Effect of Tinkercad on Students' Computational Thinking Skills and Perceptions: A Case of Ankara Province

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ABSTRACT
This study was conducted to determine the effect of Tinkercad use in computer programming education on students ' computational thinking skills and perceptions. In this context, 583 secondary school students studying in Ankara province of Turkey at the fifth, sixth, seventh and eighth grade level in the 2019-2020 academic year constitute the sample of the research. The research was carried out using an enriched pattern, one of the mixed research methods in which quantitative and qualitative research designs were used together. Research data were collected using Personal Information Form, Student Perception Questionnaire about Tinkercad Software and Information Processing Thinking Scale (For Secondary School Level). The data obtained were analyzed using the SPSS 25 program. Using the results of normality analysis, Mann Whitney U test and Kruskal Wallis H test were used among non-parametric tests. In addition, Tamhane's T2 and LSD tests from Post Hoc analyzes and Spearman correlation test from correlation tests were used. When looking at students' perceptions of Tinkercad, it was determined that they were highly motivated for interest and appreciation and found Tinkercad to be generally useful and easy to use according to research findings. It was determined that the students ' perception of computational thinking was moderate. It was found that there was a positive low-level relationship between the frequency of Tinkercad use of students and their perception of Tinkercad, while there was a positive moderate-level relationship between their perception of Tinkercad and their computational thinking skills. In addition, it has been determined that the frequency of students ' use of Tinkercad is affected by internal and external reasons, so recommendations for parents and programmers are included.
Keywords: 3D Design, Computational Thinking, Programming, Tinkercad

INTRODUCTION
The perspective of technology has changed with the expansion of the opportunities offered to us by technological developments. Steps are being taken towards the transformation of the new generation from being individuals who only use technology, to becoming individuals who produce with technology. This process has accelerated with the introduction of 3-D printing technologies into our lives. Instead of being a user of many objects that we use in everyday life, research is being conducted on the way to becoming the manufacturer of these objects.

Designing new objects emerges as a new necessity, considering the ever-changing human needs. The fact that individuals cannot find the products that are suitable for the features they enliven in their imaginations in industrial products made in uniform form and the high costs of specially made or built objects show us the need for 3D Design and Printing technologies. But the fact that some 3D design and printing devices are quite expensive prevents them from being bought or used by all segments of society. In this case, online tools are applied using the facilities provided by technology. Programs such as Tinkercad, 3Dtin, ShapeSmith, Cubify, and Autodesk 123D design are examples of the online tools used (Canessa, Fonda & Zennaro, 2013).

Tinkercad allows students to gain 3D design skills through ready-made projects or through students ' own designs. The fact that the program is a web-based program, meaning that it does not require installation, is seen as a great way to teach 3D design to students (Avila & Bailey, 2016). Instead of purchasing the objects they need in daily life problems, the students can design and produce them in 3D using Tinkercad.

Computers, which affect us in all aspects of our lives in the 21st Century, present the concept of "computational thinking" as an important skill in searching for solutions to problems. According to Wing (2006), computational thinking is a skill that everyone should learn and this skill is defined and explained by many researchers (Aho, 2012; Barr & Stephenson, 2011; Bundy, 2007; Csizmadia et al., 2015; Czerkawski, 2013; Dede, Mishra & Voogt, 2013; Denning, 2009, 2017; Hemmendinger, 2010; Hu, 2011; Kafai, 2016; Lee et al., 2011; Leon, Gonzalez, Harteveld & Robles, 2017; Lu & Fletcher, 2009; Selby & Woollard, 2014; Wing, 2014; Yadav et al., 2014; Tedre & Denning, 2016).

Computational thinking skill being a skill associated with other thinking skills such as mathematics, engineering, design, system, criticism, algorithm, creativity, spatial reasoning and mental rotation has been effective in making studies to integrate it into the educational environment in a wide curriculum from pre-school to graduate school (Citta et al., 2019; Giannakopoulos, 2012; Hershkovitz et al., 2019; Selby & Woollard, 2014; Shute et al., 2017; Shute, Masduki & Donmez, 2010; Sneider et al., 2014; Razzouk & Shute, 2012; Voskoglou & Buckley, 2012) . For this reason, researchers have chosen to use various media and tools to improve students' computational thinking skills (Basawapatna et al., 2011; Bers et al., 2014; Brennan & Resnick, 2012; Chen et al., 2017; Howland & Good , 2015; Isnaini & Budiyanto, 2018; Israel et al., 2015; Kazimoglu et al., 2012; Morelli et al., 2011; Repenning, Webb & Ioannidou, 2010; Repenning, Basawapatna & Escherle, 2016; Roscoe & Fearn, 2014; Shute et al., 2017).

