An Examination of the Self-Efficacy Perceptions of Eighth-Grade Students Regarding Computational Thinking Competencies

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ABSTRACT
This study aims to determine the self-efficacy perception levels of secondary school 8th-grade students towards computational thinking skills and examine the self-efficacy perception levels towards computational thinking skills in various variables. The study emphasises that positive attitudes and perceptions are necessary for computational thinking and that people should be willing to learn more about computer science. The study also aims to examine the relationship between students' achievement grades in Mathematics, Science and Technology, English, Turkish Revolution History and Kemalism course and their computational thinking self-efficacy perceptions. Thus, it will be determined that secondary school students' self-efficacy perceptions towards computational thinking skills are related to their achievements in which field type courses.

The research was conducted in a quantitative survey model and single survey design. The Self-Efficacy Perception Scale for Computational Thinking Skills (SCCTS) for secondary school students developed by Gülbahar, Kalelioğlu, and Kert (2018) was put into use. A total of 2247 secondary school 8th grade students, 1147 girls and 1100 boys, studying in Izmir province in the 2018-2019 academic year constitute the study sample. As a result of the analyses, the average self-efficacy perception score of 8th-grade middle school students towards computational thinking skills was above the average at 80.01 points out of 108 total scale points. It was determined that the self-efficacy perceptions of the participants differed in favour of female students according to the gender variable.
Keywords: Computational Thinking, Computer Use, Self-Efficacy, Self-Efficacy Perception, Secondary School Students.

INTRODUCTION
It is widely recognised that the ability to think is considered a crucial skill for human survival. Indeed, one of the most distinguishing features that set humans apart from other living creatures is the process of thinking, which involves various stages of abstract information processing and evaluation, ultimately resulting in measured outcomes. The cognitive abilities that facilitate thinking are known as thinking skills. By honing these skills, greater success can be achieved by effectively leveraging life experiences and intellect (Papert, 1980; Top, 2018). Undeniably, the most critical point in defining thinking skills is that children should be able to recognise how their minds work and express how the connection from abstract to concrete is formed in the process of learning and thinking (Papert, 2007). Therefore, the acquisition of thinking skills in the first years of life will pave the way for individuals to use their minds and thinking abilities in the broader area in the later stages of life.

The pace of transformation in different areas of collectively sustained life in the current era has led to the emergence of several requirements for possessing skills characterised as 21st-century skills. It is vital for the educational factor to come into play in acquiring these skills, which can be listed as decision-making, problem-solving, reasoning, and creative thinking skills, and to ensure the sustainability of the sociological structure. In order to teach the individual how to think, in addition to training on the use of technology, learning environments that will support mental development by directing the individual to think indirectly or directly should be organised (Papert, 2007).

In the digital world, which is growing at an exponential rate every day, computers, mobile and wearable devices have become more accessible and have become indispensable elements in daily life. Manovich (2013) asserts that contemporary society is enveloped by various digital devices, along with the software designed to facilitate their operation. The need for 21st-century individuals to know how technology is produced rather than consuming it and who consume it more consciously is becoming increasingly important every day (Kalelioğlu, 2015). In this process, the transformation experienced across various layers of society has significantly affected both economic and social life. Today, due to this transformation, individuals from all segments of society are expected to acquire digital literacy skills in tandem with technological advancements (Wing, 2014). While preparing students for life, while ensuring that they acquire these skills, it should be ensured that they have the necessary technology usage competence while simultaneously using these skills in solving the problems they face. Wing (2006) states that individuals should have to use digital technologies by thinking critically about solving the problems they face in all areas of life.

LITERATURE REVIEW

The concept of computational thinking serves as a common framework for problem-solving applicable to humans and machines across various disciplines. Although the term has gained prominence in recent years, its roots can be traced back to the field of computer science as early as the 1960s (Grover & Pea, 2013). Initially introduced by Papert (1996) for employing computers to resolve geometric issues, the concept was later elaborated upon by Wing (2006), who provided a more comprehensive definition. According to Wing, computational thinking involves structuring problems to make them comprehensible to computers, thereby enabling automated problem-solving. Contrary to the notion that this skill is exclusive to professionals in the computer science domain, Wing (2006) posited that computational thinking is a universal competency that all individuals should cultivate. This perspective is corroborated by influential educational organisations such as ISTE, CSTA, and NRC, which endorse Wing's stance and emphasise that computational thinking is among the essential skills for the 21st century that everyone should acquire.

While computational thinking employs mathematical reasoning to design and evaluate complex systems during the problem-solving phase, it also leverages scientific thinking. This enables common approaches to understanding concepts such as computability, intelligence, reason, and human behaviour through engineering (Korkmaz et al., 2015). Building on this, Bundy (2007) expands the scope of computational thinking by stating that it has implications for research across nearly all disciplines in the humanities and natural sciences. Also, Bundy (2007) further notes that using metaphors can facilitate processing large volumes of information, thereby providing a foundation for posing original questions and arriving at unique answers. Transitioning to educational perspectives, ISTE (2015) defines computational thinking as a form of cognitive support for problem-solving through technology. It is stated by Mannila et al. (2014), who emphasise that computational thinking involves the application of computer science concepts and processes during the problem formulation stage. Similarly, Riley and Hunt (2014) highlight the cognitive aspects, characterising computational thinking as the ability to think like a computer scientist when evaluating situations. Also, Sysło and Kwiatkowska (2013) offer a slightly different angle. They define computational thinking as a concept more centred on thinking skills based on computer programming principles rather than computer programming skills per se. Drawing upon these diverse definitions and insights from the literature, it becomes evident that computational thinking is a 21st-century skill. It is a competency that individuals of all ages and backgrounds should possess to enhance their problem-solving abilities and digital competencies.

