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**Research Paper**

# The Effect of Micro:Bit Applications on Middle School Students' Attitudes Towards Coding

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**ABSTRACT**

The aim of this study is to examine the effect of Micro:bit applications with the participation of 6th grade students on students' attitudes towards coding. In addition participants' opinion regarding Micro:bit applications were examined. In this quantitative study, six-week applications with Micro:bit coding content were carried out using the ASSURE instructional design model as an intervention. The study was conducted with the participation of 59 students studying in the 6th grade of secondary school. Research data were collected using a coding attitude scale and semi-structured interviews. Since the quantitative data showed normal distribution, the data set was analyzed with parametric tests. As a result of the dependent samples t-test, it was determined that the post-test average was higher than the pre-test average. In other words, Micro:bit applications positively affected the participants' attitudes towards coding. In addition, the participants reported many positive opinions about Micro:bit applications under the cognitive and affective categories. In line with the research data, suggestions have been made to include useful educational cards such as Micro:bit, one of the block-based applications, in courses such as Information Technologies and Software, as it can increase students' interest in the course, and expand its use in the future.

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## INTRODUCTION

The main goal of education today should be to raise individuals with 21st-century skills (Beswick & Fraser, 2019). It is claimed that STEM education, which is based on the integration of science, technology, engineering, and mathematics and deals with real-world problems, stands out in this respect (URL-1). Technology can be considered a catalyst within STEM components. In general, technology integration in education supports teachers in creating a constructivist learning environment (Koehler & Mishra, 2005). The impact of STEM education on developing 21st-century skills is largely because it is based on the engineering design process. Robotic coding applications, which include the engineering design process and programming, stand out as current examples in STEM education.

Robotics is an interdisciplinary application that includes engineering design and programming (Sullivan, 2017). According to Eguchi (2017), educational robotics (ER) applications are a learning tool that supports learners in acquiring the knowledge and skills necessary to develop 21st century skills. From this perspective, it can be said that robotic education is an effective method that can be used in design-based learning environments. Indeed, Wood (2003) makes a similar point and states that the main purpose of robotics education is to provide meaningful and permanent learning with advanced technology applications in education by providing a learning environment integrated with science and technology. Robotic learning offers students the opportunity to learn by doing in a learning environment where they can design their own products. In this way, in robotics education, students assume the role of an active learner rather than a passive recipient (Atmatzidou & Demetriadis, 2014). The integration of ER into STEM disciplines both develops thinking skills (such as inquiry, engineering design, problem solving, creativity, collaborative work) and motivates learners to participate in science and technology activities (Sullivan & Bers, 2016). The use of ER enables students to understand robotics concepts, to design and code robots in accordance with the specified purpose, and thus to be actively involved in production activities. In this process, students deal with engineering activities, mathematics, and computer science concepts (Chih-Wei et al., 2010). However, although ER applications are seen as having a high potential, they also have some limitations and challenges in terms of implementation in the classroom. In fact, robots are complex machines. There is therefore a danger of 'doing without learning' for learners when ER practices are too complex for young children to learn. Teachers and practitioners should be aware of this danger (Barak & Assal, 2018). As a result, understanding information technologies and having basic coding skills are important and essential for children's general education processes (Ruch et al., 2019). However, in order to teach coding skills to children, educators need appropriate software and hardware. In current coding education, this is often a difficult process at the K-12 level, as software and hardware are often developed for other purposes and then incorporated into educational content. Micro:bit, which was first developed in the UK, is

a very good option for coding education, especially as it was developed for use in secondary schools for education. With Micro:bit, learners gain basic programming skills and an understanding of how digital systems work (Micro:bit Educational Foundation, 2022). Micro:bit can be used and incorporated into learning activities without any knowledge of electronics or physics. Micro:bit is not limited to the parts already on the board. Another important aspect is the Micro:bit's programming environment. Children can use Micro:bit at all grade levels as soon as they start reading. Many features such as the fact that the language can be set to Turkish for Turkish students, that it is possible to program in programming language as well as being graphic-block based, that the platform is web-based and requires no installation, and that the page is colorful and interesting have made Micro:bit easy to use in schools (Ruch, 2022).

Different instructional design models can be used to incorporate programmable electronic educational cards such as Micro:bit into education. In the present study, ASSURE instructional design model (Kaoropthai, 2021), which facilitates the effective and efficient use of technology, was used. Educational technology must be innovative (Lei, 2023). The ASSURE model is a model that prioritizes the use of technology in the classroom. ASSURE is an ideal model for course design that covers learning and assessment both in the classroom environment and beyond. Focusing on learners and achieving learning objectives, this model is easy to follow (Önal & Önal, 2023).

Considering all these points, it can be stated that coding studies within the scope of educational robotics with the Micro:bit educational card application can be very engaging and useful for students. Especially in such a learning environment designed based on a structure such as the ASSURE instructional design model, STEM education can be realized in a qualified, effective and efficient way with other superior aspects of Micro:bit.

