Coding With BBC Mikro:bit

Zeynep SAGLAM
Zonguldak Çaycuma TSO Science High School

Rumeysa ERDOGAN
Bartın University

Introduction

Computer programs are the writing of a set of codes that allow algorithms to be solved by computer. The target audience of programming languages is generally considered as students studying in computer-related departments (Durak, Karaoğlan-Yılmaz, Yılmaz & Seferoğlu, 2017), learning these programs is an extra difficult and time-consuming process (Erol & Kurt, 2017), studies show that students perceive this process as difficult (Özmen & Altun, 2014). To learn a programming language, it is important to have basic maths knowledge. As artificial intelligence, internet of things, cyber security, future professions, dark factories, digital game technologies became widespread, people's perspective and interest in technology has changed. The rapid development of technology has brought together the concept of 21 st century skills (Cansoy, 2018) and in this century, the concept of education aims to bring skills and competence rather than to present knowledge to the abilities of individual (Uçak & Erdem, 2020). Skills such as problem solving, critical thinking, collaboration, communication, creativity must be gained in schools (National Research Council, 2012). For a developed society, qualified human power is very important (Sayın & Seferoğlu, 2016). Creating algorithms and solving problems with these algorithms is an important skill within the scope of 21st century skills. Another concept that is associated with the concept of algorithm is programming skill. The use of block coding tools has made it easier to learn this skill from an early age (Sırakaya, 2018) and many programs can be written even without basic mathematical knowledge. The widespread use of block coding tools and their use by large users has brought the concept of robotics to become widespread (Erten, 2019).

In the 21st century technology age, it has become very important to use the innovations required by the age in lessons in order to ensure the permanence of education, and the concepts of robotics and robotics - coding are the most important of these innovations (Butuner, 2019). It can be said that robotics is the programming of hardware to perform the desired task using coding tools. While the programmed hardware was coded with programming languages that require more electronic knowledge and are closer to machine language, in recent years they have turned into tools programmed with block coding tools. The emergence of tools that do not require much electronic knowledge, are practical to disassemble and install, and can be used repeatedly, has made it easier to learn the work done in the field of robotics from a younger age. It is said that robots will

take over many jobs with the change of professions, in this case it is very important for children to learn how to code robots. Teachers who are educated in the field can provide education in this field by choosing robotics and coding tools suitable for the age level of the student. There are many robotics and coding tools developed according to the age group and student knowledge level. There are options such as Arduino, BBC Micro:bit, lego, makeblock, which are popularly known by many users and those who want to develop projects can find many sample projects.

Coding with BBC Micro:bit

BBC Micro:bit is a small size (4cm x 5cm) electronic card that contains a microcontroller on it. It is designed by the BBC for use in computer education (Ball et al., 2016). It is especially suitable for younger children to do robotics and coding and an electronic circuit board for teaching the basic coding logic on a block-based basis (Butuner & Dündar, 2018). Activities can be carried out to make primary school students familiar with concepts such as algorithmic thinking, programming, game development (Videnovik, Zdravevski, Lameski & Trajkovik, 2018). The United Kingdom made an attempt by distributing a BBC Micro:bit card to nearly one million 7th grade students (12-13 years old) due to the lack of students taking enough computer science courses at the university and the lack of qualified people in the field (Rogers et al., 2017; Schmidt, 2016). The United Kingdom made computing curriculum compulsory in schools in 2014, and in 2015 the BBC planned to motivate students in this area with its Micro:bit distribution initiative (Sentance, Waite, Hodges, MacLeod & Yeomans, 2017).

Features of BBC Micro:bit Card

Figure 1 shows the features of the first version of the BBC Micro:bit card. Figure 2 shows the latest version of the card with new features. As with every technological device produced, new features have been added to the device in the new version.

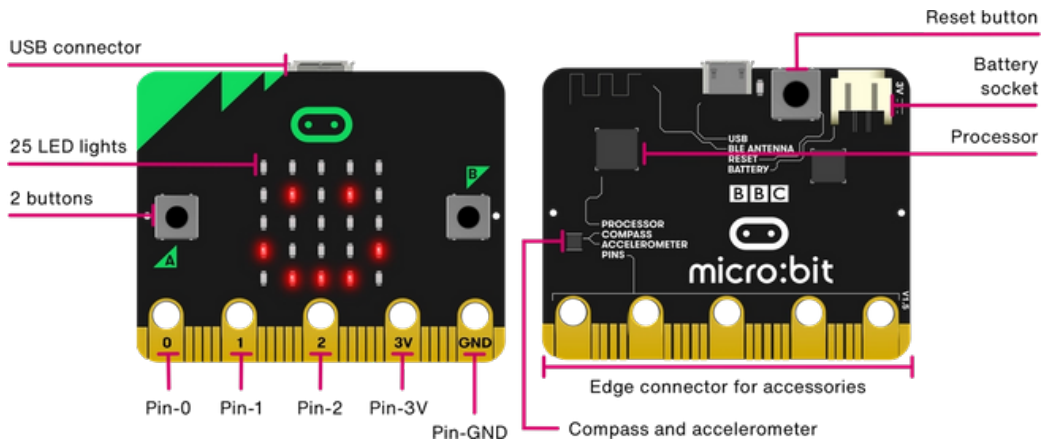

Figure 1. First Version of the BBC Mikro:Bit Card (Url1, 2021)

When Figure 1 is examined, it is seen that there are 2 buttons, a usb input, 25 LED outputs, 1 reset button, input-output pins, processor, power input, bluetooth, compass and accelerometer sensors on the BBC Micro:bit card.