While Tinkercad allows students to make three-dimensional designs with its 3D Design menu, it also enables designs to be created with codes with the Circuit and Code Blocks menus. This leads to the idea that Tinkercad is a good tool that can affect all the sub-dimensions of computational thinking (creativity, algorithmic thinking, collaboration, critical thinking and problem solving). For example, it is thought that students' individual making 3D designs has an effect on the development of their creativity skills. It is thought that students' designing by forming groups has an effect on their development of collaboration and critical thinking skills, and that students' doing this process using code has an effect on their development of algorithmic thinking and problem solving skills. Lim and Kim (2019) determined that Tinkercad has a positive effect on the development of students' computational thinking ability.

It is known that programming is frequently used in teaching computational thinking (Shute et al., 2017). Repenning, Basawapatna, and Escherle (2016) stated that any programming tool can be used in the development of computational thinking. Various visual programming tools (Scratch, Alice, Code.org et al.) are used to facilitate the teaching of this skill (Bennett, Koh & Repenning, 2011; Brennan & Resnick, 2012; Israel et al., 2019).

In this context, the effective and efficient use of Tinkercad, which is used in design education in order to ensure that students in our country are with individuals who produce with technology, will be through determining students' perceptions of Tinkercad. In addition, determining the impact of Tinkercad on the development of students ' computational thinking skills is important for whether the program is used for educational purposes.

The Purpose of Research
This research was conducted to determine the students ' perception of computational thinking skills and Tinkercad design training using Tinkercad. In this context, answers to the research questions mentioned below were sought:

1. What are the technological competence levels of the students?
2. What are the students' past experiences of online and web-based learning environments?
3. Research questions on students' perceptions of using Tinkercad software:
    - 3.1. What are the perceptions of students regarding the use of Tinkercad?
    - 3.2. Is there a significant difference in the use of Tinkercad in terms of motivation, usefulness and ease of use perceptions of students according to their gender?
    - 3.3. Is there a significant difference in the use of Tinkercad in terms of motivation, usefulness and ease of use perceptions of students according to their grade levels?
    - 3.4. What are the students' usage frequency of Tinkercad? What is the relationship between students' frequency of Tinkercad use and their perception of Tinkercad?
4. Research questions on computational thinking skills:
    - 4.1. What is the computational thinking skill of the students?
    - 4.2. Is there a significant difference between the computational thinking skills of the students according to their gender?
    - 4.3. Is there a significant difference between computational thinking skills of students according to their grade levels?
    - 4.4. Is there a significant relationship between students' Tinkercad usage perceptions and computational thinking skills?

METHOD

This research was carried out using a pattern enriched from mixed research designs, in which quantitative and qualitative data collection methods were used together in terms of the process followed and its subject. In the quantitative dimension of the research pattern, descriptive scanning method was used from non-experimental research methods. In this way, students ' perceptions and computational thinking skills related to Tinkercad software were tried to be determined. In the qualitative dimension of the research, the case study method was used.

The Target Population and the Sample

The target population of this research is composed of secondary education institutions and private course centers affiliated to the Ministry of National Education in Keçiören, Yenimahalle, Mamak and Altındağ districts of Ankara province, which provide Tinkercad training to 5th, 6th, 7th and 8th grades in the 2019-2020 academic year. The sample of the research was carried out using purposeful sampling, which is a non-random sampling method. Purposeful sampling allows for in-depth research by selecting information rich cases depending on the purpose of the studies (Büyüköztürk et al., 2017, p.92). In this context, the sample group of the study was determined with the typical case sampling method, one of the purposeful sampling methods. The typical case sampling method requires determining a situation typical of many situations in the target population regarding the research problem and collecting information on this sample (Büyüköztürk et al., 2017, p.94). In determining the research sample, the private course Center, private school and public schools that provide Tinkercad training in their institutions were taken into account. Among these institutions, the private course Center and the private school provide Tinkercad training to their students in accordance with their own facilities. Public schools, on the other hand, provide Tinkercad training to their students within the framework of the facilities provided to their schools within the scope of the "IT production" project. For this reason, the sample of the study consists of 583 students studying in 5th, 6th, 7th and 8th grades in secondary school in the 2019-2020 academic year; 13 students in a private course center in Ankara's Keçiören district, 172 students studying at a public school in the same district, 74 students studying at a private school in Yenimahalle district, 55 students studying in a state school in Mamak district and 269 students studying in a public school in Altındağ district. The characteristics of these students are given in Table 1.

