The Relationship between Pre-Service Teachers' Computational Thinking Skill Levels and Online Self-Regulated Learning Levels

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Abstract

The aim of this study was to examine the computational thinking skill levels and online self-regulatory learning levels of pre-service teachers in terms of various variables and to determine the relationship between their computational thinking skill levels and online self-regulatory learning levels. The design of the research is the correlational survey model, one of the quantitative research designs. The study group of the research consisted of pre-service teachers studying at the education faculty of a state university in Turkey and voluntarily participating in the research. A personal information form, computational thinking skills scale and online self-regulatory learning scale were used as measurement tools in the research. Within the framework of quantitative data analysis, descriptive analysis techniques, independent samples t-test, one-way ANOVA, Kruskal-Wallis H test for independent samples and Pearson Correlation technique were used. When the research findings were examined, it was seen that 63% of the pre-service teachers participating in the research had a high level of computational thinking skills and 36% had a very high level. It was also seen that 72% of the pre-service teachers had a high level of online self-regulated learning skills, 18% had a very high level, and 9% had a medium level. In addition, there was a moderate, positive and significant relationship between pre-service teachers' computational thinking skills and online self-regulatory learning levels. The research findings were interpreted in line with the relevant literature and various suggestions were made for practice and future research.

Keywords: *computational thinking, online learning, self-regulated learning, 21st century skills*

Introduction

Technology, which is one of the essentials of today, has affected and facilitated human life in many ways. Although education is one of the fields where technology has gained significant momentum, technology also makes significant contributions to education. One of these contributions has undoubtedly been distance education, which is free from spatial constraints. While information increases and changes at a rapid pace, schools, which are formal education institutions, have been insufficient to meet the education needs and distance education has become an important tool to provide lifelong education. On the other hand, the increasing number of students, developing technology and changes in learning approaches has resulted in schools benefiting from distance education. In the information society we live in, benefiting from low-cost and student-oriented methods and tools that create equal opportunities and that people can plan for themselves without the limitations of time and space has made learning more effective at all levels (Özkanal & Özgür, 2017).

According to the 'Digital 2019 in Turkey' report, in Turkey, which has a population of 82.4 million, 59.36 million people, who make up 72% of the population, are internet users and there was a 9% increase in the usage rate compared to the previous year (Bayrak, 2020). In addition, many technologies that can be used in classroom and virtual environments and facilitate learning are mentioned (Ünlü, 2019). It can be said that the internet, which is increasingly used every year, increases the opportunities for accessing and sharing information, as well as positively affecting access to educational opportunities and different learning paths. Thus, online learning, which is an independent learning model alongside face-to-face education, is gaining importance day by day.

Literature Review

Online Learning

In the process of change, in which the transition from the industrial age to the digital age is taking place, the expectation of digital transformation in education is inevitable, and the approaches and adaptation processes of educational institutions to this change are becoming increasingly important (Taşkıran, 2017). In the globalizing world of the 21st century, education, with all its possibilities, has reached a more widespread, powerful and qualified position than it has ever been in. Today, people are involved in the world of education from childhood to advanced adult ages and they are faced with education in any format regardless of their position (Parlak, 2017). One of the reasons why educational activities have become so widespread is the increase in communication opportunities (Sarıtaş & Barutçu, 2020). The increase in the use of the internet in all areas can be shown among the reasons why education and training have started to move to online environments and the concept of online learning has invaded our lives more than ever.

Online learning can be defined as an innovative multimedia-based curriculum created by utilizing the features and resources of the internet to support and advance the learning of individuals (Khan, 1997). According to another definition, online learning is a teaching method carried out from certain centers, aiming at self-learning of the individual, and providing educational content with specially prepared tools and various environments for learners (Banar & Fırat, 2015). Online learning has been in use for decades, especially at the university level. According to Dewald (1999), the benefits of online learning are that it is possible to interact directly with web resources, the learning environment is always accessible to students, it is possible to access the most appropriate resources related to the subject to be studied, and it has an interactive and flexible structure and therefore increases teaching options. According to Oliveria et al. (2018), the benefits of online learning are: flexibility, the possibility of accessing the course content at any time, low cost, and participation in the course at any time and place. Learning in online environments is facilitated and supported through the use of information and communication technologies (Broadbent & Poon, 2015).

Developments in the field of distance education bring some changes both in pedagogical perspectives and in the theoretical framework (Beldarrin, 2006). In the processes where the teacher is not in the same physical location as the student, it becomes important for the student to organize his/her own learning and to gain competence, self-confidence and a positive attitude in using online and offline resources. Therefore, there should be activities that will enable high-level thinking in the online learning environment. Learners should be able to construct their own knowledge, cooperative learning should be encouraged, the control of the materials should be left to the learner, the learner should be able to find sufficient time and opportunity, and learning should be meaningful and interactive for the learners and supported with materials (Ally, 2004). The common aspect of all these features that online learning should have is that the learner is not only an individual who takes lessons, but also an active member who can incorporate what has learned into life through practice.

According to Duckworth (2009), distance education students should be able to make their own plans about what they will learn and when and how they will learn the material, and should be able to direct the learning process themselves. According to Weimer (2002), students receiving distance education should be able to take responsibility for their own learning, participate in the design of the curriculum, and take responsibility for some levels of the teaching process. In distance education, where students move from passive learners in traditional teaching methods to active learners who direct their own learning, first of all, students' meta-cognitive skills should be developed (Holmberg, 2005). As can be seen, researchers emphasize the self-regulation skills of students who will receive distance education.

In order for learning to be effective and permanent in online environments, which are seen as an alternative solution to meeting the education needs of an increasing number of students, theories and strategies suitable for the characteristics of these environments should be used. In this context, one of the strategies that individuals can use in their individual learning processes is self-regulation skills. Self-regulation focuses on choosing the right learning strategies for one's own learning, evaluating these strategies by oneself, arranging one's strategy when necessary, and motivating oneself throughout the learning process (Pintrich, 2000). When the changing roles of students and educators in online learning environments are examined, students are individuals who are responsible for their own learning processes and actively participate in the learning environment. Educators, on the other hand, are guides who guide students in the teaching process and facilitate their learning (Kahraman, 2013). Considering the changing roles of teachers and students in self-regulation and online environments, it is seen that the roles expected from students in online learning environments are highly compatible with self-regulation skills. For this reason, it is important that self-regulation skills are developed for online learning (Özdemir, 2018).

