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STEM teaching intention and computational thinking skills of pre-service teachers

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Abstract
The aim of the study is to examine the Science, Technology, Engineering and Mathematics (STEM) teaching intention of science and primary school pre-service teachers in terms of Computational Thinking (CT) skill, gender, grade level, daily computer usage, internet usage, smartphone usage, and the department variables. The study employs the correlational survey model. The participants of this research are 440 pre-service teachers at Van Yüzüncü Yıl University, Turkey. The STEM teaching intention scale, and the CT skill scale were used for data collection. Chi-Squared Automatic Interaction Detector (CHAID) analysis, independent samples t- test, and single factor variance analysis (ANOVA) was used for data analysis. According to the results; CT has the most significant effect in terms of STEM teaching intentions. Department is also another important variable for STEM teaching intentions. STEM teaching intention measures do not differ according to gender, grade level, daily average computer usage, internet usage and smart phone usage.

Keywords STEM teaching intention · Computational thinking · Pre-service teachers

1 Introduction

Today, many countries want to train qualified citizens for being the leader regarding the scientific and technological developments, which is vital for global competition.

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Developed countries realized that education programs play an important role in the training of qualified individuals. Thus, education programs have been updated in line with the requirements of the era. Countries such as the United States of America (USA), Russia, Japan, Canada and Australia have updated their education programs. In recent years, these countries have included STEM (Science, Technology, Engineering and Mathematics) training in their education programs to train qualified citizens (Bybee 2010; Sanders 2009; Thomas 2014). Especially in the USA, the number of individuals graduated from STEM education is not at the desired level. So, it is thought that the USA will not be able to compete with other developed countries (Thomas 2014). Similar to the USA, the other countries mentioned above give importance to STEM education to compete globally.

Many countries that take STEM's important role in providing twenty-first century's skills to individuals have included STEM education in their curriculum (Sanders 2009). For instance, since 2017, STEM education has taken an important part in science and mathematics education in Turkey (Bakırcı and Karışan 2018). Recently, there are several studies on knowledge levels, attitudes and competence of the pre-service teachers and in-service teachers who are the practitioners of the education program.

The literature review in Turkey shows that the awareness of STEM education in science, mathematics and primary school pre-service teachers is insufficient (Bakırcı and Karışan 2018); engineering and design based science education is effective on science pre-service teachers' decision-making and scientific process skills (Bozkurt 2014); STEM education provides individuals to have high-level thinking, critical skills and use the scientific process skills and collaborative learning (Ercan and Şahin 2015). In addition, Bakırcı and Kutlu (2018) concluded that science teachers do not have sufficient knowledge about STEM education; however STEM education helps individuals to solve problems that are encountered in daily life. Similarly, Tarkın-Çelikkıran and Aydın-Günbatar (2017) concluded that STEM education provides an interdisciplinary perspective to pre-service chemistry teachers and makes significant contributions to consolidate chemistry knowledge. On the other hand, Yamak et al. (2014) stated that STEM education increased individual's interest and motivation towards science courses and it has an important role in science education.

On the other hand, a large number of studies in international literature argue that the applicability of a STEM-based education program will be possible only with qualified teachers (Wang 2013); STEM education improve individual's ability to solve problems, enable them learning science concepts (Denson 2011), and increase motivation towards the course. STEM education also has an impact on decision-making (Jonassen 2011); STEM-based education program provides individuals with a guidance to solve problems related to daily life and it enables them to integrate, analyse, interpret data and integrate natural events with each other (Wang 2013).

According to the literature, the importance of STEM education can be understood in training of qualified individuals and it helps countries to be part of the global competitions and to solve daily life problems through practical skills like CT (Computational Thinking). In Turkey, there is a need for teachers/pre-service teachers who know the importance of STEM education and who can apply it effectively. Particularly, pre-service teachers of science and primary school teaching should know the importance of STEM. Because they are teachers who will carry out STEM activities and bring it to students in the near future. The pre-service teachers who are aware of the requirements of the era and who have the necessary skills, updates in education programs will be able to contribute to the development of the country (Bissaker 2014; Cooper 2013). In addition, to the best of our knowledge, there is no research on the relationship between CT skills and awareness of STEM education in Turkey. Therefore, it is important to investigate the relationship between STEM education and CT skills of science and primary school pre-service teachers.