Table 1: Students' Characteristics

Grade	Gender				Total	
	Male		Female			
	N	%	N	%	N	%
5.	9	1.5	8	1.3	17	1.9
6.	135	23.1	137	23.4	272	46.6
7.	149	25.5	137	23.4	286	49.0
8.	5	0.8	3	0.5	8	1.3
Total	298	51.1	285	48.8	583	100

Of the total 583 students in Table 1, 298 students (51.1%) were male and 285 students (48.8%) were female. The reason for the small number of fifth and eighth grade students participating in the study is as follows: Eighth-grade students are not taught Tinkercad in public schools affiliated with the Ministry of education, these students received three weeks of training in a special course Center. Fifth grade students received 1 hour of training per week during a four-week special course by a private school affiliated to the Ministry of Education. Sixth and seventh grade students are given Tinkercad education within the scope of the "Production with Informatics" Project in public schools affiliated to the Ministry of Education. This training was carried out within the scope of Information Technology and Software course.

Data Collection Tool

In this study, quantitative and qualitative methods were used to collect relevant data. It was decided to use three data collection tools within the scope of the study by examining the literature. These data collection tools are Personal Information Form, Computational Thinking Scale (for Secondary School Level), and Student Perception Questionnaire on "Tinkercad" Software.

The Personal Information Form consists of two option questions prepared to learn the gender and level of education of students. This form has been prepared for pre-determined research purposes.

The computational thinking scale (for secondary school level) is a scale used to measure students ' computational thinking skills and the scale developed by Korkmaz et al. (2015) was used. The scale is a five-point Likert type scale and consists of 22 items that can be grouped under five factors. The item discrimination powers of the scale were found to be between 3,818 and 23,287. Accordingly, it can be said that each item and each factor contained in the scale serve at a meaningful level the purpose of measuring the property that needs to be measured in general, and each item is distinctive at the desired level . Furthermore, the Cronbach alpha reliability coefficient of the scale was determined to be 0.809.

The Student Perception Questionnaire about "Tinkercad" Software was used to measure students' perception of programming with Tinkercad. This scale was adapted by Akçay (2009) from the scale developed by Turşak (2007) for the Small Basic programming tool, and its reliability coefficient was determined as 0.946. In addition, the scale was developed by referring to seven expert opinions for language and field assessment. The scale was adapted for Tinkercad within the scope of the research, and it was made appropriate by taking the expert opinion of an academic member. The scale includes quantitative and qualitative research questions and consists of a total of 40 items under 5 factors. The scale has 9 items aimed at measuring students ' technological competence and 4 items aimed at learning about their past experience in online and web-based learning environments. There are 27 items about Tinkercad software aimed at students ' perception of motivation, usefulness and ease of use.

Data Collection

While collecting the research data, the students in Keçiören Private Youth Center were firstly applied the Pre-determined "Tinkercad" Software Student Perception Questionnaire and then Computational Thinking Scale (for Secondary School Level). These questionnaires were applied to students in a private school in Yenimahalle district of Ankara, a public school in Keçiören district, an imam hatip secondary school in Mamak district and a public school in Altındağ district, respectively.

Data Analysis

The data obtained at the end of the study were analyzed using the SPSS 25 program in line with the predetermined study objectives. As part of the sub-objectives of the research, descriptive analysis was carried out primarily for quantitative data. Later, a normality analysis was performed to determine whether the tests were parametric. The results were analyzed by considering the kurtosis-skewness and variance coefficient, histogram graph, Detrended normality graph and Kolmogorov-Smirnov test from normality tests. In this context, non-parametric tests Mann Whitney U test and Kruskal Wallis H test were used. By checking the homogeneous distributions of groups, Tamhane's T2 test and LSD test were applied from post Hoc analysis methods to determine which group differed in favor. Spearman correlation test was used in correlation scales since the tests did not comply with the normal distribution. The qualitative data collected by using the Student Perception Questionnaire on the "Tinkercad" Software was analyzed using the content analysis method, one of the qualitative data analysis methods.

FINDINGS

This section includes findings on students' technology usage competencies, past experiences in online and web-based learning environments, motivation for using Tinkercad, perceived usefulness, ease of use, and computational thinking skills.

Findings on Students ' Level of Technology Competence

According to the descriptive analysis results of students 'technology use competencies (web browsers, search engines, e-mail, online forums & blogs, online messaging applications, Microsoft Office applications, programming language), it has been determined that students' technology use competencies are at the beginning level ($\bar{X} = 2.62$).

When the findings of the students' past experiences about online and web-based learning environments were examined, it was determined that 70.8% of the students did not take any web-supported courses until today, and 79.6% did not take a web-supported programming language course. In addition, it was found that 96.7% of the students used the internet in their studies and 68.4% used a programming language.