In addition to all these, what is desired to be acquired by the learners in the learning-teaching processes should have a long-term structure that will allow learners to produce efficient solutions to the 21st century problems they face and include the understanding of the basic operating principles of computers, rather than the skills acquired through short-term practices and activities (Czerkawski, 2015). It can be stated that the process of acquiring knowledge expressed here has a structure aimed at fostering/developing the computational thinking skills of individuals.

Computational Thinking

Computational thinking has a long history related to computer science. In the historical process, algorithmic thinking, as it was known in the 1960s and 1970s, was defined as the process of formulating algorithmic relations by considering problems in the context of input and output (Knuth, 1985). Today, this concept has focused on using mathematics to develop algorithms and determining how solution proposals work best for problems of different sizes (Denning, 2009).

Wing (2006) claimed that computational thinking will be among the basic skills, such as reading, writing and mathematics, used by everyone by the middle of the 21st century. In accordance with the idea of that researcher, emphasizing that computational thinking is a skill that should be acquired by everyone, computational thinking began to be expressed as a 21st century skill that individuals should acquire (International Society for Technology in Education [ISTE], 2011).

Wing (2008) states that computational thinking is a kind of analytical thinking. Wing, used common methods with mathematical thinking in problem solving, engineering when designing and evaluating a complex system, and scientific thinking in understanding concepts such as computability, intelligence, reason and human behavior. He defined computational thinking as a thought process that involves formulating a problem and articulating associated solutions in such a way that a computer can perform it effectively. According to Curzon (2015), computational thinking means problem solving for people. According to Bundy (2007), computational thinking affects research in almost all disciplines, enabling the easy processing of large amounts of information, asking new questions and finding new answers more easily through metaphors. Computational thinking is a process that includes various features. These characteristic features, which are oriented towards the solution of a particular problem, are: formulating the solution of the problems encountered with the help of computers and other tools, organizing and analyzing the data in a logical way, presenting the data through the support of abstraction such as models and simulations, automating solutions with algorithmic thinking, examining possible solutions in order to integrate solution steps and resources in the most efficient and effective way, identifying and applying, and transferring the problem-solving process followed to different problem situations by generalizing (ISTE, 2011). Barr et al. (2011), describe the general characteristics of computational thinking skills as follows: formulating problems in a way that is suitable for solving them with computers and other tools, logically organizing and analyzing data, showing data with abstractions such as models and simulations, producing results with algorithmic thinking, showing, analyzing and applying possible solutions, and generalizing and transferring problem solving processes to the solution of problems in many fields. Four subtitles were defined by Weintrop et al. (2014): data and information skills, modeling and simulation skills, computational problem-solving skills, and systems administration skills.

According to Bundy (2007), computers are used for various purposes. However, the concept of computational thinking is much deeper than these and it changes the way people think. Computational thinking can provide a new language for describing electronic content, hypotheses and theories, and enhance cognitive abilities. Computational thinking can be considered as a basic skill that applies not only to computer users, but to everyone. Computational thinking is a problem-solving approach that strengthens the combination of technology and thought. Computational thinking skill is an expression of creative thinking, algorithmic thinking, critical thinking, problem solving, cooperative learning and communication skills and cannot be defined without these skills. The purpose of computational thinking in education is not the students' progress in computer science, but the students' application of their computational thinking skills in other courses as a habit (ISTE, 2015). As can be understood from these expressions, it is possible to say that computational thinking skill includes many sub-skills.

Although online learning environments have existed for years, they have gained even more importance in the days when all educators are struggling with the COVID-19 epidemic. According to the data obtained from the United Nations, the learning audience of 770 million people in the world has been affected by the closure of schools and universities (Zhong, 2020). In this context, online learning has been introduced as the easiest and most applicable solution to ensure the sustainability of education during the pandemic period. Today, there are hardly any educational institutions in developed and developing countries that do not have an online education program. Even institutions that did not establish or develop an online education platform in the past, and did not produce a strategy for this education channel, were forced to migrate to an online education environment with the COVID-19 epidemic; for the whole world, online education is no longer the last resort, it has become the only remedy (Yamamato & Altun, 2020). The Chinese higher education system, the world's largest and most populous higher education system had to undergo an e-learning experiment of unprecedented scale and scope. However, it has been understood that many students living in rural areas of China do not have the connection or equipment to participate in distance education (Lau et al., 2020). In Italy, which initially had the largest cluster of COVID-19 cases in the spread of the pandemic in Europe, the Italian Ministry of Education opened an information portal focused on distance learning and gave webinars to teachers about distance education (Kottasová & Isaac, 2020; Benu, 2020). Pretty much every university in the United States canceled face-to-face courses and conducted these courses online. Due to the rapid spread of the epidemic in the United Kingdom, distance education has been considered as a priority solution. In Turkey, primary and secondary education was conducted face-to-face or online from time to time, depending on the situation of the pandemic; higher education has completely switched to distance education (Saraç, 2020). Some studies conducted with regard to this process show that the unpreparedness of schools for this process prevented educational practices from achieving sufficient quality. The reasons for this situation include the lack of infrastructure and unpreparedness of the instructors (Ulaş, 2020), the inability to carry out theory and practice together due to insufficient e-resources (Kurnaz & Serçemeli, 2020) and the need to create virtual environments that can be communicated outside the classroom (Erkut, 2020). However, while evaluating these negative aspects, it is necessary to consider that the pandemic process is an unusual and unexpected process for the whole world. Elimination of technology access problems, rapid preparation of e-content, and informing instructors and students about the process have been made a priority both in Turkey and in other countries.

