The impact of micro:bit technology use on improving students' coding skills

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Abstract

This study analyses the use of micro:bit to improve the coding performance and the analytical skills of kids in elementary school. A sample of 460 students ranging from 6th grade to 9th grade and 60 IT teachers were selected and analyzed. Both students' skills and teachers' abilities were the focus of the effort to point out the role of the method micro:bit was used to improve overall students' coding abilities and academic performance. In the end, a web-based application is designed to allow students to get enrolled to attend specific coding courses and thus, improve their coding abilities.

Keywords: *component; micro:bit, coding skills, educational platforms, digital competencies*

I. Introduction

In a technology-based society, there is a constant need for an army of ICT specialists able to address a significant number of technical problems we face every day. The technical skills needed to have even the most common jobs constantly increase. Addressing the issues encountered during the difficult road towards creating a new generation able to face this formidable challenge successfully is not an easy task. One of the most relevant issues to solve sooner rather than later is the improvement of the ICT curricula and how these topics are taught in our school system. The British Government has offered essential investment in collaboration with the BBC (British Broadcasting Corporation) to design and implement a digital tool referred to as micro:bit. This experiment aims to improve the digital skills of the next generation worldwide. In 2018 this project was implemented in Albania as well. This project provided all schools of the country with an open source hardware ARM-based embedded system, micro:bit, designed to help students improve their coding skills. Special attention was paid to the way kids will communicate with the tool; it must be fun and interactive.

II. Educational technology

The use of technology in the education process is not new. The term "education technology" was used for the first time in England in 1967 B.Jones Robert (Mathews & Ross, 2010). It referred to the systematic application of scientific knowledge in the education process. Education Technology is considered as the use of hardware and software combined with education theories to improve the education performance using the necessary technological resources (Spector, 2015).

Another definition of the concept "education technology" is provided by (Richey, 2008) as the study and the ethics practice aiming at the academic performance increase using and managing the necessary technological resources. Another definition of the same concept is the application of the scientific and technical process in teaching (Ranga, 2006).

Other authors have studied the effectiveness of technology-based approaches in education and outlines areas for future inquiry (Todri et al., 2020). A particular focus is across the following categories of education technology: (1) access to technology, (2) computer-assisted learning, (3) technology-enabled behavioral interventions in education, and (4) online learning (Escueta et al., 2017). (Wenglinsky, 1998) defines education technology as a complex concept incorporating education theory, computer-based training, online learning, mobile-based learning, and multimedia tools.

Thus, the education technology can be presented as:

1. the theoretical and practical approach to teaching
2. technological tool and media
3. a tool for the management of the teaching process
4. interactive and pleasant tool for education (micro:bit).

III. A short description of micro:bit

Micro:bit is a portable microcomputer that the user can program. It does contain a 32-bit microprocessor and a RAM of 16 kb. This device allows students to program it and encourages them to improve and further develop critical thinking and coding skills. Micro:bit is half the size of a credit card; it contains open-source hardware explicitly designed for educational purposes. The list of its components is as follows:

1. 25 leds, which are individually programmable
2. 2 programmable buttons labeled A and B
3. Connection pins
4. Temperature and light sensors
5. Motion sensors (accelerometer and compass)
6. Wireless communication via radio and Bluetooth
7. USB interface
8. Reset button

Some initial infrastructure is needed to make the system functional. Part of this infrastructure is the micro:bit, a battery, the connector, a laptop/tablet/mobile device.

Related studies on the use of micro:bit

The first study on the effectiveness of using micro:bit for education purposes was undertaken in the United Kingdom (Martin, 2016). This study interviewed kids of 10 to 12 years old to gather their feelings regarding this new technology. The study pointed out that:

- 70% of participating girls were decided to choose Computer Science as an elective course
- 90% of participants stated that micro:bit convinced them that everybody could code

- 86% of participants admitted that micro:bit made Computer Science more interesting.