Since the characteristics of computational thinking include many areas, it is a critical stage to plan and implement some comprehensive processes for teaching it. Making and learning calculations is the beginning of computational thinking for human beings, and it is emphasised that individuals from all age groups should have some basic computational skills (Kalelioğlu et al., 2016). Calculation, arithmetic, symbols, and abstract thinking form the basis of computational work. Computational thinking is a skill used daily while cooking, practising hobbies, and performing physical and mental activities. Wing (2006), while explaining computational thinking skills, used the expression, "Today's ubiquitous information technologies were yesterday's dream, while computational thinking is tomorrow's reality". This statement once again emphasises the importance of teaching computational thinking by teachers in all areas from an early age in terms of the development of individuals.

Although computational thinking is a field that has been studied for many years, it is still necessary to question how to teach and measure it more effectively by defining it and making the necessary plans. It is expected that individuals should have some basic competencies in order to use the information technology tools and applications they need in their work areas (Perković et al., 2010). Computational thinking skills, one of the most prominent of these competencies, foster questioning and thinking in order to obtain results about the solution of the problem while using information technology tools and applications to solve the problems encountered by individuals in their fields of interest (Wing, 2006). Although computer science is one of the concepts that come to mind when it refers to computational thinking skills, it can be said that the field it actually defines has a much broader impact (Üzümcü & Bay, 2018). Computational thinking skill comes to the forefront as a concept that has the capacity to form the basis not only in the field of computer science but also in many other disciplines (CSTA, 2016). Wing (2006) argued that computational thinking should be the basis for humans and machines capable of processing information.

Computational thinking is the systematic organisation of the way and process of thinking humans have in solving the problem (Barr et al., 2011). Wing (2006) pointed out that computational thinking is the use of computer science concepts and techniques such as discrimination, pattern recognition, abstraction and algorithms in solving complex problems. Computational thinking will enable individuals to use digital devices more effectively to solve problems and create solutions quickly and accurately. It is expected that individuals will be able to think computationally to find the answer to the question of how to solve the problems that we may encounter in the future by using today's digital tools (Gülbahar et al., 2018). ISTE and CSTA (2011) argue that individuals with problem-solving and critical thinking skills are more capable of producing solutions to the problems they face in daily life and using digital devices effectively. The acquisition of computational thinking skills is an essential necessity in the digitalising world, which is among the 21st-century skills and allows applying these skills in computer sciences while solving problems by thinking critically.

Wing (2006) argued that due to the problem-solving skill that forms the basis of computational thinking, computational thinking should be possessed by individuals in the information technologies sector and in every layer of social life. These inferences in many fields have brought along question marks about the processes by which computational thinking should be acquired. The lack of a common consensus on the definition of computational thinking skill brings along many problems in its teaching and implementation (Hemmendinger, 2010).

Learning computational thinking skills is seen as a positive and effective indicator of individuals' cognitive development (Liao & Bright, 1991; Papert, 1980). However, with the rapid spread of technology in many areas of life (Howland & Good, 2015), the function of computational thinking is seen as a basic skill that supports the production of technology. Students learn many of the subcomponents of computational thinking through the courses they take in their educational life (Korkmaz et al., 2015). ISTE (2015) emphasises that the primary purpose of computational thinking in teaching is that learners gain computational thinking skills and have the ability to use them in all areas of their lives rather than progressing in the field of computer science. Transforming reasoning and thinking, which are the basic skills used in problem-solving, into a more effective form by using digital devices has become one of the main elements of life and work (Barr et al., 2011). Accordingly, individuals who produce effective solutions by employing computational thinking skills in the new age will be ahead in many areas of life.

When the studies on computational thinking skills are examined in the related literature, some studies show that there is no significant relationship between gender variables (Werner et al., 2012), while other studies show that it has a significant effect on computational thinking skills (Román-González et al., 2017). In addition, Román-González et al. (2017) found that computational thinking skill scores differed in favour of males in their study, while female students made more effort to acquire similar computational thinking skills compared to male students.

Many studies in the literature emphasise that computational thinking can be applied and integrated into mathematics and science (NRC, 2012). According to Perkins and Simmons (1988), similar skills such as reasoning, analytical thinking and problem-solving are needed in teaching science disciplines. Harel and Papert (1991) highlighted that computer science is in high-level interaction with all fields of science. Many studies in the literature also reveal results proving that the sub-dimensions of computational thinking have positive effects on the teaching of many disciplines (Blikstein & Wilensky, 2009; Hambrusch et al., 2009; Kynigos & Grizioti, 2018). Different assessment methods appear as another important condition with appropriate intervals in contexts that focus on the constructivist approach for the acquisition of computational thinking skills (Han & Bhattacharya, 2001).

Sebetci and Aksu (2014) stated that the importance of computer science, which is shaped in a structure based on science, is increasing exponentially in a world digitalising faster every day. The evaluation of computational thinking skills, an abstract concept, is one of the most discussed and agreed-upon points to be done using more than one method (Yeni, 2017). The fact that a consensus has not yet been reached for the definition and sub-dimensions of computational thinking skills is one of the main reasons for this. While measuring computational thinking skills and evaluating through projects or activities, different measurement tools have also been created in which students make self-evaluations. Korkmaz et al. (2016)'s "Computer Thinking Skill Levels Scale", Kukul (2018)'s "Computational Thinking Self-Efficacy Scale", Gülbahar et al. (2018)'s "Self-Efficacy Perception Scale for Computational Thinking Skills" can be shown as examples of these measurement tools.

In the experimental study conducted by Oluk et al. (2018) with 5th-grade students in which they aimed to measure the effect of the Scratch program on algorithm creation and development of computational thinking skills, it was concluded that the algorithm creation and computational thinking skills of the students in the experimental group increased significantly compared to the students in the control group. In the experimental study conducted by

Sırakaya (2019) with 54 Computer Programming students, it was concluded that programming instruction contributed positively to the development of individuals' computational thinking skills. Atman Uslu et al. (2018) conducted a mixed-method study to measure the effect of activities created through Scratch on the computational thinking skills of secondary school students, and at the end of the study, it was stated that students' awareness of computer science increased.

This study aimed to measure the self-efficacy perception levels of the participants towards computational thinking skills and to define the relationship between different variables. Self-efficacy is a concept that includes the use of attitudes, feelings and thoughts that individuals exhibit in order to reach the determined goals and the confidence in having these skills. Accordingly, it directly affects the result of a person's performance in the face of a situation or event (Horzum & Çakır, 2009).