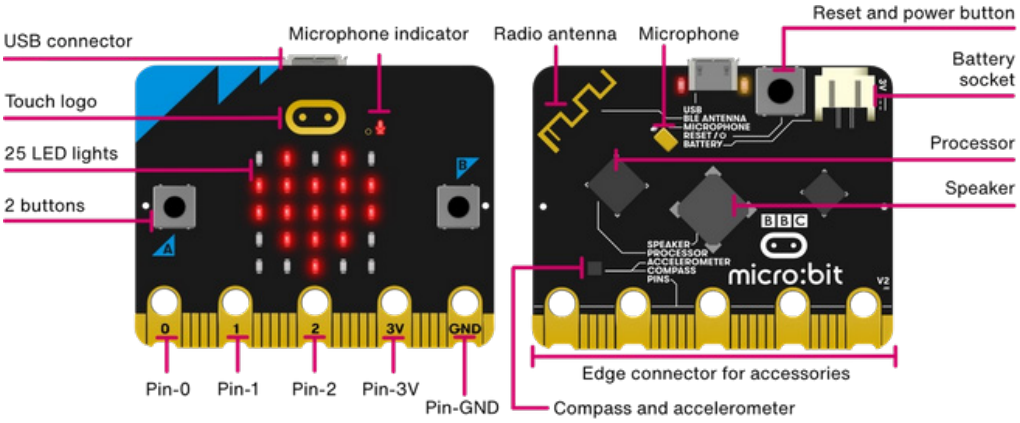

Figure 2. The Latest Version of the BBC Mikro:Bit Card (Url1, 2021

When Figure 2 is examined, it is seen that audio related features have been added to the new version of the BBC Micro:bit card. It is seen that unlike the previous version, a microphone, speaker and touch logo are added on the card. Examining the features of the hardware on the card will give an idea about what can be done with this card. The hardware built into the card is as follows:

- **Buttons:** There are two buttons named A and B on both sides of the card. The buttons can be programmed to work together as well as separately (Halfacree, 2017). The button can be used as an input device in many projects. The fact that the buttons are built into the card allows the development of projects using buttons without the need to explain the button binding business that requires electronic information to young age groups.

- **25 LEDs:** There are 25 LEDs arranged as 5 x 5 on the BBC Micro:bit card. It can be used as a screen to show words, numbers and symbols.

- **Light sensor:** The 25 LEDs on the card also function as a light sensor. With the light sensor, the amount of light falling on the device can be measured.

- **Processor:** It has a processor with 16K RAM running at 16 MHz (Schmidt, 2016). It can be described as the brain that runs the commands in the programs written.

- **Temperature sensor:** The processor also includes a temperature sensor, so projects that measure ambient temperature can be made.

- **Compass:** The BBC Micro:bit card contains the compass sensor embedded in it. This input sensor detects magnetic fields.

- **Accelerometer:** The acceleration sensor is a sensor that measures movement. It detects when the card is tilted right, left, up or down. Projects that alarm when the card is shaken or displaced can be done.
- **Bluetooth:** With the bluetooth receiver on the BBC Micro:bit, it can connect and communicate with another Micro:bit and other devices with bluetooth feature.
- **USB interface:** USB or universal serial bus used to connect computers, other devices and power. With the USB on the BBC Micro:bit, it can be connected to the computer and loaded into the program, at the same time it provides the power required by the microcontroller.
- **Audio output:** BBC Micro:bit, can be encoded by writing programs that produce sounds. However, if you are using the first version, you must use an external headset or speakers to hear these sounds.

New Version Features:

- **Built-in speaker:** There is a built-in speaker on the new version BBC Micro:bit. While in the previous version, sound is output by using headphones or speakers in sound related projects, there is no need for an extra sound output with the new version.
- **Microphone:** With the microphone built into it, projects related to sounds can be improved. The microphone also works as an audio sensor that measures the amount of sound.
- **Touch logo:** There is a touch sensor on the new BBC Micro:bit. This sensor on the logo enables data input by touch.

Pins on the BBC Micro:bit Card

In addition to the built-in inputs and outputs on the BBC Mikro:bit, new inputs-outputs can be added if desired. There are 25 pins on the board to add input outputs. Figure 3 shows the pins on the card. When Figure 3 is examined, it can be seen that there are 5 large pins shown with holes. These pins can be used by connecting equipment for input and output using alligator cables (Hodges, Sentance, Finney & Ball, 2020). Pins 0, 1, 2 are flexible pins used for general input-output purposes. They are named as GPIO, these pins have analog to digital converter (ADC) feature.

