

## REVIEW

# The BBC micro:bit in Primary Schools: A Systematic Review on Computational Thinking, Creativity, and Pedagogical Strategies

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**Abstract:** This article undertakes a systematic review of the educational integration of the BBC micro:bit in primary education. Using the PRISMA methodology as a framework, empirical studies published in the past decade (2015–2025, as of August) were identified through Scopus and through supplementary searches in Google Scholar. Three additional studies were retrieved from Google Scholar to ensure broader coverage. In total, seventeen studies met the inclusion criteria and were subjected to thematic analysis. The findings indicate that the BBC micro:bit facilitates the development of students’ computational thinking, creativity, problem-solving skills, and collaborative abilities, while nurturing their autonomy, ecological awareness, and learning engagement. Effective pedagogical strategies—including STEAM activities, project-based learning, and physical computing—were commonly employed. This review also addresses methodological limitations of the included studies and emphasizes the necessity of further longitudinal research to fully unlock the educational potential of the micro:bit.

**Keywords:** BBC micro:bit, computational thinking, primary education, educational technology, STEAM, physical computing

## 1 Introduction

The continuous and growing integration of technology into nearly every aspect of human activity has significantly influenced education (Drolia et al., 2022). In this context, there is an increasing emphasis on the need for students to become familiar with basic concepts and skills related to programming, device functionality, and creative interaction with technology from an early age. Recent studies emphasize that developing computational thinking from early childhood lays the foundation for later digital competence and motivation (Zourmpakis, 2025). Especially in primary education, where the foundations of learning and value formation are laid, the introduction of digital tools can play a crucial role in enhancing participatory and experiential learning (Papadakis et al., 2023a, 2023b).

One such tool is the programmable board BBC micro:bit. This small, user-friendly, and flexible device allows users to create interactive applications through simple and adaptable programming. Initially developed in the United Kingdom to support and strengthen students’ digital literacy, the micro:bit has since been integrated into various national education programs worldwide (Sentance et al., 2017; Kalogiannakis, Tzagkaraki, & Papadakis, 2021). It enables students to control real-world objects, develop basic applications, and combine problem-solving with creativity and collaboration (Garcia-Ruiz & Alvarez-Cardenas, 2021).

Classroom engagement with the micro:bit is supported by pedagogical approaches that foster active and experiential learning, promoting the development of essential 21st-century skills such as logical thinking, problem-solving, communication, and teamwork (Zourmpakis et al., 2023a, 2023b). The use of the micro:bit encourages students to act as creators rather than passive recipients of knowledge, fostering computational thinking and creativity through hands-on experimentation (Kalogiannakis et al., 2021). Furthermore, physical computing devices like the micro:bit enable young learners to engage in collaborative problem-solving and design thinking activities that enhance motivation and understanding of abstract programming concepts (Sentance et al., 2017). Through activities involving the micro:bit, students become active participants in the learning process, taking on the role of creators and inventors while engaging in structured, student-centered learning experiences.

In this context, examining how the micro:bit is utilized in primary education—as both a teaching tool and a driver for developing 21st-century skills—takes on special significance

(Kalogiannakis et al., 2021). As research around its application continues to grow, it becomes increasingly important to record, categorize, and analyze the pedagogical approaches and outcomes reported in relevant literature (Zourmpakis et al., 2024). The aim of this systematic literature review is to identify and highlight educational practices and instructional strategies that have been employed in integrating the micro:bit in primary school settings. The focus is on the learning objectives pursued, the teaching methods used, and the educational results reported. By analyzing recent studies, this review seeks to contribute to understanding both the benefits and the challenges of pedagogically leveraging the BBC micro:bit in elementary education (Sentance et al., 2017).

