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# Examining the Relationship between Computational Thinking and Participation Styles in Instructional Discussions

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## Abstract

This study investigated whether computational thinking skills and participation styles in online instructional discussions differ according to faculty, class, and gender and examined the relationship between computational thinking skills and participation styles in online instructional discussions. A total of 249 teacher candidates from five faculties participated in the study. Most of the participants were female (73.5%). The study collected data using the "Computational Thinking Skills Scale," "Participation Styles in Online Instructional Discussions Scale," and a demographic information form. According to the results obtained for computational thinking skills, statistically significant differences were found in the variables of faculty, class, and gender. Regarding the results obtained for participation styles in online instructional discussions, statistically significant differences were found in the variables of faculty and gender. Additionally, a statistically significant positive moderate relationship was revealed between the scores of computational thinking skills and participation styles in online discussions.

## Introduction

Computational thinking skills are considered one of the most important skills of the 21st century. They are defined as the ability to use fundamental concepts of computer science to solve problems, design systems, and understand human thought (Wing, 2006). With this skill, individuals can follow a series of steps to solve a problem (algorithmic thinking), break the problem down into smaller and manageable parts (decomposition), identify and generalize patterns (abstraction), and represent the solution efficiently (data representation) (Barr & Stephenson, 2011). Computational thinking equips individuals with the ability to solve everyday problems more systematically and effectively, thereby having the potential to develop analytical thinking, logical reasoning, and creative problem-solving skills in students and teacher candidates within the field of education (Lye & Koh, 2014). It is even stated that this skill enhances students' creativity and innovation abilities (Yadav et al., 2016). Thus, it is believed to help teacher candidates improve their learning processes, understand complex topics, organize information, and draw meaningful conclusions, ultimately making them more equipped to navigate the rapidly changing technological world.

The development of computational thinking skills aids teacher candidates in enhancing their problem-solving, critical thinking, collaboration, and communication abilities (ISTE, 2016), not only in technology and instructional technology-related fields but across all disciplines. As Wing (2008) pointed out, this skill enables students to perform better in STEM (Science, Technology, Engineering, Mathematics). Additionally, since it helps establish interdisciplinary connections, the applicability of computational thinking skills in various fields, such as mathematics, science, and social sciences, is noted (Yadav et al., 2016). Different educational areas, such as robotics programming education (Pala & Mıhçı Türker, 2021) and algorithm education (Türker & Pala, 2020), are said to impact computational thinking skills. Therefore, integrating computational thinking skills into educational curricula and conducting more research on this topic is necessary (Shute et al., 2017). From this point of view, examining computational thinking skills is gaining importance in the field of education, especially to enable teacher candidates to keep up with technological developments, be equipped against global competition, meet future professional needs, possess the ability to work interdisciplinary, and produce innovative solutions. Hence, determining abilities such as computer usage, algorithmic and analytical thinking, creative problem solving, collaboration, and critical thinking (Dolmacı & Akhan, 2020) are thought to contribute to the literature.

Students, primarily due to mitigating the effects of the COVID-19 pandemic and developing Web 2.0 technologies, have begun spending more time in remote and online learning environments (Daniel, 2020; Toquero, 2020). Ally (2004) defined online learning as accessing learning materials and content, interacting with teachers and students, supporting students, constructing personal meaning to acquire knowledge, and enhancing the learning experience conducted in internet-based environments (Pala & Erdem, 2020). One of the significant components of online learning environments is online discussions. Online discussions allow students to share their thoughts, explore different perspectives, and experience collaborative learning (Xie, 2013). Online discussion environments can be considered tools for students to express themselves and engage in social communication because they enable detailed discussions on a given topic and offer user-controlled environments (Pala & Erdem, 2020). Participation styles in online discussions reflect students' interactions and communication forms in online learning environments (Hew & Cheung, 2012). Active participation in online discussions enhances their critical thinking abilities (Richardson & Ice, 2010). Participants exhibit different characteristics in terms of whether they choose to participate in the online discussion environment, reasons for participation, and stills of participation. Therefore, understanding why and how students participate in online instructional discussions is gaining importance. Pala and Erdem (2020) defined the "reason" dimension of participation styles with their scale as the reasons for students' participation motives or motivations in online discussion environments and the "how" dimension as the forms or behaviors of participation. Considering this information, it is anticipated that there may be a relationship between participation styles in online discussions and computational thinking skills. Additionally, examining the impact of demographic variables such as the faculty, class, and gender of the students on this relationship is expected to benefit both students and educators.