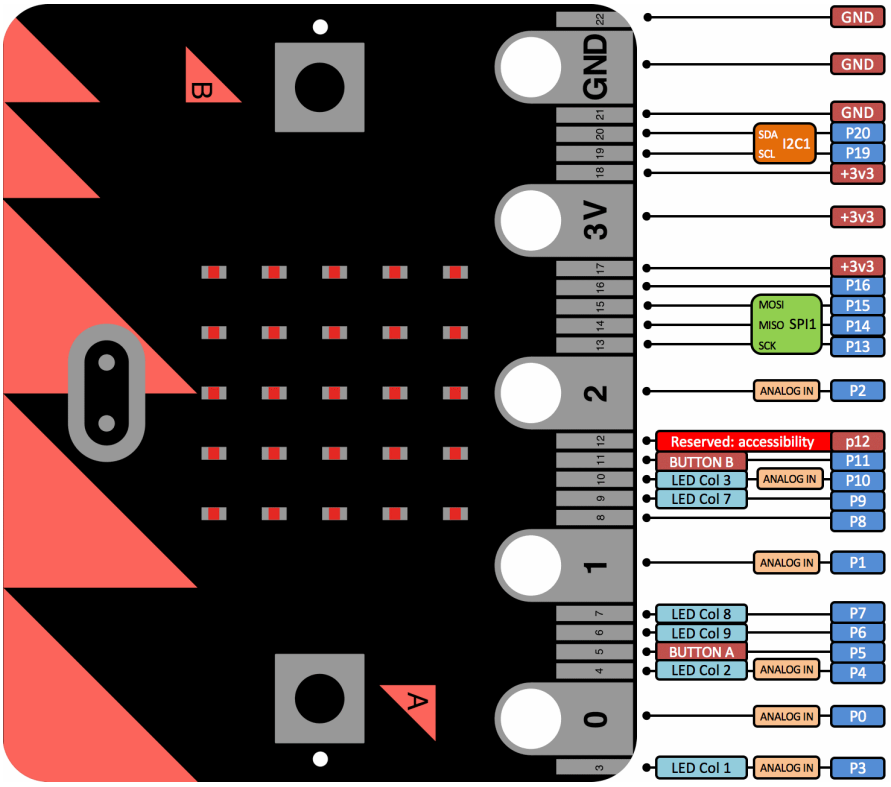

Figure 3. Pins on the BBC Micro:Bit Card (Url2, 2021)

When Figure 3 is examined, it can be seen for what purposes the pins can be used. It is possible to divide the pins into two groups as large pins and small pins.

Large pins:

- **P0:** GPIO pin, ADC
- **P1:** GPIO pin, ADC
- **P2:** GPIO pin, ADC
- **3V**: It can be used as a 3 Volt power input or output. It can be used as an output to power peripherals if the BBC is powered by a Micro:bit USB from a computer or is battery powered. If power is not connected via USB or battery, the 3V pin can be used to power the board externally.
- **GND:** It is the ground pin used to complete the electrical circuit.

Small pins:

There are 20 small pins on the board, these small pins are shared with some components on the board. When Figure 3 is examined, it is seen that these pins are named between 3 and 22 respectively. These pins can be operated using the expansion board.

- **Pin 3:** It is shared with column 1 of the sequential leds on the card, when these

leds are turned off, they can be used as digital I / O.

- **Pin 4:** It is shared with column 2 of the LEDs that are sequentially on the card and these LEDs are used as digital I / O when they are turned off.
- **Pin 5:** Shared with the A button built into the card. Enables the feature of clicking the A button on the card to be triggered or to detect when clicked. An external button can be connected and operated via this pin.
- **Pin 6:** It is shared with column 9 from leds and can be used as digital I / O when these leds are not used.
- **Pin 7:** Shared with column 8 from leds and if these leds are not used, they can be used as digital I / O.
- **Pin 8:** GPIO used as digital I / O.
- **Pin 9:** Shared with column 7 of the built-in leds and these leds can be used as digital I / O when not used.
- **Pin 10:** Shared with column 3 from leds and can be used as digital I / O when these leds are not used.
- **Pin 11:** Shared with the B button, one of the built-in buttons. This allows the button to be triggered or detected externally.
- **Pin 12:** Reserved to provide accessibility support.
- **Pin 13:** Special reserved pin for SCK signal.
- **Pin 14:** Special reserved GPIO for Master in Slave Out.
- **Pin 15:** Special reserved GPIO for Master Out Slave In.
- **Pin 16:** Special GPIO, used for “Chip select” function.
- **Pin 17 and 18:** Functions the same as the large 3V pin.
- **Pins 19 and 20:** are the I2C bus. Multiple devices can be connected to the same bus with I2C.
- **Pin 21 and 22:** These pins are used for the same purpose as GND.

