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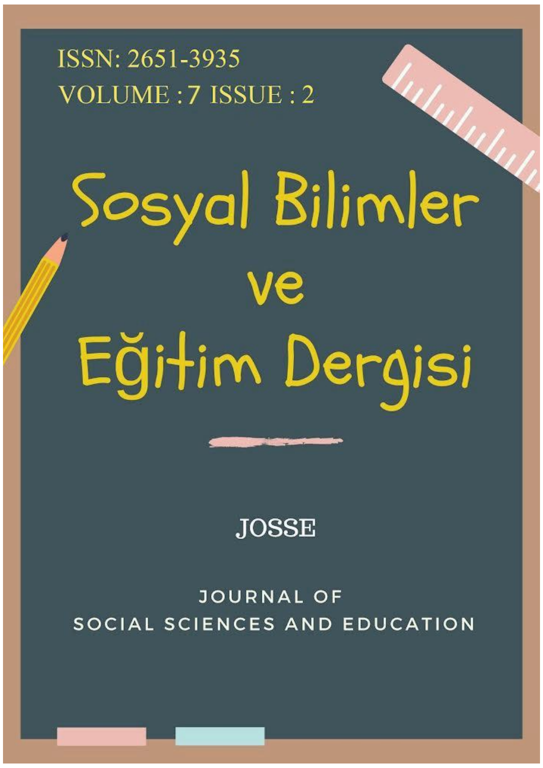

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Investigation of Higher Education Students' Computational Thinking Skill Levels

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Investigation of Higher Education Students' Computational Thinking Skill Levels

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Abstract **Research Article**

Computational thinking skill is a skill that has its origins in ancient times but has gained importance today. The competences provided to individuals by computational thinking skills are also of great importance for the education system. Therefore, it is important for students to acquire and develop these skills in order to adapt to the requirements of the modern world. Based on this, in this study, the level of information processing thinking skills of higher education students was examined and the level of this skill was investigated in line with different variables. 'Computational Thinking' scale was used as a data collection tool in the study. Cronbach Alpha internal consistency coefficient of the scale. 96 was calculated as. Demographic characteristics such as gender, department, class and education level were taken into consideration. Quantitative research method was used in the study. The research was conducted with 298 participants studying in higher education. In the analysis of the data, independent t-test and ANOVA analyses were applied to determine the score differences between the groups. As a result of the study, higher education students were found to have high levels of computational thinking skills. Gender was found to be effective on computational thinking skills. As the level of education increased, it was determined that computational thinking skills increased. It was seen that the education given in different departments had an effect on computational thinking skills. Finally, it was found that there were significant changes in students' computational thinking skills as their grade level increased.

Keywords: Computational thinking skills, computerised thinking, higher education students.

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Introduction

Along with the effects of technology, there have been significant changes in the knowledge and skills that people should possess. In the so-called information age, technological literacy has become increasingly important. In this period, competencies such as the ability to solve problems with computers and the ability to use computers effectively are expected from learners. Using computational thinking skills by adopting a systematic and planned approach to generate solutions to problems helps us to benefit more from technological tools and processes. In this context, it is extremely important for individuals who grow up with technology from a young age to develop computational thinking skills (Bocconi, 2016).

Computational thinking is one of the abilities that has its origins in ancient times but is nowadays recognized as a new learning skill. This skill has gained importance in line with the requirements of the 21st century and is frequently emphasized in international standards, curricula, research and projects (Voogt et al., 2015). Computational thinking skill involves the integration of cognitive processes and information technologies. This ability includes the capacity to organize complex information, establish relationships between data, and evaluate information from various perspectives. In addition, this skill develops algorithmic thinking and logical reasoning skills in the problem solving process. In this way, the individual gains the ability to solve complex problems by dividing them into parts. In addition, they have the ability to apply the acquired skill in real life situations (Einhorn, 2012).