The following problem statement in the study is "What are the self-efficacy perception levels of 8th-grade students towards computational thinking skills?". The sub-problems are listed as follows.

- Do 8th-grade students' self-efficacy perceptions towards computational thinking skills differ according to gender?
- Is there a difference between the self-efficacy perception levels of the participants in the study towards computational thinking skills and their smartphone use status?
- Is there any differentiation between the participants' self-efficacy perception levels towards computational thinking skills and tablet use status?
- Is there a differentiation between the participants' self-efficacy perception levels towards computational thinking skills and their daily computer usage time?
- Is there a relationship between the participants' self-efficacy perception levels towards computational thinking skills and their achievement in Mathematics courses?
- Is there a relationship between the participants' self-efficacy perception levels towards computational thinking skills and their achievement in Science courses?
- Is there a relationship between the participants' self-efficacy perception levels towards computational thinking skills and their achievement in English courses?
- Is there a relationship between the participants' self-efficacy perception levels towards computational thinking skills and their achievement in Turkish Revolution History and Kemalism course?

METHODOLOGY

Research Design

This study, which aims to determine 8th-grade students' self-efficacy perception levels towards computational thinking skills and to examine the relationship between various variables, was conducted in a quantitative research design. The quantitative research methods aim to reach statistical results by obtaining accurate and reliable measurements through collecting and analysing structured and numerically representable data (Goertzen, 2017). Türnüklü (2001) defined the primary purpose of quantitative research as producing generalisable information explaining cause-and-effect relationships. The research design was determined as a survey model. Survey research is characterised as studies conducted on large samples to determine the views of the participants on events or issues or their characteristics such as interests, skills, abilities and attitudes (Büyüköztürk et al., 2008). In addition, a single screening model was used to determine the participants' gender, smartphone use, tablet use, and daily technological device usage time, and a relational screening model was used to analyse their self-efficacy perceptions towards computational thinking skills according to various variables.

Population and Sample

The population of the study in the 2018-2019 academic year consists of 43,914 secondary school 8th-grade students studying in public schools in Izmir, Turkey. The stratified sampling method, one of the random sampling methods, was used to determine the study sample. Stratified sampling aims to represent the subgroups in the population in the sample in proportion to their weight in the population, and the process of obtaining units from sub-populations is carried out by simple, unbiased sampling (Büyüköztürk et al., 2012). Stratified sampling aims to increase the representativeness of the population by reducing sampling error (Baltacı, 2018).

In stratified sampling, the population based on a descriptive variable should be divided into two or more strata (Bernard, 2017). In the study, since the relationship between the self-efficacy perceptions of secondary school 8th-grade students towards computational thinking skills and their scores in Mathematics, Science and Technology, English and Turkish Revolution History and Kemalism courses will be analysed, the scores of the Transition from Basic Education to Secondary Education (TEOG) exam, which is an exam consisting of the average of these courses, were selected as the defining variable in the sampling.

The average scores of 8th-grade students who sat for the April 2017 TEOG exam were used to determine the schools to be selected in the study's sampling. According to the results of the April 2017 TEOG exam, firstly, the average achievement of each district was calculated, and according to the district achievements, 30 districts in Izmir province were sorted from higher to lower in Table 3.1. The districts were divided into 3 levels as groups of 10, considering their achievement averages. In the literature, it is suggested that it is necessary to reach 381 samples in a population of 50,000 people for a 95% confidence level to determine the representativeness of the population (Yazıcıoğlu & Erdoğan, 2004). Büyüköztürk (2012) emphasised that in multivariate studies (including multiple regression analyses in this context), the sample size to be reached should be 10 times or more the number of variables in the study. Therefore, in the study, it was aimed to reach 30 schools by selecting 10 districts and 3 schools from each district and a total of 3000 students by selecting 100 students from each school, and data were collected from 2354 students. The necessary permission for data collection was obtained from the Izmir Provincial Directorate of National Education.

In the selection of the districts, the ones where the implementation of the scales would be easier were selected. While selecting the schools, the schools in the districts were divided into 3 categories according to their April 2017 TEOG score averages, ranked from largest to smallest. One school was selected from each of the categories, and the scale was applied to all 8th-grade students in the school. Following the application, 2354 scales were returned as applied.

In the study, there are 9 different independent variables, and these are gender, smartphone use, tablet use, daily computer usage time, achievement in Mathematics course, achievement in Science and Technology course, achievement in English course and achievement in Turkish Revolution History and Kemalism course. Büyüköztürk et al. (2012) suggest that 90 or more data to be selected in research with 9 variables is a significant criterion in representing the population. In this respect, it was assumed that collecting a total of 2354 scale data from the population determined as a result of the research was highly representative of the population. The applied forms were analysed, and the forms in which more than 10% of the total number of items in the scale were not completed were excluded from the research. When the forms were analysed, 107 forms that did not meet this criterion were not processed, and the data of the study were formed with the data of 2,247 students in total. Table 1 presents the number of students to whom the scale was applied in terms of levels.

Table 1. Number of students comprising the sample at each level

Level	Number of Students
Level 1	709
Level 2	989
Level 3	656

The numbers of the students in the sample regarding the gender variable are given in Table 2.

Table 2. Number of students in the sample regarding gender variable

Gender	Number of Students	%
Female	1147	51,04 %
Male	1100	48,96 %

The number of students in the sample regarding the school type variable is given in Table 3.

Table 3. Number of students in the sample and in secondary schools in Turkey regarding the gender variable

School Type	Number of Students	%	Number of Students in Türkiye	%
Secondary School	2094	93.19 %	4.263.108	85.55 %
İmam Hatip Secondary School	109	4.85 %	641.593	12.87 %
Regional Primary Boarding School	44	1.96 %	78.262	1.57 %

Total	2247	100 %	4.982.963	100 %

Data Collection Tools

In the study, the "Self-Efficacy Perception Scale for Computational Thinking Skills" (SEPSCTS) developed by Gülbahar et al. (2018) for secondary school students was used. There are 36 questions on the whole scale, which has 5 sub-dimensions in total. The questions were graded as "Yes", "Partially", and "No" on a 3-point Likert scale. The total reliability coefficient of the scale was .943. The values of the sub-dimensions of the scale are given in Table 4.