BBC Micro: bit Coding Tools

In BBC Micro:bit Educational Foundation, users and collaborators share the projects

as open source and anyone who wants can access these codes. There are platforms available online to program the card. The coding tools available for programming the BBC Micro:bit are:

Microsoft Makecode Editor:

It allows programming the card with blocks or JavaScript. Figure 4 contains the editor's image. Block-based coding tools allow the young age group or people who are not interested in the field to easily encode the card. The editor also acts as a simulator and is important in that it allows people who do not yet physically have a card to program and operate the card. The program can be downloaded and recorded on the card connected to the computer with a USB cable.

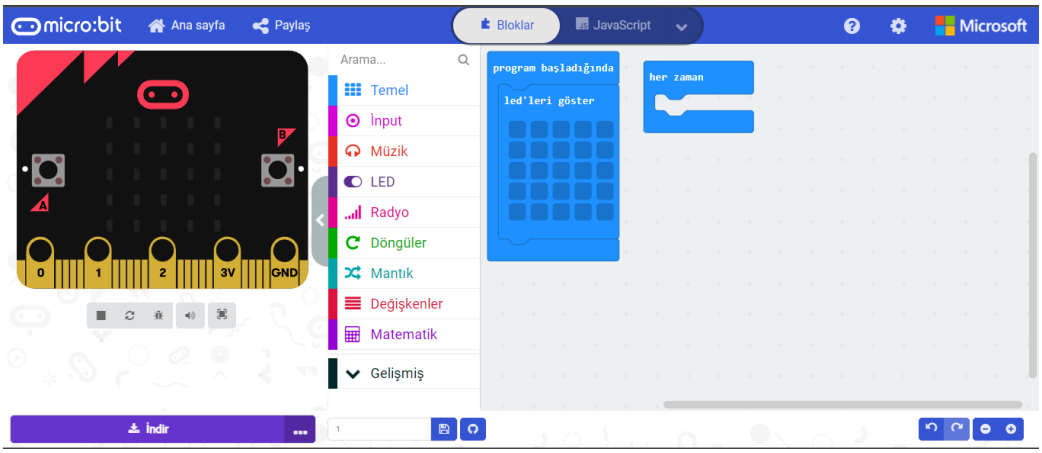

Figure 4. Microsoft Makecode Editor (Url3, 2021)

Python Editor:

There is a Micro:bit python editor developed for the use of the BBC Micro:bit card by users who know python programming language. Figure 5 shows the image of the editor.

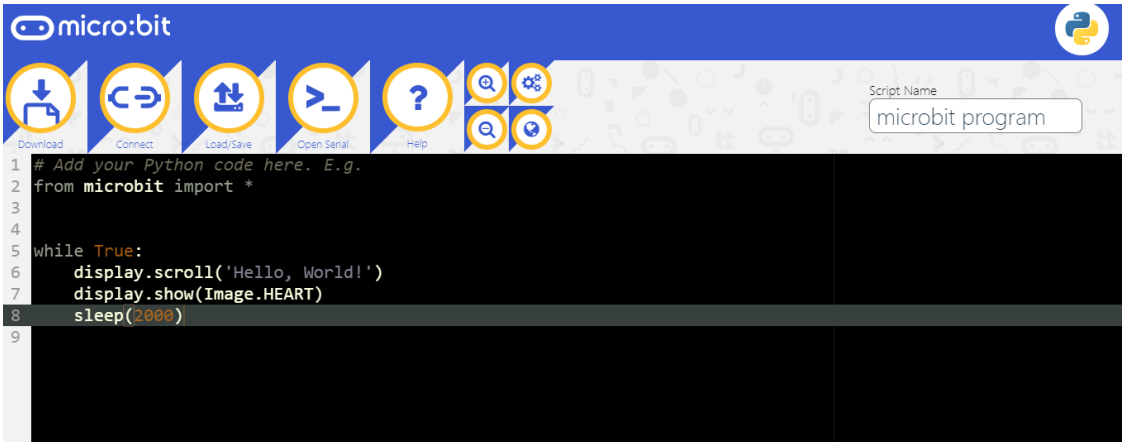

Figure 5. Mikro:Bit Python Editor (Url4, 2021)

As seen in Figure 5, the editor works with python codes. The program written using the Python programming language is saved as a hex file with the download option on the Micro:bit card. The save option allows the written program to be saved to the computer as .py extension. Created by volunteers, the editor is maintained by Mikro:bit Education Foundation. Open source software continues to be developed by volunteers.

Coding with MikroPython:

It can be said that it is a simple version of Python 3 language. It is a version of python developed to work in microcontroller environments, containing a small subset of the Python standard library. It is written using the C programming language. Before the program is loaded to the Arduino board, the compilation process is performed and in case of faulty code, it is not uploaded to the card. However, in MicroPython, the codes are loaded into the microcontroller card first and the compilation process takes place inside the card. If the codes loaded into the card are incorrect, it gives a warning.