A review of the literature shows that it is seen that the majority of the studies focus on the learner's attitude towards robotic coding (Kaloti-Hallak, 2014), the relationship between ER and academic achievement (Altakhayneh 2020; Ancheva & Voinohovska, 2019; Toma & Greca, 2018), the relationship between robotic coding and motivation (Peng et al., 2020), and the relationship between ER and higher-order thinking skills such as creativity and problem-solving skills (Noh & Lee, 2020). It is understood that there is a limited number of studies aimed at revealing the potential benefits of ER applications such as Micro:bit developed specifically for education and understanding the views of learners on this application.

Since it is known that the attitude of students towards the learning subject affects their performance (Uyar & Karakuyu, 2020), it is necessary to know the attitudes of these students towards coding teaching. It has been emphasized that whether students' attitudes towards coding are positive or negative will affect the success in coding teaching (Başer, 2013). There are a limited number of studies in the literature examining secondary school students' attitudes towards coding (Abdusselam & Uzoğlu, 2022; Akkuş and Bilgin, 2021). There are studies in the literature showing that male students' attitudes towards coding are higher than female students (Abdusselam & Uzoğlu, 2022; Başer, 2013); and that female students' attitudes towards coding are higher than male students (Chiazzese, Fulantelli, Pipitone & Taibi, 2018) exists in research. In some studies, it has been observed that there is no significant difference in students' attitudes (Akkuş & Bilgin, 2021; Yağcı, 2016). Based on this, in the present study, the effect of Micro:bit applications with 6th grade middle school students on their attitudes towards coding was tested and student opinions about this application were taken. The research question of this research is expressed as follows: 'What is the effect of Micro:bit applications carried out with 6th grade secondary school students on students' attitudes towards coding and what are the opinions of students about these applications?' In this context, the problem was addressed through the changes in students' attitudes towards coding and the examination of their perceptions of Micro:bit applications.

## METHOD

### Research Design

In Turkey, class groups are determined at the beginning of the semester and cannot be changed. Therefore, it is not possible to randomly assign students to experimental groups. In the study, pretest-posttest experimental design without a control group, which is a quantitative research method, and semi-structured interviews, which are qualitative research techniques, were used. The dependent variable of the study was learner's attitude towards coding. The independent variable was an intervention that used the Micro:bit applications. Figure 1 shows the design of the study:

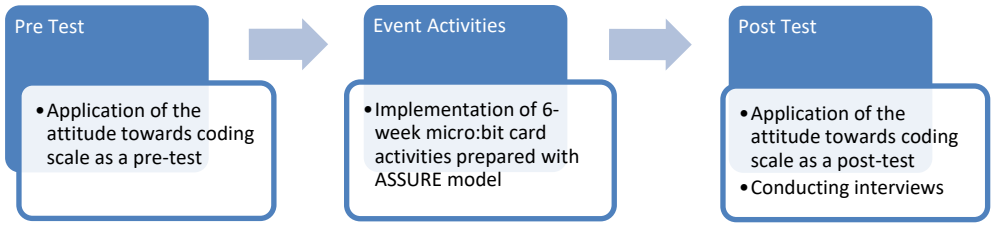


**Figure 1.** Research Design

**Instruments**

***Pre- and Post-test of Students Attitude Towards Coding***

The Attitude Towards Coding Scale for Secondary School Students (Akkuş, Özhan, & Kan, 2019) was used as a data collection tool in the study. This is a single-factor 5-point Likert-type scale. Item scoring ranges from strongly disagree (1) to strongly agree (5). As a result of the reliability analysis conducted within the scope of the present study, the pretest Cronbach's Alpha value was calculated as .89 and the posttest Cronbach's Alpha value was calculated as .80. Analyses were made with the total scores obtained from the scale.

***Interview Questions***

Semi-structured interviews were conducted with 21 volunteer participants selected according to specific criteria to gather their opinions about the process and implementation. In this context, an interview form was prepared by the researchers. The interview questions aimed to reveal students' thoughts on coding with Micro:bit in detail. The prepared form was submitted to the opinions of three field experts with doctoral degrees to ensure validity. Some sample items from the six questions in the interview form are as follows:

1. Would you evaluate your use of Micro:bit while learning coding? Can you explain why you think so?
2. What are your thoughts about the activities carried out using Micro:bit within the scope of this research? Would you evaluate these activities in general? Why do you think so?

**Study Group**

The study group was 59 students (6th grade) studying in a private secondary school in the Cappadocia region of Turkey in the 2023-2024 academic year. The participants were students who had previously received block-based coding training for two hours a week in the 4th and 5th grades, but had no experience in coding with Micro:bit. All the participants owned a technological product. The most owned technological product was a mobile phone (31.1%). 31.7% of the participants received coding training with the Scratch block-based application, 14.9% with mBlock, 50.5% with Kodu Game Lab, and 3% with Makecode.org. Some personal information about the participants is given in Table 1.