It is considered that the class in which students are enrolled will affect their computational thinking skills and participation styles in online discussions. The class level in which a student is enrolled can be considered a factor reflecting their knowledge, experiences, and academic maturity. Indeed, Korucu et al. (2017), in their research, indicated that participants' levels of computational thinking skills showed significant differences according to their class levels. Considering that students in the upper class are exposed to more course content, make more meaningful use of technological developments, and work on more comprehensive projects, their computational thinking skills are expected to be more developed. However, the fact that young students have a greater tendency towards technology and higher digital literacy skills (Prensky, 2001) is one of the indicators of how important it is to examine this variable. Similarly, upper-class students with more experience in online learning environments are expected to have higher levels of online participation. However, in their studies, Ke and Xie (2009) indicated a negative correlation between online participation and age. Considering this information, it can be said that class level is a factor in computational thinking and online participation.

Gender can show differences in computational thinking skills and participation styles in online discussions. Some studies suggest that male students have higher computational thinking skills (Atmatzidou & Demetriadis, 2016; Lei et al., 2020), while some studies indicate no significant difference between genders (Korucu et al., 2017; Alsancak, 2020), and some studies state that female students have higher computational thinking skills compared to males (Sun et al., 2023). A similar situation exists regarding gender and participation in online discussions. While some studies indicate that females participate more in online discussions (Caspi et al., 2008; Wang et al., 2023), some studies show that males participate more (Aguillon et al., 2020). Females may generally have stronger communication and social skills, enabling them to play a more active role in online discussions. Alternatively, males' tendency towards technological developments may have played a role in their participation in online discussions. Therefore, examining the gender variable is becoming important both in terms of computational thinking skills and online participation.

According to the above information, this study examined the relationship between computational thinking skills and participation styles in online instructional discussions while also investigating the role of demographic variables such as the faculty, class, and gender of the students. The aim of the study is to understand the relationship between computational thinking skills and participation styles in online discussions and to identify the factors shaping this relationship.

### Research Questions

To address the aim of the study, the following research questions were posed:

1. Do computational thinking skills differ according to faculty, class, and gender?
2. Do participation styles in online instructional discussions differ according to faculty, class, and gender?
3. Is there a significant relationship between computational thinking skills and participation styles in online instructional discussions?

## Method

### Research Model

This study, aiming to examine the relationship between teacher candidates' computational thinking skills and participation styles in online instructional discussions, is a case study using a descriptive method. An explanatory case study type, which is one of the social scientific research methods, was used within the scope of the study (Aytaçlı, 2012). In case studies, quantitative, qualitative, or mixed methods can be used (Flyvbjerg, 2011). In this study, a form was used to collect demographic data of the participants, and scales were utilized to determine computational thinking skills and participation styles in online discussions. Descriptive statistics are methods that allow the summarization of data and the description of their basic characteristics (Büyüköztürk, 2011).

**Sampling**

Participants were selected using an accessible sampling method within the scope of the study (Asiamah et al., 2017). Accessible sampling is a sampling method consisting of individuals who are reachable by the researcher and willing to participate in the study (Fraenkel et al., 2012).

**Participants**

A total of 249 teacher candidates from different departments studying at university during the 2023-2024 academic year participated in the study. Of the participants, 73.5% were female (n = 183), and 26.5% were male (n = 66). The participants ranged from 19 to 43, with an average age of 22.4. Detailed distributions of the participants' demographic characteristics are provided in Table 1.

Table 1. Participants' Demographic Data

| Faculty | Department | Gender | | | | Class | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | | Female | | Sophomore | | Junior | | Senior | | Graduated | | | |
| | | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| Faculty of Arts and Science | Turkish Language and Literature | 5 | 3.7 | 30 | 22.1 | 0 | 0.0 | 6 | 4.4 | 22 | 16.2 | 7 | 5.1 | 35 | 14.1 |
| | Mathematics | 14 | 10.3 | 21 | 15.4 | 0 | 0.0 | 2 | 1.5 | 29 | 21.3 | 4 | 2.9 | 35 | 14.1 |
| | Sociology-Philosophy | 0 | 0.0 | 23 | 16.9 | 0 | 0.0 | 0 | 0.0 | 7 | 5.1 | 16 | 11.8 | 23 | 9.2 |
| | History | 5 | 3.7 | 14 | 10.3 | 0 | 0.0 | 0 | 0.0 | 8 | 5.9 | 11 | 8.1 | 19 | 7.6 |
| | English Language and Literature | 4 | 2.9 | 11 | 8.1 | 0 | 0.0 | 0 | 0.0 | 7 | 5.1 | 8 | 5.9 | 15 | 6.0 |
| | Biology | 4 | 2.9 | 5 | 3.7 | 0 | 0.0 | 0 | 0.0 | 6 | 4.4 | 3 | 2.2 | 9 | 3.6 |
| | Total | 32 | 23.5 | 104 | 76.5 | 0 | 0.0 | 8 | 5.9 | 79 | 58.1 | 49 | 36.0 | 136 | 54.6 |
| Faculty of Education | Classroom Education | 5 | 6.7 | 33 | 44.0 | 36 | 48.0 | 1 | 1.3 | 1 | 1.3 | 0 | 0.0 | 38 | 15.3 |
| | Elementary Mathematics Education | 2 | 2.7 | 13 | 17.3 | 15 | 20.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 15 | 6.0 |
| | Turkish Education | 3 | 4.0 | 5 | 6.7 | 8 | 10.7 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 8 | 3.2 |
| | English Education | 5 | 6.7 | 2 | 2.7 | 7 | 9.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 7 | 2.8 |
| | Art Education | 1 | 1.3 | 6 | 8.0 | 7 | 9.3 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 7 | 2.8 |