Mu Editor:

Online platforms require a constant connection to the internet, while the codes are being written, Mu, a simple editor that allows the codes to be written and uploaded to the card quickly, without the need to be constantly connected to the internet. The Mu Editor is developed using Python. It needs to be downloaded and installed on the computer. It runs on Windows, OSX, Linux, Raspberry Pi. Figure 6 is the image of the Mu Editor.

Figure 6. Mu Editor

Scratch Editor:

It is a coding tool developed in MIT Media Lab so that beginner users can learn how to code (Meerbaum-Salant, Armoni & Ben-Ari, 2013). It is a frequently used tool in schools for younger age groups to learn coding. The coding tool can be accessed online

or installed on the computer. It is an advantage that people who are particularly familiar with this tool can also use it while working with the BBC Micro:bit. In order to use BBC Mikro:bit on the Online Scratch platform, the plug-in must be installed. In order to install a plug-in, the plug-in in Figure 7 must be loaded under the Add extension menu in the Scratch interface.

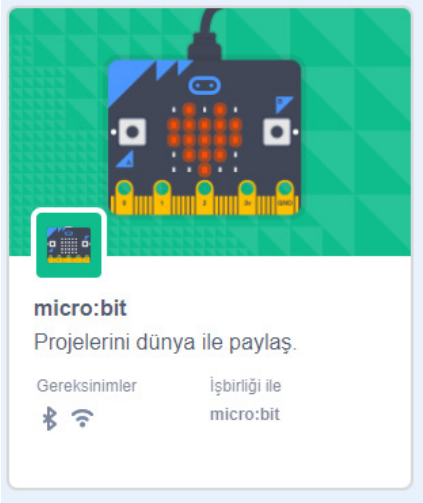

Figure 7. Scratch Micro:bit plug-in

When the plug-in is installed, the codes for programming the BBC Micro:bit tool in Figure 8 are displayed. This allows beginner users and students who are familiar with the scratch programming interface to easily program the tool.

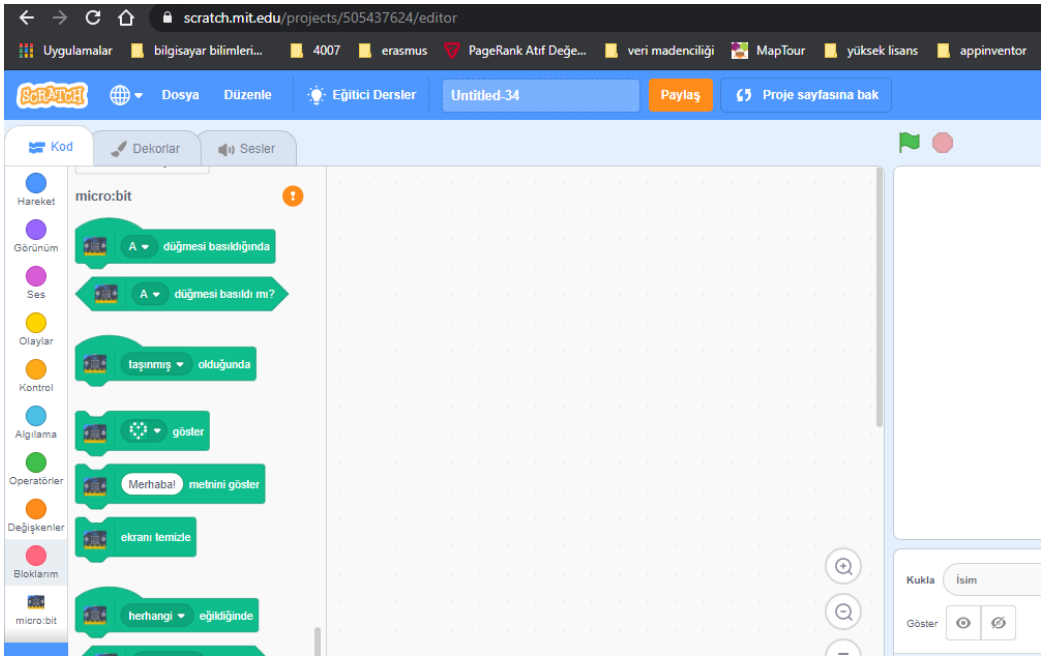

Figure 8. MIT Scratch Editor Micro:bit Codes

Codes written using the Scratch interface can be uploaded to the BBC Micro:bit tool via bluetooth.

MBlock Version5 Editor:

The Mblock coding tool allows the programming of different microcontrollers. Using the 5th version of the tool, the BBC Micro:bit can be encoded. Coding operations can be performed by adding the extension in Figure 9 by adding from the extensions section in the editor.