**Table 1.** Participant Information

| ***Variables*** | ***Group*** | ***N*** | ***%*** |
|---|---|---|---|
| **Gender** | Female | 28 | 47.5 |
| | Male | 31 | 52.5 |
| | **Total** | **59** | **100** |
| **Year of Computer Usage** | 1 year or less | 2 | 3.4 |
| | 1-3 year | 14 | 23.7 |
| | 3-5 year | 27 | 45.8 |
| | 5 years and more | 16 | 27.1 |
| | **Total** | **59** | **100** |
| **Daily Time Spent on the Computer** | 1 hour or less | 8 | 13.6 |
| | 1-3 hour | 35 | 59.3 |
| | 3-5 hour | 10 | 16.9 |
| | 5-8 hour | 6 | 10.2 |
| | **Total** | **59** | **100** |

**Content of the Course Designed According to the ASSURE Model**

The activities planned within the scope of the research were carried out for 6 weeks, with the unit content called "Learning Block-Based Application", which is a common subject within the scope of the Information Technologies and Software (ITS) course in the 6th grade teaching plan in the 2023-2024 academic year, which was designed using the ASSURE instructional design model.

***Analyze Learners:*** Within the scope of the research, the general characteristics and prior learning of the students were first analyzed. After evaluating various factors such as gender, age, grade level, ethnic background, cognitive, social, and physical disabilities, as well as socioeconomic status, the students' existing knowledge and skills were assessed using a question-and-answer technique. Regarding learning attitudes, an assessment was made in auditory, logical reasoning, visual, tactile, and musical aspects.

***State Objective:*** In this step, students were given information on how to use the Micro:bit card and how to upload the code to the Micro:bit card. The students connected the Micro:bit card to the computer, coded the task correctly and uploaded it to the

Micro:bit card. After completing the task, the students correctly explained the questions related to the coding steps of the Micro:bit card. They stated that coding with the Micro:bit card was fun and enjoyable.

***Select Media and Materials*:** In this step, course media and materials were selected according to the students' learning attitudes because of the student analyses conducted in the first stage. The general distribution of students' learning attitudes was identified as visual, auditory, and tactile. The lessons were designed face-to-face in the computer laboratory. Within the scope of the course, videos, presentations, visual aids of the course were prepared for the students, Micro:bit card activities were introduced by using Micro:bit activities were introduced using a projection, and students were divided into groups for specific tasks. Additional tasks were shared, and strategies appropriate to the students' levels were developed. Figure 2 shows the Accessories on the Micro:bit Card.

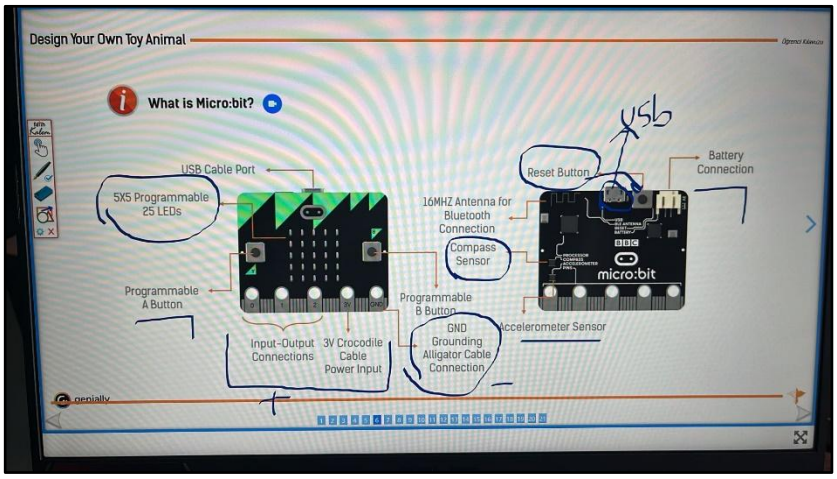


**Figure 2.** Introducing the Accessories on the Micro:bit Card

***Utilize Media and Materials:***

At this stage, the Micro:bit card and the "Makecode.org" site, which is the site for coding, were used with the students. The Makecode.org site was found to be suitable for students' ages, knowledge, levels and skills. It was also suitable for students' learning attitudes. At this stage, students did not have difficulty in using the materials, and they successfully connected the computer and Micro:bit card and uploaded their code.

***Require Learners Participations:***

At this stage, the subject of the lesson was explained with presentations and videos and students were given tasks. Students were allowed to do the tasks individually in the first stage and then in groups. The students who completed the task were allowed to help their friends who had difficulty in the assignment and peer learning was aimed. All students who completed the task were asked to do a task of their own choosing on the materials, thus enabling interactive learning in the lesson. While the students were doing the tasks, the teacher provided feedback about the paths to be followed as a guide. Students who successfully completed the activities were given small rewards to motivate them.

***Evaluate and Review:*** In the last stage, to evaluate the students and the process, the students were asked to make three games from easy to difficult. Students were asked to write the code by simply watching a video of how these games were made. The students successfully completed all three game tasks and were asked to design a game by themselves as a project. All students participating in the study successfully completed the project assignment. Students who completed the project assignment were optionally asked to tell their friends how they made the game.

The research was conducted weekly during two class hours: one for theoretical explanations and teacher-led demonstrations, and one for students to practice the activities independently. Table 2 presents the practical course activities included in the curriculum.