Similar to online learning, self-regulation skills have been one of the most important and researched topics in recent years. In this period when online learning has become an important fact of our lives, it is important for students to direct their own learning in online learning environments, in other words, to have online self-regulated learning skills. In addition to this, the characteristics of both societies and students have changed considerably in the century we live in. Today's societies seem more dynamic and technology-oriented. Grown or growing individuals also need different characteristics from previous generations in order to adapt to changes. Teachers who will raise individuals who have the characteristics of the new paradigms (information literate, technology literate, able to manage their own learning, etc.) should also develop in the same direction. It does not seem possible for a teacher who does not have the aforementioned skills to foster these skills in their students. Computational thinking skills are also shown among the skills that individuals should have in order to meet the requirements of the digital age. In order for students to acquire computational thinking skills, pre-service teachers must first acquire these skills and learn how to include them in their lessons. When pre-service teachers' awareness of computational thinking skills is raised, their perceptions and attitudes towards computational thinking can change positively. For this reason, it is important to reveal whether pre-service teachers have these skills and to make suggestions about what is needed for the development of these skills. Based on these explanations, the aim of this study is to examine the computational thinking skill levels and online self-regulatory learning levels of pre-service teachers in terms of different variables, and to determine the relationship between their computational thinking skill levels and online self-regulatory learning levels. In this direction, the sub-problems of the research are:

- What are pre-service teachers' computational thinking skill levels?
- Do pre-service teachers' computational thinking skill levels differ significantly according to various variables (gender, grade level, weekly average internet usage time, and devices used for participating in online lessons)?
- What are the online self-regulated learning skill levels of pre-service teachers?
- Do pre-service teachers' online self-regulated learning levels differ significantly according to various variables (gender, grade level, weekly average internet usage time, and devices used for participating in online lessons)?
- Is there a significant relationship between pre-service teachers' computational thinking skill levels and online self-regulated learning levels?

Method

Under this heading, the design of the research, study group, measurement tools, data collection and data analysis are discussed.

Research Model

Since the main purpose of this research is to determine the relationship between pre-service teachers' computational thinking levels and online self-regulated learning levels, the research design was determined as a correlational survey model, one of the quantitative research designs. Correlational survey models are research models that aim to determine the existence and degree of change between two or more variables. In this type of research, an attempt is made to learn whether the variables change together and if there is a change, how it happens. Three different situations may arise here: there is no significant relationship between the two variables, the variables are proportional in the same direction (positive) or the variables are proportional in the opposite direction (Karasar, 2009).

Study Group

The study group of the research consisted of pre-service teachers studying at the education faculty of a state university in Turkey and voluntarily participating in the research. The distribution of the study group according to various demographic characteristics is given in Table 1.

Table 1: *Pre-Service Teachers' Demographic Characteristics*

Gender	**f**	**%**
Female	218	73.15
Male	80	26.85
Branch		
Primary school teaching	79	26.51
Middle school mathematics teaching	84	28.19

Pre-school teaching	22	7.38
Guidance and psychological counseling	113	37.92
Grade level		
1st grade	10	3.36
2nd grade	217	72.82
3rd grade	53	17.78
4th grade	18	6.04
Average internet usage time		
0-7 hours	148	49.66
8-14 hours	88	29.53
15 hours and over	62	20.81
Online course participation device		
Desktop / laptop	223	74.83
Mobile device	75	25.17
Total	298	100

Data Collection Tools

In the study, a personal information form was prepared by the researcher in order to collect the demographic information of the pre-service teachers. In the personal information form, the gender of the pre-service teacher (female/male), the department he/she was studying at (primary school teaching, middle school mathematics teaching, pre-school teaching, guidance and psychological counseling), grade level (1, 2, 3, or 4), the average weekly internet usage time before the online classes started (0-7 hours, 8-14 hours, 15 hours and above), and the tools used for participating in online classes (desktop, laptop or mobile device) were included.

In the study, the computational thinking skills scale developed by Dolmacı and Akhan (2020) was used to determine the computational thinking skill levels of the pre-service teachers. The five-point Likert-type scale consists of 40 items and five factors. These factors can be listed as algorithmic-analytical thinking skills, creative problem-solving skills, collaboration skills, critical thinking skills, and computer-using skills. In order to determine the reliability of the scale, the internal consistency coefficient for the subscales and the whole scale was calculated by the researchers and coefficients ranging from .74 to .91 were obtained. As a result of the confirmatory factor analysis, it was concluded that the computational thinking skills scale showed good agreement and that the structure revealed by the exploratory factor analysis was confirmed. Based on these findings, it can be said that the scale used in the research to determine the computational thinking skills of pre-service teachers is a valid and reliable scale.

The online self-regulated learning scale developed by Barnard et al. (2009) and adapted into Turkish by Samsa-Yetik (2011) was used to examine pre-service teachers' online self-regulated learning skill levels. The five-point Likert-type scale, which was prepared to measure self-regulation skills in online environments at the undergraduate level, consists of 24 items and six factors. These factors can be listed as goal setting, setting the environment, task strategies, time management, seeking help, and self-evaluation. The internal consistency coefficients of the subscales ranged from .64 to .77. The internal consistency coefficient of the whole scale was .89. Nunally (1978) stated that an internal consistency coefficient above 70 is sufficient for social science research. When the internal consistency coefficients are examined, it can be said that the scale is a valid and reliable measurement tool for research that aims to reveal self-regulation skill levels in the online learning environment.

Data Collection and Analysis

Before collecting the data related to the research, the necessary permission was obtained, and the data were collected from the pre-service teachers who voluntarily participated in the research. At the beginning of the data collection process, the purpose of the research was explained to the participants, the instructions for filling out the scales were shared with them, and they were asked to answer the scale items in an objective way. Then, the data collection tools were transferred to the virtual environment and the internet access address was given so that the pre-service teachers could respond to these tools. All of the pre-service teachers in the study group filled out the scale items completely. The application of the scales to the pre-service teachers was completed within two weeks. The collected data were transferred to the digital environment and the analyses were carried out. Within the framework of quantitative data analysis, descriptive analysis techniques, independent samples t-test, one-way ANOVA, Kruskal-Wallis H test for independent samples and Pearson correlation technique were used.

For the statistical techniques to be applied in the research, the Kolmogorov-Smirnov test was applied in order to determine whether the distribution of the measurements related to the dependent variables was normal or not, considering the group size being greater than 50, and the test results are given in Table 2.