In this context, it is critical for students to acquire and develop computational thinking skills in order to gain the ability to solve complex problems that individuals face in today's world more effectively. In a world where digitalisation is accelerating and artificial intelligence and automation are increasingly used in the workplace, these skills not only teach students how to use technology, but also provide them with the basic skills of the 21st century such as critical thinking, creative problem solving, algorithmic thinking and data-driven decision making (Wing, 2006; Yadav, Hong, & Stephenson, 2016). It is predicted that individuals with these skills will be more successful not only in the fields of informatics but also in a wide range of fields from medicine to engineering, from social sciences to arts (Grover & Pea, 2013; Brennan & Resnick, 2012). However, the literature review (Çetin & Toluk Uçar, 2017; Çınar & Tüzün, 2017; Demir & Seferoğlu, 2017) shows that there is a limited number of studies on the level of computational thinking skills of university-level students (Özden, 2015; Maden, Önal, & Maden, 2022; Akın & Yıldız, 2021; Yılmaz & Güven, 2023). This situation does not provide sufficient data on which strategies are more effective to improve the computational thinking skills of individuals at higher education level. Understanding to what extent computational thinking skills are acquired in higher education and how these skills contribute to individuals' professional lives is important for both developing educational policies and making improvements in curriculum designs.

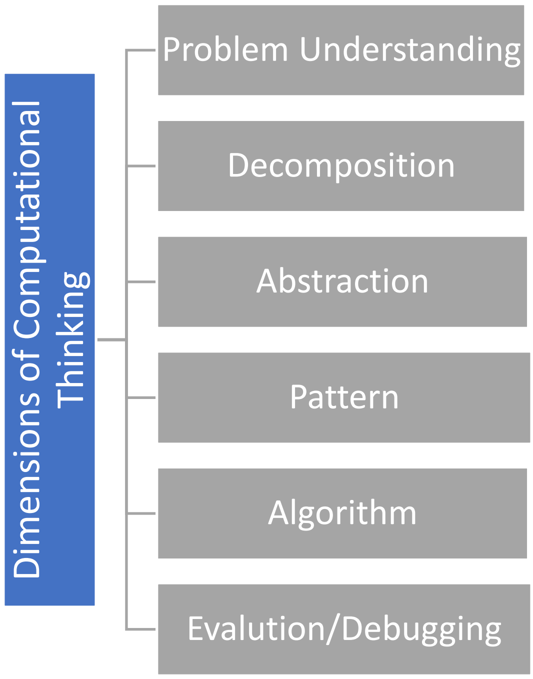
Computational Thinking Skills

In today's digital age, critical and strategic thinking skills are more important than ever in accessing information technologies, analyzing data and making decisions. In a world dominated by data abundance and complex problems, computational thinking skills have become an indispensable tool for individuals and organizations. Therefore, computational thinking plays a critical role in solving modern problems and developing innovative systems.

A review of the international literature reveals that the concept of computational thinking was first used by Papert in 1996 (Wing, 2006). Wing (2008) refers to the ability of computational thinking as "computational thinking". In studies conducted in Turkey, this skill has been referred to with different terms. For example, computational thinking (Yecan et al., 2017), computer-based thinking (Oluk & Korkmaz, 2016; Korkmaz et al., 2017), computational thinking (İlic et al., 2016; Demir & Seferoğlu, 2017; Demir et al., 2016; Barut et al., 2016), computational thinking (Şahiner & Kert, 2016) and computer thinking (Çınar & Tüzün, 2017).

Wing (2006) defines computational thinking skill as problem solving, system design and understanding human behavior by using the concepts of computer science. In other words, computational thinking skill is the ability of people to access, analyze, process and internalize information using information technologies (Türk & Bilge, 2018; Akkoyun, 2021). Hidayat et al. (2020) define computational thinking skill as the ability to think logically and systematically to access information, analyze information, solve problems and make decisions using information technologies. It also emphasizes that this skill is developed by understanding and applying methods used in computing, data analysis, algorithms and problem solving. Because computational thinking skill includes the ability to think intelligently, communicate effectively, analyze data and make decisions in situations where information technologies are used (Yücel, 2017; Wing, 2006).