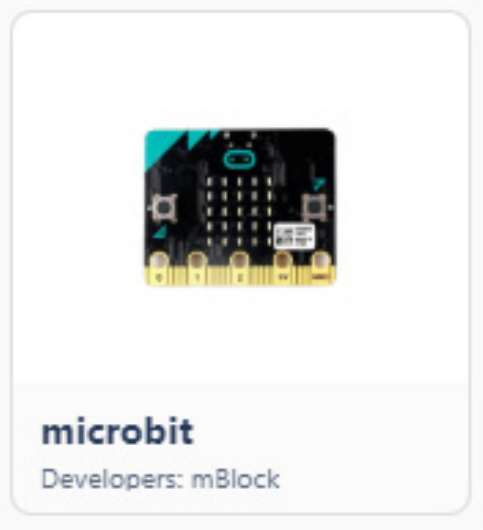

Figure 9. Adding Mikro:Bit with MBlock Plugin

Figure 10 shows the codes that come after adding the Micro:bit plugin in the Mblock editor.

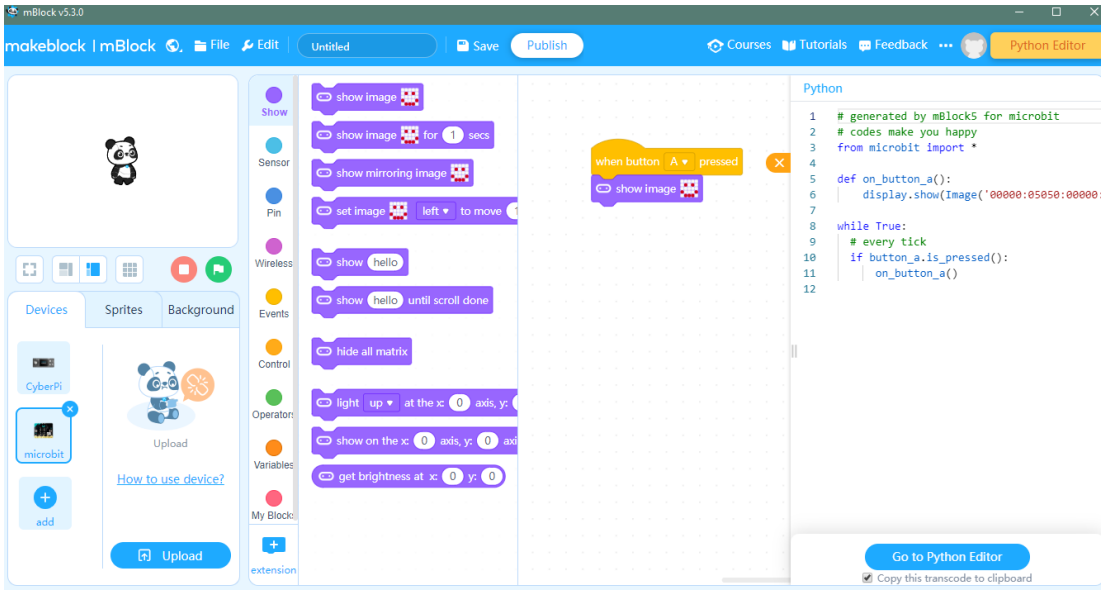

Figure 10. MBlock Editor Micro:Bit Codes

After the desired program is written with block codes in the Mblock editor, it can also be looked at how these codes are written in the python programming language, if desired. When Figure 10 is examined, how the block codes look with the python editor can be seen on the right side.

BBC Micro:bit and Education in the World

The essence of programming is not in the line of code, but in the way of thinking, one should be able to imagine and implement it using commands (Lesničar, 2018). BBC Mikro:bit is a simple piece of hardware designed for students to bring their dreams to life. While programming tools output the codes by means of computers, robotic tools output by using hardware. STEM (Science, Technology, Engineering, Mathematics) is an abbreviation that connects basic sciences. It aims to bring together the acquisitions that students have learned in different disciplines with STEM activities. Education should provide students with problem-solving skills beyond rote knowledge. The most important of the 21st century skills is considered to be problem solving (Kırkıç, Derin & Aydın, 2018). The most important tools that provide STEM education are robotic tools. The product created by students bringing together many disciplines can be a solution to a problem. Croatia made a STEM revolution in 2017 on the grounds that there were not enough educated people about STEM in the country and used the BBC Micro:bit as the most important tool in this movement (Lesničar, 2018).

The Micro:bit Educational Foundation in the UK is a foundation established to ensure the continuity of the BBC Micro:bit project given to school children in England and to provide voluntary education (URL 5, 2021). It continues to support education around the world. No one is excluded from digital education in Singapore. With the Digital Maker program launched by Infocomm Media Development Authority in 2017, 100,000 Micro:bit cards were given, teachers from different branches had to participate in workshops and produce prototypes (URL6, 2021). Finland is a country that cares about being creative and learning by doing. Innokas, a network of educators and organizations built into the University of Helsinki, is a structure that encourages alternative work practices that enhance critical and creative thinking and is interested in using BBC Micro:bit when preparing children for future professions (URL7, 2021). Academic staff at the University of Duplin Technology in Ireland volunteered to educate more than 5000 students using BBC Micro:bit (URL8, 2021). Denmark Ultra:bit is a project that was introduced to 4th grades (8-9 years old) in 2018-2019, and to 5th and 6th grades in 2019-2020, established in 90% of schools and aims to make students love writing code (URL9, 2021). In many different countries around the world (27), new projects are started to encourage students' creativity, Micro:bit is used in these projects, and approximately 25 million children benefit from these projects (URL10, 2021).

