



## Secondary School Students' Self-Efficacy Perceptions related to Block-Based Programming and Computational Thinking Skills

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**Article Type:** Research Article

**To Cite This Article:** Öztuzcu, Ö., Öztürk, G., & Mısırlı, Z. A. (2022). Secondary school students' self-efficacy perceptions related to block-based programming and computational thinking skills. *Eğitimde Kuram ve Uygulama*, 18(2), 55-67. <https://doi.org/10.17244/eku.1166393>

**Ethical Note:** Research and publication ethics were followed. For this research, the ethical approval was obtained from the Science and Engineering Ethics Committee of Balıkesir University (Date: 12 November 2021, Number: 2021/3).

## Ortaokul Öğrencilerinin Blok Temelli Programlamaya ve Bilgi İşlemsel Düşünme Becerilerine Yönelik Öz-Yeterlik Algıları

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**Makale Türü:** Araştırma Makalesi

**Kaynak Gösterimi:** Öztuzcu, Ö., Öztürk, G., & Mısırlı, Z. A. (2022). Secondary school students' self-efficacy perceptions related to block-based programming and computational thinking skills. *Eğitimde Kuram ve Uygulama*, 18(2), 55-67. <https://doi.org/10.17244/eku.1166393>

**Etik Not:** Araştırma ve yayın etiğine uyulmuştur. Bu araştırma için Balıkesir Üniversitesi Fen ve Mühendislik Bilimleri Etik Kurulu'ndan etik onay alınmıştır (Tarih: 12 Kasım 2021, Sayı: 2021/3).



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### Abstract

This study examined secondary school students' self-efficacy perceptions related to block-based programming and computational thinking skills. 256 secondary school students comprised the study's sample, and a correlational research design was utilised in the study. The study's data collection tools consisted of a personal data form, Self-Efficacy Perception Related to Block-Based Programming scale, and Self-Efficacy Perception for Computational Thinking Skills scale. As a consequence of the research, researchers concluded that students' self-efficacy perceptions related to block-based programming and computational thinking skills was moderate and that these two variables had a moderate and statistically significant positive relationship.

### Article Info

**Keywords:** Secondary school students, block-based programming, computational thinking, self-efficacy, relationship.

### Article History:

Received: 24 August 2022

Revised: 18 October 2022

Accepted: 19 October 2022

**Article Type:** Research Article

## Ortaokul Öğrencilerinin Blok Temelli Programlamaya ve Bilgi İşlemsel Düşünme Becerilerine Yönelik Öz-Yeterlik Algıları

### Öz

Bu çalışmanın amacı ortaokul öğrencilerinin blok temelli programlamaya ilişkin öz-yeterliklerini ile bilgi işlemsel düşünme becerilerine yönelik öz-yeterliklerini belirlemektir. Araştırmanın çalışma grubunu 256 ortaokul öğrencisi oluşturmaktadır ve araştırma nicel araştırma yöntemlerinden korelasyonel araştırma deseni ile tasarlanmıştır. Çalışma verileri kişisel bilgi formu, Blok Temelli Programlamaya İlişkin Öz-Yeterlik Algısı Ölçeği ve Ortaokul Öğrencileri İçin Bilgi İşlemsel Düşünme Becerisine Yönelik Öz-Yeterlik Algısı Ölçeği kullanılarak toplanmıştır. Araştırma sonucunda öğrencilerin blok temelli programlamaya ilişkin öz-yeterliklerini ile bilgi işlemsel düşünme becerilerine yönelik öz-yeterliklerinin orta düzeyde olduğu, öğrencilerin blok temelli programlamaya ilişkin öz-yeterlikleri ile bilgi işlemsel düşünme becerilerine yönelik öz-yeterlikleri arasında pozitif yönlü orta düzeyde ve anlamlı bir ilişki olduğu sonuçlarına ulaşılmıştır.

### Makale Bilgisi

**Anahtar Kelimeler:** Ortaokul öğrencileri, blok temelli programlama, bilgi işlemsel düşünme, öz-yeterlik, ilişki

### Makale Geçmişi:

Geliş: 24 Ağustos 2022

Düzeltilme: 18 Ekim 2022

Kabul: 19 Ekim 2022

**Makale Türü:** Araştırma Makalesi

## Introduction

Children today are confronted with technology from an early age. Their knowledge of the technology products they use daily is limited only by their practical application skills. Due to the widespread usage of technical devices in peoples' daily lives, education in technology has become essential. Therefore, the Turkish Ministry of National Education (Milli Eğitim Bakanlığı [MEB]) has included programming instruction in the Information Technologies and Software (ITS) curriculum (MEB, 2018a). Mandatory ITS instruction begins in the fifth and sixth grades in secondary schools (Göçer & Türkoğlu, 2018). ITS curriculum subjects include "Information Technology", "Ethics and Security", "Communication, Research, and Cooperation", "Product Development", and "Problem Solving and Programming" (MEB, 2018a). Through studying "Information Technologies" and "Computer Systems" in these subjects, students get an understanding of information technologies as well as social competence and awareness of "Ethics and Security", "Digital Citizenship", and "Cyber Bullying". Curriculum subjects also incorporate block-based programming (BBP) tools to enhance students' algorithmic reasoning, algorithm-building skills, and programming knowledge (MEB, 2018b). The inclusion of subjects related to teaching programming in the ITS curriculum might be interpreted as an indication that Turkish Ministry of National Education values the acquisition of computer programming skills (Göçer & Türkoğlu, 2018).