| Faculty | Department | Gender | | | | Class | | | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | | Female | | Sophomore | | Junior | | Senior | | Graduated | | | |
| | | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| | Total | 16 | 21.3 | 59 | 78.7 | 73 | 97.3 | 1 | 1.3 | 1 | 1.3 | 0 | 0.0 | 75 | 30.1 |
| Faculty of Sports Sciences | Trainer Education | 11 | 35.5 | 6 | 19.4 | 0 | 0.0 | 3 | 9.7 | 8 | 25.8 | 6 | 19.4 | 17 | 6.8 |
| | Sports Management | 6 | 19.4 | 8 | 25.8 | 0 | 0.0 | 4 | 12.9 | 4 | 12.9 | 6 | 19.4 | 14 | 5.6 |
| | Total | 17 | 54.8 | 14 | 45.2 | 0 | 0.0 | 7 | 22.6 | 12 | 38.7 | 12 | 38.7 | 31 | 12.4 |
| Faculty of Tourism | Tourism Guidance | 0 | 0.0 | 4 | 100.0 | 0 | 0.0 | 2 | 50.0 | 2 | 50.0 | 0 | 0.0 | 4 | 1.6 |
| | Total | 0 | 0.0 | 4 | 100.0 | 0 | 0.0 | 2 | 50.0 | 2 | 50.0 | 0 | 0.0 | 4 | 1.6 |
| Faculty of Health Sciences | Emergency Aid and Disaster Management | 1 | 33.3 | 2 | 66.7 | 0 | 0.0 | 0 | 0.0 | 2 | 66.7 | 1 | 33.3 | 3 | 1.2 |
| | Total | 1 | 33.3 | 2 | 66.7 | 0 | 0.0 | 0 | 0.0 | 2 | 66.7 | 1 | 33.3 | 3 | 1.2 |
| | General Total | 66 | 26.5 | 183 | 73.5 | 73 | 29.3 | 18 | 7.2 | 96 | 38.6 | 62 | 24.9 | 249 | 100.0 |

Upon examining Table 1, it is seen that there are 15 different departments across five faculties. A total of 136 students from the Faculty of Arts and Sciences participated in the study. The students study in departments such as Turkish Language and Literature (n=35), Mathematics (n=35), Sociology-Philosophy (n=23), History (n=19), English Language and Literature (n=15) and Biology (n=9). Approximately half of all participants, 54.6%, were students of the Faculty of Arts and Sciences; 23.5% were male, 76.5% were female, and 58.1% of the students were in their final year. In the Faculty of Education, 75 teacher candidates participated in the study. The students study in the departments of Classroom Education (n=38), Elementary Mathematics Education (n=15), Turkish Education (n=8), English Education (n=7), and Art Education (n=7). 30.1% of all participants are students of the Faculty of Education; 21.3% are male, and 78.7% are female, with almost all sophomores (97.3%). In the Faculty of Sports Sciences, a total of 31 teacher candidates participated in the study, studying in the departments of Trainer Education (n=17) and Sports Management (n=14). 12.4% of all participants are students of the Faculty of Sports Sciences; 54.8% are male, and 45.2% are female, with the majority being in the final year or graduated (38.7%). Four (1.6%) and three (1.2%) teacher candidates participated from the Faculties of Tourism and Health Sciences, respectively.

**Data Collection Tools**

In the study, the "Computational Thinking Skills Scale (CTSS)" and the "Participation Styles in Online Instructional Discussions Scale (PSOIDS)" were used to collect data. Additionally, the researcher prepared a survey form to obtain the participants' demographic information. The CTSS was developed by Akhan and Dolmacı (2020) for undergraduate students. The scale consists of a total of 40 items on a 5-point Likert scale. The reliability coefficients of the five sub-dimensions of the scale range between .74 and .91. The Cronbach's alpha reliability coefficient of the scale was found to be .94.