**Table 2.** Course Event Activities

| ***Weekly Events*** | ***Names of Activities Implemented*** |
|---|---|
| 1. Week | Happy / sad face coding activity |
| 2. Week | Button usage and writing activity |
| 3. Week | Coding the MORS alphabet activity |
| 4. Week | Dice application activity |
| 5. Week | Rock, paper, scissors game activity |
| 6. Week | Compass activity |

***Happy / sad face coding activity***

In the first week, the students were given theoretical information about the Micro:bit card. The sensors on the Microbit card and what these sensors do, where these sensors are used in daily life were explained. Students were given information about the "Makecode.org" site, which will be used to code the Micro:bit card, and the block codes to be used for coding. Information was given about how to establish the connection between the computer and the Micro:bit card and how the codes written should be uploaded to the Micro:bit card. Then, the unit titled "Coding happy/sad faces", which was the topic of the first week, was taught with the students. The lesson photos of the first week are shown in Figure 3.

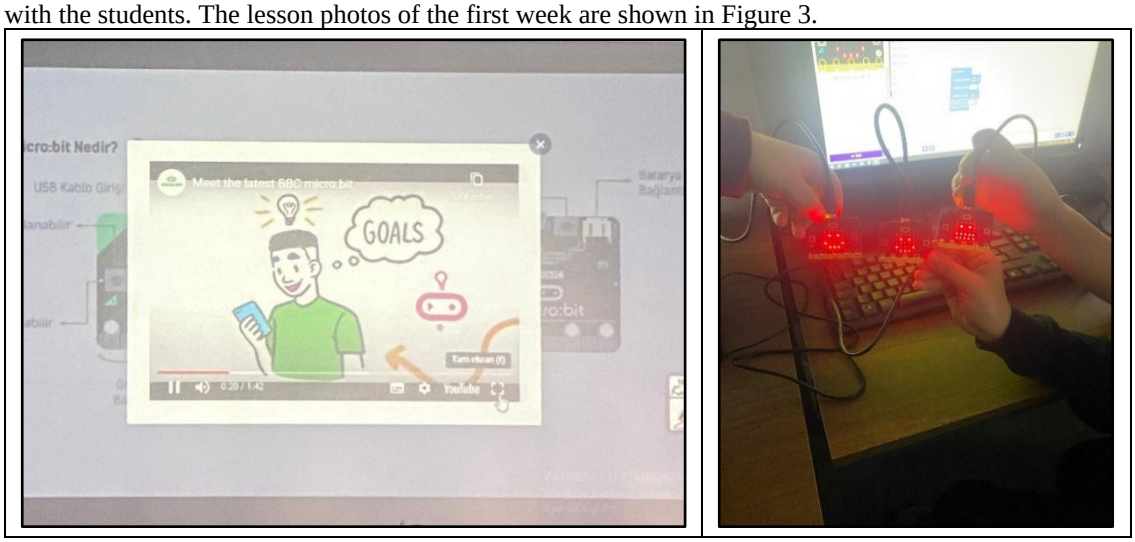


**Figure 3.** Happy / sad face coding activity

***Button usage and writing activity***

In the second week, the use of buttons was explained to the students. Information was given about the working logic of the A and B buttons on the Micro:bit card and the use of buttons in daily life tools and equipment. Students were given the task of displaying text using the buttons on the Micro:bit board and they were asked to perform these tasks. Photographs of the second week are shown in Figure 4.

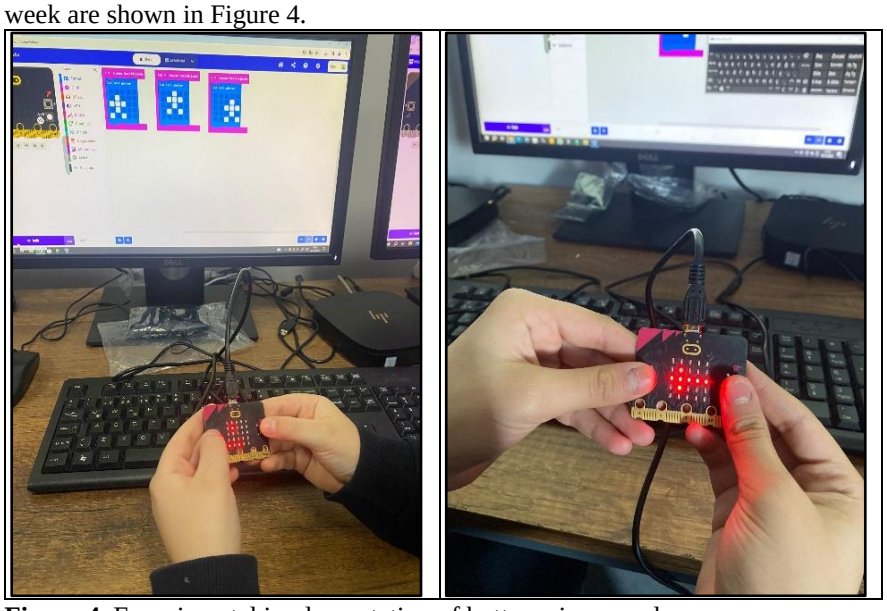

**Figure 4.** Experimental implementation of buttons, icons and arrows

***MORS alphabet coding activity***

In the third week, students were given information about Morse code and where Morse code is used. After the students discovered the connection between Micro:bit and Morse code, they were asked to perform the given tasks. Photographs of the third week are shown in Figure 5.