Programming is defined as applying commands to perform the desired tasks on a computer (Gülbahar & Karal, 2018). Teaching programming requires a more sophisticated mental process, even though programming is commonly viewed as the arranging commands in a meaningful and regular structure (Sırakaya, 2018). Programming is a complex procedure, and numerous resources have been created to aid children in learning it. The Scratch is one of the tools, which is a programming software based on blocks that use the drag-and-drop method in BBP. Students can generate various codes by arranging code blocks from bottom to top. The Massachusetts Institute of Technology developed the Scratch in 2003 as a free programming environment that allows users collaborate with other user on projects (Oluk et al., 2018). Students can code with a variety of puppets and backgrounds in the Scratch. Computational thinking (CT) is one of the most essential programming skills (Alsancak Sırakaya, 2019). Wing (2006) describes CT as understanding human behaviours, solving problems and designing systems. When solving a problem, students think like computers and employ algorithms. CT enhances creativity and problem-solving abilities (Korkmaz et al., 2015). CT is a necessary skill for students today.

Albert Bandura (1977) defined self-efficacy perceptions as individuals' judgments about how well they could perform the actions necessary to cope with possible situations. Self-efficacy perceptions related to BBP refers to students' confidence in their ability to move the Scratch's puppets with code, and this perception is important in teaching programming (Altun & Kasalak, 2018). Self-efficacy perceptions related to CT includes the students' capacity to build simple algorithms, explore multiple solutions for problem scenarios, specify variables, and employ functions. Students acquire CT skills utilising a variety of ways and resources (İbili et al., 2020). BBP and instructional robotics sets are the most often used instruments for improving CT skills.

The literature review revealed a number of studies examining the students' opinions and self-efficacy perceptions related to BBP. Gezgin et al. (2016) reviewed the high school students' opinions about the Scratch, a BBP tool, and discovered that the students expressed positive opinions. Kasalak (2017) examined whether there was a relationship between secondary school students' self-efficacy perceptions related to BBP and robotic coding activities. He found that students' self-efficacy perceptions related to BBP improved positively, they perceived the activities as entertaining, and they were willing to participate in the activities. Mladenović et al. (2017) evaluated students' programming misconceptions in their study. They observed that, in comparison to text-based programming, BBP minimises misconceptions. Vatansver (2018) examined the impact of the Scratch on the fifth and sixth grade students' problem-solving skills. The research revealed that teaching the Scratch significantly impacted students' problem-solving skills. Oluk et al. (2018) researched how the Scratch activities affected algorithm building and CT skills. The study revealed that the experimental group's skills increased more than those of the control group. Altun and Kasalak (2018) created a scale to measure secondary school students' self-efficacy perceptions related to BBP. The self-efficacy perceptions related to BBP were not significantly different across various variables according to the study's results. Dohn (2019) investigated how students' interest in coding and mathematics changed over time and discovered that students' interest in coding dropped during mathematics lesson. Ersoy (2019) investigated the opinions of ITS teachers regarding how the Scratch helping secondary school students gain programming skills. ITS teachers thought that the Scratch enhances secondary school students' creativity and that the Scratch was a suitable tool for students to gain programming skills according to the findings of the study. Bakırcı (2019) researched use of the Scratch affected secondary school students' self-efficacy perceptions for developing algorithms, course motivation and programming achievement. The experimental and control groups' achievement scores and self-efficacy perceptions increased significantly and only the experimental group's course motivation increased significantly at the end of the study. Arslan

and Akçelik (2019) investigated the students' perceptions in their first year of the Department of Computer Education and Instructional Technology before and after utilising the Scratch. It was determined that students' perceptions of the Scratch were positive prior to the instruction and that the perceptions improved after using the Scratch as a consequence of the research. Korucu and Taşdöndüren (2019) examined the secondary school students' self-efficacy perceptions related to BBP and attitudes towards robotics. They discovered that students' self-efficacy perceptions related to BBP varied based on several variables. Aydoğdu (2020) investigated the impact of BBP activities on the pre-service teachers' self-efficacy perceptions related to programming and CT skills. The research indicated that the activities improved the pre-service teachers' self-efficacy perceptions related to programming while they had no impact on their CT skills. Adsay et al. (2020) researched the secondary school students' self-efficacy perceptions related to BBP instruction, levels of STEM skills and CT skills. They determined that students' self-efficacy perceptions related to BBP instruction was low, while their levels of STEM and CT skills were moderate as a consequence of the research.

The studies examining students' opinions and self-efficacy perceptions related to CT skills were identified in the literature review. Atman Uslu et al. (2018) investigated about how visual programming activities affected students' CT skills. They discovered that the visual programming activities did not significantly influence students' CT skills. Yağcı (2018) analysed the high school students' CT skills in relation to gender, grade level and school type. He found that students saw themselves to be moderately good in CT skills. Gülbahar et al. (2018) designed a scale to assess the secondary school students' self-efficacy perceptions related to CT skills. Alsancak Sırakaya (2019) researched the impact of programming instruction on CT skills. It was revealed that the scores for CT skills significantly differed between the pre-and post-test at the end of the study. İbili et al. (2020) examined the high school students' CT skills. There were no differences in CT skills according to gender, participation in a programming course, programming experience, or owning a computer. However, there was a difference according to grade level. Kaya et al. (2020) investigated the impact of gamified robotics activities on the secondary school students' CT skills and reflective problem solving. The findings indicate that gamified robotics activities significantly enhanced CT skills and reflective problem solving. Ramazanoğlu (2021) researched the impact of robotic coding activities on the students' self-efficacy perceptions related CT skills and attitudes towards computer. He discovered that when students participated in robotic coding activities, their self-efficacy perceptions related to CT skills increased, and their anxiety towards computers decreased.