Table 4. Internal consistency coefficients related to the sub-dimensions of the Self-Efficacy Perception Scale for Computational Thinking Skills (SEPSCTS)

Number	Sub-dimensions	Item Number	Cronbach's Alpha Value
1	Algorithm Design Competence	9	.930
2	Problem-Solving Competence	10	.880
3	Data Processing Competence	7	.856
4	Basic Programming Competence	5	.838
5	Self-confidence Competence	5	.762
	The whole Scale	36	.943

When the internal consistency coefficients of the dimensions were examined, it was seen that they were between .930 and .762. Internal consistency coefficients between .70 and .90 are defined as high-reliability values and values above these values are defined as excellent reliability values (Hinton et al., 2014). In this context, it can be concluded that the reliability values of the general structure of the scale and the sub-factors of the scale are sufficient.

It can be said that gender and education level variables are among the important variables for the acquisition and development of computational thinking skills (Durak & Sarıtepeci, 2018). In the literature, studies prove a relationship between gender and self-efficacy perception level, programming, computational thinking skill level and development (Lee et al., 2014; Durak & Sarıtepeci, 2018). Considering this point, while investigating the participants' self-efficacy perception level of computational thinking skills, it was aimed to reveal the relationship with the gender variable.

ISTE (2011) and NRC (2012) suggest that the only way to demonstrate computational thinking skills is not to use digital devices and that this skill can be measured with different applications. However, studies in the literature show that individuals' interactions with technology are essential in terms of their reflection on computational thinking skills (Kalelioğlu, 2015; Top, 2018; Gülbahar et al., 2018). As a result, it may be a possible situation that students' experiences of using information technologies affect their computational thinking skills. There are studies that coding education, which has come to the fore in recent years, contributes positively to the acquisition and development of computational thinking skills (Korkmaz et al., 2015; Lye & Koh, 2014; Sarıtepeci & Durak, 2017). Due to these results, items for devices such as computers and tablets were added to determine the level of the relationship between the participants' use of digital tools, their daily usage time and their self-efficacy perception levels towards computational thinking skills.

There is a strong connection between science and computer science, which is the main element of computational thinking (Perkins & Simmons, 1988; Wing, 2006; Bundy, 2007; Barr & Stephenson, 2011). Wing (2006, 2014) emphasised that computational thinking is a skill needed by individuals from all age groups and from all fields. Accordingly, it was aimed to determine the relationship between the courses in the fields of science and social sciences and the self-efficacy perceptions towards computational thinking skills of the participants in the study and to determine the fields in which the relationship is found. As a result, while preparing the research form, items including gender, device ownership, daily computer usage time, first semester grades of Mathematics, Science and Technology, English, Turkish Revolution History and Kemalism course, and Music and Visual Arts courses were added and distributed as a printed form. From the 2354 scales applied, the forms filled in below the specified criterion were removed, and analyses were made with 2247 forms.

Data Analysis

In the study, a T-test was used to determine whether the participants' self-efficacy perceptions towards computational thinking skills differed significantly according to gender, smartphone, and tablet use. Pearson Product Moment Correlation analysis was used to determine the relationship between the participants' self-efficacy perceptions towards computational thinking skills and daily technological device usage time, Mathematics, Science and Technology, English, Turkish Revolution History and Kemalism, Visual Arts and Music course scores.

RESULTS

In the study, 8th-grade students' self-efficacy perceptions towards computational thinking skills were analysed in terms of gender, technological device use, technological device usage time and various courses. The position of the relationship between the measured variables and students' self-efficacy perceptions towards computational thinking skills in the literature was emphasised, and the results of the previous studies were evaluated and reported.

After the necessary steps were followed during the research, a data set was created with 2247 scales and analyses were made. As a result of the analysis, the mean score of the sample of 8th-grade students' perceptions of computational thinking was determined as 80.01, and it was concluded that it was above the average. According to the decision of the Board of Education and Instruction dated 28/05/2013 and numbered 22, the Information Technologies and Software (ITY) course is taught as a compulsory course for 2 hours per week in the 5th and 6th grades and as an elective course for 2 hours per week in the 7th and 8th grades. ICT course is included in the curriculum as a course in which coding and the use of digital devices are mainly covered. Coding education comes to the forefront by enabling students to plan the steps for solving problems by utilising their computational thinking skills and gaining the skills to use them at the necessary stages. It can be concluded that the fact that the students have taken ICT courses starting from the 5th grade is one of the crucial factors in the mean self-efficacy perception of the students who have reached the 8th grade towards computational thinking skills.

Considering the factors of the scale in Table 5, it can be concluded that the self-efficacy perceptions of the sample towards algorithm design competence, problem-solving competence, data processing competence and basic programming competence are above average, and their self-efficacy perceptions towards self-confidence competence are high.

Table5. Mean and standard deviation values of scales and factors

Scale	N	$\bar{X}$	Standard Deviation	Minimum	Maximum
Algorithm Design Competence (Factor 1)	2247	16.93	5.638	9	27
Problem-Solving Competence (Factor 2)	2247	24.13	4.406	10	30
Data Processing Competence (Factor 3)	2247	16.42	3.894	7	21
Basic Programming Competence (Factor 4)	2247	10.37	3.074	5	15
Self-confidence Competence (Factor 5)	2247	12.14	2.581	5	15
Total Scale	2247	80.01	14.854	36	108

51.04% (1147) of the participants were female students and 48.96% (1100) were male students. It was aimed to examine the differentiation of self-efficacy perceptions towards computational thinking skills according to gender by independent samples T-test.