ISTE (International Society for Technology in Education) and CSTA (Computer Science Teachers Association) state that computational thinking includes some characteristics. Computational thinking includes several characteristics and skills. First, it is necessary to formulate problems in order to solve them with the help of computers or other tools. This process involves organizing and analyzing data in a logical way. Data are also presented through models and simulations. Solutions are automated with algorithmic thinking in mind. These skills include finding, analyzing and implementing the most appropriate solution using available resources efficiently. Finally, the ability to transfer and generalize the solution to various problems is also an important part of computational thinking (ISTE 2011; Barr et al., 2011).



The sub-dimensions of computational thinking skills in Figure 1 are explained below.

• **Understanding the Problem:** It means identifying the problem.

• **Disassembly:** It is the process of dividing a complex or multi-component structure into smaller parts. The reason for failure in unsolvable problems may be that the problem is not divided into small enough parts (Üzümcü & Bay, 2018).

• **Abstraction:** It means focusing on one point to reveal the qualities sought and ignoring other situations (CSTA, 2016). It is emphasized as the basic condition of problem solving. By establishing the connection between problems, it enables the solution to the problem to be re-evaluated (Togyer & Wing, 2017).

• **Pattern:** It is defined as a set of repeating operations.

• **Algorithm:** It defines the process of reaching a solution by showing the steps one by one in solving a problem or implementing a plan. Algorithmic thinking is defined as performing a task step by step not only in computer science but also in other disciplines (Selby & Woollard, 2013).

• **Evaluation Debugging:** One of the most common steps in the process of creating algorithms or preparing a computer program is testing. This step involves testing and evaluating the program or algorithm. For good problem solving, regular evaluation of solutions is extremely important (Liu et al., 2017).

Considering all these sub-dimensions, the importance of information processing skills in today's world is undeniable (Berisha-Namani, 2011). Because having strong information processing skills allows individuals to analyze complex situations and make informed decisions (John et al., 2021).

With the increasing dependence on technology and the abundance of information available, being able to filter and evaluate information is crucial to avoid misinformation and make sound decisions. Therefore, developing information processing skills is essential for individuals to navigate the complexities of the modern world and be successful in various areas of life (Pratiwi et al., 2022). In this context, the study aimed to examine the level of information processing thinking skills of higher education students. The level of this skill in students was investigated in line with different variables. This study aims to provide an in-depth analysis to understand and evaluate students' computational thinking skills. It is aimed that the findings of the study will contribute to university education and students' academic achievement. In this direction, the sub-research questions of the study are as follows:

1. What is the level of computational thinking skills of higher education students?
2. Do higher education students' computational thinking skill levels differ according to gender factor?
3. Do higher education students' computational thinking skill levels differ according to their level of education?
4. Do the computational thinking skill levels of higher education students differ according to the department they study?
5. Do higher education students' computational thinking skill levels differ according to class?

Method

Model

Quantitative research method was used to answer the research questions of this study. Quantitative research is a systematic and structured approach to collecting and analyzing data to understand and explain phenomena. The collected data are then quantified and analyzed using statistical methods. Quantitative research is accepted as a reliable method in research by allowing precise measurement and objective analysis of data (Kurnaz & Nas 2022). Among quantitative research methods, the survey model was used. The survey model is a research method used to describe a specific situation or event using a large sample group. This model is widely used especially in the fields of education and social sciences. The survey model is used to examine a situation in its current state and to collect data about this situation (Karasar, 2014). In this model, it is usually possible to obtain information using data collection tools such as questionnaires, tests or observations and to make a general evaluation about a particular group or situation with the data obtained. The survey model is used to analyze data using descriptive statistics and to help researchers understand the basic characteristics of the data (Büyüköztürk, 2011). The survey model was preferred to ensure the reliability and generalizability of the findings to larger populations and to understand broad trends.

