

## MICRO BIT AS AN INNOVATIVE TOOL IN FULFILLING THE DIGITAL COMPETENCIES OF STUDENTS

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### *Abstract*

This scientific paper focuses on the use of Micro Bit as an innovative tool in fulfilling the digital competencies of students. Analysis of technical specifications and key features of Micro Bit shows that this tool provides an easy platform for programming and project development. Through applications and examples of using Micro Bit in the classroom, students develop programming skills, digital creativity, online communication, and collaboration, as well as digital security. These digital competencies are important for the adaptation of students in today's digital world. The purpose of this scientific paper is to investigate how Micro Bit affects the fulfillment of students' digital competencies. The methodology used to examine the role of Micro Bit in fulfilling the digital competencies of students is the exemplary study methodology. The selected sample is the primary and lower secondary school "Heronjte e Lumë " in the village of Vërmicë with parallels separated in Shkoza and Dobrushte in the city of Prizren from the Republic of Kosovo. The data for this research will be qualitative, which aims to evaluate practical examples of the use of Micro Bit in fulfilling the digital competencies of students. To collect the data, interviews with teachers, focus group interviews with students, and classroom observations were used. The results of the research showed that the use of Micro Bit in fulfilling the digital competencies of students brings obvious benefits.

**Keywords:** Competencies, digital, innovative, Micro Bit, students, tool.

## INTRODUCTION

In an era of rapid technological development, where technology is an everyday part of our lives, education must fulfill a critical task: to prepare students to live and succeed in a digital society. In this context, digital competencies become extremely important. They help students develop the knowledge and skills needed to use technology successfully, create and express their ideas digitally, and solve problems using digital tools and resources. Therefore, to fulfill these digital competencies in this study we will analyze how the use of Micro Bit can be an effective and innovative tool to show and evaluate the fulfillment of students' digital competencies. Beyond traditional teaching, this innovative technology can provide an engaging and interactive platform for developing digital skills in a highly creative and engaging way.

On the other hand, Micro Bit (also referred to as BBC Micro Bit, stylized as micro:bit ) is an open-source ARM-based hardware system created by the BBC for use in computer education in the United Kingdom. It was first announced at the launch of the BBC's 'Make It Digital ' campaign on 12 March 2015 with the aim of providing 1 million devices to pupils in the UK. The device's final design and features were revealed on July 6, 2015, while the actual distribution of the devices, initially planned for September 2015 to schools and October 2015 to the general public, began on February 10, 2016 (*Wakefield, 2015; Sue, Jane, Steve, Emily, & Lucy, 2017*).

The device is described as half the size of a credit card and has an ARM Cortex-M0 processor, accelerometer and magnetometer sensors, Bluetooth and USB connectivity, a display consisting of 25 LEDs, two programmable buttons, and can be powered by either USB or an external battery pack. Device inputs and outputs are via five-ring connectors that form part of a larger 25-pin terminal connector. In October 2020, a physically nearly identical v2 board featuring a Cortex-M4F microcontroller, with more memory and other new features, was released (*Matt, 2015; Sebastian, 2015*).

### ***1.1. The context and importance of digital Competencies in education***

Digital competencies have gained tremendous importance in education. Students must be able to use technology and express their digital skills successfully to be prepared for the challenges of the labor market and the information society. Digital competencies include the knowledge

and skills to use digital tools and technologies, as well as to analyze, interpret and create information innovatively.

Digital competencies includes the safe, critical, and responsible use and engagement with digital technologies for learning, work, and participation in society. It is defined as a combination of knowledge, skills, and attitudes (EC, 2019).

The main components of digital competencies in 5 areas are summarized below:

**Information and data literacy:** To articulate information needs, to find and retrieve data, information, and digital content; To judge the importance of the source and its content; To store, manage and organize data, information, and digital content.

**Communication and collaboration:** To interact, communicate and collaborate through digital technologies being aware of cultural and generational diversity; To participate in society through public and private digital services and participatory citizenship; To manage one's digital presence, identity, and reputation.