The PSOIDS was developed by Pala and Erdem (2020). The scale consists of 32 items on a 5-point Likert scale. It comprises two sub-dimensions named "Why" (14 items) and "How" (18 items). The "Why" sub-dimension consists of items expressing participants' primary motivations or reasons for joining online instructional environments, while the "How" sub-dimension consists of items related to participation forms or behaviors. The reliability coefficients of the sub-dimensions of the scale range between 0.70 and 0.85. The overall Cronbach's alpha reliability coefficient of the scale is reported as .89.

A Demographic Information Survey form, prepared by the researcher, was used to obtain demographic information such as gender, age, educational status, department, and class level of the participants.

**Data Analysis**

The normality of the data obtained in the study was examined using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Since it was determined that the data did not follow a normal distribution, non-parametric tests were applied. The Kruskal-Wallis H test determined the differences in computational thinking skills and participation styles according to faculty and class variables. The Mann-Whitney U test was used to determine the differences in computational thinking skills and participation styles according to the gender variable. Spearman’s Rho correlation analysis examined the relationship between computational thinking skills and participation styles in online instructional discussions.

## Results

### Findings Related to the Computational Thinking Skills Scale

To determine whether the variables of faculty, class, and gender differ according to computational thinking skills and their sub-dimensions, Kruskal-Wallis H and Mann-Whitney U tests were applied. The statistical tables related to each of the variables are provided below.

Table 2. CTSS Scores by Faculty Variable - Kruskal-Wallis H Test

| Groups (Faculty) | N | Computer Usage Skills | Algorithmic-Analytical Thinking Skills | Creative Problem-Solving Skills | Collaboration Skills | Critical Thinking Skills | Scale General |
|---|---|---|---|---|---|---|---|
| Faculty of Education | 75 | 105.75 | 128.73 | 103.8 | 120.22 | 110.79 | 109.84 |
| Faculty of Arts and Science | 136 | 133.14 | 124.15 | 131.82 | 122.78 | 130.09 | 128.88 |
| Faculty of Sport Sciences | 31 | 133.00 | 121.73 | 142.95 | 143.48 | 131.37 | 140.61 |
| Faculty of Tourism | 4 | 126.00 | 86.75 | 168.88 | 102.25 | 136.00 | 123.25 |
| Faculty of Health Sciences | 3 | 153.00 | 155.33 | 102.00 | 184.33 | 169.17 | 169.33 |
| Total | 249 | | | | | | |

| Groups (Faculty) | N | Computer Usage Skills | Algorithmic-Analytical Thinking Skills | Creative Problem-Solving Skills | Collaboration Skills | Critical Thinking Skills | Scale General |
|---|---|---|---|---|---|---|---|
| $X^2$ | | 8.147 | 1.948 | 11.469 | 4.965 | 5.121 | 6.312 |
| *df* | | 4 | 4 | 4 | 4 | 4 | 4 |
| *P* | | 0.086 | 0.745 | 0.022* | 0.291 | 0.275 | 0.177 |

* p < .05

As can be seen from Table 2, to determine whether there is a significant difference in the scale's mean rankings based on the faculty variable, a Kruskal-Wallis H test was conducted. A statistically significant difference was found in the "Creative Problem-Solving Skills" sub-dimension of the scale ($\chi^2$=11.469; df=4; p=.022). Subsequently, the Mann-Whitney U test was used to identify which groups contributed to this significant difference. The analysis revealed that the significant difference favored the Faculty of Arts and Science over the Faculty of Education (U=3934.00; z=-2.751; p=.006) and the Faculty of Sports Sciences over the Faculty of Education (U=813.500; z=-2.427; p=.015).

Compared with Table 1, it was observed that most students in the Faculty of Arts and Science and the Faculty of Sports Sciences who showed significant differences in the "Creative Problem-Solving Skills" sub-dimension were senior or graduated. In contrast, almost all students in the Faculty of Education were sophomores. This suggests that Faculty of Education students may not yet have sufficient experience, and their problem-solving skills related to instructional issues may be more limited compared to those in the upper classes.

Table 3. CTSS Scores by Class Variable - Kruskal-Wallis H Test

| Groups (Class) | N | Computer Usage Skills | Algorithmic-Analytical Thinking Skills | Creative Problem-Solving Skills | Collaboration Skills | Critical Thinking Skills | Scale General |
|---|---|---|---|---|---|---|---|
| Sophomore | 73 | 108.40 | 131.38 | 103.49 | 123.36 | 111.66 | 112.73 |
| Junior | 18 | 119.78 | 110.44 | 143.44 | 121.92 | 141.39 | 122.78 |
| Senior | 96 | 130.85 | 136.05 | 135.06 | 131.77 | 130.57 | 136.67 |
| Graduate | 62 | 136.99 | 104.60 | 129.40 | 117.34 | 127.32 | 122.02 |
| Total | 249 | | | | | | |
| $X^2$ | | 6.496 | 8.554 | 9.829 | 1.630 | 4.119 | 4.764 |
| *df* | | 3 | 3 | 3 | 3 | 3 | 3 |
| *P* | | 0.090 | 0.036* | 0.020* | 0.653 | 0.249 | 0.190 |