## 2 Methodology

This study employed the PRISMA methodology (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), an internationally recognized framework for conducting systematic literature reviews (Page et al., 2021). PRISMA ensures transparency, reliability, and clarity in every stage of the review process, including the search strategy, selection criteria, evaluation, and analysis of sources. It provides structured guidelines for documenting the inclusion and exclusion criteria, search methods, reasons for exclusion, and the quantitative or qualitative analysis applied to the selected studies. The choice of PRISMA as the methodological tool strengthens the validity of the review and supports a more objective and scientifically grounded interpretation of the findings. To ensure comprehensive coverage of relevant studies, searches were conducted across multiple databases, including Scopus, Web of Science and Google Scholar. This multi-database approach minimized the risk of omitting pertinent literature and enhanced the systematic nature of the review, aligning with the methodological standards recommended by PRISMA.

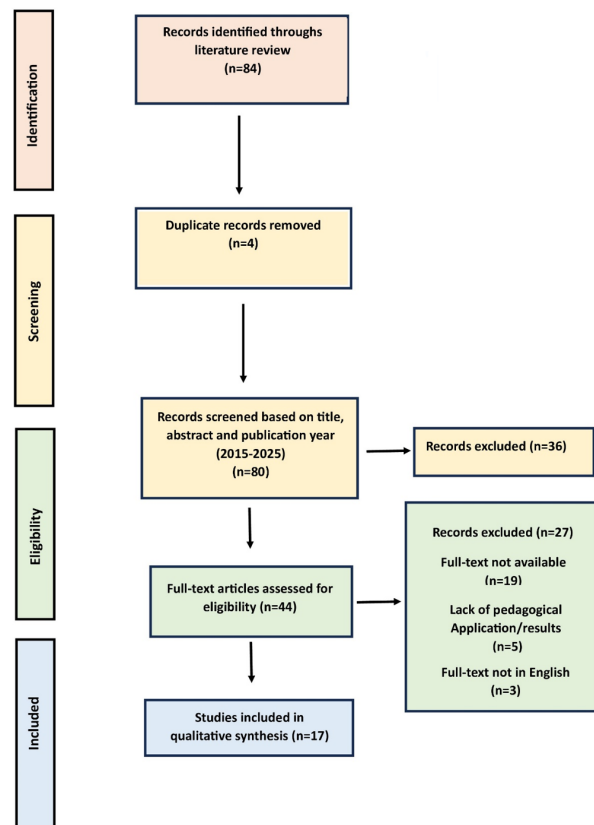
The literature search was systematically conducted across multiple academic databases, including Scopus, Google Scholar, and Web of Science, all recognized for their extensive coverage of peer-reviewed research. The search was performed in May 2025 using the keywords “micro:bit” AND “primary” AND “school,” with the aim of identifying studies directly examining the use of the BBC micro:bit in primary education. The initial search yielded a total of 84 records: 43 from Scopus, 41 from Google Scholar, and none from Web of Science that met the inclusion criteria. To ensure the quality and relevance of the review, four duplicate records were removed, resulting in 80 unique articles. An initial screening of titles and abstracts, considering publications between 2015 and 2025, led to the exclusion of 36 articles due to irrelevance, leaving 44 articles for full-text assessment. During this stage, further exclusions were applied: 19 articles were inaccessible in full text, 3 articles were not written in English, and 5 articles lacked pedagogical implementations or clearly defined learning outcomes.

Following this rigorous screening process, a total of 17 studies fulfilled all inclusion criteria. These studies were published between 2015 and 2025, written in English, presented empirical findings, focused on the BBC micro:bit as a central educational tool, and involved students in primary education. Although several studies originated from conference proceedings, they were retained when they reported original empirical data or relevant educational interventions, thereby ensuring that methodologically sound contributions were not excluded solely based on publication format.