1.1 STEM, CT and their relation

STEM is defined as an interdisciplinary educational approach that includes science, technology, engineering and mathematics. This approach helps to solve problems that individuals face with daily life by establishing a relationship between science, technology, engineering and mathematics (Dugger 2010). In addition, STEM education contributes to the development of qualified citizens, competition of countries in the global market, and development of STEM literacy (Thomas 2014). Furthermore, STEM education has the potential to provide great contribution to individuals' development in accordance with twenty-first century skills.

STEM teaching intention is defined as the willingness of pre-service teachers to use STEM-based teaching in their courses and the desire to teach based on an interdisciplinary holistic approach. Behavior intention related to STEM teaching is comprised of values, knowledge, attitudes, subjective norm, perceived behavior control and behavioral dimensions (Lin and Williams 2016). While the value dimension for STEM includes changes in the evaluation criteria of individuals and self-evaluation, the attitude dimension includes the interest and application of individuals in the teaching of STEM. The knowledge dimension of STEM is the subject matter knowledge of pre-service teachers and teachers. Behavioral control and behavioral orientation dimensions include evaluating and using resources and opportunities efficiently in STEM-based teaching (Kırılmazkaya 2017; Lin and Williams 2016). To explain these two STEM dimensions with one example, it can be explained with the pre-service teachers' willingness to use STEM-based instruction in their studies when they start their work.

Partnership for twenty-first century learning (P21) is an organization with international members. It studies globally to develop educational policies. P21 has created a framework for twenty-first century's learners (P21 Framework for twenty-first Century Learning). According to this, twenty-first century learning outcomes can be examined under four categories (P21 2018). Within this framework, it is seen that two learning outputs, namely, *Learning and Innovation Skills* and *Information*, *Media and Technology Skills*, overlap with the Computational Thinking (CT) skill. According to the International Society for Technology in Education (ISTE) (2018), today's learners should be trained to keep up with the developments in a constantly evolving technological environment. This is only possible with CT which is new literacy of twenty-first century (Wing 2011).

CT can be defined in three ways as generic, operational, and educational-curricular (Román-González et al. 2017). According to the generic definition, CT is a thinking process that involves formulating problems with computational steps and algorithms (Aho 2012). According to the operational definition, an individual who has CT formulates the problem in order to solve it through the use of computers and other tools, such as analysing and editing the data; presenting the data with models and simulations; automate data through algorithmic thinking; identify, analyse and implement possible solutions to achieve the most efficient and effective combination of steps and resources; the process of the problem solving process by following the steps to generalize and/or to transfer into a wide variety of problem situations (ISTE and CSTA 2011). According to the educational-curricular perspective, it is a framework that includes concepts such as CT logic, algorithms, decomposition, patterns, abstraction, and evaluation or computational concepts, computational practices and computational perspectives (Román-González et al. 2017). When we look at the definitions of CT, it can be seen that twenty-first century's individuals should have these skills when solving the problem. CT skills also include creativity, algorithmic thinking, cooperativity, critical thinking, problem solving, and communication skills (Korkmaz et al. 2017).

CT is a skill that is contained by many researches and affects almost all disciplines (Psycharis 2018). The aim of STEM is to make individuals be creative problem-solvers, which is possible by gaining skills like CT (Young 2018). Consequently, CT, which should be at the center of all STEM disciplines (Carbone and Crowder 2017; Grover and Pea 2013), is important for solving various problems, especially in mathematics, science and engineering (Bilbao et al. 2017). When the steps in the operational definition of CT are explored, it can be seen that researchers from science and mathematics disciplines used similar steps (Sengupta et al. 2013). When the STEM implementations are examined, CT taxonomy related to mathematics and science can be introduced. This taxonomy is based on four main dimensions. *Data practices* are about the processing of raw data. *Modeling and Simulation Practices* include situations such as using, evaluating, and generating dynamic computer-generated dynamic models. *Computational Problem-Solving Practices* include situations such as converting encountered problem with computational tools to solvable point, selecting or generating these tools. Finally, *Systems Thinking Practices* are elements to think of a structure according to the system approach (Weintrop et al. 2016). In interviews conducted with STEM practitioners, they had used expressions that cover all these four steps (Beheshti et al. 2017). In addition, one of the indispensable disciplines of STEM education is the technology dimension. CT is a twenty-first century skill related to the use of technology. Therefore, it is expected that individuals with CT skill will have qualifications in using technology. As a result, it is thought that STEM teaching intention of individuals with CT skills will supposed to be higher.