Sample and Population

According to Yıldırım and Şimşek (2018), the population represents a comprehensive concept that includes objects, individuals, communities and countries. A sample is a group selected from the population and expected to adequately represent the population (Gravetter & Forzano, 2012). Stratified sampling, which is a probability sampling method, was preferred for this study. This sampling method is based on the concept of a homogeneous population (Neuman & Robson, 2014). The principle of sub-stratification is taken as a basis for stratification sampling. Sub-strata can generally be determined according to demographic characteristics in the context of the subject being studied (Onwuegbuzie & Collins, 2007). In this study, gender, department, grade and education level were selected as demographic information.

The research was conducted with 298 participants studying in higher education. Demographic information about the participants is presented in the tables. Table 1 shows the distribution of the participants according to their gender, Table 2 according to their level of education, Table 3 according to their department of study and Table 4 according to their grade level.

Table 1.

Distribution of Participants According to Gender

Gender	*f*	%
Woman	142	47,7
Male	156	52,3
Total	298	100

According to the data in Table 1, there were 298 participants in total. 47.7% (142) of the participants were female and 52.3% (156) were male. This distribution shows that the number of female and male participants in the sample is almost equal, but the number of male participants is slightly higher. This kind of gender distribution suggests that the research has largely maintained a balance between genders and the results can be generalized for both genders.

Table 2

Distribution of the Participants According to their Level of Education

Education Levels	*f*	%
Associate degree	162	54,3
License	136	45,7
Total	298	100

According to Table 2, 54.3% of the participants (n=162) were associate degree graduates and 45.7% (136) were bachelor's degree graduates. This distribution shows that the majority of the participants in the sample are associate degree graduates. Since associate degree graduates are more than bachelor's degree graduates, it is thought that the findings of the study can be generalized more for individuals with this level of education. However, the fact that bachelor's graduates also have a significant proportion shows that the results are suitable for making meaningful inferences for both levels of education. In the evaluation of the findings of the study, it can be said that more balanced and comprehensive interpretations can be made by taking into account the effect of educational level.

Table 3

Distribution of the Participants according to their Department of Education

Department of Education	*f*	%
Business	34	11,4
Logistics Management	32	10,7
Computer Programming	58	19,4
Information Security Technology	61	20,4
Digital Game Design	43	14,4
Public Relations and Advertising	38	12,7
Interior Architecture	32	10,7
Total	298	100

When Table 3 is examined, the highest percentage of participants come from the fields of Information Security Technology (20.4%) and Computer Programming (19.4%). Digital Game Design (14.4%) and Public Relations and Advertising (12.7%) also have a significant proportion. The proportion of respondents from Business Administration (11.4%), Logistics Management (10.7%) and Interior Architecture (10.7%) is lower compared to other fields. This distribution shows that the sample is more focused on technology and IT fields. This suggests that the findings of the study may be more generalizable, especially in these fields. At the same time, since there were enough representatives from other fields, it can be said that information can also be obtained about the general trends of various levels of education. This diversity allows the results of the study to be compared across different levels and fields of study.

Table 4

Distribution of Participants according to Class Level

Education Levels	*f*	%
Class 1	71	23,8
Class 2	68	22,8
Class 3	84	28,1
Class 4	75	25,1
Total	298	100

According to Table 4, the group with the highest proportion among the participants is 3rd grade students (28.1%). This is followed by 4th grade students (25.1%), 1st grade students

(23.8%) and 2nd grade students (22.8%). This distribution indicates a balanced representation of each grade level in the sample. The slightly higher representation of 3rd grade students may indicate that students at this grade level are more likely to participate in the research. This diversity allows the findings of the study to be compared across students at different grade levels and increases the generalizability of the results. Moreover, the presence of a sufficient number of participants from each grade level allows the study to assess the situations and experiences of students at different stages of the learning process.