* p < .05

As seen from Table 3, a Kruskal-Wallis H test was conducted to determine whether the mean rankings of CTSS scores differ significantly according to the class variable. The results revealed statistically significant differences in the sub-dimensions of Algorithmic-Analytical Thinking Skills ($\chi^2$=8.554; df=3; p=.036) and Creative Problem-Solving Skills ($\chi^2$=9.829; df=3; p=.020) of the scale. Additionally, significant differences were found in the overall scale ($\chi^2$=27.780; df=14; p=.015). Following this, the Mann-Whitney U test, a non-parametric comparison technique, was used to identify which groups contributed to the significant differences identified by the Kruskal-Wallis H test.

As a result of the analyses, significant differences in the Algorithmic-Analytical Thinking Skills sub-dimension were found between sophomore and graduated groups, favoring the sophomore group (U=1758.00; z=-2.232; p=.026) and between the senior and graduated groups favoring the senior group (U=2243.50; z=-2.611; p=.009). In the Creative Problem-Solving Skills sub-dimension, significant differences were found between the sophomore and senior groups, favoring the senior group (U=2627.00; z=-2.788; p=.005) and between the sophomore and graduated groups favoring the graduated group (U=1758.50; z=-2.231; p=.026). Upon examining the obtained findings, it can be stated that students with more experience possess higher computational thinking skills. The reason that the upper classes have more skills compared to the lower classes may be that they have used IT-based technologies more frequently. However, in the sub-dimension of Algorithmic-Analytical Thinking Skills, the differences favor the lower class.

Table 4. Mann-Whitney U Test Showing Differences in CTSS Scores by Gender Variable

| Groups (Gender) | N | Computer Usage Skills | | Algorithmic-Analytical Thinking Skills | | Creative Problem-Solving Skills | | Collaboration Skills | | Critical Thinking Skills | | Scale General | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. |
| Male | 66 | 137.3 | 9061.5 | 142.9 | 9430.5 | 144.1 | 9512.0 | 132.4 | 8736.5 | 138.0 | 9106.0 | 144.3 | 9521.0 |
| Female | 183 | 120.6 | 22063.5 | 118.6 | 21694.5 | 118.1 | 21613.0 | 122.3 | 22388.5 | 120.3 | 22019.0 | 118.1 | 21604.0 |
| Total | 249 | | | | | | | | | | | | |
| *U* | | 5227.500 | | 4858.500 | | 4777.000 | | 5552.500 | | 5183.000 | | 4768.000 | |
| *z* | | -1.640 | | -2.356 | | -2.520 | | -0.973 | | -1.716 | | -2.534 | |
| *P* | | 0.101 | | 0.018* | | 0.012* | | 0.331 | | 0.086 | | 0.011* | |

* p < .05

In Table 4, when examining the scores of male and female teacher candidates in the CTSS, statistically significant differences were found between groups in terms of Algorithmic-Analytical Thinking Skills (U=4858.50; z=-2.356; p=.018), Creative Problem-Solving Skills (U=4777.00; z=-2.520; p=.012), and overall scale (U=4768.00; z=-2.534; p=.011), favoring the male group. However, no significant differences were found in other sub-dimensions. One possible reason for these differences could be that males adapt more quickly to technological developments.

**Findings on the Online Instructional Discussion Participation Styles Scale**

Kruskal Wallis-H and Mann Whitney-U tests were applied to determine whether the faculty, class, and gender variables differed regarding PSOIDS and its sub-dimensions. Statistical tables for the variables mentioned above are provided below.

Table 5. Kruskal Wallis-H Test for PSOIDS Scores by Faculty Variable

| Groups (Faculty) | N | To Socialize / Connective | To Get Information / Analytical | To Discuss / Innovative | To Fulfill Requirements / Practical | Why | How | Scale General |
|---|---|---|---|---|---|---|---|---|
| Faculty of Education | 75 | 110.21 | 111.67 | 120.85 | 117.49 | 113.54 | 112.18 | 110.81 |
| Faculty of Arts and Science | 136 | 125.28 | 129.84 | 119.31 | 124.45 | 127.20 | 122.57 | 124.40 |
| Faculty of Sport Sciences | 31 | 158.23 | 135.92 | 155.02 | 148.48 | 141.21 | 165.63 | 160.42 |
| Faculty of Tourism | 4 | 122.00 | 106.75 | 174.00 | 113.63 | 130.13 | 132.63 | 131.38 |
| Faculty of Health Sciences | 3 | 142.83 | 150.33 | 111.17 | 110.17 | 137.50 | 125.83 | 132.33 |
| Total | 249 | | | | | | | |
| $X^2$ | | 9.980 | 4.553 | 8.480 | 4.370 | 3.712 | 12.458 | 10.482 |
| *df* | | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| *P* | | 0.041* | 0.336 | 0.076 | 0.358 | 0.446 | 0.014* | 0.033* |