There is a need for further studies focusing on the contribution of CT to STEM learning (English 2017). In the literature, there are studies on CT skills that carry out STEM studies with collaborative learning and Project based learning strategies (Hsu et al. 2018; Young 2018). Recently, the concepts and models such as Computational Thinking Pedagogical Framework (CTPF) (Kotsopoulos et al. 2017) and Computational STEM Pedagogy-CSP (Psycharis 2018) are the steps to be followed for the use of CT in learning environments. Recent studies have revealed that computationally enriched environments have positive effects on science and mathematics courses students (Hutchins et al. 2017; Pollack et al. 2017; Swanson et al. 2017; Swanson et al. 2018; Yasar 2013).

STEM education plays an important role in providing twenty-first century's skills to students. CT is a skill that individuals should have in current era. STEM can support development of CT skill when CT instruction and STEM content is combined and integrated. The use of computational tools can also allow more in-depth learning of STEM content (Jona et al. 2014). Therefore, CT and STEM are two elements that should be considered together.

1.2 Aims

The purpose of this study is to examine the STEM teaching intention of science and primary school pre-service teachers in terms of CT skill and some other related variables. Therefore, the study aims to answer the following research questions.

1. Are STEM teaching intentions of pre-service teachers divided into sub-sections in terms of independent variables (CT, gender, grade level, daily computer usage, internet usage and smartphone usage time, and the department)?
2. Is there a relationship between STEM teaching intention and CT skills for pre-service teachers?
3. Does the STEM teaching intention of pre-service teachers differentiate by gender?
4. Does the STEM teaching intention of pre-service teachers differ according to the department and grade level?
5. Does the STEM teaching intention of pre-service teachers differ according to the daily computer and internet usage time?
6. Does the STEM teaching intention of pre-service teachers differ according to daily smartphone usage?

2 Methodology

2.1 Research design

This research aims to identify STEM teaching intentions and CT skills measurement of pre-service teachers, and to reveal the relationship between the variables. Therefore, the study employed correlational survey design. Correlational design models are used in studies that aim to determine the degree of interchange between two and more variables (Karasar 2009).

2.2 Participants

The participants of this research were 440 pre-service teachers studying at Van Yüzüncü Yıl University during the spring semester of 2017–2018 academic year. Table 1 presents the profile of the participants.

Table 1 The Profile of Participants

		Department		Total
		Elementary Science Education (SE)	Primary School Instruction Education (PE)	
Gender	Female	130	174	304
	Male	40	96	136
Total		170	270	440

2.3 Data collection and instruments

STEM teaching intention scale was adapted by Hacıömeroğlu and Bulut (2016). It was used to measure the STEM teaching intentions of pre-service teachers. It is a 7-point Likert Style Scale composed of 31 items and has five factors. Cronbach alpha reliability coefficient is 0.94. The coefficients for subscales are as follows: Knowledge ($\alpha = 0.93$), Value ($\alpha = 0.86$), Attitude ($\alpha = 0.87$), Subjective criteria ($\alpha = 0.69$), Perceived behaviour control and Behaviour attitude ($\alpha = 0.86$). This five-factor structure explains 63.09% of the total variance. According to the confirmatory factor analysis results, the fit index values obtained respectively X^2/sd = 4.15; RMSEA = 0.09; GFI = 0.88; AGFI = 0.81; CFI = 0.93; NNFI = 0.91; NFI = 0.90; RMR = 0.07; SRMR = 0.07.