Table 2: *Tests of Normality*

	Kolmogorov-Smirnov			
	Gender	**Statistic**	**df**	**p**
Computational thinking	Female	.057	218	.078
	Male	.091	80	.158
Online self-regulated learning	Female	.049	218	.200
	Male	.072	80	.200
	Grade level	**Statistic**	**df**	**p**
Computational thinking	1st grade	.152	10	.200
	2nd grade	.054	217	.200
	3rd grade	.136	53	.015
	4th grade	.209	18	.036
Online self-regulated learning	1st grade	.265	10	.045
	2nd grade	.051	217	.200
	3rd grade	.077	53	.200
	4th grade	.195	18	.069
	Average internet usage time	**Statistic**	**df**	**p**
Computational thinking	0-7 hours	.073	148	.052
	8-14 hours	.077	88	.200
	15 hours and over	.081	62	.200
Online self-regulated learning	0-7 hours	.064	148	.200
	8-14 hours	.079	88	.200
	15 hours and over	.082	62	.200

	Online course participation device	Statistic	df	p
Computational thinking	Desktop / laptop	.987	196	.061
	Mobile device	.988	102	.526
Online self-regulated learning	Desktop / laptop	.992	196	.315
	Mobile device	.987	102	.436

The fact that the calculated p values are greater than α=.05 is interpreted as that the scores at this significance level do not deviate excessively from the normal distribution and have a normal distribution (Büyüköztürk, 2007). Accordingly, Table 2 indicates, that the distributions of the measurements related to the dependent variables show a normal distribution in terms of gender, weekly average internet usage time and devices used for participating in online courses. In this direction, parametric statistical techniques (independent samples t-test, one-way ANOVA) were used for the mentioned variables. In addition, it is seen that the distribution of the measurements related to the dependent variables does not show a normal distribution in terms of the grade level variable. Based on this finding, the Kruskal-Wallis H test, which is a non-parametric test, was used for the grade level variable.

Findings

Investigation of Pre-service Teachers' Computational Thinking Skill Levels

Descriptive statistical techniques were used to determine the computational thinking skill levels of the pre-service teachers participating in the study, and the results are presented in Table 3.

Table 3: *Pre-Service Teachers' Computational Thinking Skill Levels*

Factors	n	x̄	SD	Min	Max	Very low	Low	Medium	High	Very high
Using a computer	298	23.42	2.82	12.00	30.00	n=0 %=0	n=1 %=0.34	n=11 %3.69	n=190 %=63.76	n=96 %=32.22
Algorithmic-analytical thinking	298	37.85	4.30	24.00	50.00	n=0 %=0	n=0 %=0	n=15 %=5.03	n=215 %=72.15	n=68 %=22.82
Creative problem solving	298	43.21	5.14	23.00	55.00	n=0 %=0	n=0 %=0	n=8 %=2.69	n=184 %=61.75	n=106 %=35.57
Collaborating	298	27.56	4.32	10.00	35.00	n=0 %=0	n=4 %=1.34	n=24 %=8.05	n=154 %=51.68	n=116 %=38.93
Critical thinking	298	24.92	2.33	19.00	30.00	n=0 %=0	n=0 %=0	n=0 %=0	n=167 n=56.04	n=131 %=43.96
Total	298	156.95	13.94	117.00	200.00	n=0 %=0	n=0 %=0	n=1 %=0.34	n=189 %=63.42	n=108 %=36.24

When Table 3 is examined, it is seen that 63% of the pre-service teachers who participated in the study had a high level of computational thinking skills and 36% of them had a very high level. When the findings are examined in terms of factors of computational thinking; in the factor of "using a computer" 64% of pre-service teachers had a high level and 32% of them had a very high level; in the "algorithmic-analytical thinking" factor, 72% of the pre-service teachers had a high level and 23% of them had a very high level; in the "creative problem solving" factor 62% of pre-service teachers had a high level and 36% of them had a very high level; in the factor of "collaboration" 52% of pre-service teachers had a high level and 39% of them had a very high level; and in the "critical thinking" factor, it is seen that 56% of pre-service teachers had a high level and 44% of them had a very high level.

Investigation of Pre-Service Teachers' Computational Thinking Skill Levels According to Various Variables

In order to determine whether the computational thinking skill levels of the pre-service teachers participating in the study differed significantly according to the gender variable, an independent samples t-test was applied, and the results are presented in Table 4.

Table 4: *Pre-service Teachers' Computational Thinking Skill Levels by Gender*

Factors	Gender	n	$\bar{x}$	SD	*t*	df	*p*
Using a computer	Female	218	23.29	2.70	-1.238	296	.217
	Male	80	23.75	3.13			
Algorithmic-analytical thinking	Female	218	37.82	4.25	-.207	296	.836
	Male	80	37.94	4.48			
Creative problem solving	Female	218	43.17	4.88	-.212	296	.832
	Male	80	43.31	5.80			
Collaborating	Female	218	27.84	3.95	1.818	296	.070
	Male	80	26.81	5.14			
Critical thinking	Female	218	24.90	2.26	-.152	296	.880
	Male	80	24.95	2.55			
Total	Female	218	157.02	13.44	.143	296	.887
	Male	80	156.76	15.31			

When Table 4 is examined, it is seen that the computational thinking skill levels of the pre-service teachers who participated in the study did not differ significantly according to the gender variable. When the obtained scores were analyzed in terms of computational thinking skill factors, no significant difference was found.

The Kruskal-Wallis H test was applied to determine whether the computational thinking skill levels of the pre-service teachers participating in the study differed significantly according to the grade level variable, and the results are presented in Table 5.

Table 5: *Pre-Service Teachers' Computational Thinking Skill Levels According to Their Grade Level*

Factors	Grade level	n	Mean rank	df	X^2	*p*
Using a computer	1st grade	10	148.95	3	7.482	.058
	2nd grade	217	144.32			
	3rd grade	53	153.26			
	4th grade	18	201.19			
Algorithmic-analytical thinking	1st grade	10	131.10	3	7.337	.062
	2nd grade	217	149.39			
	3rd grade	53	136.95			
	4th grade	18	198.03			
Creative problem solving	1st grade	10	177.75	3	1.426	.699
	2nd grade	217	149.70			
	3rd grade	53	142.66			
	4th grade	18	151.53			
Collaborating	1st grade	10	117.10	3	5.614	.132
	2nd grade	217	146.44			
	3rd grade	53	154.93			
	4th grade	18	188.36			
Critical thinking	1st grade	10	143.50	3	1.163	.762
	2nd grade	217	150.58			
	3rd grade	53	141.16			
	4th grade	18	164.36			
Total	1st grade	10	143.65	3	5.702	.127
	2nd grade	217	147.94			
	3rd grade	53	141.40			
	4th grade	18	195.42			
	Total	298				

When Table 5 is examined, it is seen that the computational thinking skill levels of the pre-service teachers participating in the study did not differ significantly depending on the grade level they were studying. When the obtained scores were analyzed in terms of computational thinking skill factors, no significant difference was found.