The initial assessment of relevance was based on the examination of titles and abstracts, whereas the final selection was conducted through full-text review to confirm the appropriateness of each study. The 17 selected studies formed the basis for a thematic analysis aimed at identifying and categorizing pedagogical practices, instructional strategies, intended learning objectives, and reported educational outcomes associated with the use of the micro:bit in primary education. The entire selection process is illustrated in a PRISMA flow diagram, depicting the sequential stages of identification, exclusion, and final inclusion of the studies. (see in Figure 1)

## 3 Results

The analysis of the selected studies reveals that the use of the BBC micro:bit in primary education contributes significantly to the development of a variety of student skills. Across different educational contexts, students enhanced computational thinking problem-solving abilities and creativity and teamwork and collaboration (Zourmpakis, 2025). Furthermore, the integration of micro:bit activities fostered environmental awareness and critical thinking, while promoting learner autonomy and initiative-taking through hands-on, project-based experiences. The device's simplicity and portability also made it highly adaptable to diverse classroom and



**Figure 1** PRISMA flow diagram for the study selection process

remote learning environments, as demonstrated during the COVID-19 pandemic (Garcia-Ruiz & Alvarez-Cardenas, 2021).

Many studies employ flexible and creative teaching strategies that effectively integrate the BBC micro:bit into primary education. Among these, STEAM-based activities stand out, combining technology, science, art, and mathematics to foster interdisciplinary learning and creativity (Kunac & Kunac, 2024). Other approaches include student-centered methodologies such as Project-Based Learning (PBL), which have been shown to enhance learning outcomes and creativity, particularly among children with special needs, promoting inclusion and self-expression (Papadakis, Tzagkaraki, & Kalogiannakis, 2024). These activities are typically conducted in collaborative classroom or laboratory settings designed to encourage active student engagement, with the teacher serving as a facilitator and guide.

During the research activities, students had the opportunity to engage in various applications, such as game development and building robotic systems, participating in environmental field actions, collecting and analyzing data using sensors, and taking part in international educational programs aimed at enhancing communication and collaboration between schools. Collectively, these activities effectively apply physical interaction with technology and practical knowledge application (Kunac & Kunac, 2024).

The results across the reviewed studies are consistently positive. Increased student interest and active participation were recorded, along with improved understanding of technology and computer science concepts (Philbin, 2024). Students gained greater confidence and expressed enthusiasm for the learning process, highlighting the engaging and hands-on nature of micro:bit activities (Sentance et al., 2017). Both students and educators recognized the positive impact of the micro:bit on teaching and learning, emphasizing its ability to enhance creativity, critical thinking, and problem-solving skills (Harun et al., 2025). The micro:bit provides a comprehensive learning experience that supports both conceptual understanding and the cultivation of essential 21st-century competencies (Kalogiannakis et al., 2021). Overall, the evidence suggests that integrating the micro:bit in primary education can create high-quality and innovative learning experiences, particularly when activities are well-designed and based on sound pedagogical principles (Kunac & Kunac, 2024). However, there remains a need for more longitudinal and empirical studies to further validate these findings and promote their integration into primary school curricula (Zourmpakis, 2025). Table 1 summarizes the analyzed studies, including key details such as the educational level, methodology, and main findings of each case.