Data Collection Tool

The "Computational Thinking" scale developed by Üzümcü (2023) was used as a data collection tool in the study. The construct validity of the Computational Thinking scale was first evaluated by two different field experts. Then, exploratory factor analysis was performed for statistical validity. The scale consists of 28 items. It has a 5-point Likert type and 6-factor structure. Computational Thinking Scale options were: (1) Strongly Disagree, (2) Disagree, (3) Undecided, (4) Agree, and (5) Strongly Agree. The Cronbach's Alpha internal consistency coefficient of the scale was 0.96. As part of the reliability assessment process, item-total correlation coefficients were calculated using item analysis methods. Item-total correlation coefficients. 30 is expected to be higher than 30. In addition, a lower-upper group item analysis was also conducted as part of the reliability study. In this analysis, the comparison of the differences between the item mean scores of the lower 27% and upper 27% groups with the total scores of the test using an unrelated t-test is accepted as an indicator of the internal consistency of the scale. Üzümcü (2023) also calculated the Cronbach Alpha coefficient, which is the consistency coefficient of the scale.

Participants were informed about the purpose of the study before filling out the scale. The scale was delivered to the participants via an online form. The participants were informed by the researcher that their sincere responses to the items in the scale would contribute to the research scientifically. It took an average of 10 minutes to fill out the scale. All participants voluntarily participated in the study.

Collection of Data and Analysis

Analyses were conducted to determine whether the data met the normality assumption. For the normal distribution test, kurtosis and skewness coefficients were taken into consideration. As a result of the normality test, since the kurtosis and skewness values were within the range of ±1.0, it was determined that the distribution did not show an abnormal deviation from normal (Kline, 2015). In the analysis of the data, independent t-test and ANOVA analyses were applied to determine the score differences between the groups.

Ethical Committee Approval

In this study, all the rules specified in the "Directive on Scientific Research and Publication Ethics of Higher Education Institutions" were followed. None of the actions specified under the second section of the Directive, "Actions Contrary to Scientific Research and Publication Ethics", have been carried out.

Within the scope of our study, ‘Informed Consent Form’ was signed by the participants. Scales, questionnaires and photographs belonging to others were used, and the necessary permissions were obtained from their owners and these permissions were stated in the study.

Findings

In this study, it was aimed to examine the level of computational thinking skills of higher education students. The data obtained were tabulated and presented in line with the sub-problems.

Findings Related to the First Sub-Research Question

Descriptive statistics related to the first sub-problem of the study, which is higher education students' computational thinking skill levels, are shown. The findings obtained as a result of the analysis are given in Table 5.

Table 5

Descriptive Statistics on Higher Education Students' Computational Thinking Skill Levels

Dimension Related to the Scale	N	$\bar{X}$	Ss	Min	Max	Skewness	Kurtosis
Computational Thinking Scale	298	4,03	,14	3,54	4,25	,122	-,362

Since the mean score of the participants on the scale is 4.03 and the standard deviation is 0.14, the participants' computational thinking skill levels are generally high and close to each other. It is seen that the scores are close to the average. The minimum score is 3.54 and the maximum score is 4.25. This indicates that the participants are generally at a similar level in their computational thinking skills and that there are few outliers. Most of the scores are concentrated around the mean and there are no large deviations in the distribution. In this case, higher education students were found to have high levels of computational thinking skills.

Findings Related to the Second Sub-Research Question

The averages of higher education students' computational thinking skill levels exhibit a normal distribution. Based on this, it was analyzed with independent sample t-test to reveal whether there is a significant difference in higher education students' computational thinking skill levels according to gender. The results obtained are given in Table 6.

Table 6

Independent Sample T-Test Analysis Results Regarding Higher Education Students' Computational Thinking Skill Levels by Gender

Gender	N	X̄	Ss	t	sd	p	f
Woman	142	3,87	,13	-16,3	296	<,001	13,2
Male	156	4,19	,19				

The average score of female participants is 3.87, while the average score of male participants is 4.19. The average score of men is higher than that of women. The standard deviation of women is 0.13 and the standard deviation of men is 0.19. This indicates that men's scores show a slightly wider distribution than women's scores. There is a statistically significant difference between male and female participants in terms of their scores on the computational thinking scale. Men scored higher than women in computational thinking skills. As a result, it is possible to say that gender is effective on computational thinking skills.