Table 6. T-test results of SEPSCTS and factor scores regarding gender variable

Scale	Gender	N	$\bar{X}$	SS	SD	t	p
F1	Female	1147	16.95	5.585	2245	0.17	.569
	Male	1100	16.90	5.695			
F2	Female	1147	24.52	4.151	2245	4.283	.000
	Male	1100	23.72	4.624			
F3	Female	1147	16.54	3.752	2245	1.453	.003

	Male	1100	16.30	4.034			
F4	Female	1147	10.14	3.000	2245	-3.616	.077
	Male	1100	10.61	3.134			
F5	Female	1147	12.24	2.527	2245	1.992	.063
	Male	1100	12.03	2.633			
Total Scale	Female	1147	80.39	14.283	2245	1.237	.021
	Male	1100	79.61	15.424			

Table 6 shows that participants' self-efficacy perceptions towards computational thinking skills differed significantly according to gender ($t=1.237$, $p= 0.021$). It was concluded that self-efficacy perceptions of female students ($\bar{X}$ =80.39, p=14.283) were higher than male students ($\bar{X}$ =79.61, p=15.424).

Table 6 shows that problem-solving competence (Factor 2) and data processing competence (Factor 3) differed significantly according to gender variable, and there was no significant difference in other factors. It is seen that the problem-solving competencies of the participants (Factor 2) differed significantly according to gender (t=4,283, p= 0.000). It was determined that the problem-solving competencies of female students ($\bar{X}$=24,52, s=4,151) were higher than those of male students ($\bar{X}$=23,72, s=4,624). This finding can be interpreted as there is a significant difference between the problem-solving competence of 8th-grade secondary school students and gender with a low difference. The data processing competencies of the participants (Factor 3) differ significantly according to gender (t=1.453, p=0.003). It was concluded that the data processing competencies of female students ($\bar{X}$=16.54, s=3.752) were higher than male students ($\bar{X}$=16.3, s=4.034). Considering this result, it can be concluded that there is a significant difference between the data processing competence of 8th-grade students and their gender.

A T-test was conducted to examine the difference in self-efficacy perceptions towards computational thinking skills according to the participants' smartphone use status. It was found that 79.88% of the participants had a smartphone, while 20.12% did not have a smartphone. The results of the T-test are given in Table 7.

Table 7. T-test results of SEPSCTS scores and factor scores regarding smartphone use

Scale	Smartphone Use	N	$\bar{X}$	SS	SD	t	p
F1	No	452	17.27	5.424	2245	1.455	0.084
	Yes	1795	16.84	5.689			
F2	No	452	24.13	4.288	2245	0.017	0.077
	Yes	1795	24.13	4.436			
F3	No	452	16.13	3.960	2245	-1.765	0.315
	Yes	1795	16.50	3.875			
F4	No	452	10.38	2.878	2245	0.055	0.006
	Yes	1795	10.37	3.123			
F5	No	452	12.08	2.495	2245	-0.537	0.540
	Yes	1795	12.15	2.602			
Total	No	452	80.00	14.415	2245	-0.022	0.435
	Yes	1795	80.01	14.967			

Table 7 shows that the participants' self-efficacy perceptions towards computational thinking skills did not differ significantly according to their smartphone use status ($t=-0.022$, $p= 0.435$). This result shows no significant difference between the participants' self-efficacy perceptions towards computational thinking skills and their smartphone use. When the factors in the scale are examined, it is concluded that there is a significant difference between basic programming competence (factor 4) and smartphone use ($t=0.055$, $p=0.006$).

Independent samples T-test was conducted to determine the difference in the participants' self-efficacy perceptions towards computational thinking skills according to their tablet use. While it was determined that 42.23% of the participants had a tablet, 57.77% of them did not have a tablet. The T-test results of self-efficacy perception scale scores for computational thinking skills according to tablet use are presented in Table 8.

Table 8. T-test results of SEPSCTS scores and factor scores according to tablet ownership

Scale	Smartphone Use	N	X̄	SS	SD	t	p
F1	No	1298	16.62	5.496	2245	-3.005	0.057
	Yes	949	17.34				
F2	No	1298	23.87	4.486	2245	-3.304	0.100
	Yes	949	24.49				
F3	No	1298	16.23	3.878	2245	-2.801	0.892
	Yes	949	16.69				
F4	No	1298	10.25	3.052	2245	-2.194	0.280
	Yes	949	10.54				
F5	No	1298	12.02	2.532	2245	-2.486	0.125
	Yes	949	12.3				
Total	No	1298	79.01	14.618	2245	-3.743	0.164
	Yes	949	81.38				

According to Table 8, self-efficacy perceptions towards computational thinking skills do not show a significant difference according to tablet usage (t=-3.743, p=0.164). This finding can be interpreted as that there is no significant difference between 8th-grade secondary school students' self-efficacy perceptions towards computational thinking skills and their tablet use. When the factors of the scale are analysed, it is seen that there is no significant difference between the factors of the scale and tablet use.

One-factor analysis of variance (One-Way ANOVA) was performed to examine whether there is a difference in the self-efficacy perceptions of secondary school 8th-grade students towards computational thinking skills according to their daily computer usage hours. During the analysis of variance, the grouping of the daily computer usage hours of the participants in the study was made as given in Table 9.

Table 9. Grouping the daily computer usage time of the participants in the study

Usage time	Number of Students	%
0 to 1 hour	1232	54.82
1 to 3 hours	663	29.50
3 to 5 hours	207	9.21
5 hours and over	145	6.47
Total	2247	100

The descriptive statistics of the scores of 8th-grade secondary school students' self-efficacy perceptions towards computational thinking skills according to the duration of daily computer use are presented in Table 10.

Table 10. Descriptive statistics of the scores of the participants regarding SEPSCTS according to the duration of daily computer usage

Scale	Daily Technology Usage Time	N	X̄	SS
SEPSCTS	0 to 1 hour	1232	79.89	14.740
	1 to 3 hours	663	80.66	14.674
	3 to 5 hours	207	78.03	14.905
	5 hours and over	145	80.89	16.370
	Total	2247	80.01	14.854

ANOVA test results of students' self-efficacy perceptions towards computational thinking skills regarding their daily computer usage time are shown in Table 11.