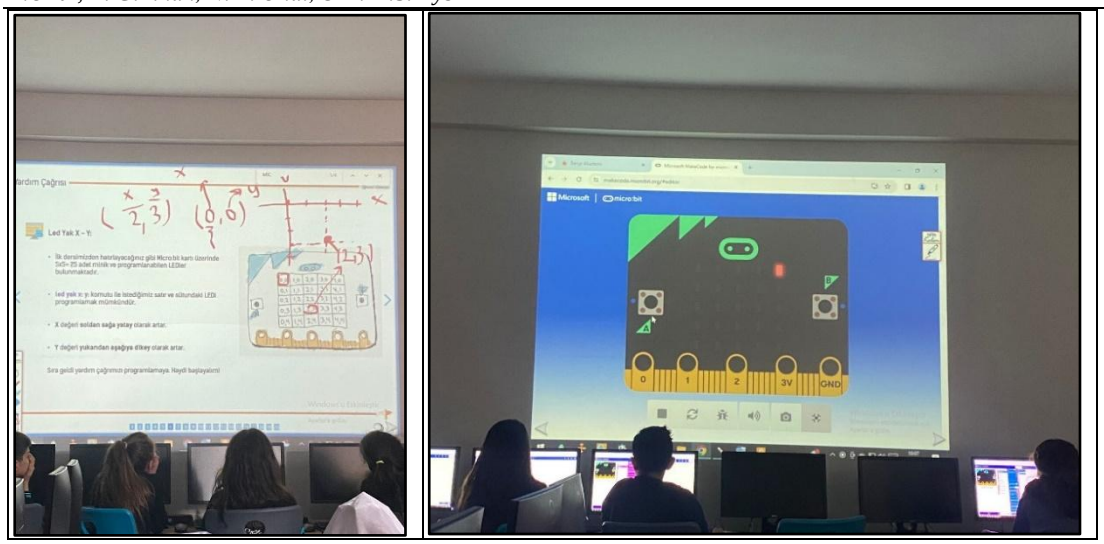

**Figure 5.** Coordinate System and Morse Code Usage

***Dice application activity***

As the fourth week activity, students were given information about the dice application. The connection of the dice application with Micro:bit was explained and students were told to do the given tasks. The visuals of the fourth week are given in Figure 6.

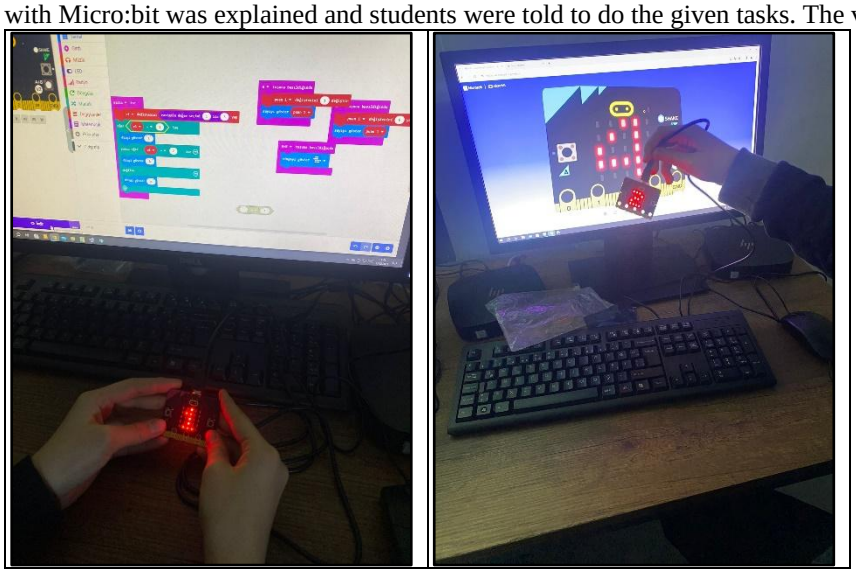

**Figure 6.** Coding Dice Application

***Rock, Paper, Scissors game activity***

As the fifth week activity, students were informed about the traditional game of rock, paper and scissors. Students were told how to play the rock, paper, scissors game with Micro:bit and were asked to fulfill the given tasks. The visuals of the fifth week are given in Figure 7.