**Table 1** Summary of the empirical studies reviewed

| Author(s)                                                      | Title of the Article                                                                                                                                                                         | Year | Educational Level                               | Methodology                                                                                                                 | Key Findings                                                                                                                                                                                                                                      |
|----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Harun, M. A., Ridzuan Aw, S., & Mohd, M                        | Development of micro:Bit Robot Kit as a Tool in STEM Education Enrichment for Primary School Students                                                                                        | 2025 | Primary Education                               | Development and implementation of a low-cost Micro:bit robot kit for hands-on STEM learning                                 | The Micro:bit robot kit enhances creativity, problem-solving, and computational thinking. Facilitates hands-on STEM experiences, promotes student engagement, and supports active learning in science, technology, engineering, and mathematics.  |
| Hartley, K. et al                                              | Meet MicroCode: a Live and Portable Programming Tool for the BBC micro:bit                                                                                                                   | 2024 | Primary Education (ages 10–11)                  | Qualitative Method (Interviews)                                                                                             | MicroCode increased student engagement and enhanced their sense of agency.                                                                                                                                                                        |
| Philbin, C.A.                                                  | Beyond Apps: Tablet and Micro:bit Devices as Tools for Creative Computing in Primary Schools                                                                                                 | 2024 | Primary Education                               | Practical Description with Empirical Evidence (Case Study)                                                                  | The use of tablets and micro:bit enhanced creativity and understanding of Computer Science, increasing students' enthusiasm and engagement. Further research is recommended for empirical validation.                                             |
| Papadakis, S. et al                                            | Teaching Electricity Topics with Project-Based Learning and Physical Computing to Enhance Primary School Students in Science Education. An Educational Experiment with BBC micro:bit Board   | 2024 | Primary Education (Grade 5, ages 10–11)         | Quantitative Educational Experiment Using PBL & Physical Programming                                                        | A slight improvement in student performance was observed. The importance of prior knowledge and the selection of appropriate physical programming tools is emphasized.                                                                            |
| Kunac, I., & Kunac, M                                          | Teaching programming with micro:bit.                                                                                                                                                         | 2024 | Primary Education                               | Systematic review / Teaching programming with micro:bit                                                                     | Enhancement of digital skills and computational thinking. Positive engagement from students and teachers. Emphasis on hands-on activities and practical application of physical computing concepts.                                               |
| Mardian, V. & Azzahra, W.                                      | A Review: The Impact of Micro:Bit-Assisted STEM Education                                                                                                                                    | 2024 | Primary Education (mainly)                      | Systematic review of 12 empirical studies (2020–2024)                                                                       | Micro:bit-assisted STEM education enhances students' 21st-century skills, knowledge, and attitudes. Promotes meaningful engagement and highlights the need for further research on interdisciplinary learning and gender differences.             |
| Edwards, L. et al.                                             | Supporting fieldwork for primary education with computing micro:bit, clip:bit and game controllers                                                                                           | 2023 | Primary Education                               | Qualitative Presentation and Analysis of micro:bit Implementation in Educational Field Projects                             | The micro:bit actively supports student participation in field activities and enhances environmental education.                                                                                                                                   |
| Piljek, P. et al.                                              | Prototyping and Integration of Educational Low-Cost Mobile Robot Platform                                                                                                                    | 2023 | Primary Education                               | Design and Implementation of a Robotics Platform with micro:bit – Pilot Workshop with Students                              | The micro:bit is successfully integrated into robotics activities, enhancing experiential STEM learning and fostering creativity.                                                                                                                 |
| Nagai, T. et al.                                               | PICA-PICA: Exploring a Customisable Smart STEAM Educational Approach via a Smooth Combination of Programming, Engineering and Art                                                            | 2023 | Primary Education                               | 4-Day Workshop Using micro:bit in STEAM Activities (Programming & Art)                                                      | The children demonstrated high motivation and enthusiasm, successfully combining programming and creativity with a focus on ecological awareness.                                                                                                 |
| Kong, S.C. & Kwok, W.Y.                                        | A Pedagogy in STEM Classrooms for Primary Students to Develop Knowledge of Electric Circuits and Problem-Solving Skills                                                                      | 2022 | Primary Education                               | 8 lessons / 280 minutes with activity sheets, code templates, pre- and post-tests, questionnaires, and interviews           | Significant improvement in knowledge of electrical circuits and problem-solving skills was observed, along with high student satisfaction with the learning experience.                                                                           |
| Tisza, G., Sharma, K., Papavlasopoulou, S. et al.              | Understanding Fun in Learning to Code: A Multi-Modal Data approach                                                                                                                           | 2022 | Primary Education                               | Two-hour Workshop with BBC micro:bit, Collecting Data from Wrist Sensors and Face Camera, with Pre- and Post-Questionnaires | The use of BBC micro:bit in a programming workshop contributed to a positive learning experience. Enjoyment was positively associated with learning outcomes, whereas negative emotions (e.g., anxiety) and low arousal had a detrimental effect. |
| Kastner-Hauler et al.                                          | Combined Effects of Block-Based Programming and Physical Computing on Primary Students' Computational Thinking Skills                                                                        | 2022 | Primary Education (ages 8–10)                   | Teaching with micro:bit and OER Book, 3 Weeks, with Pre- and Post-Tests                                                     | The combination of block-based programming and micro:bit improves computational thinking.                                                                                                                                                         |
| Lu, Wu, Huang                                                  | Evaluation of Disabled STEAM-Students' Education Learning Outcomes and Creativity under the UN Sustainable Development Goal: Project-Based Learning Oriented STEAM Curriculum with micro:bit | 2022 | Primary Education (Students with Special Needs) | Case Study (3 Students), 10-Week PBL STEAM Program with 12 Lessons, Using micro:bit and Handicrafts                         | The PBL STEAM program improved learning outcomes and creativity in students with special needs.                                                                                                                                                   |
| Michail Kalogiannakis, Effransia Tzagaraki, Stamatis Papadakis | A Systematic Review of the Use of BBC Micro:Bit in Primary School                                                                                                                            | 2021 | Primary Education                               | Systematic Literature Review of 12 Empirical Studies (2016–2020)                                                            | Students demonstrate a positive attitude toward micro:bit, finding it engaging and supportive of creativity, critical thinking, and problem-solving. The need for further empirical research at the primary education level is emphasized.        |
| Miguel A. Garcia-Ruiz, Omar Alvarez-Cardenas                   | Experiences in Developing and Testing BBC Micro:bit Games in a K-12 Coding Club during the COVID-19 Pandemic                                                                                 | 2021 | Primary Education                               | Qualitative Case Study from a One-Month Online Coding Club Using BBC Micro:bit and Simulator.                               | Primary school students developed and tested games using BBC Micro:bit in a remote learning environment. They learned concepts such as logic, sensors, random numbers, and physical computing.                                                    |
| Maja Videnovik, et al.                                         | The BBC Micro:bit in the International Classroom: Learning Experiences and First Impressions                                                                                                 | 2018 | Primary Education                               | Experimental Presentation and Hands-On Use of micro:bit by 36 Students and 5 Teachers Across 4 Countries                    | User-friendly tool, enhancing motivation, collaboration, and creativity                                                                                                                                                                           |
| Sue Sentance, et al.                                           | Teaching with physical computing devices: the BBC micro:bit initiative                                                                                                                       | 2017 | Primary Education (ages 11–12)                  | Qualitative Study: Interviews with 15 Teachers and 54 Students                                                              | Variety of Micro:bit Uses in the Classroom. Students were enthusiastic, while teachers acted as facilitators and resource providers.                                                                                                              |