Findings Related to the Third Sub-Research Question

The averages of higher education students' computational thinking skill levels exhibit a normal distribution. Based on this, it was analyzed with independent sample t-test to reveal whether there is a significant difference in higher education students' computational thinking skill levels according to the level of education. The results obtained are shown in Table 7.

Table 7

Independent Sample T-Test Analysis Results Regarding Higher Education Students' Computational Thinking Skill Levels According to Level of Education

Education Level	N	X̄	Ss	t	sd	p	f
Associate degree	162	3,87	,13	-22,1	296	,218	1,52
License	136	4,23	,14				

While the average score of associate degree students is 3.87, the average score of undergraduate students is 4.23. The average score of undergraduate students is higher than the average score of associate degree students. The standard deviations are 0.13 for associate degree students and 0.14 for undergraduate students. These values show that the score distributions of both groups are quite similar. There is no statistically significant difference between the scores of the computational thinking scale between associate and undergraduate students ($p<.05$). As a result, it is seen that there is no significant difference between students' computational thinking skill levels according to their level of education.

Findings Related to the Fourth Sub-Research Question

One-way analysis of variance (ANOVA) was analyzed to reveal whether there is a significant difference between higher education students' computational thinking skill levels according to the department they study. The results of the descriptive analysis are given in Table 8 and the results of ANOVA are given in Table 9.

Table 8

Descriptive Analysis of Higher Education Students' Computational Thinking Skill Levels According to the Department of Study

Scale	Department of Education	N	X̄	ss	Min	Max
Computational Thinking Skill Scale	Business	34	3,82	,11	3,54	4,04
	Logistics Management	32	3,89	,16	3,54	4,11
	Computer Programming	58	3,88	,13	3,57	4,14
	Information Security Technology	61	4,02	,22	3,68	4,54
	Digital Game Design	43	4,18	,16	3,89	4,54
	Public Relations and Advertising	38	4,25	,11	4,04	4,46

Interior Architecture	32	4,28	,12	4,04	4,57

The average score of business administration students is 3.82. This average has the lowest score among these departments. This result shows that students in this department have relatively lower computational thinking skills than other departments. Interior architecture and public relations and advertising departments have the highest average scores. This indicates that students in these departments have high computational thinking skills. In addition, departments such as information security technology, digital game design and computer programming also have high averages. It shows that students studying in these fields have strong computational thinking skills. Scheffe test was conducted in order to reveal where the significant difference between the levels of computational thinking skills of higher education students according to the department they were studying. The results obtained are given in Table 9.

Table 9

One-Way Analysis of Variance (ANOVA) Results Regarding Higher Education Students' Computational Thinking Skill Levels According to the Department of Study

Scale		Sum of Squares	Mean Squares	F	P	Difference	Impact Value
Computational Thinking Skill Scale	Between Groups	8,30	1,38	53,86	<,001	Difference there is	6
	Within Groups	7,47	,026				291

As seen in Table 9, the fact that the p value is less than .001 indicates that there are significant differences between the groups in their computational thinking skill levels. This shows that the average computational thinking scores between different departments are statistically different from each other. In other words, according to the ANOVA results, there are significant differences between higher education students' computational thinking skill scale scores. Because statistically significant differences were found in the levels of computational thinking skills between different departments. This difference is strongly supported by the value of $p<0.001$. This finding indicates that computational thinking skills may vary depending on the department in which the student is studying. When Table 8 and Table 9 are considered together, it can be expected that computational thinking skills are higher in technical and creative majors (Digital Game Design, Computer Programming, Information Security

Technology, Interior Architecture). Such majors tend to provide students with more practical and technical skills. This may explain the high level of computational thinking skills.