Table 11. Homogeneity of variance test statistics of SEPSCTS scores of the participants regarding the duration of computer usage

	Levene Statistic	df1	df2	Sig.
F1	1.235	3	2243	0.295
F2	0.055	3	2243	0.983
F3	0.361	3	2243	0.781
F4	1.494	3	2243	0.214
F5	1.209	3	2243	0.305
SCALE	1.129	3	2243	0.336

According to Table 11, the significance value p= 0.336 at a 95% confidence interval and since it is more than 0.05, the variances of the groups are homogeneous. Subsequently, a one-way analysis of variance was performed. Table 12 presents the results of the one-way variance analysis of the groups.

Table 12. One-way variance analysis of the participants" self-efficacy perception scores for computational thinking skills regarding their daily computer usage time scores

	Source of Variance	Sum of squares	df	Mean Squares	F	Sig.
F1	Between groups	113.599	3	37.866	1.192	0.311
	Within groups	71279.400	2243	31.779		
	Total	71393.439	2246			
F2	Between groups	95.222	3	31.741	1.637	0.179
	Within groups	43502.092	2243	19.395		
	Total	43597.314	2246			
F3	Between groups	105.366	3	35.122	2.321	0.073
	Within groups	33947.295	2243	15.135		
	Total	34052.660	2246			
F4	Between groups	56.852	3	18.951	2.008	0.111
	Within groups	21171.599	2243	9.439		
	Total	21228.451	2246			
F5	Between groups	30.302	3	10.101	1.518	0.208
	Within groups	14928.93	2243	6.656		
	Total	14959.232	2246			
Total Scale	Between groups	1226.658	3	408.886	1.855	0.135
	Within groups	494360.145	2243	220.401		
	Total	495586.804	2246			

The results of the significance analysis of the participants' self-efficacy perception scores for computational thinking skills according to their daily computer usage time are given in Table 12. The analysis results show no significant difference in terms of self-efficacy perception towards computational thinking skills according to daily technological device usage time scores (p=0.135).

The Pearson Product Moment Correlation analysis was carried out to determine the relationship between the scores of the scale and sub-factors of the participants' self-efficacy perceptions towards computational thinking skills and their Mathematics course scores. Table 13 presents the correlation analysis results between the scale scores and sub-factors of the participants' self-efficacy perceptions towards computational thinking skills and their Mathematics course scores.

Table 13. The results of the correlation analysis between the participants' self-efficacy perceptions regarding computational thinking skills and their Mathematics course scores

		Mathematics Course Achievement	F1	F2	F3	F4	F5	Total Scale
Mathematics Course Achievement	r	1	.157**	.362**	.241**	.023	.253**	.279**
	p		.000	.000	.000	.284	.000	.000
	N	2247	2247	2247	2247	2247	2247	2247

According to the results of the analyses, a statistically significant positive weak relationship was found between the participants' self-efficacy perception level scores for computational skills and their Mathematics course scores at p<.05 level (r= .279; p<.05). When the sub-factors of the scale were examined, no statistically significant relationship was found between the perception level scores in the sub-factors of algorithm designing competence (r= .157; p<.05) and basic programming competence (r= .023; p<.05) and Mathematics course scores. A statistically weak relationship was found between perception level scores and Mathematics course scores in the sub-factors of problem solving competence (r= .362; p<.05), data processing competence (r= .241; p<.05) and self-confidence competence (r= .253; p<.05).

A review of the literature shows that there are studies showing that attitude towards mathematics course and academic achievement in mathematics course has a positive effect on computational thinking skills (Moursund, 2006; Akçay, 2009; Burke & Kafai, 2010; Kalelioğlu & Gülbahar, 2014; Kazakoff, 2015). Lewis and Shah (2012) found a significant correlation between the mathematics and programming tests they applied at the end of a 36-hour study with 47 6th-grade students in 2011, using Snap, Logo, and mainly Scratch.

It was emphasised that computational thinking has always been a part of mathematics and mathematics education. In terms of mathematics education, computational thinking should be integrated into mathematical thinking, which is an essential component that affects mathematics achievement. Wing (2006) stated that computational thinking is also based on mathematical thinking, considering that the foundations of all sciences are based on mathematics due to the nature of computer science.

The Pearson Product Moment Correlation analysis was performed to determine the relationship between the scores of the scale and sub-factors of the self-efficacy perceptions of the participants towards computational thinking skills and their Science and Technology course scores. Table 14 shows the results of the correlation analysis.

Tablo 14. Correlation analysis results of the participants' self-efficacy perception scores for computational thinking skills regarding Science and Technology course scores

		Science and Technology Course Achievement	F1	F2	F3	F4	F5	Total Scale
Science and Technology Course Achievement	r	1	.171**	.349**	.274**	.036	.247**	.291**
	p		.000	.000	.000	.088	.000	.000
	N	2247	2247	2247	2247	2247	2247	2247

The results of the analyses reveal that there is a statistically significant weak positive relationship between the participants' self-efficacy perception level scores for computational skills and their Science and Technology course scores at p<.05 level (r= .291; p<.05). Considering the sub-factors of the scale, no relationship was found between the scores of the algorithm designing competence (r= .171; p<.05) and basic programming competence (r= .036; p<.05) sub-factors and the scores of the Science and Technology course. A weak relationship was found between the scores of the other sub-factors, namely problem-solving competence (r= .349; p<.05), data processing competence (r= .274; p<.05) and self-confidence competence (r= .247; p<.05), and the Science and Technology course scores.

Even though computational thinking is considered as a concept associated with computer science, it has an organic and strong connection with science and mathematics (Bundy, 2007). Computational thinking plays an essential role in the development of skills such as problem-solving, abstraction, algorithmic thinking, creative thinking, and logical thinking, which are among the basic concepts of computer science and are widely used in mathematics and science (Barr & Stephenson, 2011).