## 4 Discussion

This study thoroughly examined the effects of using and implementing the BBC micro:bit platform in primary education, with an emphasis on multiple and diverse aspects of the learning process, such as student engagement, creativity, computational thinking, and the development of digital and cognitive skills. Through the analysis of 17 selected contemporary studies conducted over the past decade, the positive impacts of micro:bit use are highlighted, although certain limitations are also noted, primarily related to its educational implementation. Nevertheless, its integration into education demonstrates significant potential, functioning as a powerful tool that enhances experiential and collaborative learning while linking technology with creative and interdisciplinary approaches (Papadakis et al., 2024). At the same time, important areas for further research and optimization of educational practices are identified.

The study by Hartley et al. (2024), conducted through qualitative interviews, clearly indicates that the use of MicroCode for the BBC micro:bit increases student engagement in class and strengthens the sense of agency during computer science or STEM lessons. Specifically, it explores how MicroCode supports students' access to programming, as it does not require installation or connection to complex platforms, facilitating its integration into educational settings. Students reported increased confidence because they could understand and control their commands without constant dependence on the teacher. Furthermore, interactive feedback helped students understand the outcomes of their actions more immediately, enhancing their emotional connection to the activity. This study addresses a significant gap in the literature concerning programming tools adapted for primary school-aged children, emphasizing usability and portability, which are often overlooked (Hartley et al., 2024).

