



# Improving students' creative thinking skills using BBC Microbit in Informatics subjects

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## ABSTRACT

Information and communication technology (ICT) has become an integral part of modern life and has had a significant impact on the world of education, especially in vocational schools. Education is essentially a process for students to acquire knowledge and develop skills through learning experiences. In this study, the learning method used combines the Science, Technology, Engineering, and Math (STEM) disciplines with a focus on developing computer programs using micro:bit block programming to solve real-life problems. The results of the study show that the use of micro:bit as an alternative teaching method for computer science in vocational schools can improve students' creative thinking skills with an average score of 90 after treatment. This study used a pre-experimental design method with 35 subjects from the X grade of the Computer Network and Telecommunication Engineering program at SMK Negeri 1 Cirebon, using written tests and observations as data collection techniques. The use of simple and inexpensive technology products such as micro:bit can enhance learning effectiveness and help students better understand programming concepts. Therefore, micro:bit can be considered as an alternative teaching method for computer science in vocational schools.

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## INTRODUCTION

Information and communication technology (ICT) has become an integral part of modern life. Technological developments have had a major impact on the world of education, especially in SMK. Education is essentially a process that enables students to acquire knowledge and develop skills through learning experiences (Andriani et al., 2020). One way to hone students' skills is to use simple or complex technological products. In the independent curriculum, informatics is one of the compulsory subjects in SMK (Ujang Cepi Barlian et al., 2022) (Kurniati et al., 2022). The informatics

subject taught at SMK aims to teach skills and knowledge in the use of information and communication technology.

Students at the Vocational High School learn programming fundamentals such as C, C++, Python, and Scratch as part of the Informatics course. The level of depth of programming material varies depending on the focus of expertise chosen by each school and package of expertise. Within the Computer Networking and Telecommunications Engineering skill set, Scratch is the most widely used programming language (Hansun, 2014), while in the Software Engineering skill package, the more popular programming languages are Python, C++, Java, or C. Although teaching using programming languages such as C, C++, Python, Visual Basic, Scratch, and the like is becoming popular and is considered the best way to start learning programming, there are some students who may be less motivated. Almost all students in the Computer Networking and Telecommunication Engineering skill package admit that programming is very difficult for them and they have difficulty understanding it.

According to (Lee et al., 2014) explained that computational thinking skills are essential in helping and facilitating students in solving algorithmic and programming problems. This is because this ability involves a variety of skills and techniques that can train students to formulate problems into smaller and more easily solved parts. Besides that, (Angeli et al., 2020) as well as (Wing, 2014) suggests that computational thinking is also able to trigger students' creative thinking skills in solving problems.

In fact, current learning approaches tend to limit students' ability to develop computational thinking processes. Teachers often use teaching methods that are monotonous and unattractive, so that students become less enthusiastic about learning (Tedre et al., 2016). In addition, teachers often teach how to solve algorithmic and programming problems using structures, and students need only copy the methods to memorize and use in finding the correct answers on exams. Of course, such a learning approach will make students less interested and active in developing computational thinking skills, so that it has a negative impact on students' computational thinking skills. (Tedre et al., 2016).

BBC micro:bit is a very small, pocket-sized, programmable block-based computing device (Da Silva et al., 2020) as well as having a small battery to power the circuit board and was originally introduced for Educational purposes (Vostinar et al., 2020), as well as Internet of Things (IoT) technology, namely a system of physical objects in which there are microcontrollers, sensors, microchips, and other communication systems. IoT is used to transfer data over a network without human-to-human or human-to-computer interaction (Fidai et al., 2019). This can be interpreted as computing that is interconnected and spread everywhere, this technology was born because of a new paradigm that is spread throughout the world with its presence on every device. (Glaroudis et al., 2019).

Bebras is an activity that can assist in the development of computer science skills and computational thinking, and a guide designed to assist teachers in training students' CT skills (Combéfis et al., 2020).

The learning model that combines five disciplines sciences namely Science, Technology, Engineering and Math (Zubaidah, 2019). For learning activities will focus on developing computer programs based on knowledge of science, mathematics, and engineering design. process to get a product or process to solve a real-life problem (Srisangngam et al., 2020).

According to Siregar et al's 2020 research entitled "Increasing Students' Creative Thinking Ability Through a Realistic Mathematical Approach". The results of his research explained that this study showed that the level of students' creative thinking skills was still low. Therefore, research was conducted to test the effectiveness of a realistic mathematics approach in improving students' creative thinking skills. The method used is a quasi-experimental method with a pretest-posttest control group research design. The results showed that there was an increase in students' creative thinking skills with a realistic mathematical approach in learning mathematics. In addition,

students' responses to learning mathematics using a realistic mathematics approach were also positive (Siregar et al., 2020).