**Creation of digital content:** Creation and modification of digital content; To enhance and integrate information and content into an existing body of knowledge by understanding how copyrights and licenses should be applied; Be able to give understandable instructions for a computer system.

**Security:** To protect devices, content, personal data, and privacy in digital environments; Protect physical and psychological health and be aware of digital technologies for social well-being and social inclusion; Be aware of the environmental impact of digital technologies and their use.

**Problem-Solving:** To identify needs and problems and to solve conceptual problems and problem situations in digital environments; To use digital tools to innovate processes and products; To keep up to date with the digital evolution.



Figure 1. The main components of digital competencies (EC, 2019).

## ***1.2. Focusing on Micro Bit as an innovative tool***

In this scientific paper, we focus on the role of Micro Bit as an innovative tool to help fulfill the digital competencies of students. The Micro Bit is an advanced microcontroller designed to facilitate learning programming and developing digital projects. It provides a convenient platform for students to explore the world of technology and create various applications using coding and electronics.

## ***1.3. The purpose and research of the paper***

The purpose of this scientific paper is to investigate how Micro Bit affects the fulfillment of students' digital competencies. We will analyze how using the Micro Bit can help students develop skills such as programming, problem-solving, creating technology projects, and team collaboration. We will consider the benefits and challenges of using the Micro Bit in an educational context and provide recommendations for educators and practitioners for the successful use of this innovative tool.

## **Literature Review**

### ***2.1. History and development of the Micro Bit***

Micro Bit was created to encourage children to be actively involved in writing computer software and building new things, rather than being consumers of media. It was designed to work alongside other systems, such as the Raspberry Pi, building on the BBC's heritage with the BBC Micro for computing in education. The BBC planned to give out free computers every year to children aged 11 and 12 in Britain, starting in October 2015 with around 1 million devices. Ahead of the rollout, an online simulator was made available to help educators prepare, and some teachers would receive the device in September 2015. The device was scheduled to go on general sale by the end of 2015. However, issues delayed the launch until March 22, 2016.

The BBC had a difficult decision to choose which school year group would be the first to receive the Micro Bits free, and the BBC's head of learning said the reason they grew it for year seven (instead of year five) was that it had more impact with that age group as they were more interested in using it outside the classroom.

Planning for the project began in 2012 as part of the BBC's computer education program, and by the time of its launch in July 2015, the BBC had recruited 29 partners to help with the

production, design, and distribution of the device. The BBC has said that most of the development costs have been borne by the project partners (*Sebastian, 2015; Adam, 2015; Anderson, 2015*).

The technological development was carried out after intensive work with developers and experts who managed to create the Micro Bit, a small microcontroller that includes a processor, sensors, an LED screen, and various interfaces for connecting to other components. Collaboration with industry The BBC and its partners actively engaged with the technology and education industries to secure the necessary support and investment for the project. This helped provide the resources and expertise needed to grow Micro Bit's power and influence. Testing and evaluation took place after the prototype, where extensive testing was done across schools and educational institutions to assess the effectiveness and acceptability of the Micro Bit. Feedback and input from students and teachers were essential to improve and refine the design and functions of the Micro Bit (*BBC, 2012*).

## ***2.2. Technical specifications and key features***

Micro Bit has technical specifications and key features that make it a powerful and suitable tool for improving students' digital competencies. Here are some of the technical specifications and key features of the Micro Bit (*Micro:bit, 2023*):

1. **Microcontroller:** The Micro Bit includes an ARM Cortex-M0 microcontroller, which is capable of executing programming code and controlling other functions of the Micro Bit's components.
2. **LED Display:** The Micro Bit has a 5x5 LED display, where various letters, numbers, and patterns can be displayed. This screen allows students to create and display visual information interactively.
3. **Sensors:** The Micro Bit includes a diverse range of sensors, including the accelerometer (which can detect the movement and orientation of the Micro Bit), the magnetometer (which can detect magnetic fields), and the light width (which can detect the intensity of light).