This is further confirmed by the findings of Edwards et al. (2023), where the micro:bit, in combination with other devices such as the clip:bit and game controllers, was employed in out-of-class educational projects, i.e., field-based activities. Their use enabled students to participate more actively, providing opportunities to collect data from the physical environment and analyze it in real time (Papadakis, 2020, 2022). This significantly increased student interest, active engagement, and commitment to the learning process. Such practice allowed students to feel that they played a meaningful role in shaping their knowledge, which is considered critical for successful learning. Student enthusiasm helped maintain focus during device use, promoting observation, critical thinking, and problem-solving, while simultaneously fostering greater environmental awareness. Overall, the findings indicate that using the micro:bit in such activities makes learning more vivid and relevant to real-life contexts, enhancing experiential learning and the connection between theory and practice (Edwards et al., 2023).

One of the most notable benefits of integrating the BBC micro:bit into primary education is creativity. Philbin's (2024) study provides empirical evidence showing that combining tablets with the micro:bit creates a computational thinking environment, allowing students to explore creatively and understand various programming concepts. Specifically, increased enthusiasm, higher engagement, and improved understanding of computer science concepts were observed. However, the study emphasizes the need for further empirical research, as its findings, although promising, are based on a case study methodology (Philbin, 2024). In line with this, Harun, Ridzuan Aw, and Mohd (2025) demonstrated that the use of a low-cost micro:bit robot kit effectively supports creativity and hands-on STEM activities, further promoting problem-solving and computational thinking in primary school students.

Similar dimensions of creativity are highlighted in the study by Nagai et al. (2023), which focused on the design and implementation of a four-day STEAM workshop combining programming, art, and ecological awareness. Students engaged in activities that involved creating "smart" art projects using the micro:bit, integrating environmental themes. The findings demonstrated that this design, which combines programming with artistic expression, promotes active student participation while enhancing environmental and ecological sensitivity, serving as a strong motivational factor for learning (Nagai, et al, 2023). A common feature in both studies is the emphasis on the micro:bit as a tool for expression rather than merely a technological device. In this way, programming shifts from a procedural skill to a creative framework that links learning with students' artistic experiences and concerns.

The integration of the BBC micro:bit into primary education has been shown to be effective in enhancing problem-solving skills as well as familiarizing students with technical topics such as electrical circuits. The study by Kong and Kwok (2022) implemented the pedagogical approach "To Play and Learn, To Inquire, To STEM and Code" with 369 fifth-grade students across nine schools in Hong Kong. Using the micro:bit, students built electrical circuits through

activities involving either pre-written or customized code, leading to statistically significant improvements in both their circuit knowledge and problem-solving abilities. Moreover, students reported increased satisfaction with the learning process (Kong & Kwok, 2022).

Similarly, the research by Papadakis et al. (2024) focused on a Project-Based Learning (PBL) approach combined with tangible programming for teaching electricity-related topics to primary students. Learners engaged in activities that integrated programming with practical applications to enhance understanding of electrical circuits and develop problem-solving skills. The results demonstrated that this approach improved student performance, while highlighting the importance of prior knowledge and the careful selection of tools for effective instruction (Papadakis et al., 2024). Mardian and Azzahra (2024) similarly found that micro:bit-assisted STEM education improves students' 21st-century skills, knowledge, and attitudes, promoting meaningful engagement and reinforcing the value of interdisciplinary learning in primary classrooms.

Additionally, the study by Lu et al. (2022) examined the impact of a STEAM program based on the PBL methodology, which incorporated the micro:bit and papercraft techniques for students with educational needs. The program spanned 10 weeks and included 12 lessons aimed at enhancing participant creativity. It was implemented with three primary school students with learning difficulties and assessed their performance using creativity tests before and after the intervention. The findings indicated improvements in both creativity and learning outcomes. Furthermore, this research underscores the value of introducing technological tools such as the micro:bit into STEAM programs to provide appropriate support for students with educational needs, ensuring quality education that is equitable for all (Lu, Wu, & Huang, 2022).