One-way ANOVA was applied in order to determine whether the computational thinking skill levels of the pre-service teachers participating in the study differed significantly according to the weekly average internet usage time before starting online lessons, and the results are presented in Table 6.

Table 6: *Pre-Service Teachers' Computational Thinking Skill Levels According to Weekly Average Internet Usage Time*

Factors	Source	Sum of squares	sd	Mean square	*F*	*p*
Using a computer	Between Groups	17.48	2	8.740	1.097	.335
	Within Groups	2350.92	295	7.969		
	Total	2368.40	297			
Algorithmic-analytical thinking	Between Groups	20.18	2	10.091	.543	.581
	Within Groups	5477.32	295	18.567		
	Total	5497.50	297			
Creative problem solving	Between Groups	43.35	2	21.674	.820	.441
	Within Groups	7793.75	295	26.420		
	Total	7837.10	297			
Collaborating	Between Groups	3.03	2	1.516	.081	.922
	Within Groups	5534.38	295	18.761		
	Total	5537.41	297			
Critical thinking	Between Groups	10.43	2	5.215	.958	.385
	Within Groups	1606.47	295	5.446		
	Total	1616.90	297			
Total	Between Groups	112.23	2	56.115	.287	.750
	Within Groups	57601.11	295	195.258		
	Total	57713.34	297			

When Table 6 is examined, it is seen that the computational thinking skill levels of the pre-service teachers participating in the study did not differ significantly depending on the average weekly internet usage time before starting online lessons. When the obtained scores were analyzed in terms of computational thinking skill factors, no significant difference was found.

In order to determine whether the computational thinking skill levels of the pre-service teachers participating in the study differed significantly according to the devices used for participating in online learning, an independent samples t-test was applied, and the results are presented in Table 7.

Table 7: *Pre-Service Teachers' Computational Thinking Skill Levels According to the Devices Used for Participating in Online Learning*

Factors	Device	n	x̄	SD	*t*	df	*p*
Using a computer	Desktop / laptop	223	23.70	2.83	2.979	296	.003
	Mobile device	75	22.59	2.65			
Algorithmic-analytical thinking	Desktop / laptop	223	37.94	4.39	.618	296	.537
	Mobile device	75	37.59	4.03			
Creative problem solving	Desktop / laptop	223	43.25	5.08	.249	296	.803
	Mobile device	75	43.08	5.34			
Collaborating	Desktop / laptop	223	27.70	4.38	.959	296	.338

	Mobile device	75	27.15	4.14			
Critical thinking	Desktop / laptop	223	25.09	2.30	2.171	296	.031
	Mobile device	75	24.41	2.39			
Total	Desktop / laptop	223	157.67	13.91	1.540	296	.125
	Mobile device	75	154.81	13.90			

When Table 7 is examined, it is seen that the computational thinking skill levels of the pre-service teachers who participated in the study did not differ significantly depending on the devices used for participating in online learning; on the other hand, significant differences were found in the factors of “using a computer” ($t_{(296)} = 2.979$, $p \leq .05$) and “critical thinking” ($t_{(296)} = 2.171$, $p \leq .05$). The scores of the pre-service teachers who participated in online learning via a desktop or laptop in the factors of “using a computer” ($\bar{x}$=23.70) and “critical thinking” ($\bar{x}$=25.09) were found to be significantly higher than the scores of the pre-service teachers who participated in online learning via a mobile device in the “using a computer” ($\bar{x}$=22.59) and “critical thinking” ($\bar{x}$=24.41) factors.

Investigation of Pre-Service Teachers' Online Self-Regulated Learning Levels

Descriptive statistical techniques were used to determine the online self-regulated learning levels of the pre-service teachers participating in the study, and the results are presented in Table 8.

Table 8: *Online Self-regulated Learning Levels of Pre-Service Teachers*

Factors	n	X	SD	Min	Max	Very low	Low	Medium	High	Very High
Setting goals	298	18.65	2.99	8.00	25.00	n=0 %=0	n=5 %=1.68	n=27 %=9.06	n=197 %=66.11	n=69 %=23.15
Environment configuration	298	16.65	2.74	5.00	20.00	n=0 %=0	n=2 %=0.67	n=20 %=6.71	n=131 %=43.96	n=145 %=48.66
Task strategies	298	13.40	2.79	4.00	20.00	n=2 %=0.67	n=11 %=3.69	n=96 %=32.22	n=153 %=51.34	n=36 %=12.08
Time management	298	9.93	2.54	3.00	15.00	n=4 %=1.34	n=29 %=9.73	n=85 %=28.52	n=138 %=46.31	n=42 %=14.09
Seeking help	298	13.98	2.81	5.00	20.00	n=0 %=0	n=14 %=4.70	n=54 %=18.12	n=185 %=62.08	n=45 %=15.10
Self-assessment	298	13.99	3.02	4.00	20.00	n=2 %=0.67	n=13 %=4.36	n=75 %=25.17	n=155 %=52.01	n=53 %=17.79

Total	298	86.59	11.57	44.00	116.00	n=0 %=0	n=1 %=0.34	n=28 %=9.40	n=216 %=72.48	n=53 %=17.79

When Table 8 is examined, it is seen that 72% of the pre-service teachers who participated in the study had online self-regulated learning skills at a high level, 18% at a very high level and 9% at a medium level. When the findings are examined in terms of the factors of online self-regulated learning; it is seen that in the "goal setting" factor, 66% of pre-service teachers had a high level, 23% of them had a very high level and 9% of them had a medium level; in the "environment configuration" factor, 48% of pre-service teachers had a high level, 44% of them had a very high level and 8% of them had a medium level; in the "task strategies" factor, 51% of pre-service teachers had a high level, 32% of them had a medium level and 12% of them had a very high level; in the "time management" factor, 46% of the pre-service teachers had a high level, 28% of them had a medium level and 14% of them had a very high level; in the "seeking help" factor, 62% of pre-service teachers had a high level, 18% of them had a medium level and 15% of them had a very high level; in the "self-assessment" factor, it is seen that 73% of pre-service teachers had a high level, 18% of them had a very high level and 9% of them had a medium level.

Investigation of Pre-Service Teachers' Online Self-Regulated Learning Levels According to Various Variables

In order to determine whether the online self-regulated learning levels of the pre-service teachers participating in the study differed significantly according to the gender variable, an independent samples t-test was applied, and the results are presented in Table 9.