4. Connectivity Interfaces: The Micro Bit has several interfaces for connecting to other components. It includes a USB port, various ports for connecting to sensors and external devices, as well as interfaces for connecting to other Micro Bits.
5. Programming: Micro Bit can be programmed through different programming environments, such as MicroPython, JavaScript, and also in other different programming languages. This allows students to learn programming syntax and create their code to control the functions and actions of the Micro Bit.
6. Lighting: Micro Bit has lighting that can be controlled and used for narration, announcements, or various visual effects.

### ***2.3.Applications and examples of the use of Micro Bit in teaching***

Micro Bit offers many applications and examples of use in learning to help students develop digital competencies. Here are some concrete examples of the use of Micro Bit in different areas of learning:

*Programming lesson:* Micro Bit can be used to teach students to code and create various applications. Students can create games, interactive experiences, and other applications using coding in languages such as MicroPython or JavaScript. This helps them develop programming and logical thinking skills.

*Technological projects:* Micro Bit can be used to create various technological projects. Students can build Micro Bit controlled devices such as vehicles, alarm systems, thermometers, and many more. This helps them understand the basics of electronics and develop skills to conceive, design and implement technology projects.

*Mathematics and sciences:* The Micro Bit can be integrated into math and science learning through its sensors. Students can detect and display sensor data to analyze changes in physical environments, conduct simple experiments, and perform mathematical calculations. This links theoretical learning with practical application.

*Art and creativity:* Micro Bit can be used to develop students' creative skills through interactive art creation. Students can create visualizations, animations, and various visual effects through the Micro Bit's LED display. This encourages imagination and artistic expression innovatively and digitally.

*Robotics and Vehicles:* The Micro Bit can be used to control simple robots and vehicles. Students can program the Micro Bit to control the movement, angle, and actions of robots or vehicles they have built. This helps them understand the basic concepts of robotics and explore their real-world applications.

These are just a few examples of using the Micro Bit in teaching. Its applications and possibilities are numerous and vary according to the creativity and needs of the teacher and students. Using Micro Bit in the classroom can encourage student engagement and involvement, offering them an interactive and innovative tool to develop digital competencies in a relevant and fun way (*Micro:bit, 2023*).

#### ***2.4. The use of Micro Bit for the development of students' digital competencies***

Micro Bit provides a convenient platform to develop students' digital competencies in different ways. Through hands-on projects and activities, students can explore and develop their digital skills through Micro Bit. Here are some examples of using Micro Bit to develop students' digital competencies:

**Programming Projects:** Students can use the Micro Bit to create programming projects, such as games, simulations, informational applications, etc. Through this, they develop programming skills and problem-solving logic.

**Engineering Projects:** Students can build engineering projects using Micro Bits, such as motion-controlled devices, automatic systems, thermometers, etc. This helps them understand the basics of electronics and engineering.

**Art Projects:** The Micro Bit can be used to create various art projects. Students can display visualizations, graphic models and create various visual effects with the Micro Bit's LED display. This encourages creativity and artistic expression.

**Collaborative Projects:** Students can work in groups to create collaborative projects using the Micro Bit. They can share their code, collaborate to realize complex projects, and develop their collaboration and communication skills.

## **Research Methodology**

### ***3.1. Research design***

The methodology used to examine the role of Micro Bit in fulfilling the digital competencies of students is the exemplary study methodology. This methodology focuses on drawing on good teaching and successful practices in the use of the Micro Bit in the context of one or more case studies. These case studies are special cases of using Micro Bit in teaching that show the fulfillment of students' digital competencies.

The exemplar methodology represents a useful yet underutilized approach to studying developmental constructs. It features a research approach whereby individuals, entities, or programs that exemplify the construct of interest in a particularly intense or highly developed manner compose the study sample. Accordingly, it reveals what the upper ends of development look like in practice. Utilizing the exemplar methodology allows researchers to glimpse not only what is but also what is possible about the development of a particular characteristic (*Bronk, King, & Matsuba, 2013*).

The use of case study methodology provides an essential perspective on the fulfillment of students' digital competencies through Micro Bit. By identifying and analyzing successful practices, a strategy can be developed to improve the use of Micro Bit in the teaching context to increase the effectiveness and student outcomes in fulfilling digital competencies. This methodology adds a special dimension to understanding the impact of Micro Bit on the fulfillment of digital competencies, based on practical examples of the successful use of Micro Bit in education.