The Computational Thinking Skills Scale developed by Korkmaz et al. (2017) was used to assess CT skills of pre-service teachers. It is a 5 point Likert style scale with 29 items and 5 factors. The Cronbach alpha reliability coefficient is 0.82. The reliability coefficients for subscales are as follows: Creativity ($\alpha = 0.84$), Algoritmic thinking ($\alpha = 0.87$), Cooperativity ($\alpha = 0.87$), Critical thinking ($\alpha = 0.78$), Problem solving ($\alpha = 0.727$). The scale explains 56.12% of the total variance. According to confirmatory factor analysis results, goodness of fit values are X^2/sd < 3; 0 < RMSEA<0.05; 0 < S-RMR < 0.05; 0.97 < NNFI<1; 0.97 < CFI < 1; 0.95 < GFI < 1; 0.95 < AGFI<1; 0.95 < IFI < 1. Factor loading values are between 0.842 to 0.494.

2.4 Data analysis

CHAID analysis was used to understand whether STEM attitude measurements of participants were divided into subdivisions in terms of CT skills, gender, department, grade level, duration of computer, internet and smart phone usage. CHAID analysis is a statistical method which allows the participants to be divided into subgroups in terms of the dependent variable. The subgroups are not predetermined. Based on the measurement results of the dependent variable, similar subgroups are formed. In addition, the relationship between CT ability and STEM attitude was determined by the Pearson correlation coefficient. Moreover, independent sample t- test and single factor variance analysis (ANOVA) was used to compare the independent variables.

3 Findings

The results will be presented in order with the research questions.

> **RQ1:** Are STEM teaching intentions of pre-service teachers divided into subsections in terms of independent variables?

The research tested whether the pre-service teachers were divided into subdivisions regarding CT skills, gender, department of study, grade level, daily average computer, the internet and smartphone usage time. CHAID analysis was conducted. The results of this analysis are presented in Fig. 1.

The model in Fig. 1 shows the results of STEM teaching intention measurement. It can be seen that the CT has the most significant effect in terms of STEM teaching

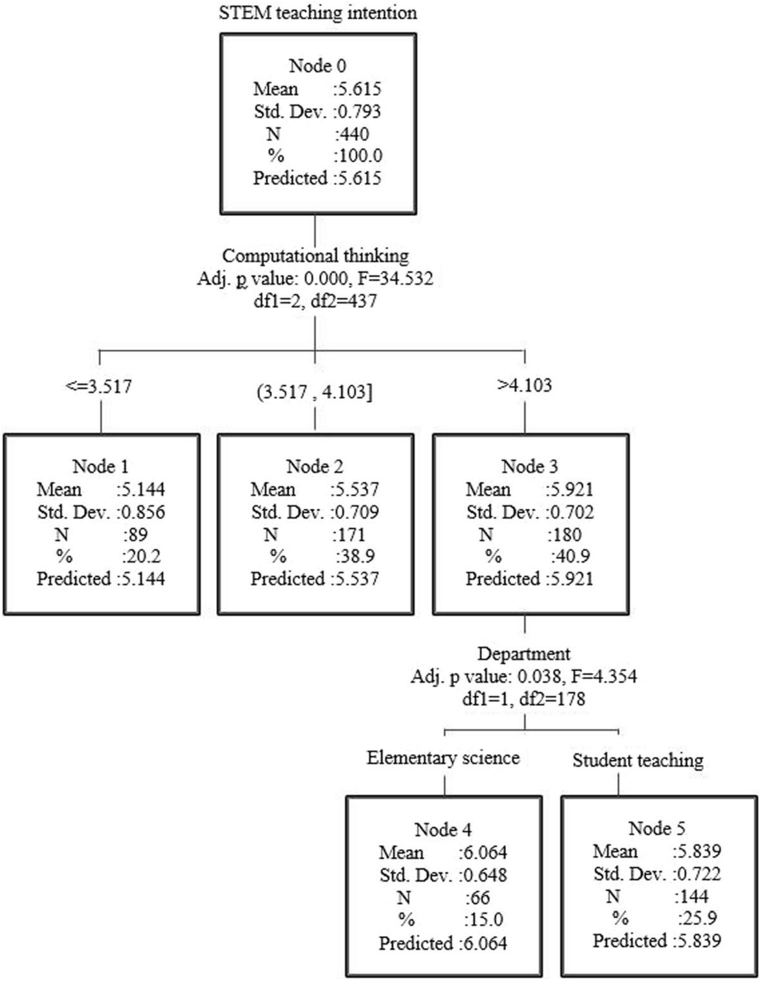

Fig. 1 CHAID analysis scheme showing the relationship between STEM teaching intentions results and CT and other demographic characteristics