Another crucial factor for a successful educational experience, particularly regarding programming at an early age, is fun and emotional engagement during the learning process. The study by Tisza et al. (2022) demonstrated that the use of the BBC micro:bit strengthens students' sense of enjoyment and active participation. The researchers collected multimodal data to capture behavior, emotions, and performance from 53 primary school students participating in a two-hour micro:bit programming workshop. The findings indicated that enjoyment was correlated with higher engagement and better learning outcomes. The micro:bit increased students' confidence and creativity, as its immediate feedback created an experimental environment without fear of failure. The study concludes that, for programming activities in primary education to be effective, they must integrate tools that not only teach technical skills but also support the psychological experience of the student—something that the micro:bit successfully achieves (Tisza et al., 2022).

One of the central goals of integrating the micro:bit into education is the enhancement of computational thinking. The study by Kastner-Hauler et al. (2022) provides empirical evidence that combining block-based programming with tangible programming through the micro:bit fosters the development of computational thinking skills in students aged 8–10. In this study, a three-week instructional program was implemented using an open digital book (OER) containing structured micro:bit activities. Results from pre- and post-tests revealed statistically significant improvements in algorithmic thinking and computational skills. The study emphasizes the importance of appropriate pedagogical design and the selection of tools that encourage students to engage in computational thinking, problem-solving, and transforming their ideas into executable code. Furthermore, when activities integrate programming with physical objects, the learning experience is enhanced, creating a more comprehensible environment for young learners. Kunac and Kunac (2024) also highlighted that micro:bit programming enhances digital skills and computational thinking in primary students, further supporting its role as an effective early learning tool.

The integration of the micro:bit into robotic platforms represents a particularly promising axis in educational practice. Furthermore, it demonstrates that the device is effective in creating innovative educational environments that support experiential STEM learning. As shown in the study by Piljek et al. (2023), the use of educational robots encourages students to develop creativity, critical thinking, and collaboration skills, which are essential in modern technology. This research emphasizes the importance of active student engagement, which fosters motivation and perseverance and contributes to a deeper understanding of technological concepts, confirming that integrating the micro:bit into educational robotics environments can be a key driver for STEM learning (Piljek et al., 2023).

The systematic review by Kalogiannakis et al. (2021) presents data from 12 empirical studies focusing on the use of the micro:bit in primary education. The results highlight that the micro:bit enhances children's computational thinking and creativity, while also positively supporting

problem-solving skills. Students' positive attitudes toward using the micro:bit underscore its potential; however, the authors note the need for further empirical research with larger samples to gain a deeper understanding of its effectiveness across diverse learning environments and socio-cultural contexts (Kalogiannakis et al., 2021).

The international study by Videnovik et al. (2018) corroborates these findings, emphasizing that the micro:bit, as a user-friendly and accessible tool, increases motivation and promotes collaboration among students across different educational systems. Strengthening teamwork and positive classroom interaction emerge as significant outcomes of using the micro:bit, contributing to the creation of a supportive learning environment. The study concludes that integrating the micro:bit into educational practice can transform traditional teaching, fostering more active and participatory learning (Videnovik et al., 2018).

Another study highlighting the micro:bit's role in enhancing engagement and learning outcomes is that of Sentance et al. (2017). Primary school students participated in an educational program with physical computing devices such as the micro:bit and described the tool as fun, creative, and easy to use, while noting that it helped them understand fundamental programming concepts in a practical way. Particular emphasis was placed on the excitement students experienced from creating tangible projects and immediately seeing the results of their actions, which fostered autonomy. The study concludes that the micro:bit serves as an effective bridge between abstract concepts and experiential learning, enhancing creativity, collaboration, and positive attitudes toward computer science and programming (Sentance et al., 2017).