The data for this research will be qualitative, which aims to evaluate practical examples of the use of Micro Bit in fulfilling the digital competencies of students.

### **3.2. Research sample**

In this research, to evaluate the role of Micro Bit in fulfilling the digital competencies of students, a purposive sample of students was used. The selection of the sample was an important step in planning the research. The selected sample is the primary and lower secondary school "Heronjte e Lumë " in the village of Vërmicë with parallels separated in Shkoza and Dobrushte in the city of Prizren from the Republic of Kosovo, where Micro Bit has been used in the teaching of digital competencies. that was part of a project supported by a non-profit organization. After we have chosen the school, classes VIII<sub>1</sub>, VIII<sub>2</sub>, IX<sub>1</sub>, and IX<sub>2</sub> have been included in the research to represent the general level of students in the chosen school.



### ***3.3. Research planning***

Initially, a research plan was developed to establish the goals, main research questions, and strategies to collect and analyze data. This included designing a research protocol and identifying the resources and materials needed to conduct the study.

Selection of study examples Several examples have been selected that present the use of Micro Bit in the context of an ICT technology course. These examples include programming projects, engineering projects, artistic projects, etc.

### ***3.4. Research questions***

1. What was the effect of using Micro Bit on the fulfillment of students' digital competencies?
2. What exemplars were used by the students with Micro Bit in fulfilling the students' digital competencies?
3. How do students rate their fulfillment of digital competencies after using Micro Bit?
4. What challenges or obstacles did students encounter when using Micro Bit to develop digital competencies?
5. What do teachers evaluate as the benefits of using Micro Bit in the development of students' digital competencies?

### ***3.5. Data collection***

To collect the data, several different methods were used. Interviews were conducted with teachers individually, while interviews with students were conducted in focus groups to understand their experience with the use of Micro Bit and to evaluate its impact on the development of digital competencies. The observations were made to evaluate the commitment and involvement of the students during the activities with Micro Bit.

### ***3.6. Data Analysis***

The collected data is analyzed to identify the advantages and challenges of using Micro Bit in the fulfillment of digital competencies. The results achieved through the projects are analyzed, and the student's progress and the teachers' and students' perceptions of the questions posed are

evaluated. Through data analysis, the most effective uses of Micro Bit and successful practices that help fulfill students' digital competencies are identified. These good practices can be used as models and guides to improve the use of Micro Bit in the teaching context.

### ***3.7. Limitations of the Study***

In any research, there are potential limitations and challenges. In this study, some limitations may include the sample size of teachers, students, the time available to conduct the research, and other variables that may have an impact on the fulfillment of digital competencies. It is important to consider these limitations and evaluate the results in their context.

## **Results and Discussion**

### ***4.1. Summary of research results***

In this section, we will present the main results of our research on the impact of Micro Bit on the fulfillment of students' digital competencies. Our analyzes were based on data collected from interviews with teachers, focus groups with students, and observations of student projects. In the following, we will present the summary of the results in three important categories:

When asked what role Micro Bit had in the development of students' digital skills and observation, we got these results. During the interviews with the teachers, it was noticed that the use of Micro Bit has positively influenced the development of students' programming skills. From focus groups with students, it was found that using the Micro Bit has helped students develop creativity and technical problem-solving skills. Observations of student projects confirmed that students demonstrated deep knowledge and developed skills in using the Micro Bit to create independent digital projects.

The next question was asked what were the benefits of using the Micro Bit in teaching digital competencies? From interviews with teachers, it was evident that the use of Micro Bit has increased the motivation and engagement of students in learning digital skills. Focus groups with students confirmed that using the Micro Bit has stimulated their interest in digital technology and increased their ability to communicate and collaborate creatively.

The next question was asked what are the potential challenges of using the Micro Bit? During the interviews with teachers, it was discussed that there are technical and logical challenges related to the use of Micro Bit in teaching digital competencies, such as the lack of technical

resources and the need for additional training for teachers. From the focus groups with students, several challenges that students encounter when using Micro Bit were identified, such as connection interruptions and difficulties in advanced programming.