intentions. According to CT measurements, pre-service teachers were categorised under three subgroups. These three groups differ significantly from each other ($F_{(2,437)} = 34.532$, $p < 0.001$). The STEM teaching intention average of the 20.2% of the first group was $\bar{x}$=5.144, the 38.9% of the second group was $\bar{x}$=5.537, and the 40.9% of the third group was $\bar{x}$=5.921. In the third group, pre-service teachers show a significant difference according to the department they study ($F_{(1,178)} = 4.354$, $p < 0.05$). The

Table 2 t-test results of STEM teaching intention measurements by gender

Gender	N	$\bar{x}$	S	sd	t	p
Female	304	5.64	0.78	438	0.905	0.366
Male	136	5.56	0.82			

Table 3 T-test results of STEM teaching intention measurements according to the department

Department	N	$\bar{x}$	S	sd	t	p
SE	170	5.71	0,73	438	2.000	0.046*
PE	270	5.56	0,82			

$*p < 0.05$

STEM teaching intention average score of the pre-service teachers in science education is collected in a group with $\bar{x}$=6.064 average, and the scores of the pre-service teachers in the primary education department are collected in another group with $\bar{x}$=5.839 average score.

The other variables taken into account as independent variables within the scope of analysis (i.e., gender, grade level, daily average computer internet and smart phone use) were not included in the model because they did not provide comparative results in terms of STEM teaching intention.

> **RQ2:** Is there a relationship between STEM teaching intention and CT skills for pre-service teachers?

There is a moderate relationship between STEM teaching intentions and CT skills ($r = 0.373$) at a significance level of 0.001 (Table 2).

> **RQ3:** Does the STEM teaching intention of pre-service teachers differentiate by gender?

STEM teaching intentions of pre-service teachers did not differ significantly by gender ($t_{(438)} = 0.905$, $p > 0.05$).

> **RQ4:** Does the STEM teaching intention of pre-service teachers differ according to the department and grade level?

STEM teaching intention findings are given in Table 3 according to the department of pre-service teachers.

Table 4 Descriptive statistics of STEM teaching intentions measurements by grade level

Grade levels	N	%	$\bar{x}$	Ss
Freshmen	84	19,1	5.52	0.98
Sophomore	104	23,6	5.59	0.77
Junior	146	33,2	5.62	0.71
Senior	100	22,7	5.67	0.76
5th Year	6	1,4	6.16	0.67
Total	440	100,0	5.61	0.79

Table 5 ANOVA results of STEM teaching intentions measurements by grade level

	Sum of Squares	df	Mean Square	F	p
Between Groups	2.946	4	0.737	1.174	0.322
Within Groups	272.982	435	0.628		
Total	275.929	439			

STEM teaching intentions of the pre-service teachers showed a significant difference according to the department ($t_{(438)} = 2.000$, $p < 0.05$). STEM teaching intention levels ($\bar{x}$= 5.71) of Science Education Department pre-service teachers were significantly higher than those in the Primary Education Department ($\bar{x}$= 5.56).

The descriptive statistics of the STEM teaching intention measurements of pre-service teachers according to the grade level are presented in Table 4. The results of ANOVA are presented in Table 5.

The results of the analysis indicate that the STEM teaching intentions of the pre-service teachers did not differ significantly by the grade level ($F_{(4,\ 435)} = 1.174$, $p > 0.05$).

RQ5: Does the STEM teaching intention of pre-service teachers differ according to the daily computer and internet usage time?

Descriptive statistics analysis of pre-service teachers' STEM teaching intention measurements according to daily computer usage time are presented in Table 6. ANOVA results are presented in Table 7.

STEM teaching intentions of pre-service teachers did not differ significantly according to daily computer usage time ($F_{(8,\ 431)} = 0.849$, $p > 0.05$).

The descriptive statistics of the STEM teaching intention measurements according to the daily internet usage time are presented in Table 8. ANOVA results are presented in Table 9.