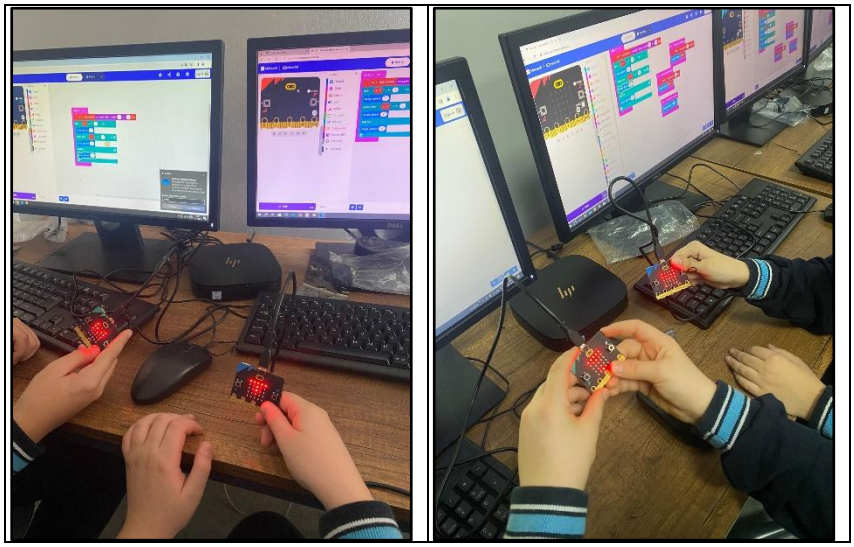

**Figure 7.** Stone, Paper, Scissors Application

***Compass activity***

As the sixth week activity, students were informed about the compass activity. Information was given about the working logic of the compass and the accelerometer on the Micro:bit card. Students were given the task of making a compass using the accelerometer on the Micro:bit card. The visuals of the sixth week are given in Figure 8.

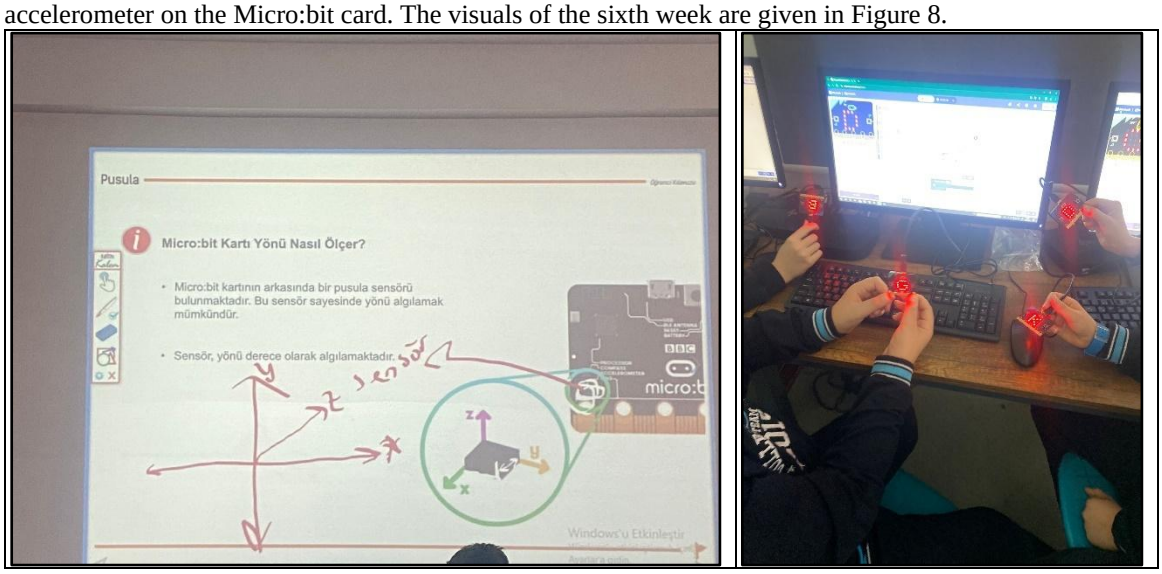


**Figure 8.** Accelerometer and compass activity

Following the completion of the applications, the scale was reapplied as a post-test. Afterwards, the opinions of 21 randomly selected students about the application were taken.

**Data Analysis**

In the data analysis phase, firstly, the data obtained from the pre-test and post-test applications were checked and transferred to the SPSS 29 program. The conformity of the attitude scale data applied as pre-test and post-test to the normal distribution assumption was determined according to the normality test results. The results of the Shapiro-Wilks test for the pretest and posttest data of the scale are presented in Table 3.

**Table 3.** Shapiro-Wilks Test Results for Attitude Scale Data

| Data Collection Instrument | Test | Shapiro-Wilks | | | | |
|---|---|---|---|---|---|---|
| | | Statistics | N | p | Skewness | Kurtosis |
| Coding Attitude Scale | Pre Test | .088 | 59 | .200 | -.527 | .289 |
| | Post Test | .115 | 59 | .055 | -.499 | -.573 |

Since it is known that Shapiro-Wilk test is a more effective way to determine normality than other tests when the sample is small (Razali & Wah, 2011), it was used in this study. Since the skewness and kurtosis values of the pre-test data related to the scale

were between -1.5 and +1.5, the pre-test data showed a normal distribution at the significance level (p>.05). In addition, the post-test data related to the scale also showed normal distribution at the significance level and the skewness and kurtosis values were found to be within the acceptable range. Since skewness and kurtosis values are obtained between -1.5 and +1.5, parametric tests can be performed (Tabachnick & Fidell, 2013). In order to test the homogeneity of variances, which is another assumption of parametric tests, levene test was conducted. Table 4 presents the results of the Levene's test. Since the data met both the assumptions of normal distribution and homogeneity of variances, the dependent groups t-test was used to examine whether there was a significant difference between the pre-test and post-test scores of the data collection tool applied to the students.