The next question was about the effect of using Micro Bit on the fulfillment of students' digital competencies. During the interviews with teachers and students, it was emphasized that the use of this innovative tool brought development in several important aspects of students' digital competencies.

The students' responses show that they positively evaluate their fulfillment of digital competencies after using Micro Bit. They feel that this technology has helped them develop a range of digital skills and has brought them some tangible benefits. They feel that they have made significant progress in programming, digital creativity, online communication and collaboration, and digital security, as well as motivation and interest in the field of digital technology.

The findings show that students encountered several challenges and obstacles while using Micro Bit to develop digital competencies. These challenges may be related to technical aspects, usage, or interaction with the device. Despite the above challenges, students can face them by using the right strategies, such as commitment to learning, continuous effort, and searching for additional resources. Regular interaction with Micro Bit and the use of hands-on projects can help students improve their digital skills with time and experience.

On the other hand, the interview with the teachers shows that they appreciate some benefits of using Micro Bit in the development of students' digital competencies. These benefits help improve teaching and increase student engagement and success. Teachers appreciate the increase in students' digital competencies and the positive impact on the way of teaching. Micro Bit provides a convenient and innovative tool to develop students' digital competencies and encourages them to be creative, innovative, and engaged in the field of digital technology.

During classroom observations, it was observed that the students used Micro Bit to develop digital competencies through various projects and applications that were realized in their learning. Here are some examples of students using Micro Bit to meet digital competencies:

Interactive Art Installations: Students have created interactive art installations using Micro Bits to activate sensors and lighting depending on the impact they make. This creates a varied and engaging artistic experience for students. One of the projects was the coding for the heart icon.

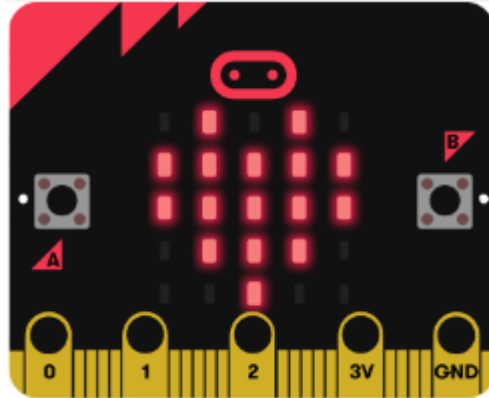


Figure 2. Heart in Micro Bit

Programming Projects: Students used the Micro Bit to create programming projects, writing code to control the device's activities. For example, they created code in Micro Bit that does the number of steps.



Figure 3. Code in Micro Bit for steps counter

Communication and Sensors: Students used the Micro Bit to learn about communication and the use of sensors. Through the Micro Bit, they communicated with the device by receiving data from various sensors such as temperature.

```
from microbit import *  
while True:  
    if button_a.was_pressed():  
        display.scroll(temperature())
```

Interactivity Projects: Students used the Micro Bit to develop interactive projects that involved interacting with the device and its response to student interactions. This included the creation of various games and interactive applications. Example game about catching apples.