Table 6 Descriptive statistics of STEM teaching intentions measurements based on daily computer usage time

Daily computer usage time	N	%	$\bar{x}$	Ss
Less than 1 h	300	68.2	5.62	0.80
1 h	52	11.8	5.69	0.73
2 h	50	11.4	5.67	0.70
3 h	15	3.4	5.53	0.56
4 h	13	3.0	5.40	1.10
5 h	5	1.1	4.90	1.48
6 h	2	0.5	5.97	0.55
7 h	1	0.2	5.06	–
More than 7 h	2	0.5	5.82	0.62
Total	440	100.0	5.61	0.79

Table 7 ANOVA results based on the daily computer usage time of STEM teaching intentions measurements

	Sum of Squares	df	Mean Square	F	p
Between Groups	4.283	8	0.535	0.849	0.560
Within Groups	271.646	431	0.630		
Total	275.929	439			

The results of single-factor analysis of variance for the unrelated measurements show that there is no difference in daily internet usage time among participants' STEM teaching intentions ($F_{(8, 431)} = 1.450$, $p > 0.05$).

- **RQ6:** Does the STEM teaching intention of pre-service teachers differ according to daily smartphone usage?

Descriptive statistics of participants' STEM teaching intention measurements based on daily smart phone usage time are presented in Table 10. ANOVA results are presented in Table 11.

STEM teaching intentions of participants did not differ significantly by daily average smart phone usage time ($F_{(8, 431)} = 1.485$, $p > 0.05$).

Table 8 Descriptive statistics of STEM teaching intentions measurements based on daily internet usage time

Daily internet usage	N	%	$\bar{x}$	Ss
Less than 1 h	27	6.1	5.54	1.34
1 h	34	7.7	5.71	0.83
2 h	78	17.7	5.72	0.86
3 h	93	21.1	5.52	0.64
4 h	81	18.4	5.80	0.49
5 h	57	13.0	5.46	0.81
6 h	20	4.5	5.41	1.17
7 h	8	1.8	5.66	0.52
More than 7 h	42	9.5	5.56	0.70
Total	440	100.0	5.61	0.79

Table 9 ANOVA results according to daily average internet usage time of STEM teaching intentions measurements

	Sum of Squares	df	Mean Square	F	p
Between Groups	7.233	8	0.904	1.450	0.174
Within Groups	268.696	431	0.623		
Total	275.929	439			

Table 10 Descriptive statistics of STEM teaching intentions measurements based on daily smartphone usage time

Daily smartphone usage	N	%	$\bar{x}$	Ss
Less than 1 h	13	3.0	5.37	1.23
1 h	26	5.9	5.71	1.05
2 h	51	11.6	5.94	0.67
3 h	72	16.4	5.58	0.75
4 h	75	17.0	5.57	0.81
5 h	56	12.7	5.52	0.82
6 h	47	10.7	5.58	0.67
7 h	28	6.4	5.51	0.97
More than 7 h	72	16.4	5.61	0.65
Total	440	100.0	5.61	0.79

4 Conclusion and discussion

This research aimed to investigate the STEM teaching intention of science and primary school pre-service teachers in terms of CT skill and some other related variables, and the relation between STEM teaching intentions and CT. It was found that STEM teaching intention measurements of participants were divided into independent sub-sections which were taken into consideration in terms of the independent variables of CT and the department of pre-service teachers (see Fig. 1). CHAID analysis showed that CT has the most significant effect on STEM teaching intention. CT is an important skill for problem solving and it affects all disciplines (Psycharis 2018), including STEM (Bilbao et al. 2017; Carbone and Crowder 2017; Grover and Pea 2013; Sengupta et al. 2013; Young 2018). Therefore, it is very reasonable to argue that CT is the most important variable for STEM teaching intentions. The other variable that has an important effect on STEM teaching intention is the department. Participants from two different departments were included in this research. When the science and primary pre-service teachers' STEM teaching intentions were compared, the results were more in favour of science pre-service teachers. This can be explained with the fact that science teachers take more STEM related courses at the university. Furthermore, they take teaching methods courses with STEM focus. Additionally, science teachers participate in STEM implementations in physics, chemistry, and biology laboratory classes, which could indirectly influence this situation. It can be argued that the research on this field is limited and the findings of this research echoes the results of