Conclusion

While educational environments are organized to raise generations that produce and not consume, all over the world (Öz, 2019), one of the most important elements in these environments is robotic-coding tools (Şahin, 2019). These tools should be selected

correctly in proportion to the student's age level and readiness in this regard. With these trainings starting from kindergarten, it is important to develop algorithmic thinking skills and problem-solving skills in students. The new generation students are a generation that is qualified as digital native and it is very important to use these tools correctly in the education of these students. If these tools are not suitable for the level of the student, they will be seen as difficult and complex and will decrease the motivation of the students (Ersoy, Madran & Gülbahar, 2011). In this context, tools that show the concrete results of the encoded algorithms and are not complicated for the student to use will motivate students to produce (Numanoğlu & Keser, 2017). BBC Micro:bit is a tool developed for this purpose, allowing students who are at the beginning of the road to do easy robotic-coding (Sentance et al., 2017), while allowing advanced students in this field to do their dream projects. It is more cost effective than many robotics tools (Ball et al., 2016). While it is possible for students who do not have a concrete tool to write codes for this tool with online simulators, it is a plus feature that this tool can be coded with many tools. The campaign, which was initiated by England, was distributed to 7th grade students by distributing BBC Micro:bit and encouraging them to their computer science, has become an example to the whole world and many countries have made their students enthusiastic with similar campaigns and projects. BBC Micro:bit is a tool with many plus features such as ease of use for newcomers to coding, ease of access to various sample projects thanks to the community established in its name, affordable cost, ability to recognize sensors developed for other tools, coding on different platforms, and the opportunity to experiment with online simulators. The release of the second version of the tool with new features indicates that it is open to development.

References

Ball, T., Protzenko, J., Bishop, J., Moskal, M., De Halleux, J., Braun, M., ... & Riley, C. (2016, May). Microsoft touch develop and the bbc micro: bit. In *2016 IEEE/ACM 38th International Conference on Software Engineering Companion (ICSE-C)* (pp. 637-640). IEEE.

Butuner, R. (2019). Effect of Coding and Robotic Coding Training on Students. Journal of. In Wu, W. & Alan, S.(Eds.), *Research Highlights in Education and Science*, 24-30.

Butuner, R., Dündar, Ö., (2018). Kodlama Eğitiminde Robot Kullanımı Ve Robotik Kodlama Eğitici Eğitiminde Öğretmenlerin Tecrübe Ve Görüşlerinin Alınması. In Yılmaz, E. & Sulak, S.A.(Eds.), *Human Society and Education in the Changing World*, 24-30. Palet Yayınları.

Cansoy, R. (2018). 21st Century Skills According to International Frameworks and Building *Them in the Education System. Journal of the Human and Social Sicence Researches*, *7*(4), 3112-3134.

Durak, H., Karaoğlan Yılmaz, F. G., Yılmaz, R. ve Seferoğlu, S. (2017). Erken yaşta programlama eğitimi: Araştırmalardaki güncel eğilimlerle ilgili bir inceleme. A. İşman, F. Odabaşı, ve B. Akkoyunlu (Ed.*), The Turkish Online Journal of Educational Techonogy* (ss. 119-137). Ankara: Pegem Yayınevi.

Erol, O., & Kurt, A. A. (2017). Investigation of CEIT Students' Attitudes towards Programming. *Mehmet Akif Ersoy* Üniversitesi *Eğitim Fakültesi Dergisi, 1*(41), 314–325.

Ersoy, H., Madran, R. O., & Gülbahar, Y. (2011). A Model Proposed for Teaching Programming Languages: Robotic Programming. *Akademik Bilişim*, *11*, 731-736.

Erten, E. (2019). *A Case Study On Coding And Robotic Teaching* (Master's thesis, Balıkesir Üniversitesi Fen Bilimleri Enstitüsü).

Halfacree, G. (2017). *The official BBC Micro: bit user guide.* Indianapolis, in: Wiley.

Hodges, S., Sentance, S., Finney, J., & Ball, T. (2020). Physical computing: A key element of modern computer science education. *Computer*, *53*(4), 20-30. doi:10.1109/MC.2019.2935058

Kırkıç, K.A., Derin, G. & Aydın, E. (2018). Yenilikçi Bir Öğretim Yaklaşımı Olarak Stem Eğitimi. Kırkıç, K.A. & Aydın, E. (Eds.), *Merhaba Stem Yenilikçi Bir Öğretim Yaklaşımı*, Bölüm 1, S.13.