Table 9: *Pre-Service Teachers' Online Self-Regulated Learning Levels by Gender*

Factors	Gender	n	$\bar{x}$	SD	*t*	df	*p*
Setting goals	Female	218	18.73	3.04	.779	296	.436
	Male	80	18.43	2.85			
Environment configuration	Female	218	16.85	2.42	2.150	296	.032
	Male	80	16.09	3.43			
Task strategies	Female	218	13.78	2.74	3.979	296	.000
	Male	80	12.36	2.69			
Time management	Female	218	10.17	2.45	2.724	296	.007
	Male	80	9.28	2.68			
Seeking help	Female	218	14.10	2.70	1.263	296	.208
	Male	80	13.64	3.08			
Self-assessment	Female	218	14.11	2.99	1.166	296	.244
	Male	80	13.65	3.09			
Total	Female	218	87.74	10.92	2.881	296	.004
	Male	80	83.44	12.73			

When Table 9 is examined, it is seen that the online self-regulated learning levels of the pre-service teachers participating in the study differed significantly according to the gender variable ($t_{(296)} = 2.881$, $p \leq .05$). The online self-regulated learning levels of female pre-service teachers ($\bar{x} = 87.74$) were significantly higher than the online self-regulated learning levels of male pre-service teachers (x̄ = 83.44). In addition, when the scores obtained are analyzed in terms of online self-regulated learning factors, there was a significant difference in the "environment configuration" ($t_{(296)}$ = 2.150, p≤.05), "task strategies" ($t_{(296)}$ = 3.979, p≤.05) and "time management" ($t_{(296)}$ = 2.724, p≤.05) factors. The scores of the female pre-service teachers in all three factors were higher than the scores of the male pre-service teachers.

The Kruskal-Wallis H test was applied to determine whether the online self-regulated learning levels of the pre-service teachers participating in the study differed significantly according to the grade level variable, and the results are presented in Table 10.

Table 10: *Pre-Service Teachers' Online Self-Regulated Learning Levels According to Their Grade Level*

Factors	Grade level	n	Mean rank	df	X^2	*p*
Setting goals	1st grade	10	149.35	3	9.264	.026
	2nd grade	217	140.77			
	3rd grade	53	177.86			
	4th grade	18	171.36			
Environment configuration	1st grade	10	133.30	3	1.801	.615
	2nd grade	217	147.23			
	3rd grade	53	162.58			
	4th grade	18	147.39			
Task strategies	1st grade	10	149.25	3	.656	.883
	2nd grade	217	151.77			
	3rd grade	53	143.79			
	4th grade	18	139.06			
Time management	1st grade	10	122.00	3	3.534	.316
	2nd grade	217	151.31			
	3rd grade	53	156.96			
	4th grade	18	121.00			
Seeking help	1st grade	10	99.15	3	16.138	.001
	2nd grade	217	141.35			
	3rd grade	53	186.58			
	4th grade	18	166.47			
Self-assessment	1st grade	10	146.00	3	6.241	.100
	2nd grade	217	142.43			
	3rd grade	53	171.92			
	4th grade	18	170.69			
Total	1st grade	10	123.10	3	6.584	.086
	2nd grade	217	143.77			
	3rd grade	53	174.34			
	4th grade	18	160.14			

When Table 10 is examined, it is seen that the online self-regulated learning levels of the pre-service teachers who participated in the study did not differ significantly depending on their grade level; on the other hand significant differences were found in the "setting goals" ($x^2_{(3)}$ = 9.26, p≤.05) and "seeking help" ($x^2_{(3)}$ = 16.14, p≤.05) factors of online self-regulated learning. The mean rank of the pre-service teachers studying in the third and fourth grade was significantly higher than the mean rank of the pre-service teachers studying in the first and second grade.

One-way ANOVA was applied in order to determine whether the online self-regulated learning levels of the pre-service teachers participating in the study differed significantly according to the weekly average internet usage time before starting online learning applications, and the results are presented in Table 11.

Table 11: *Pre-Service Teachers' Online Self-Regulated Learning Levels According to Weekly Average Internet Usage Time*

Factors	Source	Sum of squares	sd	Mean rank	*F*	*p*
Setting goals	Between Groups	47.65	2	23.82	2.703	.069
	Within Groups	2600.36	295	8.82		
	Total	2648.00	297			
Environment configuration	Between Groups	21.41	2	10.70	1.428	.241
	Within Groups	2210.60	295	7.49		
	Total	2232.00	297			
Task strategies	Between Groups	16.10	2	8.05	1.033	.357
	Within Groups	2299.38	295	7.80		
	Total	2315.48	297			
Time management	Between Groups	29.10	2	14.55	2.276	.105
	Within Groups	1886.42	295	6.40		
	Total	1915.52	297			
Seeking help	Between Groups	31.75	2	15.87	2.024	.134
	Within Groups	2313.09	295	7.84		
	Total	2344.84	297			
Self-assessment	Between Groups	25.76	2	12.88	1.417	.244
	Within Groups	2682.18	295	9.09		
	Total	2707.95	297			
Total	Between Groups	870.19	2	435.10	3.299	.038
	Within Groups	38904.04	295	131.88		
	Total	39774.23	297			

When Table 11 is examined, it is seen that the online self-regulated learning levels of the pre-service teachers who participated in the study differed significantly depending on the weekly average internet usage time before starting online learning applications ($F_{(2\text{-}297)} = 3.299$). According to the results of the Tukey HSD test conducted to find out between which groups this difference occurred; the online self-regulated learning levels of pre-service teachers who had an weekly average internet usage time in the range of "0-7 hours" ($\bar{x}$=87,88) were significantly higher than the online self-regulated learning levels of pre-service teachers who had an weekly average internet usage time of "15 hours or more" ($\bar{x}$=83,98). When the obtained scores were examined in terms of online self-regulated learning factors, no significant difference was found.

In order to determine whether the online self-regulated learning levels of the pre-service teachers participating in the study differed significantly according to the devices used for participating in online learning, an independent samples t-test was applied, and the results are presented in Table 12.