Self-efficacy perceptions related to BBP and CT skills are crucial in programming instruction. In the literature, there were studies in which students' self-efficacy perceptions related to BBP (Adsay et al., 2020; Altun & Kasalak, 2018; Aydoğdu, 2020; Bakırcı, 2019; Kasalak, 2017) and self-efficacy perceptions related to CT skills (Gülbahar et al., 2018; Ramazanoğlu, 2021) were examined. No research in the literature simultaneously examined students' self-efficacy perceptions related to BBP and CT skills. Researchers believed that there was a correlation between the students' self-efficacy perceptions related to BBP and CT skills. They also anticipated that evaluating students' self-efficacy perceptions related to BBP and CT skills would enhance the field of programming instruction.

On this basis, the purpose of this study was to determine the secondary school students' self-efficacy perceptions related to BBP and CT skills. The following questions were investigated to this purpose:

- What was the students' self-efficacy perceptions related to BBP and CT skills?
- Did the independent variables (gender, owning a computer, making BBP activities outside the classroom, mother's level of education, father's level of education, grade level, computer usage time, and Internet usage time) influence students' self-efficacy perceptions related to BBP and CT skills?
- Was there a relationship between students' self-efficacy perceptions related to BBP and CT skills?

## Method

The study was designed in a correlational research design. Correlational studies investigate the relationship among two or more variables (Büyükoztürk et al., 2016). Demographic characteristics served as independent variables in the study. The dependent variables were the students' self-efficacy perceptions related to BBP and CT skills. Research and publication ethics were followed. For this research, the ethical approval was obtained from the Science and Engineering Ethics Committee of Balıkesir University (Date: 12 November 2021, Number: 2021/3).

## Sample

The students enrolled in secondary schools from urban area in Balıkesir in Türkiye during the academic year 2021-2022 comprised the study's sample. The convenience sampling method was used to choose the sample for the study. The negative aspects of the convenience sampling method are that it is impossible to generalize the result but the collection

of data from a sample that is conveniently accessible to the researcher is a time-saving sampling strategy (Büyüköztürk et al., 2016). Table 1 displays the participants' demographic features.

Table 1. The Participants' Demographic Features.

|   |                             | Gender |      | Total | %    |
|---|-----------------------------|--------|------|-------|------|
|   |                             | Female | Male |       |      |
|   |                             | f      | f    | f     | %    |
| Owning a computer                           | Yes                         | 111    | 92   | 203   | 79.3 |
|   | No                          | 22     | 31   | 53    | 20.7 |
| Making BBP activities outside the classroom | Yes                         | 24     | 28   | 52    | 20.3 |
|   | No                          | 109    | 95   | 204   | 79.7 |
| Mother's level of education                 | Primary school              | 33     | 25   | 58    | 22.7 |
|   | Secondary school            | 22     | 21   | 43    | 16.8 |
|   | High school                 | 41     | 44   | 85    | 33.2 |
|   | 2-year college              | 9      | 9    | 18    | 7.03 |
|   | Bachelor's or higher degree | 28     | 24   | 52    | 20.3 |
| Father's level of education                 | Primary school              | 24     | 21   | 45    | 17.6 |
|   | Secondary school            | 21     | 18   | 39    | 15.2 |
|   | High school                 | 43     | 37   | 80    | 31.3 |
|   | 2-year college              | 13     | 10   | 23    | 8.9  |
|   | Bachelor's or higher degree | 32     | 37   | 69    | 26.9 |
| Grade level                                 | 5th                         | 46     | 42   | 88    | 34.4 |
|   | 6th                         | 30     | 34   | 64    | 25.0 |
|   | 7th                         | 36     | 29   | 65    | 25.4 |
|   | 8th                         | 21     | 18   | 39    | 15.2 |
| Computer usage time                         | 1 hour and below            | 93     | 72   | 165   | 64.5 |
|   | 2 hours                     | 24     | 30   | 54    | 21.1 |
|   | 3 hours                     | 12     | 10   | 22    | 8.5  |
|   | 4 hours and above           | 4      | 11   | 15    | 5.8  |
| Internet usage time                         | 1 hour and below            | 51     | 52   | 103   | 40.2 |
|   | 2 hours                     | 44     | 38   | 82    | 32.0 |
|   | 3 hours                     | 19     | 21   | 40    | 15.6 |
|   | 4 hours and above           | 19     | 12   | 31    | 12.1 |
| Total                                       |                             | 133    | 123  | 256   | 100  |

Note. f: frequency

52% of the participants (N=133) were female students, 34.4% of the students (N=88) were fifth grade students, 33.2% of the students' mothers' level of education (N=85) were high school, 31.3% of the students' fathers' level of education (N=80) were the high school, 79.3% of the students (N=203) had a computer, 64.5% of the students (N=165) spent an hour and below on a computer, 40.2% of students (N=103) spent an hour and below on the Internet, and 79.7% of the students (N=204) did not make BBP activities outside of the classroom (Table 1).

### Data Collection Tools

The study's data collection tools consisted of three sections. There was a personal data form to access the students' demographic features in the first section. The "Self-Efficacy Perception Related to Block-Based Programming" (SPRBBP) scale (Altun & Kasalak, 2018) was utilised to measure the students' self-efficacy perceptions related to BBP in the second section. The students' self-efficacy perceptions related to CT skills measured by using the "Self-Efficacy Perception for Computational Thinking Skills" (SPCTS) scale (Gülbahar et al., 2018) in third section.

The SPRBBP is a five-point likert scale with 12 items. There are five options on the scale: I am not confident at all (1), I am confident hardly (2), 50%-50% (3), I am confident moderately (4), and I am confident exactly (5). Participants can receive a total score between 12 and 60 from the scale. SPRBBP score was calculated by dividing the total score obtained by a participant from the scale by 12. The following scaling was used to evaluate the participants' SPRBBP score: 1.00-1.80: I am not confident at all, 1.81-2.60: I am confident hardly, 2.61-3.40: 50%-50%, 3.41-4.20: I am confident moderately, 4.21-5.00: I am confident exactly. Two dimensions comprised the scale: easy BBP tasks and complex BBP tasks. The scale's Cronbach's alpha reliability coefficient was found as 0.893 (Altun & Kasalak, 2018). The reliability coefficient for the SPRBBP was found as 0.941 based on the findings of this study.