Sukmagati, et al in a study entitled "Development of STEM-Based Student Worksheets (LKS) to Improve Middle School Students' Creative Thinking Ability" The results of his research explained that the development of STEM-based LKS was appropriate for use in learning activities. The LKS succeeded in improving students' creative thinking skills in the aspects of fluency, flexibility, elaboration, and originality. The results of the feasibility test showed that the LKS was very suitable for use in learning and was easily understood by students. The results of the pretest-posttest n-gain test showed a high increase after using STEM-based worksheets. Therefore, it can be concluded that STEM-based LKS can be an effective alternative in improving students' creative thinking skills (Sukmagati et al., 2020).

In addition, other studies that have been conducted by Wulandari, et al. With the title "Improving Creative Thinking Skills of Grade 5 Students Using the Mind Mapping Model" The results of his research show that the Mind Mapping model is effective in improving students' creative thinking skills. There was an increase in the percentage of very creative categories from the pre-cycle stage of 28.6% to 61.9% in the second cycle stage. Thus, the Mind Mapping model can help students convey new ideas and improve their creative thinking skills (Wulandari et al., 2019).

In this paper, we propose using BBC Micro:bit as a solution to improve students' creative thinking skills in answering free questions in informatics subjects. Our goal is to address the challenge of students' lack of motivation to learn programming and a lack of engaging learning, which can hinder students' progress in computational thinking skills. In addition, the dissimilarity in the choice of programming languages taught in each SMK skill package can also hinder students' abilities in programming. In this study, we intend to analyze the impact of using BBC Micro:bit on students' computational thinking skills in answering bebras questions in informatics subjects at VOCATIONAL SCHOOLS.

## RESEARCH METHODOLOGY

This research was conducted at SMK Negeri 1 Cirebon for 3 months, from September to November 2022, involving 35 students of class X Computer Networking and Telecommunications Engineering as research subjects. The research method used is quantitative research with a pre-experimental design type one group pretest-posttest (single group pretest-posttest). (Khotifah et al., 2022) said, that one group pretest-posttest design is a research activity that provides an initial test (pretest) before being given treatment, after being given treatment then gives a final test (posttest). In this design, the test was carried out twice, namely before being given the treatment is called the pretest and after the treatment is called the posttest. As for the research pattern of the one group pretest-posttest design according to Sugiyono (2013:75) as follows:

$$O_1 X O_2$$

Where :

O1 = Pretest value (before treatment)

X = Micro:bit learning model

O2 = Posttest value (after being given treatment)

In this study, testing was carried out twice, namely before treatment (Pretest) and after treatment (Posttest) using the same questions. After the Pretest (O1) was carried out, the researcher provided simulation learning using micro:bit to help students solve Bebras questions related to algorithms and programming (X). Then, Posttest (O2) was carried out at the end of the study. At the planning stage, the researcher groups Bebras questions related to algorithms and programming, then arranges lesson plans and worksheets as worksheets containing assignments

done by students, containing instructions, steps to complete a task in the form of theory or practice adapted to the Bebras questions. will be applied to classes for Pretest and Posttest(Aldila et al., 2017). The research design can be seen in Figure 2.

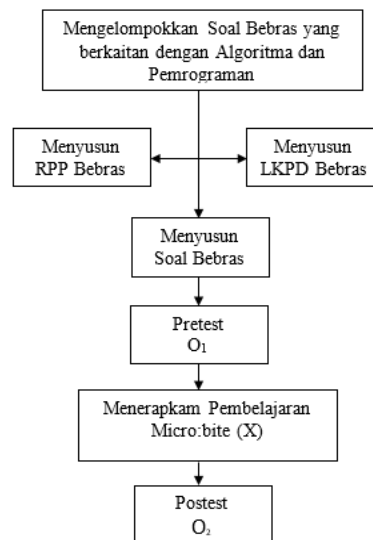


Figure 2. Research Design

## RESULTS AND DISCUSSION

Bebras questions are very useful for students and teachers in improving critical thinking skills. Students are taught to think about informatics concepts, while teachers must consider the relation of computer science to everyday life(Harrington et al., 2019). The main challenge in solving Bebras questions is to think creatively and quickly. It is hoped that students will be more motivated to understand and identify informatics problems, as well as deepen their understanding of computer technology.

To be able to solve Bebras problems quickly, students need to have knowledge of programming principles, ideas, and concepts that are inseparable from learning informatics.(Chahyadi et al., 2021). Therefore, an appropriate method is needed so that students can interact with certain objects in solving these problems. This idea and concept understanding exercise can be done using micro:bit.

In the first stage, students are given the opportunity to answer 10 questions related to programming. The minimum completeness criterion set was 70. Of the 35 students who were sampled in this study, the results obtained were the average pretest scores shown in Table 1.

Table 1. Pretest Results

No	Value Intervals	The number of students
1	0-20	1
2	30-40	4
3	50-60	20
4	70-80	8
5	90-100	2
Amount		35

Based on the results of the post-test conducted, it can be seen that as many as 20 students have a dominant score range between 50-60 with an average score of 59.71. This shows that students still have difficulty in solving bebras questions related to algorithms and programming. Therefore, special treatment is needed to help students be able to more quickly and accurately answer these questions.