Finally, the study by Garcia-Ruiz and Alvarez-Cardenas (2021) adds an important dimension to the use of the micro:bit, highlighting its support for learning in remote environments. Through online coding activities, the micro:bit proved effective for teaching basic programming concepts, particularly during crises such as the COVID-19 pandemic. This flexibility allows students to maintain their learning trajectory and develop programming skills even outside the traditional classroom, confirming the tool as a valuable resource for contemporary educational challenges. By creating games, students were encouraged to develop programming, logical thinking, and collaboration skills despite the absence of physical presence in the classroom. Overall, the findings indicate that integrating physical programming through the micro:bit can effectively support student learning and engagement, even under crisis conditions (Garcia-Ruiz & Alvarez-Cardenas, 2021).

Nevertheless, alongside these positive outcomes, several limitations and challenges emerge that warrant careful consideration. A recurrent issue concerns the professional development of teachers. As Sentance et al. (2017) highlight, many educators initially acted as facilitators rather than expert users of the micro:bit, indicating that insufficient training may constrain the effective implementation of physical computing tools in the classroom. Moreover, the majority of studies reviewed focus on short-term interventions (e.g., workshops or pilot projects), which raises questions about the long-term sustainability and transferability of these practices within formal curricula (Philbin, 2024). Another critical concern relates to equity: not all schools have equal access to resources and funding, which may lead to disparities in students' opportunities to engage with innovative technologies (Kalogiannakis et al., 2021). Finally, although many studies report increased enthusiasm, some also note negative emotions such as frustration or anxiety during programming activities (Tisza et al., 2022), suggesting that the learning experience may not be uniformly positive for all learners. These challenges underline the need for further systematic research that not only validates the reported benefits but also addresses the structural, pedagogical, and emotional barriers that may limit the widespread and sustainable adoption of the micro:bit in primary education.

## 5 Limitations

Although this systematic review followed the PRISMA guidelines to ensure transparency and methodological rigor, several limitations should be acknowledged. First, despite the inclusion of multiple databases (Scopus, Web of Science, and Google Scholar), there remains the possibility of publication bias, as studies not indexed in these databases or written in other languages may have been omitted. Second, the majority of the reviewed studies were short-term interventions, limiting the ability to assess the long-term impact of BBC micro:bit integration on students' learning outcomes. Third, many studies relied on small sample sizes or qualitative data, which restricts the generalizability of the findings. Finally, this review did not include unpublished research or gray literature, which could have provided additional perspectives on the educational use of the BBC micro:bit. Future reviews should expand the database coverage, incorporate longitudinal research, and explore meta-analytic approaches to strengthen the evidence base in

this growing field.

## 6 Conclusion

Despite these limitations, the findings of this review provide valuable insights into the integration of the BBC micro:bit in primary education. The use of the BBC micro:bit in primary education provides a learning environment that significantly enhances students' active engagement and promotes a deeper understanding of concepts through experiential and interdisciplinary approaches. Through programming activities and the development of interactive applications, students are introduced to STEM concepts in a creative and playful manner. The micro:bit supports the development of computational thinking, problem-solving, and systemic approaches, while strengthening the connection between theory and practice, as students can immediately observe the outcomes of their decisions. Additionally, the micro:bit fosters experimentation, autonomy, and metacognitive engagement, as students can design, implement, test, and refine their own creations individually or collaboratively. Importantly, the micro:bit serves as a connecting link across different subject areas, such as physics, arts, and mathematics.

These findings strongly suggest that the introduction and integration of the micro:bit in education can create a more active learning model for primary school children, transforming the educational process from rote memorization into a more creative and hands-on interaction with knowledge. Although research data on primary education remains relatively limited, the existing evidence reinforces the need for further exploration of the micro:bit's potential in authentic learning environments.

Overall, while the evidence demonstrates that the BBC micro: bit can enrich primary education by fostering creativity, computational thinking, and engagement, its integration should also be viewed through a critical lens. Ensuring adequate teacher training, securing equitable access to technological resources, and assessing the long-term sustainability of such initiatives are crucial steps for maximizing its educational value. Without addressing these challenges, there is a risk that the benefits of the micro:bit will remain unevenly distributed or short-lived, thus limiting its transformative potential in primary education.

## Conflicts of Interest

The author declares that there is no conflict of interest.

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