SPCTS is a three-point likert scale with 36-items. There are three options on the scale: no (1), partially (2), and yes (3). Participation can receive a total score between 36 to 108 from the scale. SPCTS score was calculated by dividing

the total score obtained by a participant from the scale by 36. The following scaling was used to evaluate the participants' SPCTS score: 1.00-1.66: no, 1.67-2.33: partially, and 2.34-3.00: yes. There were five dimensions on the scale: Problem solving competence, Algorithm design competence, Data processing competence, Self-confidence competence, and Basic programming competence. The scale's Cronbach's alpha reliability coefficient was calculated as 0.943 (Gülbahar et al., 2018). The reliability coefficient for the SPCTS was found as 0.955 based on the findings of this study. According to Alpar (2020), Cronbach's alpha values greater than 0.60 suggest that the data gathering instrument is reliable.

**Data Analysis**

The study's data was analysed with a statistical analysis software (IBM SPSS Statistics 24). The skewness and kurtosis values of the SPRBBP and SPCTS scores were examined to determine whether parametric or nonparametric tests will be utilised. Table 2 displays the skewness and kurtosis values of the SPRBBP and SPCTS scores according to the variables.

Table 2. Skewness and Kurtosis Values of the SPRBBP and SPCTS Scores.

| Scale                       | Variable                                    |                             | Skewness | Kurtosis |
|-----------------------------|---|-----------------------------|----------|----------|
| SPRBBP                      | -   | -                           | 0.295    | -0.716   |
|                             | Gender                                      | Female                      | 0.386    | -0.511   |
|                             |   | Male                        | 0.207    | -0.893   |
|                             | Owning a computer                           | Yes                         | 0.299    | -0.720   |
|                             |   | No                          | 0.268    | -0.736   |
|                             | Making BBP activities outside the classroom | Yes                         | -0.385   | -0.410   |
|                             |   | No                          | 0.441    | -0.423   |
|                             | Mother's level of education                 | Primary school              | 0.100    | -0.627   |
|                             |   | Secondary school            | 0.006    | -0.933   |
|                             |   | High school                 | 0.302    | -0.966   |
|                             |   | 2-year college              | 0.640    | -0.051   |
|                             |   | Bachelor's or higher degree | 0.346    | -0.829   |
|                             | Father's level of education                 | Primary school              | 0.237    | -0.443   |
|                             |   | Secondary school            | 0.187    | -0.974   |
|                             |   | High school                 | 0.100    | -0.835   |
|                             |   | 2-year college              | 0.286    | -1.129   |
|                             |   | Bachelor's or higher degree | 0.324    | -0.903   |
|                             | Grade level                                 | 5th                         | 0.504    | -0.341   |
|                             |   | 6th                         | 0.241    | -0.502   |
|                             |   | 7th                         | 0.163    | -1.008   |
|                             |   | 8th                         | 0.059    | -0.824   |
|                             | Computer usage time                         | 1 hour and below            | 0.291    | -0.712   |
| 2 hours                     |   | 0.115                       | -0.912   |          |
| 3 hours                     |   | 0.774                       | -0.561   |          |
| 4 hours and above           |   | 0.666                       | -0.210   |          |
| Internet usage time         | 1 hour and below                            | 0.208                       | -0.795   |          |
|                             | 2 hours                                     | 0.479                       | -0.468   |          |
|                             | 3 hours                                     | 0.524                       | -0.929   |          |
|                             | 4 hours and above                           | 0.165                       | 0.369    |          |
| SPCTS                       | -   | -                           | -0.410   | -0.329   |
|                             | Gender                                      | Female                      | -0.385   | -0.154   |
|                             |   | Male                        | -0.375   | -0.546   |
|                             | Owning a computer                           | Yes                         | -0.436   | -0.269   |
|                             |   | No                          | -0.341   | 0.453    |
|                             | Making BBP activities outside the classroom | Yes                         | -0.843   | 0.872    |
|                             |   | No                          | -0.280   | -0.381   |
|                             | Mother's level of education                 | Primary school              | -0.730   | 0.535    |
|                             |   | Secondary school            | -0.441   | -0.540   |
|                             |   | High school                 | -0.260   | -0.542   |
|                             |   | 2-year college              | 0.366    | -1.114   |
| Bachelor's or higher degree |   | -0.595                      | -0.313   |          |
| Father's level of education | Primary school                              | -0.319                      | -0.311   |          |
|                             | Secondary school                            | -0.868                      | 0.547    |          |

|                     |                             |        |        |
|---------------------|-----------------------------|--------|--------|
|                     | High school                 | -0.353 | 0.016  |
|                     | 2-year college              | -0.526 | -1.142 |
|                     | Bachelor's or higher degree | -0.464 | -0.484 |
| Grade level         | 5th                         | -0.205 | -0.291 |
|                     | 6th                         | -0.411 | -0.040 |
|                     | 7th                         | -0.574 | -0.204 |
|                     | 8th                         | -0.841 | 0.093  |
| Computer usage time | 1 hour and below            | -0.413 | -0.273 |
|                     | 2 hours                     | -0.393 | -0.106 |
|                     | 3 hours                     | -0.266 | -1.360 |
|                     | 4 hours and above           | 0.355  | -0.584 |
| Internet usage time | 1 hour and below            | -0.553 | 0.249  |
|                     | 2 hours                     | -0.165 | -0.525 |
|                     | 3 hours                     | -0.410 | -0.799 |
|                     | 4 hours and above           | -0.213 | -0.697 |