The Ministry of National Education emphasises that science and technology literacy is an important factor in social development by stating that it plays a vital role in students' analytical thinking and questioning, making the right decisions about solving problems and becoming self-confident individuals who can establish correct interactions (MoNE, 2013). The utilisation of interdisciplinary approaches in education stands out as an essential issue that needs to be implemented among educators, and breakthroughs are being made in its implementation (Moye, 2011). The results of the analyses show that there is a positive relationship between the computational thinking skills and sub-factors of Science and Technology teaching and course success. In this sense, in preparing the Science and Technology course curriculum, the selection of content that will increase students' computational thinking skills may positively affect their course success.

The Pearson Product Moment Correlation analysis was performed to determine the relationship between the scores of the scale and sub-factors of the participants' self-efficacy perceptions towards computational thinking skills and their English course scores. Table 15 shows the results of the correlation analysis.

Table 15. Correlation analysis results of the participants' self-efficacy perception scores for computational thinking skills regarding their English course scores

		English Course Achievement	**F1**	**F2**	**F3**	**F4**	**F5**	**Total Scale**
English Course Achievement	r	1	.154**	.297**	.244**	.021	.234**	.258**
	p		.000	.000	.000	.322	.000	.000
	N	2247	2247	2247	2247	2247	2247	2247

The results of the analyses show that there is a statistically significant positive relationship between the participants' self-efficacy perception level scores for computational skills and their English course scores at $p<.05$ level ($r= .258$; $p<.05$). When the sub-factors of the scale were analysed, no statistically significant relationship was found between the perception level scores and English course scores in the sub-factors of algorithm designing competence ($r= .154$; $p<.05$) and basic programming competence ($r= .021$; $p<.05$). In the other sub-factors of problem-solving competence ($r= .297$; $p<.05$), data processing competence ($r= .244$; $p<.05$) and self-confidence competence ($r= .234$; $p<.05$), a statistically weak relationship was found between the perception level scores and English course scores.

Pearson Product Moment Correlation analysis was performed to determine the relationship between the scores of the scale and sub-factors of the self-efficacy perceptions of the participants towards computational thinking skills and Turkish Revolution History and Kemalism course scores. The results of the correlation analysis are given in Table 16.

Table 16. *Correlation analysis results of the participants' self-efficacy perception scores for computational thinking skills according to their scores in Turkish Revolution History and Kemalism course*

		Turkish Revolution History and Kemalism Course Achievement	**F1**	**F2**	**F3**	**F4**	**F5**	**Total Scale**
Turkish Revolution History and Kemalism Course Achievement	r	1	.193**	.307**	.257**	.019	.222**	.274**
	p		.000	.000	.000	.370	.000	.000
	N	2247	2247	2247	2247	2247	2247	2247

The results of the analyses show that there is a statistically significant weak positive relationship at $p<.05$ level between the participants' self-efficacy perception level scores for computational skills and their Turkish

Revolution History and Kemalism course scores (r= .274; p<.05). When the sub-factors of the scale were analysed, no statistically significant relationship was found between the perception level scores in the sub-factors of algorithm designing competence (r= .193; p<.05) and basic programming competence (r= .019; p<.05) and Turkish Revolution History and Kemalism course scores. In the other sub-factors of problem-solving competence (r= .307; p<.05), data processing competence (r= .257; p<.05) and self-confidence competence (r= .222; p<.05), a statistically weak relationship was found between the perception level scores and Turkish Revolution History and Kemalism course scores.

DISCUSSION

The relationship between the self-efficacy perceptions of 8th-grade students towards computational thinking skills and different variables was analysed, and a study was conducted to reveal the variables showing differences. According to the results of the analysis, the mean score of self-efficacy towards computational thinking skills of the sample of 8th-grade students was found to be 80.01, and it was concluded that it was above the mean.

Analysing the mean scores of the participants according to the sub-factors of the scale, it was determined that the mean score of algorithm designing competence was 16.93, the mean score of problem-solving competence was 24.13, the mean score of data processing competence was 16.42, the mean score of basic programming competence was 10.37, and the mean score of self-confidence competence was 12.14. These results suggest that 8th-grade students' self-efficacy perceptions towards computational thinking skills and scale sub-factors are above average. Kukul (2018) concluded that there was no significant difference between the computational thinking skills and self-efficacy of 5th-grade students in his study in which programming instruction was differentiated. Experience is the most crucial factor that increases an individual's self-efficacy perception. Thinking skills are among the skills that are presented and developed in line with the needs of students through activities in which the content is enriched and created (Güneş, 2012). In this regard, it can be said that the implementation of content designed to gain computational thinking skills to increase individuals' self-efficacy in the education and training process is of critical importance at this point.

According to the 8th-grade students' gender variable, it was concluded that their self-efficacy perceptions towards computational thinking skills differed. The self-efficacy perception score for computational thinking skills of female students was found to be 80.39 and 79.61 for male students, and it was concluded that there was a slight difference in favour of female students. It can be said that the 8th-grade students who constitute the sample of this study are adolescents due to their age. In Türkiye, adolescence starts at the ages of 10-12 for girls and 12-14 for boys (Yavuzer, 1994). The development of abstract thinking ability in adolescents has a vital role in increasing problem-solving ability and academic success (Doğan, 2007). From this point of view, it can be said that there is a positive result in the gender variable due to the earlier development of abstract thinking skills of female students who enter adolescence earlier. However, it was concluded that the emergence of different results in the context of gender variables in the studies conducted in the measurement of computational thinking skills was due to the lack of sufficient saturation of the studies conducted on this subject in the relevant literature.

When the sub-factors of the scale were examined in terms of gender variable, it was concluded that the dimensions of problem-solving competence (Factor 2) and data processing competence (Factor 3) showed a significant difference in favour of female students in terms of gender variable. The mean score of problem-solving competence was found to be 24.52 for female students and 23.72 for male students. This result shows that problem-solving competence differs with a low difference in favour of female students in terms of gender variables in 8th-grade students. The mean score of data processing competence was 16.54 for female students and 16.30 for male students. This result shows that problem-solving competence differs with a low difference in favour of female students regarding gender variables in 8th-grade students. Coding education aims to define the current problem and organise the data by dividing the problem into parts and translating them into codes that the computer can analyse (Saeli, 2012). Since data processing is among the steps of problem-solving, it can be concluded that individuals with problem-solving competence also have high data processing skills.