In the second stage, the teacher provides an explanation regarding the use and function of Micro:bit as well as examples of programming that can be made using Micro:bit. In addition, the teacher will also provide examples of Bebras questions related to algorithms and programming, so that students can apply their understanding of Micro:bit concepts in answering Bebras questions. This stage aims to help students understand the concept of algorithms and programming in more depth and be able to apply this knowledge in solving various kinds of problems, as shown in Figure 3.



Figure 3. The teacher gives a lesson

The third stage is when students are guided to practice using micro:bit to get used to answering programming challenges. In this stage, students will be given guidance on using micro:bit, for example students make a Car Reverse Sensor. First of all, on the Extensions menu, select Grove to add a block (library). By adding this block, students can use external components to function properly, as shown in Figure 4 and Figure 5.

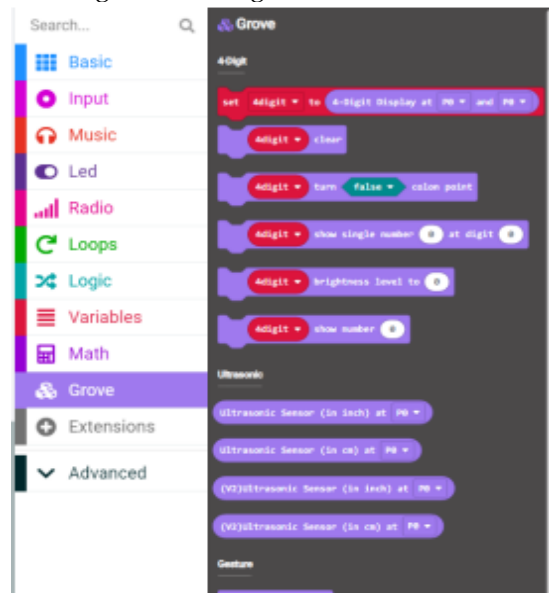


Figure 4. Extensions Grove Block



Figure 5. Block While Running

After students carry out practical work using the Micro:bit programming block, they are able to understand the formation of algorithms in the Micro:bit programming language and identify the program code that has been made. In this practicum, students also practice making a Car Reverse Sensor by selecting the Extensions menu and selecting Grove to add the necessary blocks (library) so that it can function. The Micro:bit programming language is based on a cartesian coordinate system in a 2-dimensional plane using x coordinates (abscissa) and y coordinates (ordinate).

Terdapat lima kartu yang diletakkan berderet. Setiap kartu berisikan lambang hati dalam jumlah tertentu, dari kiri ke kanan secara berurutan adalah 16, 8, 4, 2, dan 1 hati. Di bagian bawah kartu terdapat tulisan angka 0 atau 1. Angka 1 dituliskan jika kartu di atasnya terbuka (dan terlihat gambar hatinya). Angka 0 dituliskan jika kartu tertutup. Kartu-kartu dapat digunakan untuk membangkitkan kode\_kode untuk angka-angka. Sebagai contoh, terdapat 9 gambar hati yang dapat terlihat pada gambar berikut ini, sehingga kode untuk angka 9 adalah 01001.



**Tantangan:**

Temukan kode untuk 26 gambar hati.

- A. 10011
- B. 11111
- C. 11011
- D. 11010

Kunci: D

Picture6. Bebras problem (source:<https://bebras.or.id/>)

After the practicum, the researcher conducted a post-test and the results showed that students could quickly and easily answer Bebras questions related to algorithms and programming as shown in Figure 6. In Figure 6 is an example of a solution for calculating binary numbers whose implementation is obtained from reading the Car Reverse sensor . this shows that the use of Micro:bit programming blocks can be the right method to make it easier for students to understand algorithms and programming material, the posttest results are shown in table 2.

Table 2. Posttest results

No	Value Intervals	The number of students
1	0-20	0
2	30-40	0
3	50-60	1
4	70-80	12
5	90-100	22
Amount		35

From the post-test results data, it can be seen that the range of student scores has increased very significantly with an average value of 90. It can be said that after the treatment using micro:bit students can answer bebras questions related to programming algorithms.

## CONCLUSION

In this study, it was concluded that the use of BBC micro:bit as an alternative teaching in informatics subjects in vocational high schools can have a significant effect on increasing students' creative thinking skills in answering bebras questions, with an average score of 90. The research method used was pre-experimental design with the type of one group pretest-posttest, where an initial test is carried out before being given treatment and a final test after being given treatment. The research subjects were 35 students of class X Computer Network Engineering and Telecommunications at SMK Negeri 1 Cirebon. Data collection was carried out by written test and observation. The learning model used is STEM learning which aims to develop computer programs based on knowledge of science, mathematics, and engineering design. and solve problems in real life. Therefore, the next research opportunity is to develop a BBC micro:bit-based learning model to improve students' computational thinking skills in vocational schools, by exploring the use of micro:bit as a tool to help students learn programming and hone their computational thinking skills.

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