Lesničar, M. (2018). *BBC micro:bit injegova primjena urazrednoj nastavi* (Doctoral dissertation, University of Pula. Faculty of Educational Sciences).

Meerbaum-Salant, O., Armoni, M., & Ben-Ari, M. (2013). Learning computer science concepts with scratch. *Computer Science Education*, *23*(3), 239-264.

National Research Council (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. Committee on Defining Deeper Learning and 21st Century Skills, James W. Pellegrino and Margaret L. Hilton, Editors. Board on Testing and Assessment and Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Numanoğlu, M., & Keser, H. (2017). Robot Usage in Programmıng Teachıng - Mbot Example. *Bartin University Journal of Faculty of Education*, *6*(2), 497.

Öz, Ö. (2019). Digital Leadership: Being School Leader in Digital World. *International Journal of Leadership Studies: Theory and Practice*, *3*(1), 45-57.

Özmen, B., & Altun, A. (2014). Undergraduate students' experiences in programming: Difficulties and obstacles. *Turkish Online Journal of Qualitative Inquiry, 5*(3), 1–27.

Rogers, Y., Shum, V., Marquardt, N., Lechelt, S., Johnson, R., Baker, H., & Davies, M. (2017). From the BBC Micro to micro: bit and Beyond: A British Innovation. *interactions*, *24*(2), 74-77.

Sayın, Z., & Seferoğlu, S. S. (2016). *Coding Education as a new 21st Century Skill and its Effect on Educational Policies.* Akademik Bilişim Konferansı. Aydın: Adnan Menderes Üniversitesi.

Schmidt, A. (2016). Increasing Computer Literacy with the BBC micro: bit. *IEEE Pervasive Computing*, *15*(2), 5-7. doi: 10.1109/MPRV.2016.23.

Sentance, S., Waite, J., Hodges, S., MacLeod, E., & Yeomans, L. (2017, March). " Creating Cool Stuff" Pupils' Experience of the BBC micro: bit. In *Proceedings of the 2017 ACM SIGCSE technical symposium on computer science education* (pp. 531-536).

Sırakaya, M. (2018). Student Views on Coding Training. *Ondokuz Mayis University Journal of Education Faculty*, *37*(2), 79-90.

Şahin, E. (2019). *Application And Analysis Of Coding Teaching By Using Robotic Vehicles And Materials In 6-12 Age Groups* (Doctoral dissertation, Marmara Universitesi (Turkey)).

URL1: https://microbit.org/get-started/user-guide/overview/

URL2: https://makecode.microbit.org/device/pins

URL3: https://makecode.microbit.org/#editor

URL4: https://python.microbit.org/v/2

URL5: https://microbit.org/about/

URL6: https://microbit.org/impact/case-studies/imdas-digital-maker-programme/

URL7: https://www.innokas.fi/koulutus/

URL8: https://microbit.org/impact/case-studies/computer-science-inclusive/

URL9: https://microbit.org/impact/case-studies/dr-ultrabit/

URL10: https://microbit.org/impact/foundation-reports/

Uçak, S. & Erdem, H. H. (2020). On The Skills Of 21st Century And Philosophy Of Education In Terms Of Searching A New Aspect In Education. *Uşak Üniversitesi Eğitim Araştırmaları Dergisi*, *6*(1), 76-93.

Videnovik, M., Zdravevski, E., Lameski, P., & Trajkovik, V. (2018, April). The BBC micro: bit in the international classroom: learning experiences and first impressions. In *2018 17th International Conference on Information Technology Based Higher Education and Training (ITHET)* (pp. 1-5). IEEE.

About the Authors

Zeynep SAGLAM, is ICT Teacher at Zonguldak Çaycuma TSO Science High School. She is receiving her master's degree in Information Systems and Technologies at Bartın University. Her research interests include computer science, robotic coding, measurement and evaluation and learning. Her tasks are directorate of National Education Research and development, ICT Teacher, Directorate of National Education Robotic Coding Coordinator and Information Systems and Technologies Graduate student.

E-mail: zeynepelicora@gmail.com, Orcid: https://orcid.org/0000-0002-5790-6570

Rumeysa ERDOGAN, MSc, is research assistant in the Department of Computer Technology & Information Systems (CTIS) at Bartin University in Turkey. She started her master's degree in Computer Engineering at Ankara Yıldırım Beyazıt University and is continuing. She is interested in machine learning, human computer interaction and computer science.

E-mail: rerdogan@bartin.edu.tr, Orcid: https://orcid.org/0000-0002-6218-7072

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 19%.

To Cite This Chapter:

Saglam, Z. & Erdogan, R. (2021). Coding With BBC Mikro:bit. In S. Kocer, O. Dundar & R. Butuner (Eds .), *Programmable Smart Microcontroller Cards* (pp. 19–33). ISRES Publishing.