Table 2 shows that the skewness and kurtosis values of SPRBBP scores were 0.295 and -0.716 respectively, whereas the skewness and kurtosis values of SPCTS scores were -0.410 and -0.329 respectively. Skewness and kurtosis values imply a normal distribution between -1.0 and +1.0 According to Büyükoztürk (2020), however, skewness and kurtosis values indicate a normal distribution between -1.5 and +1.5 according to Tabachnick and Fidell (2013). It was inferred that the data indicated a normal distribution according to the results in Table 2. The t-test was employed to examine whether the students' SPRBBP and SPCTS scores differed according to gender, owning a computer, and making BBP activities outside the classroom because the data had a normal distribution. The t-test is used to decide whether there is a difference between the means of two independent samples (Büyükoztürk, 2020). One-way analysis of variance (ANOVA) for independent samples was utilised to see whether the students' SPRBBP and SPCTS scores differed according to their mother's level of education, father's level of education, grade level, computer usage time, and Internet usage time. ANOVA is used to decide whether there is a difference between the means of three or more independent samples (Büyükoztürk, 2020).

The Pearson correlation coefficient was utilised to establish the relationship between SPRBBP and SPCTS scores. The Pearson correlation coefficient provides insight into the direction and magnitude of the relationship between two variables. The Pearson correlation coefficient takes a value between -1 and +1, and the relationship's strength diminishes as it approaches zero (Alpar, 2020).

## Results

The study's first sub-question was that "what was the students' self-efficacy perceptions related to BBP and CT skills?" Descriptive statistics regarding the students' SPRBBP and SPCTS scores were calculated to answer the question. The descriptive statistics of SPRBBP and SPCTS scores are in Table 3.

Table 3. Descriptive Statistics of SPRBBP and SPCTS Scores.

| Scale  | N   | Minimum | Maximum | $\bar{x}$ | SD   |
|--------|-----|---------|---------|-----------|------|
| SPRBBP | 256 | 1       | 5       | 2.63      | 1.01 |
| SPCTS  | 256 | 1       | 3       | 2.21      | 0.47 |

Note. N: number of students,  $\bar{x}$ : mean, SD: standard deviation

The mean score on the SPRBBP was 2.63 (Table 3). According to the scaling stated in the Method section, this result corresponds to the option "50%-50%". As a result, the secondary school students' self-efficacy perceptions related to BBP can be regarded as moderate. Similarly, the mean score on the SPCTS was 2.21 (Table 3). This result corresponds to the "partially" option according to the scaling stated in the Method section. It may be concluded that the secondary school students' self-efficacy perceptions related to CT skills was moderate.

When the answers given by the students to the SPRBBP scale were examined item by item, it was seen that 33.2% (N=85) of the students marked the item "I can move the puppet on the stage as fast as I want." as "I am confident moderately" and "I am confident exactly". Consequently, it can be concluded that several students perceive their own self-efficacy at a high level when it comes to changing the puppet's speed. 61.3% of the students (N=157) marked the item "I can develop a game consisting of highly complex and long codes (texts) when the needed ones are clearly described." as "I am not confident at all" and "I am confident hardly". Consequently, it can be stated that the majority of students had a low level self-efficacy perception when producing long code.

When the student responses to the SPCTS scale were analysed item by item, it was observed that 71.5% (N=183) of the students marked the item “I pay attention to the operations’ priorities in the problem solving process.” as “Yes” and 58.55% (N=150) of the students marked the item “I understand how to code algorithms for digital tools” as “No”. Accordingly, it may be concluded that the majority of students had a low level self-efficacy perception in converting the algorithms into code.

The study’s second sub-question was that “did the independent variables (gender, owning a computer, making BBP activities outside the classroom, mother’s level of education, father’s level of education, grade level, computer usage time, and Internet usage time) influence students’ self-efficacy perceptions related to BBP and CT skills?” The t-test for independent samples was used to decide whether the students’ SPRBBP and SPCTS scores differ according to the variables of gender, owning a computer and making BBP activities outside the classroom. Table 4 displays the t-test results.

Table 4. T-test Results.

| Scale  | Variable                                    |        | N   | $\bar{x}$ | SD   | df  | t     | p    |
|--------|---|--------|-----|-----------|------|-----|-------|------|
| SPRBBP | Gender                                      | Female | 133 | 2.60      | 0.95 | 254 | 0.518 | .605 |
|        |   | Male   | 123 | 2.67      | 1.08 |     |       |      |
|        | Owning a computer                           | Yes    | 203 | 2.67      | 1.02 | 254 | 1.107 | .269 |
|        |   | No     | 53  | 2.49      | 0.99 |     |       |      |
|        | Making BBP activities outside the classroom | Yes    | 52  | 3.4       | 0.93 | 254 | 6.624 | .000 |
|        |   | No     | 204 | 2.44      | 0.94 |     |       |      |
| SPCTS  | Gender                                      | Female | 133 | 2.24      | 0.43 | 254 | 1.196 | .233 |
|        |   | Male   | 123 | 2.17      | 0.5  |     |       |      |
|        | Owning a computer                           | Yes    | 203 | 2.22      | 0.47 | 254 | 0.909 | .364 |
|        |   | No     | 53  | 2.15      | 0.46 |     |       |      |
|        | Making BBP activities outside the classroom | Yes    | 52  | 2.46      | 0.36 | 254 | 4.601 | .000 |
|        |   | No     | 204 | 2.14      | 0.52 |     |       |      |

Note. N: number of students,  $\bar{x}$ : mean, SD: standard deviation, df: degree of freedom

The students’ self-efficacy perceptions related to BBP were not significantly different by gender ( $t(254)=0.518$ ,  $p>.05$ ) and owning a computer ( $t(254)=1.107$ ,  $p>.05$ ) (Table 4). The students’ self-efficacy perceptions related to BBP differed significantly by making BBP activities outside the classroom ( $t(254)=6.624$ ,  $p0.05$ ). Similarly, students’ self-efficacy perceptions related to CT skills were not significantly different by gender ( $t(254)=1.196$ ,  $p>.05$ ) and owning a computer ( $t(254)=.909$ ,  $p>.05$ ). The students’ self-efficacy perceptions related to CT skills differed significantly by making BBP activities outside the classroom ( $t(254)=4.601$ ,  $p>.05$ ).