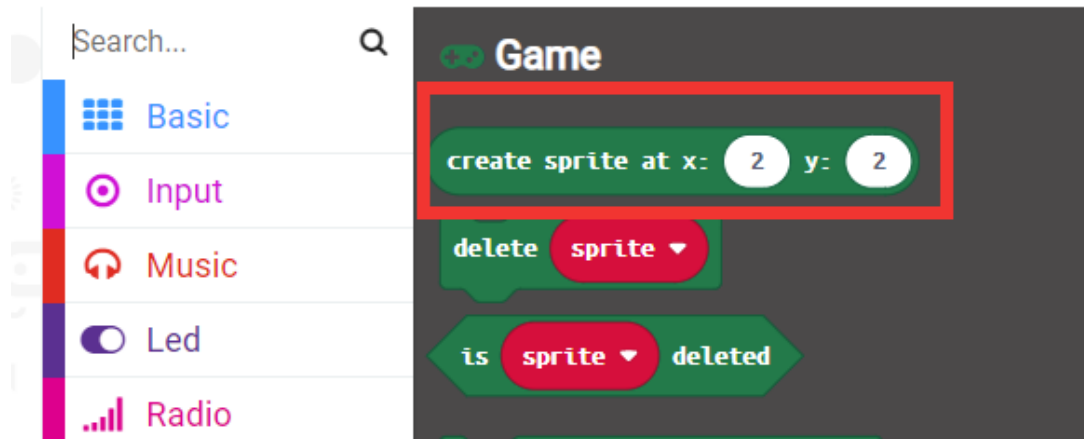


Figure 4. Apple catching game

Innovative Projects: Students used the Micro Bit to create innovative projects. Through Micro Bit programming, they developed various projects such as interactive music, and lighting windows.

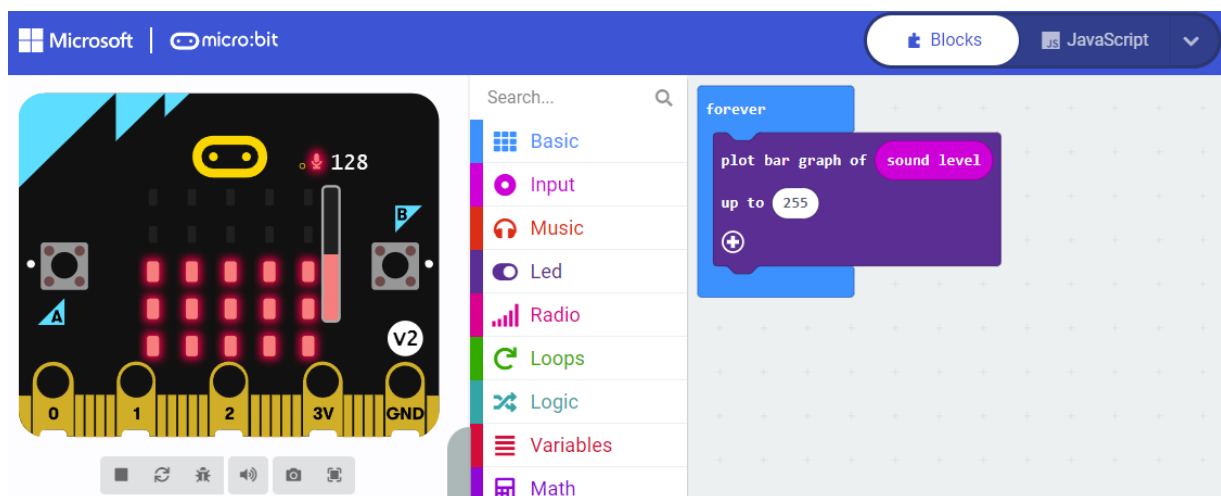


Figure 5. Noise measurement with Micro Bit

Also, our findings show that the use of Micro Bit has a significant impact on the development of students' digital competencies. The results show that the use of Micro Bit has contributed to the increase in students' programming skills. Students have demonstrated improved knowledge of programming logic, code structuring, and technology problem-solving using the Micro Bit. The use of Micro Bit has stimulated the creativity and imagination of students in creating digital projects. Students have created innovative projects, using Micro Bits to build their code-

controlled cars and other digital devices. The use of Micro Bit has improved students' abilities to communicate and collaborate through digital technology. Students worked in groups and shared their ideas and projects effectively through various platforms. The use of Micro Bit has increased students' awareness of digital safety and the dangers of the Internet. Students have learned about security practices, privacy, and the criticality of information through activities related to Micro Bit. The use of Micro Bit has positively influenced the motivation and interest of students to learn and explore the field of digital technology. Students have shown a high level of engagement and desire to further develop their digital competencies.

The summary of results shows that the use of Micro Bit has a positive and improving impact on the fulfillment of students' digital competencies. Programming skills, digital creativity, communication and collaboration, digital security, as well as motivation and interest in learning are the aspects that have benefited the most from the use of this innovative tool.

These results shed light on the importance of using technology like Micro Bit in preparing students for the digital world and highlight the need to incorporate innovative tools in teaching digital competencies in today's education.