Table 12: *Pre-Service Teachers' Online Self-Regulated Learning Levels According to the Devices Used to Participate in Online Learning*

Factors	Device	n	x̄	SD	*t*	df	*p*
Setting goals	Desktop / laptop	223	18.79	3.07	1.369	296	.172
	Mobile device	75	18.24	2.71			
Environment configuration	Desktop / laptop	223	16.68	2.78	.368	296	.713
	Mobile device	75	16.55	2.64			
Task strategies	Desktop / laptop	223	13.44	2.75	.379	296	.705
	Mobile device	75	13.29	2.94			
Time management	Desktop / laptop	223	9.89	2.64	-.487	296	.626
	Mobile device	75	10.05	2.22			
Seeking help	Desktop / laptop	223	13.87	2.94	-1.129	296	.260
	Mobile device	75	14.29	2.36			
Self-assessment	Desktop / laptop	223	14.07	2.93			
	Mobile device	75	13.75	3.27			
Total	Desktop / laptop	223	86.73	11.81	.358	296	.721
	Mobile device	75	86.17	10.90			

When Table 12 is examined, it is seen that the online self-regulated learning levels of the pre-service teachers who participated in the study did not differ significantly depending on the devices used for participating in online learning. When the scores were analyzed in terms of online self-regulated learning factors, no significant difference was found.

The Pearson correlation technique was applied to determine whether there was a significant relationship between pre-service teachers' computational thinking skill levels and online self- regulated learning levels, and the results are presented in Table 13.

Table 13: *Relationship between Pre-service Teachers' Computational Thinking Skill Levels and Online Self-regulated Learning Levels*

		Using a computer	**Algorithmic-analytical thinking**	**Creative problem solving**	**Collaborating**	**Critical thinking**	**Computational thinking**
Setting goals	Pearson Correlation	.404	.490	.474	.197	.454	.545
	Sig. (2-tailed)	.000	.000	.000	.001	.000	.000
	N	298	298	298	298	298	298
Environment configuration	Pearson Correlation	.185	.260	.239	.236	.345	.336
	Sig. (2-tailed)	.001	.000	.000	.000	.000	.000
	N	298	298	298	298	298	298
Task strategies	Pearson Correlation	.170	.323	.393	.202	.294	.391

	Sig. (2-tailed)	.003	.000	.000	.000	.000	.000
	N	298	298	298	298	298	298
Time management	Pearson Correlation	.184	.340	.369	.105	.275	.357
	Sig. (2-tailed)	.001	.000	.000	.070	.000	.000
	N	298	298	298	298	298	298
Seeking help	Pearson Correlation	.219	.268	.356	.283	.268	.391
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	298	298	298	298	298	298
Self-assessment	Pearson Correlation	.230	.295	.418	.281	.259	.422
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	298	298	298	298	298	298
Online self-regulated learning	Pearson Correlation	.342	.483	.550	.321	.463	.598
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	298	298	298	298	298	298

When Table 13 is examined, it is seen that there was a moderate, positive and significant relationship between pre-service teachers' computational thinking skill levels and online self-regulated learning levels ($r = 0.598$, $p \leq .05$). Accordingly, it can be said that as the computational thinking skill levels of pre-service teachers increased, their online self-regulated learning levels also increased. In addition, it has been observed that there was a positive and significant relationship between all factors of computational thinking skill and all factors of online self-regulated learning ($p \leq .05$).

Discussion, Conclusion and Suggestions

When the research findings were examined, it was seen that 63% of the pre-service teachers participating in the research had a high level of computational thinking skills, and 36% had a very high level. In the study conducted by Korkmaz et al. (2015), it was determined that 50% of the individuals had high perceptions of their computational thinking skill level, while 50% of them had moderate perceptions. Similarly, in the study of Sarıtepeci (2017), it was found that 73% of the participants had a moderate level of computational thinking skills, while 27% had a high level.

While it was seen that the computational thinking skill levels of the pre-service teachers participating in the research did not differ significantly depending on the means of participating in online learning, a significant difference was found in the dimensions of using a computer and being able to think critically. Computer use and critical thinking scores of pre-service teachers who participated in online learning via desktop or laptop computers were found to be significantly higher than the scores of pre-service teachers who participated in online learning via mobile devices.It is thought that individuals who participate in online learning using desktop or laptop computers use personal computers for both learning and other purposes more than individuals who participate in online learning using mobile devices. It is thought that the increase in the duration of the students' desktop or laptop computer use may have led to the further development of their computer use skills. It was observed that the computational thinking skill levels of the participants did not differ significantly according to the variables of gender, class level and average weekly internet usage time.

When the research findings were examined, it was seen that 72% of the pre-service teachers participating in the research had a high level of online self-regulated learning skills, 18% had a very high level and 9% had a medium level. Çatana-Kuleli (2018), in her study examining the readiness levels of pre-service teachers for online learning, concluded that the participants found themselves sufficient above the average. In the study conducted by Lee and Tsai (2011), it was observed that students exhibited higher levels of self-regulatory learning and information-seeking behaviors in the internet-based environment than in the face-to-face environment. Students perceive themselves as more talented and more interested in self-regulated learning in the internet-based learning environment compared to the traditional environment; in addition, they experience more information seeking in the internet-based environment, and they see themselves as more interested and talented in this regard. The study conducted by Paechter and Maier (2010) revealed that students found online learning environments beneficial in terms of their power to provide clear and easy understanding of learning material, to support self-regulated learning and to distribute information.

It was observed that the online self-regulatory learning levels of the pre-service teachers participating in the research differed significantly according to the gender variable. Online self-regulated learning levels of female pre-service teachers were significantly higher than male pre-service teachers' online self-regulated learning levels. In addition, when the scores obtained were examined in terms of online self-regulatory learning dimensions; significant differences were found in the dimensions of environment configuration, task strategies and time management. The scores of female pre-service teachers for all three dimensions were higher than the scores of male pre-service teachers. Patrick et al. (1999), in their study examining the relationship between self-regulated learning, goal orientation and performance, found that boys were more externally oriented than girls, and that girls tended to use cognitive strategies more. Çatana-Kuleli (2018) concluded that women's readiness for online learning was higher in the self-directed learning sub-dimension.