Table 5 displays descriptive statistics of the students’ SPRBBP and SPCTS scores by mother’s level of education, father’s level of education, grade level, computer usage time, and Internet usage time.

Table 5. Descriptive Statistics of the SPRBBP and SPCTS Scores.

| Scale  | Variable                    |                             | N   | $\bar{x}$ | SD   |
|--------|-----------------------------|-----------------------------|-----|-----------|------|
| SPRBBP | Mother’s level of education | Primary school              | 58  | 2.43      | 0.91 |
|        |                             | Secondary school            | 18  | 2.82      | 0.91 |
|        |                             | High school                 | 85  | 2.59      | 1.01 |
|        |                             | 2-year college              | 52  | 2.54      | 1.04 |
|        |                             | Bachelor’s or higher degree | 43  | 2.79      | 1.16 |
|        |                             | Total                       | 256 | 2.63      | 1.01 |
|        | Father’s level of education | Primary school              | 45  | 2.59      | 0.94 |
|        |                             | Secondary school            | 39  | 2.63      | 1.07 |
|        |                             | High school                 | 80  | 2.5       | 0.89 |
|        |                             | 2-year college              | 36  | 2.74      | 1.05 |
|        |                             | Bachelor’s or higher degree | 69  | 2.77      | 1.14 |
|        |                             | Total                       | 256 | 2.63      | 1.01 |
|        | Grade level                 | 5th                         | 88  | 2.35      | 0.92 |
|        |                             | 6th                         | 64  | 2.64      | 0.96 |
|        |                             | 7th                         | 65  | 2.90      | 1.07 |
|        |                             | 8th                         | 39  | 2.81      | 1.07 |
|        |                             | Total                       | 256 | 2.63      | 1.01 |
|        | Computer usage time         | 1 hour and below            | 165 | 2.63      | 1.02 |
|        |                             | 2 hours                     | 54  | 2.62      | 0.93 |
|        |                             | 3 hours                     | 22  | 2.32      | 1.05 |



|                             |                             |                             |      |      |      |
|-----------------------------|-----------------------------|-----------------------------|------|------|------|
|                             |                             | 4 hours and above           | 15   | 3.19 | 0.96 |
|                             |                             | Total                       | 256  | 2.63 | 1.01 |
| Internet usage time         |                             | 1 hour and below            | 103  | 2.66 | 1.06 |
|                             |                             | 2 hours                     | 82   | 2.56 | 0.99 |
|                             |                             | 3 hours                     | 40   | 2.45 | 1.02 |
|                             |                             | 4 hours and above           | 31   | 2.95 | 0.83 |
|                             |                             | Total                       | 256  | 2.63 | 1.01 |
| SPCTS                       | Mother's level of education | Primary school              | 58   | 2.20 | 0.43 |
|                             |                             | Secondary school            | 18   | 2.26 | 0.41 |
|                             |                             | High school                 | 85   | 2.16 | 0.47 |
|                             |                             | 2-year college              | 52   | 2.21 | 0.49 |
|                             |                             | Bachelor's or higher degree | 43   | 2.24 | 0.54 |
|                             |                             | Total                       | 256  | 2.21 | 0.47 |
| Father's level of education | Primary school              | 45                          | 2.16 | 0.43 |      |
|                             | Secondary school            | 39                          | 2.27 | 0.48 |      |
|                             | High school                 | 80                          | 2.15 | 0.40 |      |
|                             | 2-year college              | 36                          | 2.36 | 0.53 |      |
|                             | Bachelor's or higher degree | 69                          | 2.21 | 0.53 |      |
|                             | Total                       | 256                         | 2.21 | 0.47 |      |
| Grade level                 | 5th                         | 88                          | 2.13 | 0.45 |      |
|                             | 6th                         | 64                          | 2.20 | 0.44 |      |
|                             | 7th                         | 65                          | 2.21 | 0.49 |      |
|                             | 8th                         | 39                          | 2.38 | 0.48 |      |
|                             | Total                       | 256                         | 2.21 | 0.47 |      |
| Computer usage time         | 1 hour and below            | 165                         | 2.23 | 0.46 |      |
|                             | 2 hours                     | 54                          | 2.18 | 0.45 |      |
|                             | 3 hours                     | 22                          | 2.05 | 0.60 |      |
|                             | 4 hours and above           | 15                          | 2.30 | 0.43 |      |
|                             | Total                       | 256                         | 2.21 | 0.47 |      |
| Internet usage time         | 1 hour and below            | 103                         | 2.31 | 0.43 |      |
|                             | 2 hours                     | 82                          | 2.13 | 0.48 |      |
|                             | 3 hours                     | 40                          | 2.07 | 0.52 |      |
|                             | 4 hours and above           | 31                          | 2.25 | 0.41 |      |
|                             | Total                       | 256                         | 2.21 | 0.47 |      |

Note. N: number of students,  $\bar{x}$ : mean, SD: standard deviation

There were differences between the students' SPRBBP and SPCTS scores when compared to mother's level of education, father's level of education, grade level, computer usage time, and Internet usage time. The ANOVA for independent samples was used to examine whether the observed differences between the scores were statistically significant. The ANOVA results are given in the Table 6.