Two years after the Make it Digital initiative, in 2018 a study was undertaken by the Department of Educational Research at Lancaster University to assess the continued use of the micro: bit device in some UK schools. The study surveyed 40 participating schools, where it turned out that the micro: bit was used more often by the lower secondary education cycle, respectively by students of the age group (11-14 years). The most common uses of micro:bit by students were during group work and during the development of the Computer Science lesson, but also from this study it was noticed that a good part of the students used the micro: bit device for development of various projects in other subjects such as Geography, Physical Education or Mathematics.

Similar studies were undertaken in St. Mary's Belfast, Ireland, in 2017 and at the University of Lancaster, the United Kingdom, in 2018. These studies reached similar results.

IV. Population and sample selection

The population of this study is composed of an ensemble of students in Albanian schools participating in the 21st century schools project. Thus, 460 students (N = 460) from three elementary schools in the city of Tirana and 60 ICT teachers in different schools in the country. The sample selection is based on non-probability sampling for both students and teachers. The first phase of sample population selection was based on a random selection of schools that had the opportunity to provide the micro:bit devices to their students. In order to avoid the effects of differences in school performance among students, only the schools that were included in the project were selected. After the school selection process, contacts with school directors were established. An initial test was organized with students to understand their coding skills better. Students were informed that the reason for the test was only academic, and the study would respect the anonymity of the experiment. Our team made all the effort to respect individual and professional rules regarding the ethics aspect. In this regard, all regional education offices were previously informed. The same procedure was followed with ICT teacher selection.

The questionnaire for students contained general questions related to their demographic data and questions related to the approach towards the use of micro: bit as a digital device, which affects the improvement of their coding skills. The purpose of this questionnaire (physically distributed to students) was to collect data and students' attitudes about how do they evaluate the use of micro: bit in

improving coding skills and how do they use the micro: bit device to develop digital competence.

V. Empirical analysis of data generated by instruments

From the analysis of data to see the number of student participants by gender component, it resulted that226 males (49.1%) and 234 females (50.9%) participated in the study. The tendency of distributing the questionnaires to the students was such that it included an almost equal number between male and female students, in such a way that the final result was not influenced by this component, knowing that the male gender is more drawn towards technology and computer science, especially coding.

a. Frequency display for the Gender component

	Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	226	49.1	49.1	49.1
	Female	234	50.9	50.9	100.0
	Total	460	100.0	100.0	

In terms of grades, the study is extended to all grades of the Lower Secondary Education cycle taking into account the sixth, seventh, eighth and ninth grades. These classes were selected because according to the initiative of the micro: bit project, this was the most appropriate focus group for the implementation of the micro: bit device in the Western Balkans. From the data of table below, we see that the highest percentage of surveyed students have seventh grade students with 180 students surveyed (39.1%), eighth grade with 130 students (28.3%), ninth grade with 90 students surveyed (19.6%) and the sixth grade with 60 students participating in the questionnaire at the level of 13%.

b. Frequency display for the Grade component

	Grade	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Grade 6	60	13.0	13.0	13.0
	Grade 7	180	39.1	39.1	52.2
	Grade 8	130	28.3	28.3	80.4
	Grade 9	90	19.6	19.6	100.0
	Total	460	100.0	100.0	

Asked whether students had known about the basic concepts of coding 275 students (59.8%) answered that they had knowledge about the basic concepts of

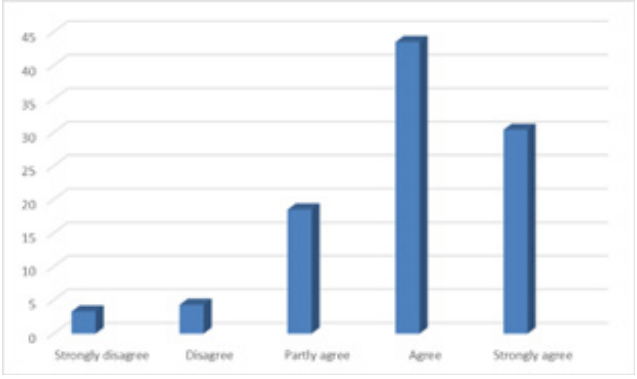
programming (such as variables, outputs, logical conditions or loops) and 185 students in the mass (40.2 %) claimed the opposite. From the data generated by this type of question we see an improvement in the trends of knowledge of basic notions of coding, compared to the previous reports , where only 34.5% of Albanian students of grade 9, had acceptable knowledge in the field of coding.