While it was seen that the online self-regulatory learning levels of the pre-service teachers participating in the research did not differ significantly depending on the grade level they were studying, a significant difference was found in the goal setting and help seeking dimensions of online self-regulated learning. The mean rank of the pre-service teachers studying in the third and fourth grades was significantly higher than the mean rank of the pre-service teachers studying in the first and second grades. Çatana-Kuleli (2018) revealed in her study that the participants were least ready for online learning in the 1st grade and most ready in the 4th grade. Considering the dimension of goal setting, the student sets standards for homework, sets short- and long-term goals sets high standards for the learning process, and does not compromise on the quality of the work; when it comes to the help-seeking dimension, it is seen that behaviors such as finding someone to consult when needed, sharing problems with classmates, and asking for help from the educator become more common as they get to know the learning environment better and gain experience in the learning process. For this reason, the experiences of upper-grade students regarding the learning environment may explain their more professional behavior when setting goals and feeling more comfortable in seeking help.

It was observed that the online self-regulatory learning levels of the pre-service teachers participating in the research differed significantly depending on the weekly average internet usage time before they started online learning applications. The online self-regulated learning levels of the pre-service teachers whose weekly average internet use was between 0-7 hours were significantly higher than the online self-regulated learning levels of the pre-service teachers whose weekly average internet use was 15 hours or more. Here, it is necessary to look at the internet usage purposes of today's youth as well as the internet usage time. It is known that young people at any educational level use the internet for mostly for purposes of communication, entertainment, social media, games, etc. The increase in the amount of time students spend on the internet, whether in or out of class, may cause them to spend less time and effort on learning and managing their learning. In addition, it was seen as a result of the research that the self-regulatory learning levels of the pre-service teachers participating in the research did not differ significantly depending on the devices used for participating in online learning.

It was seen that there was a moderate, positive and significant relationship between pre-service teachers' computational thinking skills and online self-regulatory learning levels. Accordingly, it can be said that as the pre-service teachers' computational thinking skills increased, their online self-regulatory learning levels also increased. In addition, it has been observed that there was a positive and significant relationship between all dimensions of computational thinking skills and all dimensions of online self-regulated learning. The essence of computational thinking is to think like a computer scientist when faced with a problem. Computational thinking is the ability to use general methods of mathematical thinking skills in solving a problem; the ability to think like an engineer in designing a large, complex system and relating it to real-life situations; and the ability to think like a scientist in understanding intelligence, the mind and human behavior (Wing, 2008).

An individual who can think computationally will be able to successfully perform the processes of determining learning goals, structuring the learning environment, determining and monitoring task strategies, managing his time, and making self-evaluation, which are the dimensions of self-regulated learning. According to Barr et al. (2011) computational thinking does not only allow the development of cognitive skills in students, but it also inherently fosters affective skills such as the confidence to deal with complex processes, the determination to work through difficult problems, tolerance for ambiguity, the ability to deal with open-ended problems, and the ability to work and communicate with others for a purpose and solution. Individuals with the aforementioned affective skills will face fewer difficulties in the help-seeking and self-evaluation dimensions of self-regulated learning. With computational thinking, the focus is not on people thinking like computers, but on their way of solving problems. Therefore, managing our lives, problem solving, communication, helping each other, setting goals, designing the learning environment, planning time, directing learning, and self-evaluation can be considered as computational actions (Batı et al., 2017).

The 21st century requires previously unexpected qualities in terms of growing individuals. The change in the qualifications that students are expected to acquire also affects the required teacher qualifications. On the one hand, the need for lifelong education increases the applications of online or offline distance education in formal and non-formal education; on the other hand, students need to make self-regulation in both face-to-face education and distance education. At a time when blended education models are increasing, online-offline learning gains momentum through teaching practices such as flipped learning, diplomas are insufficient and certificates are gained, and doing this with distance-online education becomes widespread, learners need to have the qualities sought by the 21st century. One of the skills that support these qualities is computational thinking.

Computational thinking skills generally consist of gains such as enabling problem solving with tools such as computers, algorithmic thinking, analyzing data and providing possible solutions by arranging them logically. When computational thinking skills and programming skills are compared, it is understood that the goals of both skill areas are very similar. For this reason, it is thought that computational thinking skills can be gained by individuals through programming education (Barut et al., 2016). As a matter of fact, it can be said that programming education occupies an important place in the changes in curricula carried out in our country and around the world in gaining computational thinking skills. It is understood that with these and similar changes made in various countries, the aim is to develop students' logical thinking and problem-solving skills through computational thinking (Bocconi et al., 2016). In support of this idea, it is emphasized in the literature that computational thinking improves problem solving and critical thinking, and that this significantly increases the problem-solving capacity and creativity of learners (Yıldız-Durak & Sarıtepeci, 2017; ISTE, 2011; Weintrop et al., 2014; Yadav, 2011). In addition, it is predicted that the reorganization of curricula and textbooks for the acquisition of computational thinking skills and the structuring of both programming education and other courses within the scope of computational thinking skills will contribute to the acquisition of 21st century life skills. Lye and Koh (2014) suggest that students have more computer applications. Considering that in the information and communication age we live in, individuals benefit from technological tools while solving the problems they encounter both in their daily work and in their lessons and homework, it is thought that it will not be difficult to achieve this. In addition, it may be beneficial for the development of computational thinking skills to bring students face to face with exercises that increase in complexity and difficulty step by step, and with different kinds of problems, and to encourage them to explore various sources and collaborate with friends while solving them.

Both computational thinking skills and online self-regulated learning skills can help today's students for selection of appropriate tools and strategies in problem solving and to use appropriate algorithms in solving these problems. Thus, students will be able to transfer their knowledge and skills from daily life to the solution of problems and will be able to manage the solution process of these problems in a healthy way. In this direction, the sub-dimensions of computational thinking skills can be used to increase the quality of courses in higher education and other education levels; using computers, algorithmic and analytical thinking, creative problem solving, collaboration, and critical thinking skills can be reflected in learning outcomes, the teaching process and evaluation. This also applies to teacher training programs. In teacher training programs, besides computational thinking and self-regulated learning skills, different applications (the flipped classroom model, online-offline conferences, panels, discussion groups, etc.) can be included to provide online-offline learning experience. Of course, it will be beneficial at this point to give importance to the studies aimed at increasing students' information and communication technology usage levels and learner control features, and to ensure that students make reflective assessments after all online training that they receive. Various measurement and evaluation processes can be carried out to determine whether pre-service teachers have the mentioned skills at the beginning of the teaching profession. Finally, the effect of online self-regulatory learning and computational thinking skills of students in different school types and levels can be investigated, and performance-based studies can be conducted examining computational thinking and online self-regulated learning skills.

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