Table 6. The ANOVA Results.

| Scale  | Variable                    | Source of Variation | Sum of Squares | df  | Mean Square | F     | p    | Significant Difference |
|--------|-----------------------------|---------------------|----------------|-----|-------------|-------|------|------------------------|
| SPRBBP | Mother's level of education | Between groups      | 781.075        | 4   | 195.269     | 1.334 | .258 | -                      |
|        |                             | Within groups       | 36741.796      | 251 | 146.382     |       |      |                        |
|        |                             | Total               | 37522.871      | 255 |             |       |      |                        |
|        | Father's level of education | Between groups      | 431.083        | 4   | 107.771     | 0.729 | .573 | -                      |
|        |                             | Within groups       | 37091.788      | 251 | 147.776     |       |      |                        |
|        |                             | Total               | 37522.871      | 255 |             |       |      |                        |
|        | Grade level                 | Between groups      | 1831.127       | 3   | 610.376     | 4.310 | .006 | 5th-7th                |
|        |                             | Within groups       | 35691.744      | 252 | 141.634     |       |      |                        |
|        |                             | Total               | 37522.871      | 255 |             |       |      |                        |
|        | Computer usage time         | Between groups      | 976.895        | 3   | 325.632     | 2.245 | .084 | -                      |
|        |                             | Within groups       | 36545.976      | 252 | 145.024     |       |      |                        |
|        |                             | Total               | 37522.871      | 255 |             |       |      |                        |
|        | Internet usage time         | Between groups      | 725.222        | 3   | 241.741     | 1.656 | .177 |                        |
|        |                             | Within groups       | 36797.649      | 252 | 146.022     |       |      |                        |
|        |                             | Total               | 37522.871      | 255 |             |       |      |                        |

|       |                             |                |           |     |          |       |             |         |
|-------|-----------------------------|----------------|-----------|-----|----------|-------|-------------|---------|
| SPCTS | Mother's level of education | Between groups | 483.775   | 4   | 120.944  | 0.424 | .791        |         |
|       |                             | Within groups  | 71582.471 | 251 | 258.189  |       |             |         |
|       |                             | Total          | 72066.246 | 255 |          |       |             |         |
|       | Father's level of education | Between groups | 1349.777  | 4   | 337.444  | 1.198 | .312        |         |
|       |                             | Within groups  | 70716.469 | 251 | 281.739  |       |             |         |
|       |                             | Total          | 72066.246 | 255 |          |       |             |         |
|       | Grade level                 | Between groups | 2213.694  | 3   | 737.898  | 2.662 | <b>.049</b> | 5th-8th |
|       |                             | Within groups  | 69852.552 | 252 | 277.193  |       |             |         |
|       |                             | Total          | 72066.246 | 255 |          |       |             |         |
|       | Computer usage time         | Between groups | 1009.078  | 3   | 336.359  | 1.193 | .313        |         |
|       |                             | Within groups  | 71057.168 | 252 | 281.973  |       |             |         |
|       |                             | Total          | 72066.246 | 255 |          |       |             |         |
|       | Internet usage time         | Between groups | 3095.571  | 3   | 1031.857 | 3.770 | <b>.011</b> | A-B     |
|       |                             | Within groups  | 68970.675 | 252 | 273.693  |       |             | A-C     |
|       |                             | Total          | 72066.246 | 255 |          |       |             |         |

Note. df: degree of freedom, A: 1 hour and below, B: 2 hours, C: 3 hours, D: 4 hours and above

The students' self-efficacy perceptions related to BBP did not differ according to their mothers' level of education [F(4,251)=1.334, p>.05], fathers' level of education [F(4,251)=0.729, p>.05], computer usage time [F(3,252)=2.245, p>.05], and Internet usage time [F(3,252)=1.656, p>.05]. There was a significant difference according to grade level [F(3,252)=4.310, p<.05]. The Post Hoc tests that were Scheffe and Dunnett's C revealed a statistically significant difference between the fifth and seventh grade students' mean scores on the SPRBBP.

The students' self-efficacy perceptions related to CT skills did not differ according to their mothers' level of education [F(4,251)=0.424, p>.05], fathers' level of education [F(4,251)=1.198, p>.05], and computer usage time [F(3,252)=1.193, p>.05]. There was a significant difference according to grade level [F(3,252)=2.662, p<.05] and Internet usage time [F(3,252)=3.770, p<.05]. According to the Post Hoc tests that were Scheffe, Dunnett's C and LSD tests, the fifth and eighth grade students' mean scores on the SPCTS demonstrated a significant difference. The students' mean scores on the SPCTS whose Internet usage time was "1 hour and below" and whose Internet usage time was "2 hours" significantly differed, and the students' mean scores whose Internet usage time was "1 hour and below" and whose Internet usage time was "3 hours" significantly differed.

"Was there a relationship between students' self-efficacy perceptions related to BBP and CT skills?" was the study's third sub-question. The Pearson correlation coefficient between the SPRBBP and SPCTS scores was calculated. The correlation analysis results are presented in Table 7.

Table 7. Correlation Analysis Results.

| Variables                | N   | p   | r     |
|--------------------------|-----|-----|-------|
| SPRBBP score*SPCTS score | 256 | .00 | 0.552 |

A Pearson's correlation coefficient between 0.00-0.19 is a negligible relationship, between 0.20-0.39 is a weak relationship, 0.40-0.69 a moderate relationship, between 0.70-0.89 is a strong relationship, between 0.90-1.00 is a very strong relationship according to Alpar (2020) and Schober et al. (2018). Table 7 reveals that the SPRBBP and SPCTS scores have a significant positive moderate correlation, r=0.552, p<.05. According to the coefficient of determination (r<sup>2</sup>=0.3047), self-efficacy perceptions related to CT skills explains 30% of the variance in self-efficacy perceptions related to BBP, or self-efficacy perceptions related to BBP explains 30% of the variance in self-efficacy perceptions related to CT skills.