#### ***4.2. Discussion of the impact of Micro Bit on increasing digital competencies***

collected data and our analysis, we can open our discussion that the use of Micro Bit has a positive impact on the fulfillment of students' digital competencies. The use of this tool has contributed to the increase in programming skills, creativity, communication, and online collaboration. However, the technical challenges and potential challenges to successfully using the Micro Bit in an educational context should be addressed. These results can be used to improve teaching practices and take necessary measures to optimize the use of Micro Bit and the fulfillment of students' digital competencies. The results can also contribute to further research and policy development to promote the successful integration of technology in the learning of digital competencies.

The use of Micro Bit has shown a positive impact on increasing the digital competencies of students. Through activities using Micro Bit, students have developed various digital knowledge and skills such as programming, digital creativity, online communication and collaboration, digital security, as well as motivation and interest in digital technology. In terms of programming, Micro Bit has provided a suitable environment for students to develop

programming skills and coding logic. They have learned to structure and develop digital projects using code to control the Micro Bit. Also, the use of the Micro Bit has stimulated the creativity and imagination of students, encouraging them to create innovative projects and explore different ways to use the Micro Bit for different purposes. In terms of communication and collaboration, Micro Bit has helped improve students' communication and collaboration skills. They have had the opportunity to work in groups and share ideas, information, and results of their work through online platforms. Using Micro Bit has also provided an opportunity to learn and practice digital security. Students have had the opportunity to learn about digital security risks and safety practices while using Micro Bit and related activities. In the end, the use of Micro Bit has increased the students' motivation and interest in learning digital technology. They have shown high commitment and desire to expand their knowledge and skills in this field.

#### ***4.3. Discussion of pedagogical implications and Recommendations for teaching practice***

Discussion of pedagogical implications and recommendations for teaching practice related to the use of Micro Bit is essential to reflect on the experience and draw appropriate lessons for teaching. Based on the research results and teachers' evaluations, some important implications and recommendations for teaching practice can be offered. Here are some of them:

- *Incorporating hands-on projects with Micro Bits:* Teachers can incorporate hands-on projects with Micro Bits into teaching digital competencies. These projects allow students to apply their knowledge and skills in a real context and develop creativity, programming, collaboration, and digital security.
- *Promoting students' independent ability:* Using Micro Bit can promote students' independent ability in learning digital skills. Teachers can encourage students to experiment, develop their projects, and look for solutions to the challenges they encounter, helping them to be creative and solve problems autonomously.
- *Integrating Micro Bit into the curriculum:* Micro Bit can be integrated into different teaching subjects to enhance the teaching of digital competencies. Teachers can identify ways to integrate the use of Micro Bits into subjects such as math, science, technology, art, etc., creating a strong connection between digital technology and learning content
- *Stimulation of cooperation and teamwork:* Micro Bit can be used to stimulate collaboration and teamwork in learning digital skills. Teachers can organize projects and

activities that encourage students to work together, share ideas, and solve problems in groups, creating a collaborative and supportive learning environment.

- *Creating a supportive and encouraging environment:* Teachers can create a supportive and encouraging environment for students while using Micro Bit. This environment can include evaluating and exchanging ideas, providing needed help and guidance, encouraging experimentation, and trying new things.

These recommendations and pedagogical implications are intended to improve the teaching of digital competencies and prepare students for today's digital world. Using Micro Bit in the classroom can help increase students' engagement, interest, and digital skills, creating a rich and immersive experience for them.

## Conclusions

In conclusion, the use of Micro Bit in fulfilling the digital competencies of students brings obvious benefits. This innovative tool encourages learning about creativity, programming, collaboration, and digital safety in an engaging and student-friendly way. It is recommended that teaching be adapted to improve the use of Micro Bit and help students develop digital competencies as effectively as possible. This innovative tool provides a convenient and interactive platform for learning through hands-on projects. Students benefit from collaboration and knowledge sharing, while teaching should be adapted to improve the use of Micro Bit and help students develop digital competencies as effectively as possible. The use of Micro Bit has great potential to improve teaching and prepare students for today's and tomorrow's digital world.

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