Findings Related to the Fifth Sub-Research Question

One-way analysis of variance (ANOVA) was analyzed to reveal whether there is a significant difference between higher education students' computational thinking skill levels according to their grade levels. The results of the descriptive analysis are given in Table 10 and the results of ANOVA are given in Table 11.

Table 10

Descriptive Analysis of Higher Education Students' Scores on Computational Thinking Skill Levels According to Class Level

Scale	Class Level	N	$\bar{X}$	ss	Min	Max
Computational Thinking Skill Scale	Class 1	71	3,86	,14	3,54	4,14
	Class 2	68	3,87	,12	6,57	4,14
	Class 3	84	4,12	,21	3,68	4,54
	Class 4	75	4,26	,12	4,04	4,57

Standard deviations are generally low, indicating that students' scores are close to each other within the class. In 3rd grade, the standard deviation (0.21) was slightly higher than the other grades. When the average scores at the class level are analyzed, it is seen that the students' computational thinking skill levels increase as their class levels increase. In other words, it is seen that the average scores increase as we move from the 4th grade to the 4th grade. This shows that students' computational thinking skills improve during the education process and that they have higher skills in higher grades.

Scheffe test was conducted in order to reveal where the significant difference between the computational thinking skill levels of higher education students according to their grade levels originated from. The results obtained are given in Table 11.

Table 11

One-Way Analysis of Variance (ANOVA) Results Regarding Higher Education Students' Computational Thinking Skill Levels by Grade Level

Scale		Sum of Squares	Mean Squares	F	P	Difference	Effect Size
Computational Thinking Skill Scale	Between Groups	8,11	2,70	103,7	<,001	Difference there is	3
	Within Groups	7,66	,026				294

The fact that the p value in Table 11 is very low (<0.001) indicates that there are significant differences between the levels of computational thinking skills according to grade levels. According to the results of the analysis, a significant difference was found between 2nd and 3rd grade (p<0.05). This finding indicates that 3rd grade students exhibit an average of 0.24 points lower computational thinking skills compared to 2nd grade students. Similarly, a significant difference was found between 2nd and 4th grade students (p<0.05). According to this finding, 4th grade students have an average of 0.38 points lower computational thinking skills than 2nd grade students. In addition, a significant difference was also observed between 3rd and 4th grade (p<0.05). In this case, it was determined that 4th grade students showed an average of 0.13 points lower computational thinking skills compared to 3rd grade students. As a result, shows that there are significant changes in students' computational thinking skill levels as their grade levels increase.

Discussion and Results

In the information age, the rapid development of technology and the impact of digital transformation processes in all areas of our lives have made computational skills important. In this context, computational thinking skills refer to a set of competencies that encompass the ability to understand, analyze and solve complex problems, which are particularly important in STEM (Science, Technology, Engineering and Mathematics) fields. The possession of these skills by higher education students plays a critical role in both their academic success and career planning. In addition, higher education students' computational thinking skill levels are extremely important as they face rapid changes and innovations today and these skills need to be developed (Bakırtaş & Lamba, 2020). In this study, it was aimed to examine higher education students' computational thinking skill levels.

In the first sub-research question of this study, the levels of higher education students' computational thinking skills were examined. According to the results of the study, higher education students were found to have high levels of computational thinking skills. Majeed et al., (2022) also obtained similar results. It was determined that 100 3rd year computer science students had high computational thinking skills. In the study of Korkmaz et al., (2015), it was determined that half of the perceptions of individuals towards their computational thinking skill levels were high. Pérez-Suasnavas et al., (2023) found the opposite result in their study. It was found that university students had difficulty in computational thinking skills. It is suggested that this is due to the personal characteristics of the students.