* $p < .05$

As shown in Table 5, a Kruskal Wallis-H test was conducted to determine whether there were significant differences in the rankings of PSOIDS and its sub-dimensions based on the faculty variable of teacher candidates. The results indicated statistically significant differences in To Socialize / Connective sub-dimension ($\chi^2=9.980$; $df=4$; $p=.041$), How sub-dimension ($\chi^2=12.458$; $df=4$; $p=.014$), and overall scale ($\chi^2=10.482$; $df=4$; $p=.033$). Following this analysis, the Mann-Whitney U test, a non-parametric comparison technique, was used to determine which groups the significant differences originated from.

The analysis revealed that the differences in To Socialize / Connective sub-dimension favored the Faculty of Sports Sciences over the Faculty of Education ($U=721.50$; $z=-3.069$; $p=.002$) and the Faculty of Sports Sciences over the Faculty of Arts and Science ($U=1550.00$; $z=-2.300$; $p=.021$). Similarly, the differences in How sub-dimension favored the Faculty of Sports Sciences over the Faculty of Education ($U=682.50$; $z=-3.336$; $p=.001$) and the Faculty of Sports Sciences over the Faculty of Arts and Science ($U=1370.00$; $z=-3.040$; $p=.002$). Overall, the differences in the entire scale favored the Faculty of Sports Sciences over the Faculty of Education ($U=734.50$; $z=-2.973$; $p=.003$) and the Faculty of Sports Sciences over the Faculty of Arts and Sciences ($U=1475.50$; $z=-2.604$; $p=.009$).

Considering these findings, it can be inferred that students studying in the Faculty of Sports Sciences, engaged in high social interaction activities in their daily lives, such as trainer and sports manager, may exhibit participatory behavior and actively engage in online environments for social interaction. These participants, who are active in their daily lives, may have motivations such as seeking attention, receiving feedback on their comments, and validating their opinions. As teacher candidates trained to become trainers and managers in their field, they may focus more on managing the environment rather than on why others participate. Hence, the scores in the How dimension and the overall scale of the scale may have shown significant differences.

Table 6. Kruskal Wallis-H Test for PSOIDS Scores by Class Variable

| Groups (Faculty) | N | To Socialize / Connective | To Get Information / Analytical | To Discuss / Innovative | To Fulfill Requirements /Practical | Why | How | Scale General |
|---|---|---|---|---|---|---|---|---|
| Sophomore | 73 | 109.76 | 113.77 | 121.93 | 117.31 | 113.88 | 114.2 | 112.25 |
| Junior | 18 | 127.33 | 158.56 | 140.75 | 121.72 | 122.92 | 144.3 | 140.61 |
| Senior | 96 | 138.08 | 131.69 | 125.62 | 128.21 | 138.78 | 128.3 | 134.89 |
| Graduate | 62 | 122.01 | 118.12 | 123.08 | 130.03 | 117.36 | 127 | 120.16 |
| Total | 249 | | | | | | | |
| $X^2$ | | 6.579 | 7.117 | 1.049 | 1.371 | 5.973 | 3.166 | 5.222 |
| *df* | | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| *P* | | 0.087 | 0.068 | 0.789 | 0.712 | 0.113 | 0.367 | 0.156 |

When Table 6 is examined, it is observed that there is no significant difference in PSOIDS scores among teacher candidates based on their class.

Table 7. Mann-Whitney U Test for PSOIDS Scores by Gender Variable

| Groups (Gender) | N | To Socialize / Connective | | To Get Information / Analytical | | To Discuss / Innovative | | To Fulfill Requirements / Practical | | Why | | How | | Scale General | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. | S.T. | S.O. |
| Male | 66 | 140.2 | 9253.5 | 118.9 | 7844.0 | 151.4 | 9994.0 | 136.2 | 8987.5 | 142.2 | 9384.0 | 139.1 | 9178.0 | 142.2 | 9388.0 |
| Female | 183 | 119.5 | 21871.5 | 127.2 | 23281.0 | 115.5 | 21131.0 | 121.0 | 22137.5 | 118.8 | 21741.0 | 119.9 | 21947.0 | 118.8 | 21737.0 |
| Total | 249 | | | | | | | | | | | | | | |
| *U* | | 5035.500 | | 5633.000 | | 4295.000 | | 5301.500 | | 4905.000 | | 5111.000 | | 4901.000 | |
| *z* | | -2.003 | | -0.812 | | -3.484 | | -1.474 | | -2.262 | | -1.851 | | -2.269 | |
| *P* | | 0.045* | | 0.417 | | 0.000** | | 0.140 | | 0.024* | | 0.064 | | 0.023* | |

* p < .05, ** p < .01

When analyzing the PSOIDS scores of male and female teacher candidates presented in Table 7, statistically significant differences favoring the male group were found in To Socialize / Connective (*U=5035.50; z=-2.003; p=.045*), Original Learning / Innovative (*U=4295.00; z=-3.484; p=.000*), Why (*U=4905.00; z=-2.262; p=.024*), and overall scale (*U=4901.00; z=-2.269; p=.023*) sub-dimensions. However, no significant differences were found in the other sub-dimensions.