**Table 4.** Homogeneity of Variances (Levene) Test Results for Attitude Scale Data

| Tests | Levene statistic | Sd1 | Sd2 | p |
|---|---|---|---|---|
| Pre Test | .251 | 1 | 57 | .618 |
| Post Test | .857 | 1 | 57 | .358 |

The interview data of the research were analyzed with descriptive thematic analysis. Situations such as describing the demographic characteristics and different qualities of the participants, describing the general characteristics of a city, and summarizing the life story of a person are descriptive thematic analysis (Miles & Huberman, 1994). In descriptive thematic, the aim is to present the data to the reader in an organized and interpreted way. While presenting these data, direct quotations from the participants' views are often presented to the reader (Yıldırım & Şimşek, 2003).Participants' evaluations of Micro:bit applications are grouped into two themes: advantages and disadvantages.

## RESULTS

### Results Obtained from the Analysis of Quantitative Data

The results of the dependent groups t-test (paired-samples t-test) conducted to determine the statistical significance of the difference between the pre-test and post-test scores of the students' attitudes towards coding are presented in Table 5.

**Table 5.** Dependent Groups t-Test Results of Attitude Scale Scores

| Tests | N | $\bar{X}$ | Ss | Sd | t | p |
|---|---|---|---|---|---|---|
| Pre Test | 59 | 35.37 | 8.89 | 9.86 | -4.11 | .001 |
| Post Test | 59 | 40.66 | 6.18 | | | |

When Table 5 is examined, it is seen in the dependent groups t-Test results of the scale that the post-test averages of the students ($\bar{X}$=40.66) are higher than the pre-test averages ($\bar{X}$=35.37). This difference was statistically significant (t= -4.11, p= .001). In this context, as a result of the test, it can be stated that the use of Micro:bit card in the lesson positively affected the students' attitudes towards coding. The study also investigated whether there was a difference in students' attitudes towards coding according to gender. The results of whether the attitude scores towards the lessons taught using Micro:bit cards showed a significant difference according to the gender variable are presented in Table 6.

**Table 6.** t-test Results of Attitude Scale Scores According to Gender Variable

| | Gender | N | $\bar{X}$ | Ss. | t | p |
|---|---|---|---|---|---|---|
| Pre test | Female | 28 | 32.67 | 9.34 | -2.270 | .618 |
| | Male | 31 | 37.80 | 7.83 | | |
| Post test | Female | 28 | 40.07 | 6.66 | -.688 | .265 |
| | Male | 31 | 41.19 | 5.78 | | |

As seen in Table 6, participants' attitudes towards ICT lessons using Micro:bit cards do not show a significant difference according to gender variable (p>.05). According to the results of the scale, the mean score of the pre-test for females was $\bar{X}$=32.67 and the mean score of males was $\bar{X}$=37.80, while the mean score of the post-test for females was $\bar{X}$=40.07 and the mean score of males was $\bar{X}$=41.19. Although the difference is not statistically significant, since the total scores of male students are higher than female students, it can be said that they are more inclined than female students to take lessons taught using Micro:bit cards in this sample.

### The findings from Qualitative Data

In this part of the study, data obtained from semi-structured interviews with participants were analyzed to evaluate the six-week implementation process. The aim here is to examine in detail the opinions of the experimental group students regarding Micro:bit applications. Interviews were conducted with 21 participants, determined by criterion sampling, among 59 students in the experimental group. The criteria determined in the study were i) volunteering to interview in the general research, ii) participating in all the practices carried out for six weeks, and iii) being in the highest and lowest groups in terms of attitude scale scores.

The advantages theme includes two themes called contribution to cognitive and affective learning areas. The theme of contribution to cognitive learning areas. It consists of opinions about Micro:bit applications improving engineering skills (f=8),

using them in game design (f=6), facilitating understanding (f=4) and supporting robotics competitions (f=4). Some of the participants' opinions that the Micro:bit card improves their engineering skills are as follows:

**S15:** *I am a person who loves all kinds of coding, so I want to study a branch related to coding in the future, and if I cannot, I want to study a branch close to it. So coding will always be interacting in my life.*
***S17:*** *I'm thinking of becoming a software developer in the future, so that might help.*
***S6:*** *If my future profession is software or anything related to software, there will definitely be advantages to using Micro:bit in the past.*

Some participant opinions stating that Micro:bit can be used in robotic competitions are as follows:
**S2:** *We can use Micro:bit in technology related competitions*
**S5:** *We can use Micro:bit in competitions such as Teknofest.*

Selected quotations that reflect participants' views of the six participants who mentioned that they could use the Micro:bit card in making games are as follows:
**S13:** *I'm thinking of making a game called "Guessing" game. And I'm thinking of making the shapes I'll use from Micro:bit.*
**S8:** *Thanks to this, you will grow up and become a software developer and make games.*
**S15:** *I like Micro:bit the most because I can write games. I can write all kinds of games, for example, the snake game, and in the future, I want to make games that children play.*

The affective learning gains theme includes the opinions that Micro:bit is funny (f=17), interesting (f=5), exciting (f=4) and makes people love the lesson (f=3). Some of the participants' opinions that stated that it was funny are as follows:
**S1:** *I think the activities I did using Micro:bit were very fun and interesting. It made me very excited to play games while the LED was on.*
**S19:** *I think making Micro:bit was a lot of fun. The activity I find most fun is rock, paper, scissors.*