Table 11 ANOVA results of STEM teaching intentions based on average daily smartphone usage time

	Sum of Squares	df	Mean Square	F	p
Between Groups	7.404	8	0.925	1.485	0.160
Within Groups	268.525	431	0.623		
Total	275.929	439			

the previous studies. For instance, the work of Karışan and Bakırcı (2018) showed that STEM teaching intentions of science and primary school pre-service teachers are higher than math pre-service teachers. A moderate significant relationship was found between STEM teaching intention and CT skills scores. The individuals with CT skills have similar STEM teaching intentions and individuals who have low CT skills have low STEM teaching intentions.

STEM teaching intentions of pre-service teachers did not show a significant difference by gender (see Table 1). This finding also confirms the results of CHAID analysis. STEM teaching intention measurements of participants did not constitute homogeneous subgroups according to gender. This may result from the fact that the participants have taken the same courses and lectures. From this point of view, future research can compare the STEM teaching intentions of pre-service teachers from different universities in terms of gender. When the related literature is examined, the research of Bakırcı and Karışan (2018) showed that STEM awareness of pre-service teachers did not differ by gender. Similarly, Aydın et al. (2018) reported that the level of engineering knowledge of secondary school students (grades 4 and 5) did not differ by gender whereas it showed significant differences in favour of female students of 6th and 8th grade. Tekerek and Karakaya (2018) found that there was no significant relationship between STEM awareness and gender in their research with science pre-service teachers. The research focusing the relationship between STEM education and gender found no significant difference; however, in some studies, there was a significant difference. In this study, there was no significant difference between the male and female pre-service teachers' STEM teaching intentions, which again echoes the results of the several research studies.

The STEM teaching intentions of science and primary school pre-service teachers were found to be in favour of science pre-service teachers (Table 3). Science pre-service teachers' STEM teaching intentions are higher than primary school pre-service teachers' and this finding is confirmed by CHAID analysis results. Pre-service teachers with high CT skills ($\bar{x}$> 4.103) are grouped in different subsets (see Fig. 1). On the other hand, it was found that there was no significant difference between the pre-service teachers' STEM teaching intentions and grade level (Tables 4 and 5). It is thought that the differentiation in terms of the department may due to the fact that science teachers took more science and mathematics courses in both high school and university. Since science teachers are more interested in mathematics and science courses, they have chosen to study STEM. Bakırcı and Karışan (2018) found that science teachers had the highest awareness, and this was followed by mathematics and primary school pre-service teachers. This is an expected result as STEM education has been part of the Science and Mathematics Courses since 2017 (Bakırcı and Kutlu 2018).

Finally, regarding other variables focused on, it was found that there was no significant difference between participants' daily computer, internet and smart phone usage time and their STEM teaching intentions. This suggests that there is no correlation between participants' STEM teaching intentions and their computer, internet and smartphone usage time. Although computer, internet and smartphone usage are directly related to technology, which is one of the four basic components of STEM, it has been found that these variables do not influence STEM teaching intentions of participants. There are two approaches to STEM education. First one is the holistic approach which is based on four basic disciplines. According to this approach, STEM education should teach at least two disciplines in one subject (Bybee 2010; Sanders 2009; Smith and Karr-Kidwell 2000). In this study, although computer, internet and smart phone usage were associated with STEM technology component, it was revealed that it did not have any effect on STEM teaching intentions of participants. Because the nature of today's problems is multidisciplinary, it requires the adoption of interdisciplinary approaches in the solution of these problems (Roehrig et al. 2012; Sanders 2009). The second approach is traditional STEM education. Traditional STEM education teaches science, technology, engineering and mathematics as four separate fields and approaches these fields independently. According to this approach, although STEM is a holistic approach, sometimes it is very difficult to include four basic disciplines in activities. What important here is to enable students to learn four disciplines of STEM in relation with other disciplines (Moore et al. 2014; Yılmaz et al. 2017). This research showed that pre-service teachers' STEM teaching intentions did not align with the traditional STEM education instead they adopted a holistic approach to STEM education.

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