While it would be expected that females, generally having more assertive communication and social skills and engaging more intensively with content, would take on a more active role in online discussions, the findings do not support this expectation. The tendency of males to technological developments, their desire to shape discussions, and their awareness of why they participate in discussions may have played a role in their participation in online discussions.

**Findings on the Relationship Between PSOIDS and CTSS**

A Spearman's Rho correlation analysis was conducted to examine the relationship between PSOIDS and CTSS. The results obtained are presented in Table 8.

Table 8. *Spearman's Rho Correlation Analysis to Determine the Relationship Between PSOIDS and CTSS Scores*

| **Variable** | ***N*** | ***r*** | ***p*** |
|---|---|---|---|
| Computational Thinking Stills Scale<br>Participation Scale of Online Instructional Discussions Scale | 249 | 0.520 | 0.000** |

** p < .01

As indicated in Table 8, Spearman's Rho correlation analysis conducted to determine the relationship between PSOIDS scores and CTSS scores resulted in a statistically significant moderate positive correlation at the $p<.01$ level ($r=-.520$; $p<.01$).

## Discussion and Conclusion

Computational thinking, recognized as one of the most important skills of the 21st century, is defined as the ability to use concepts from computer science—such as algorithmic thinking, decomposition, and generalization—in problem-solving (Wing, 2006; Barr & Stephenson, 2011). Developing this skill enables teacher candidates to have more effective learning processes and become better equipped for their students. Therefore, Shute et al. (2017) suggest that educational programs should incorporate additions for this skill. Currently, computational thinking is at the core of many interdisciplinary fields, including artificial intelligence, robotics, and machine learning. Considering that we are in an era where teacher candidates most need skills such as computer proficiency, algorithmic thinking, creative problem solving, critical thinking, and the ability to generate collaborative solutions, acquiring these skills will contribute to shaping future generations.

Online learning environments, which gained more importance due to the COVID-19 pandemic, have started to become indispensable practices in the field of education. One of the significant components of online learning environments is online discussions. In online discussion settings, students can express themselves and engage in social communication (Pala & Erdem, 2020). The ways in which students participate in online discussions reveal why and how they engage. Pala and Erdem (2020) identified students' reasons for participating in online discussion environments or their participation motivations through the dimension of 'why' in participation styles and their forms or behaviors of participation through the 'how' dimension. Considering these participation styles, it is observed that characteristics such as engaging in social interactions, collaborating, and providing analytical comments parallel computational thinking skills. Considering this information, it was hypothesized that there might be a relationship between participation styles in online discussions and computational thinking skills. Additionally, it was thought that examining the effect of demographic variables such as the student's faculty, class, and gender on this relationship would benefit both students and educators. In line with this purpose, whether computational thinking skills and participation styles in online instructional discussions differ according to faculty, class, and gender and the relationship between computational thinking skills and participation styles in online instructional discussions were examined.

The study was conducted with 249 teacher candidates from five faculties. Of the participants, 73.5% were female (n = 183) and 26.5% were male (n = 66). The highest participation was from the Faculty of Arts and Science (N = 136), and the lowest participation was from the Faculty of Health Sciences (N = 3). In the study, data were collected using the "Computational Thinking Skills Scale (CTSS)," the "Participation Styles in Online Instructional Discussions Scale (PSOIDS)," and a demographic information form. Since the obtained data did not follow a normal distribution, non-parametric statistical methods were employed.

According to the results obtained regarding computational thinking skills, statistically significant differences were found in the variables of faculty, class, and gender. Based on the faculty variable, the sub-dimension of creative problem solving scored higher in the Arts and Science Faculty and the Sports Sciences Faculty compared to the Education Faculty. This difference is believed to stem from the fact that most students in the Arts and Science and Sports Sciences Faculties are seniors or have already graduated. Creative problem-solving is defined as formulating problems, generating and analyzing new options, and planning the implementation of new solutions (Treffinger, 1995). Therefore, it can be said that Education Faculty students, who are sophomores, do not yet have sufficient experience, and their skills in developing solutions to instructional problems are more limited compared to upper-class students.