c Familiarity with coding notions

Coding notion:		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NO	185	40.2	40.2	40.2
	YES	275	59.8	59.8	100.0
	Total	460	100.0	100.0	

In the following questions, students were able to rate the Linkert scale (strongly disagree, disagree, partly agree, strongly agree) on certain statements regarding the use of the micro: bit. Assertion: I think that micro:bit has aroused my interest in the field of coding, students respond according to the data generated in table following. From the data of this table we see a very positive perception regarding the interest of students in the field of coding between the use of the micro: bit device in the learning process.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	15	3.3	3.3	3.3
	Disagree	20	4.3	4.3	7.6
	Partly agree	85	18.5	18.5	26.1
	Agree	200	43.5	43.5	69.6
	Strongly agree	140	30.4	30.4	100.0
	Total	460	100.0	100.0	

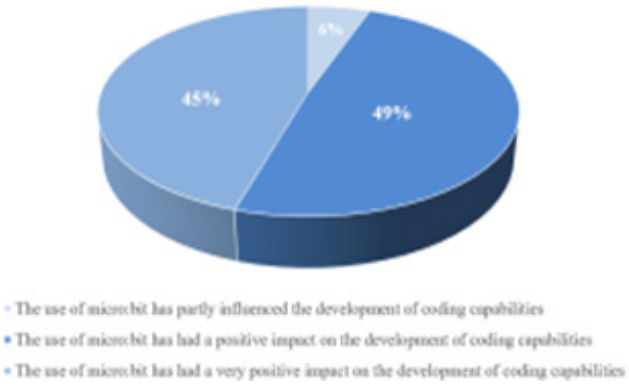


Regarding the statement: Micro:bit helped me to understand more about the notions of coding, from the results of the questionnaires we see a positive approach of students about using the device micro: bit to understand the notions

of programming, where about 71% of them are in the Linkert scale 5 and 4 degree of agreement (agree and strongly agree).

The survey of teachers who teach the subject of Information and Communication Technology targeted 60 lower secondary school teachers to complete an online questionnaire regarding the attitude, implementation and approach to the use of micro: bit during the development of lessons, but only 53 teachers managed to complete the questionnaire. Based on the result of the questionnaire addressed to ICT teachers, these data were generated. Asked about the degree of knowledge of using micro: bit, all teachers stated that they had very good knowledge in using this device. Where only 2 teachers stated that they had not very good knowledge in knowing this device, while the vast majority possessed good knowledge (34%) and very good knowledge (62.2%).

Regarding the implementation of micro: bit for the development of coding skills, the teachers responded according to the following graph: None of them selected the option Using micro: bit did not affect the development of coding skills.



VI. Test results

The sampling group consisting of students underwent a preliminary test at the end of the questionnaire to see and evaluate the knowledge they possessed in the field of computer science, respectively in the coding discipline. Due to the limited time we had available, the students were informed that the primary subject of the study was considered the questionnaire and that the completion of the test was completely in their free hands. Therefore, the rate of return of the tests was not at the expected level, but this fact does not affect the quality or testability of hypotheses and research questions, as the test results of students belong to the category of secondary data. The test was completed by 185 students and the answers obtained show that:

- 87% of students know the concept of block-based programming.
- 71% of them manage to distinguish basic programming concepts
- 62% of students manage to correctly identify the main instructions of a certain block in the work environment Make it Code.
- 74% of them are able to show what is displayed on the screen after the execution of a simple program (block-based programming).
- 38% manage to solve complex exercises using micro:bit.

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