When the levels of computational thinking skills were analyzed according to gender, it was found that the computational thinking skills of males were higher than those of females. This result can be attributed to various factors such as gender roles, inequalities in educational opportunities and cultural norms. For example, it is thought that when males are directed or encouraged more towards technology and STEM (Science, Technology, Engineering, Mathematics) fields, their skill levels in these fields may be higher. In addition, social expectations and role models may also support men to gain more experience in these fields. Esteve-Mon et al., (2020) also found that female students had lower levels of computational thinking skills than male students. The reason for this is explained by the fact that their digital competence skills are more limited. In the study conducted by Oluk and Çakır (2017), computer thinking skill levels of university students were examined. According to the findings of the study, when the computer thinking skill levels of the students were evaluated in terms of gender, it was seen that there was a difference in favor of male students. However, Sarıtepeci (2017), Oluk (2017), Akgün (2020) and Aksit (2018) have studies showing that women have higher computational thinking skill levels than men. The reason for this is shown as the reason that girls spend more time to develop these skill levels.

According to the level of education, it was concluded that there was no statistically significant difference between the scores of the computational thinking scale between associate and undergraduate students. The studies in the literature do not fully parallel with this finding. Sert-Orhan (2023) found that 4th grade students had higher information processing thinking skills compared to 1st grade students. In his study, Paf (2019) emphasized that as a result of examining the results obtained in the context of the class variable, students' information processing thinking skill levels increased as their grade levels increased. Subaşı (2022), on the other hand, based on the findings obtained regarding the grade level, found that the computational thinking skills of 4th grade students were higher than those of 1st and 2nd grade students. In the study conducted by Kuleli (2018), it was determined that the levels of computational thinking skills of pre-service teachers differed in favor of upper grades. This difference between the findings of the study and the literature can be attributed to several reasons. It can be said that the demographic characteristics of student groups, learning environments and the content of educational programs also affect the results. In addition, while some educational institutions may have a special curriculum or additional support programs for computational thinking skills, the lack of such support in some institutions may negatively affect students' skill levels. In addition, students' personal motivation, interests and study habits also play an important role in the development of these skills.

When the computational thinking skill levels of the students according to the department of study are analyzed, it is seen that the computational thinking skills of the students in the business administration department are relatively lower compared to the other departments. Interior architecture and public relations and advertising departments have the highest average scores, indicating that these students have high computational thinking skills. In addition, departments such as information security technology, digital game design and computer programming also show high averages. These results suggest that students studying in these fields have strong computational thinking skills. The results reflect the impact of education in different departments on computational thinking skills. Bilbao, Bravo, Garcia, Rebollar, and Varela (2022) also found that engineering students have higher computational thinking skills.

In conclusion, this study revealed important findings by evaluating the participants' computational thinking skills. In general, the participants' computational thinking skill levels were found to be high and close to each other. Factors such as gender and level of education were found to be effective on these skills. It was concluded that male participants had higher scores than female participants, while there was no difference between undergraduate students and associate degree students. In addition, education in different departments was found to have a significant impact on these skills. Students studying in technical and creative departments were found to have stronger computational thinking skills.

Recommendations

The results show that educational programs and students' developmental processes affect their computational thinking skills. In this direction, the following suggestions are made for future studies:

1. In this study, the effects of demographic variables such as gender and educational level on computational thinking skills were examined. In future studies, the effect of different demographic factors such as age, occupational choice, cultural background on these skills can be investigated.

2. The effectiveness of different educational methods used to develop computational thinking skills can be investigated.

3. Interdisciplinary projects and studies should be encouraged through collaboration between different departments. This can help students develop different perspectives and apply their computational thinking skills in different fields.

4. Computational thinking skills should be supported by using digital tools and online platforms in education.

5. In the study, it was found that students studying in technical and creative departments have stronger computational thinking skills. Therefore, programs and course contents specific to these departments should be developed and these skills of students should be further strengthened.

Ethical Committee Approval

Ethics committee permission information

Name of the ethics review board: Beykoz University

Date of ethical assessment decision: 24.05.2024

Ethics assessment certificate number: E-45152895-299-2400007523

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