According to the class variable, statistically significant differences were found in the Algorithmic-Analytical Thinking Skills and Creative Problem-Solving Skills sub-dimensions. In the Algorithmic-Analytical Thinking Skills sub-dimension, the difference is in favor of the sophomore group compared to the graduated group and in favor of the senior group compared to the graduated group. Differences in the Algorithmic-Analytical Thinking Skills sub-dimension are in favor of lower classes, while differences in the Creative Problem-Solving Skills sub-dimension are in favor of upper classes. These findings suggest that algorithmic thinking skills are higher in lower classes and creative problem-solving skills are higher in upper classes. This finding contradicts the other findings of the study. This situation can be examined in future studies.

When examining CTSS scores according to the gender variable, statistically significant differences were found between males and females in the sub-dimensions of Algorithmic-Analytical Thinking Skills, Creative Problem-Solving Skills, and in the overall scale, with these differences favoring the male group. Atmatzidou and Demetriadis (2016) and Lei et al. (2020) have stated that male students have higher computational thinking skills. However, some studies indicate no significant difference between genders (Korucu et al., 2017; Alsancak, 2020), while other research suggests that females have higher computational thinking skills than males (Sun et al., 2023). The quicker adaptation of males to technological developments could be one of the reasons for this difference. Nevertheless, this study finding needs to be re-examined in future studies. For instance, in the studies by Zubaidah et al. (2017), it was expressed that male students have higher creative thinking skills than females, likely due to differences in brain anatomy affecting students' learning and activity styles.

According to the results obtained regarding participation styles in online instructional discussions, statistically significant differences were found in the variables of faculty and gender. Based on the faculty variable, statistically significant differences were found in the "To Socialize / Connective" and "How" dimensions and the overall scale, favoring the Sports Sciences Faculty group in all sub-dimensions. Students studying in the Sports Sciences Faculty may participate in high-social-interaction activities in their daily lives, such as trainers and sports managers, which might have enabled them to engage in social interactions and exhibit forming behaviors in online environments. These participants, who are also active in their daily lives, may have motivations such as seeking attention, receiving feedback on their comments, and validating their opinions. Teacher candidates educated to become trainers and managers by nature may have focused more on how to manage the environment rather than why other participants are participating. Therefore, the "How" dimension and overall scale scores might have shown significant differences.

According to the gender variable, statistically significant differences were found between males and females in the "To Socialize / Connective," "To Discuss / Innovative," "Why," and overall scale, favoring the male group. Ardito et al. (2020) noted that males focus on operational aspects in actions such as coding, while females focus on group dynamics; Caspi et al. (2008) observed that females send more messages in discussions and prefer written communication more than males; Tsai et al. (2015) stated that females express themselves better in online discussions. However, the study's results contradict these findings in the literature. Gender differences in computer processes have been reported (Espino & Gonzales, 2016). Possible reasons include males' greater affinity for technological developments, willingness to shape discussions, or awareness of why they participate in discussions. It can be said that these participants have an interest in presenting what is different. It can be said that this group, which subjectivizes the discussion with experiential examples, considers both the values in the environment and the content but tries to put forward what is new (Pala & Erdem, 2020). This may be related to the study's sample group; therefore, conducting the study with different sample groups would contribute to the literature.

Another sub-problem the study addresses is whether a significant relationship exists between computational thinking skills and participation styles in online instructional discussions. The study reveals a statistically significant, positive, and moderately strong relationship between CTSS and PSOIDS scores. Therefore, environments organized according to student styles in online instructional discussions can be used to develop computational thinking skills. For example, increasing interaction with the content, exemplifying subjective solutions and different perspectives, giving students responsibility, and providing information on why and how to participate (Pala & Erdem, 2020) contribute to students' computational thinking skills. Additionally, it has been stated that participation styles significantly impact active participation, which in turn significantly affects academic success (Demir et al., 2023). Thus, it can also contribute to developing students' academic success.

## Recommendations and Limitations

Significant differences were found for the sub-problems addressed within the scope of this study, which examined the relationship between computational thinking skills and participation styles in online discussions. However, it should be taken into consideration that the study was conducted with students studying in five faculties of a state university in Turkey and with the assumption that the student's answers to the scales were sincere. Scale scores may give different results according to different countries and cultures. Similarly, the results may differ when studied with other faculties and departments. In addition, the number and grade levels of the students participating in the study also differ. The number of students is concentrated in some classes and some departments. A more detailed examination can be made with a more homogenous sample group. Similarly, repeating this study with groups in which the distribution of males and females is homogeneous can be evaluated in terms of computational thinking skills and participation styles.

## Notes

**Competing Interests**

The author has no relevant financial or non-financial interests to disclose.

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**Availability of data and materials**

The data that support the findings of this study are available at reasonable requests from the author.

**Compliance with ethical standards**

Human Research Ethics Committee, Aksaray University, approval number: 2023/07-107

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