Sample quotes from participants who stated that Micro:bit made them love the course are as follows:
**S18:** *I didn't like coding very much, but after Micro:bit I started to like it more.*
**S14:** *I have not used the Micro:bit application before. As I learned to use Micro:bit, I also developed my coding skills, which improved through the robotics course..*

Within the theme of disadvantages regarding the application, only one participant mentioned the technical features of Micro:bit such as 25 LEDs and lack of speaker support.
**S4:** *The events were very nice. However, the fact that there were only 25 LEDs limited the issue a bit. I found the rock-paper game fun.*

## DISCUSSION AND CONCLUSION

In this research, Micro:bit card was used as material in the course content designed according to the ASSURE model. The aim is to encourage students' active participation active participation in lessons with block-based coding applications with the Micro:bit card, and to reinforce their learning through interactive applications. These applications aim to support the learning, it is aimed to support the learning process by giving various tasks to students. Similarly, Göloğlu Demir and Kaplan Keleş (2021) reported that the teachers stated that they used technology to reinforce content. After the intervention, the opinions of the students about the implementation process and block-based coding instruction with Micro:bit card were examined. Students generally expressed positive opinions. It has been observed that students also mentioned some deficiencies regarding learning block-based applications with the Micro:bit card. It can be stated that students have positive cognitive and affective effects of learning block-based applications with the Micro:bit card. Many factors, such as the novelty effect of the Micro:bit card for students and the fact that today's students live in close contact with technology, may have prepared the ground for these positive views. Similar to the present research, the meta-analysis review conducted by Kalogiannakis, Tzagaraki & Papadakis (2021) stated that students adopted a positive attitude towards the use of Micro:bit, that students found the relevant activities interesting and that they participated in the activities with enthusiasm. It is also emphasized that Micro:bit can improve creative thinking, computational thinking and problem-solving skills, and make it easier to understand conceptual and procedural information and activities related to programming. Most previous studies were along the same lines (Kalelioğlu & Sentance, 2020; Kieu , Nguyen & Nguyen, 2023; Lu, Lo & Syu, 2021).

Students' attitudes towards coding do not differ significantly according to gender. The possible reason for this situation is that all students found the intervention interesting. This result is in line with previous studies (Akkuş & Bilgin, 2021; Yağcı, 2016). It is emphasized that coding education should be for all students regardless of gender (Uyar et al., 2022). Conversely, in some studies, it was found that attitudes towards coding showed a significant difference in favor of men according to gender (Başer, 2013; Uyar et al., 2022). On the contrary, there are also studies reporting that female students' attitudes towards programming show a significant difference in favour of female students (Chiazzese, Fulantelli, Pipitone & Taibi, 2018). In this framework, it can be thought that the attitude towards coding may change over time or be influenced by social culture. As a matter of fact, in

a comprehensive study conducted with data from 32 different countries on the digital gender divide, it was emphasised that gender differences may affect access to ICT, attitudes towards technology and digital knowledge and skills. It is emphasised that this situation will change according to the dynamics of the countries themselves. In other words, these distinctions are linked to cultural, social and economic inequalities in education (Campos & Scherer, 2024)

Another important result of the study shows that the educational applications using Micro:bit cards positively affected students' attitudes towards coding. This result is consistent with the results of the interviews conducted within the scope of the research. The interview data showed that the participants generally expressed positive opinions about the Micro:bit. The possible reason for this situation may be that the relevant intervention was a novelty for the students. Again, the fact that Micro:bit is an interesting and suitable application for the student level may have mediated the formation of this positive attitude. No study was found in the literature that directly examined the effect of Micro:bit applications on coding. However, it can be stated that other studies that can be considered related support this result. In previous studies, there are studies indicating that educational cards increase learning and motivation (Kılıçkıran et al., 2020) and ER applications positively affect academic success (Çimentepe, 2019; Ergün and Balçın, 2019; Selçuk, 2019). The use of ER provides a fun, interactive and engaging learning environment for students (Alimisis, 2013). There are different studies on the significant potential of ER use and coding education for students (Abueita et al., 2022; Çam & Kıyıcı, 2022; Chang et al., 2010; Sade, 2020).

The research sample consisted of 59 students studying at a private school in Kayseri, and the data collection tools were limited only to the specified scales. With the analyzes obtained from these limitations, some suggestions can be made for future research.

- Researchers should be directed to more research and practice on the use of educational cards in lessons so that students can use software and robotic coding, which have an important place in the professions of the future, more effectively.
- At the same time, meetings can be held with the relevant departments of universities to ensure and popularize the integration of the Micro:bit card into coding education.
- Similar studies can be conducted by expanding the scope of the study to include more student samples in different regions.
- It may be recommended to use various teaching methods and techniques in Information Technologies and Software courses, to carry out project studies that will attract the attention of students, and to determine applications that can be used in courses.

**Ethical Approval and Participant Consent:** The necessary ethical approval for the study was obtained from Nigde Ömer Halisdemir University Research Ethics Committee, (Date: 31/01/2024, Ethical Clearance Code: 2024/01-30,06/02/2024-474387).

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