Gender roles of individuals have an effect on technology attitudes (Stein & Nickerson, 2004). In the literature, different findings have emerged in many studies on the relationship between gender and self-efficacy and what kind of changes occur in the teaching process during the acquisition of programming and coding skills (Aşkar & Davenport, 2009; Crews & Butterfield, 2003; Werner et al., 2012; Roman-Gonzalez et al., 2017; Atmatzidou & Demetriadis, 2016). In the determination of the relationship between individuals' self-efficacy perceptions towards computational thinking skills and gender, it is suggested that studying with samples selected from different age groups and grade levels will reveal effective results.

It was found that the participants' self-efficacy perceptions towards computational thinking skills did not differ according to smartphone use. When the sub-factors of the scale were examined in terms of smartphone use variable, it was concluded that there was a significant difference in basic programming competence (Factor 4). As a result, it can be concluded that there is a significant relationship between 8th-grade students' basic programming competencies and smartphone use.

When the relationship between the participants' self-efficacy perceptions towards computational thinking skills and tablet use was examined, it was concluded that there was no significant differentiation. It was also found that there was no significant differentiation between the factors of the scale and tablet use. Accordingly, it is concluded that there is no relationship between 8th-grade secondary school students' self-efficacy perceptions towards computational thinking skills and tablet use.

When the relationship between the participants' self-efficacy perceptions towards computational thinking skills and their daily computer usage time was examined, it was concluded that there was no significant differentiation. Accordingly, it is concluded that there is no relationship between middle school 8th-grade students' self-efficacy perceptions towards computational thinking skills and their daily computer usage time.

As a result of the correlation analysis between the participants' self-efficacy perceptions towards computational thinking skills and their Mathematics course scores, a significant weak positive relationship was found. As a result of the correlation analysis between the sub-factors of the scale and the participants' Mathematics course scores, it was concluded that there was a weak positive relationship between the Mathematics course scores and the sub-factors of Problem-solving competence (Factor 2), Data processing competence (Factor 3) and "Self-confidence competence (Factor 5).

A significant weak positive relationship was found as a result of the correlation analysis between the participants' self-efficacy perceptions towards computational thinking skills and the Science and Technology course scores. When the correlation analysis between the sub-factors of the scale and the Science and Technology course scores of the participants was analysed, it was found that there was a weak positive relationship between the Science and Technology course scores and the sub-factors of Problem-solving competence (Factor 2), Data processing competence (Factor 3) and Self-confidence competence (Factor 5).

As a result of the correlation analysis between the participants' self-efficacy perceptions towards computational thinking skills and their English course scores, a significant weak positive relationship was found. When the correlation analysis between the sub-factors of the scale and the participants' English course scores was analysed, it was found that there was a weak positive relationship between the English course scores and the sub-factors of Problem-solving competence (Factor 2), Data processing competence (Factor 3) and Self-confidence competence (Factor 5).

As a result of the correlation analysis between the participants' self-efficacy perceptions towards computational thinking skills and the scores of the Turkish Revolution History and Kemalism course, a significant weak positive relationship was found. When the correlation analysis was analysed according to the sub-factors of the scale and the scores of the participants in the Turkish Revolution History and Kemalism course, it was found that there was a weak positive relationship between the scores of the Turkish Revolution History and Kemalism course and the sub-factors of problem-solving competence (Factor 2), data processing competence (Factor 3) and self-confidence competence (Factor 5).

CONCLUSION AND RECOMMENDATIONS

It was concluded that there was a relationship between the participants' self-efficacy perceptions towards computational thinking skills in numerical courses such as Mathematics and Science and Technology, which are considered as the basis of computer science, and verbal courses such as Turkish Revolution History and Kemalism, and English, which emphasise language skills. While this result supports that computational thinking skill is a skill related to mental abilities, it plays an important role in the conceptualisation of computational thinking skills by explaining its connection with verbal skills as well as numerical skills (Brennan & Resnick, 2012; Lye & Koh, 2014; Wing, 2006, 2008).

Although computational thinking is usually defined in terms of computer science concepts, the working systems of computers contribute greatly to individuals' problem-solving skills in their daily lives. Therefore, the people who should have computational thinking skills should not only be professionals working in computer science but also individuals from all segments of society (Wing, 2006).

Teaching different ways of thinking will contribute to the development of individuals' learning skills and increase their analytical thinking and problem-solving competencies (Cohen, 1998). For this reason, it is thought that teachers who design and implement learning environments should plan, design, implement and evaluate in line with students' acquisition of these competencies.

In the Tenth Development Plan (2014), the individual profile planned to be raised with the current education system is defined as productive and happy individuals who have developed thinking, perception and problem-solving skills, who have internalised democratic values and national culture, who are open to sharing and communication, who have strong artistic and aesthetic feelings, who have self-confidence and a sense of responsibility, entrepreneurship and innovation, who are prone to the use and production of science and technology, and who are equipped with the basic knowledge and skills required by the information society. The structure of computational thinking skills, which includes problem-solving, technology use, thinking and productivity, supports this definition. With its 21st-century skills, computational thinking skill has taken its place among the skills that individuals who will form the future should have first.

The PISA exam, which is implemented by the Organisation for Economic Cooperation and Development (OECD) and aims to evaluate International Student Achievement, has been held in our country since 2003. PISA is a comprehensive international assessment project that measures whether 15-year-old students in OECD countries have acquired the necessary life skills at the end of compulsory education. The primary purpose of this exam is to measure maths and science literacy levels and problem-solving skills. According to the 2015 PISA exam results, Turkey ranked 52nd among 72 countries. Taş et al. (2016) stated that gains such as solving problems, creating and applying algorithms, using and interpreting data, and using abstract content are among the competencies of the PISA exam. Providing students with computational thinking skills will be influential in their success in the PISA exam.

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