### Discussion, Conclusion, and Recommendations

Children are introduced to technology at an early age in the 21st century, and their awareness of technology is limited only by their ability to utilise it. This has resulted that the Turkish Ministry of National Education included the ITS curriculum. Students have been taught programming in the ITS curriculum, and CT is one of the essential skills for teaching programming (Alsancak Sırakaya, 2019). The secondary school students' self-efficacy perceptions related to BBP and CT skills was analysed and compared based on various variables, and the relationship between students' self-efficacy perceptions related to BBP and CT skills was investigated within the scope of this study.

The secondary school students' self-efficacy perceptions related to BBP and CT skills were found moderate in this study. Adsay et al. (2020) investigated secondary school students' self-efficacy perceptions related to BBP

instruction, levels of CT skills and STEM skills, and found that students had low self-efficacy perceptions related to BBP instruction and moderate levels of CT skill. Similarly, the high school students' self-efficacy perceptions related to CT skills found moderate (Yağcı, 2018).

The study indicated that the secondary school students' self-efficacy perceptions related to BBP did not differ significantly by gender. Adsay et al. (2020), discovered that the students' self-efficacy perceptions related to BBP instruction did not differ significantly by gender. Similarly, according to Kasalak (2017), Altun and Kasalak (2018), Korucu and Taşdöndüren (2019), and Adsay et al. (2020) gender did not affect the students' self-efficacy perceptions related to BBP. The study indicated that secondary school students' self-efficacy perceptions CT skills did not differ significantly by gender. In the study by Alsancak Sırakaya (2019), the students' self-efficacy perceptions related to CT skills did not differ based on gender, however, the female students' levels of CT skills were shown to be higher in the research did by Adsay et al. (2020). Therefore, several investigations should be undertaken to determine whether students' self-efficacy perceptions related to BBP and CT skills differs by gender.

The study indicated that the BBP self-efficacy of secondary school students varied significantly by grade. According to the research, there was a large variation between the fifth and seventh grade students' self-efficacy perceptions related to BBP. According to the research, there was a substantial difference in the fifth and eighth grade students' self-efficacy perceptions related to CT skills. Adsay et al. (2020) discovered that seventh grade students have stronger self-efficacy perceptions related to BBP instruction and sixth grade students have higher levels of CT skills. İbili et al. (2020) discovered that CT skills did not vary by grade level. According to Yağcı (2018), students' self-efficacy perceptions related to CT skills differed by grade level. Accordingly, it can be said that various research should be undertaken to determine whether grade level differences exist between students' self-efficacy perceptions related to BBP and CT skills.

When mother's level of education, father's level of education, owning a computer, and computer usage time were considered, students' self-efficacy perceptions related to BBP and CT skills did not differ significantly. According to a study by Korucu and Taşdöndüren (2019), the secondary school students' self-efficacy perceptions related to BBP were not affected by the computer usage time but were affected by the owning a computer. Consequently, distinct investigations should be done to determine whether students' self-efficacy perceptions related to BBP and CT skills vary based on the variable of owning a computer. In addition, no similar study in the literature assessed the effect of parent's level of education variables on self-efficacy perceptions related to BBP and CT skills. The relationship between different variables and the secondary school students' self-efficacy perceptions related to BBP and CT skills can be explored in different studies.

The study indicated that the secondary school students' self-efficacy perceptions related to BBP was not significantly affected by the Internet usage time. Therefore, it may be concluded that Internet usage time does not influence students' self-efficacy perceptions related to BBP. Nonetheless, self-efficacy perceptions related to CT skills varied considerably according to Internet usage time.

It was demonstrated that the secondary school students' self-efficacy perceptions related to BBP and CT skills differed significantly based on the variable of making BBP activities outside the classroom. Similarly, Korucu and Taşdöndüren (2019) found that the ability of secondary school students to work on the Scratch outside of the classroom had a substantial impact on their impression of self-efficacy perceptions related to BBP. Students making BBP activities outside the classroom benefits their confidence in BBP and CT skills. Students can practise what they learned in the ITS lesson by completing BBP tasks outside of the classroom. In light of the fact that participation in extracurricular activities effectively develops self-efficacy perceptions related to BBP and CT skills, teachers should encourage students to practise what they have learned through various activities.

According to the findings, secondary school students' self-efficacy perceptions related to BBP and CT skills demonstrated a moderate and statistically significant relationship. Based on this conclusion, it can be concluded that the students with high level self-efficacy perceptions related to BBP was also vital in terms of their self-efficacy perceptions related to CT skills. In research examining self-efficacy perceptions related to BBP instruction, levels of STEM skills, and CT skills, Adsay et al. (2020) discovered a substantial positive correlation between secondary school students' self-efficacy perceptions related to BBP instruction and levels of CT skills.

In this study, data were obtained using the SPRBBP and SPCTS scales. The literature has other measurement tools in addition to the measurement tools employed in the study. The research can be repeated on different groups of students using other measurement tools. The students in secondary schools in a city in the west of Türkiye comprise the study's sample. The study might be repeated with students from various places or educational levels. Considering both the students' self-efficacy perceptions related to BBP and CT skills is seen to contribute to the field of programming instruction on the basis of this study. It can be suggested that the research be expanded by examining the relationships between students' self-efficacy perceptions related to BBP and CT skills and other variables.

### Contribution Rate of the Researchers

**Özge Öztuzcu:** Conceptualization, Validation, Investigation, Resources, Data Curation, Writing - Original Draft, Visualization

**Gülcan Öztürk:** Conceptualization, Methodology, Validation, Formal analysis, Writing - Review & Editing, Supervision

**Zeynel Abidin Mısırlı:** Conceptualization, Writing - Review & Editing, Supervision.

### Financial Support and Acknowledgment

The authors declared that this research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

### Conflict of Interest

The authors declare that they have no conflict of interest.

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