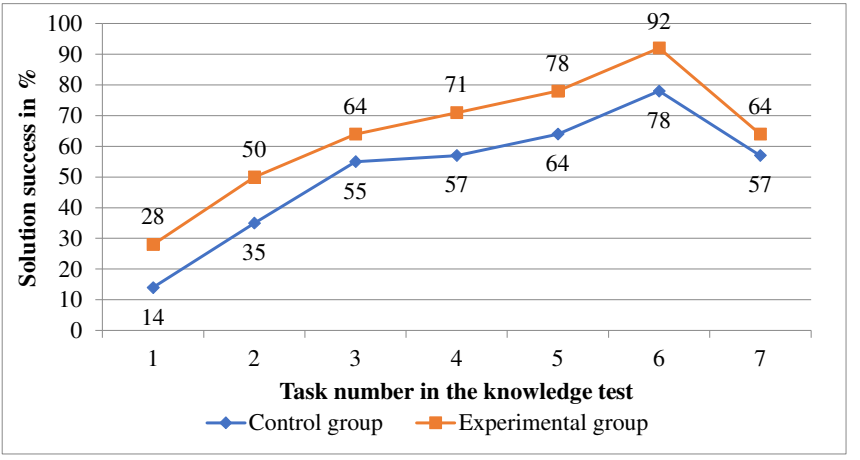

Figure 1. Comparative results of the control and experimental groups (success in solving tasks)

The experimental group achieved better results in all seven tasks, as you can see from the graph. The teaching process itself, whether using a modern or traditional approach, contributes greatly to student achievement, but the use of information and communication technologies (micro: bit) still leads the way, which is consistent with the results and opinions of various authors. In order to check the influence of the application of modern technologies on the attitude of the students of the experimental group, their thoughts were asked with a questionnaire (Table 6).

Table 6. Opinion about the application of micro:bit

Answers offered	Number of students	Percent (%)
I didn't like it at all	0	0
I loved it	6	43
I really liked it	8	57

As can be seen in Table 6, the majority of students (57%) rated the use of micro: bit very positively, while not a single student stated that they disliked this way of working. Later, the students were asked how much more interesting they found teaching with the micro: bit compared to the traditional way of working in the classroom.

Table 7. Opinion about the interestingness of teaching with the micro: bit

Answers offered	Number of students	Percent (%)
It's not more interesting	0	0
It's the same	0	0
It's more interesting	2	14
It's much more interesting	12	85

A significantly larger number of students (as many as 85%) think that this way of working is much more interesting compared to the traditional way of working. The students were also asked about the future use of the micro: bit in teaching (Table 8).

Table 8. Opinion on the more frequent use of micro:bit

Answers offered	Number of students	Percent (%)
I wouldn't like it	0	0
Sometimes I would like to	6	43
I would much prefer it	8	57

The largest percentage (57%) of students believe that this type of teaching should be used more often. This second part of the survey, like the first, supports the use of micro: bit in teaching, considering the students' satisfaction with this type of teaching. Of course, the results of this research should not be generalised, as there are differences between students, teachers' skills and ways of working in different schools, and the number of students who participated in this experiment is relatively small. Nevertheless, this study has shown that a more detailed investigation is needed, which has implications for further research.

CONCLUSIONS

The dizzying technical-technological progress requires changes in all functional areas, including education. The need for teacher training, lifelong learning and entrepreneurial skills is ever increasing in the digital age. This research points to the need for more frequent use of modern technologies in education, concluding that their use increases the productivity of the teaching process and student motivation. However, this study has implications for many other studies with a different approach and methodology. It

would be useful to study teachers' attitudes towards the possibilities of using micro: bit in other subjects, the evaluation of their competences, as well as the competences of students in the second cycle of education. The research conducted provided only a rough overview of the impact of the use of micro: bit, without a deeper analysis of the knowledge and skills required for each of the tasks given to the students, as well as insights into the impact of this type of teaching on individual student performance in relation to the first tests and the number of correct answers in the test. This paper highlights the need for a comprehensive evaluation of the effectiveness of implementing the micro: bit, encompassing the assessment of both teachers' and students' proficiency across various educational levels.

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ИСКУСТВО СА КОРИШЋЕЊЕМ BBC MICRO: BIT У НАСТАВИ

Сажетак: *Micro:bit је нови уређај за учење који олакшава учење програмирања и електронике. Овај уређај омогућава развој логичког мишљења, вештине решавања проблема и дигиталне писмености код ученика уопште. Коришћење micro:bit омогућава релативно лако програмирање у различитим програмским окружењима на различитим рачунарима и мобилним телефонима. Додатне функционалности micro:bit се постижу проширењем са посебним елементима. Истраживање је спроведено у основној школи у Републици Србији. Ученици су подељени у контролну и експерименталну групу, при чему су ученици експерименталне групе користили micro:bit уређај. Резултати рада показују да употреба micro:bit на часу позитивно утиче на учинак ученика из предмета „Техника и технологија" за час „Управљање процесима и стварима на даљину коришћењем информационо-комуникационих технологија". Поред тога, приказана су размишљања ученика о употреби micro:bit на часу.*

Кључне речи: *micro:bit, образовање деце, ИКТ технологија, информатика, истраживање у образовању.*