Research Findings on Students ' Perceptions of Tinkercad Software Usage

In determining students ' perceptions of Tinkercad usage, descriptive analysis was performed about the "Tinkercad" software by taking into account the motivation, usefulness and ease of use sub-dimensions of the student Perception Survey. Accordingly, the distribution of categories according to the motivational theme of the Tinkercad perception scale of students is shown in Table 2, the distribution of categories according to the usefulness theme is shown in Table 3, and the distribution of categories according to the ease of Use theme is shown in Table 4.

Table 2: Students ' Perceptions of Motivation for Using Tinkercad

Motivation	Strongly disagree	Disagree	Neither agree nor diasgree	Agree	Strongly agree		
	%	%	%	%	%	X̄	S
Interest / Enjoyment	4.3	13.7	27.3	35.5	19.2	3.82	1.00
Perceived Competence	7.7	9.4	22.5	35.0	24.9	3.60	1.18
Willingness	3.1	17.3	33.5	34.3	11.8	3.65	0.92
Participation	6.7	14.7	33.3	33.1	12.2	3.49	1.02
Average	5.45	13.7	29.1	34.4	17.0	3.68	0.83

When Table 2 is examined, it is seen that the items of interest and enjoyment in the motivation theme in the questionnaire have the highest average ($\bar{X}$ = 3.82). This can be interpreted as a sub-theme in which Tinkercad has the most influence. Participation-oriented substances were identified as substances that affect motivation at the lowest rate (X=3.49). This can be interpreted as a sub-theme in which Tinkercad has the most influence. Participation-oriented items were identified as items that affect motivation at the lowest rate (X=3.49).

Table 3: Usefulness Perceptions of Students Regarding the Use of Tinkercad

Usefulness	Strongly disagree	Disagree	Neither agree nor diasgree	Agree	Strongly agree		
	%	%	%	%	%	X̄	S
Working More Effectively and Quickly	1.4	9.4	31.6	39.9	17.7	3.82	0.87
Job Performance	2.2	10.0	32.1	37.8	17.5	3.79	0.91
Increasing Productivity	7.5	9.8	25.9	32.4	24.0	3.55	1.17
Effectiveness	6.7	8.9	21.3	36.0	25.7	3.66	1.15
Makes Job Easier	6.0	10.3	19.7	32.2	31.4	3.72	1.18
Useful	6.9	13.2	29.9	34.9	15.1	3.56	1.05
Average	5.1	10.2	26.7	35.5	21.9	3.69	0.78

When Table 3 is examined, it is seen that the average score of the items related to the students' perception of usefulness of Tinkercad is $\bar{X}$ = 3.69. Students 'perceptions of" working more effectively and quickly“,” job performance “and” makes job easier" seem to be above average. "Effectiveness", "Useful" and "Increasing Productivity" perceptions, on the other hand, show that although they are below the average, they are highly positive ($\bar{X}$ = 3.66, $\bar{X}$ = 3.56 and $\bar{X}$ = 3.55). In this case, it was determined that students generally found Tinkercad useful.

Table 4: Ease of Use Perceptions of Students on Using Tinkercad

Ease of Use	Strongly disagree	Disagree	Neither agree nor diasgree	Agree	Strongly agree		
	%	%	%	%	%	X̄	S
Easy to Learn	4.1	12.9	28.6	34.2	20.2	3.71	1.01
Easy to Use	7.7	10.8	14.1	34.6	32.8	3.73	1.23
Easy to Become Skillful	5.8	15.1	29.2	28.8	20.9	3.43	1.14
Clear and Understandable	3.4	22.0	42.0	18.5	4.1	3.34	0.76
Average	5.2	15.2	28.4	29.0	19.5	3.44	0.70

When Table 4 is examined, it is seen that the average of students' perception of the ease of use of Tinkercad is $\bar{X} = 3.44$. It is seen that students' perception of "Easy to Learn" ($\bar{X} = 3.71$) and "Easy to Use" ($\bar{X} = 3.73$) towards Tinkercad software is above the average of ease of use ($\bar{X} = 3.44$). However, students' perception of "Easy to Become Skillful" ($\bar{X} = 3.43$) and "Clear and Understandable" ($\bar{X} = 3.34$) were found to be positive, although they are below the general ease of use perception. In this case, Tinkercad software is easy to learn and use.

Findings Regarding Students' Perceptions of Motivation, Usefulness and Ease of Use According to Their Gender

The Mann Whitney U Test, one of the non-parametric tests, was used to determine whether there is a significant difference according to gender for the subthemes of motivation, usefulness, and ease of use of the Student Perception Questionnaire about Tinkercad Software.

Table 5: Comparison of Tinkercad Usage Perceptions by Gender

		Gender	N	Average Rank	Sum of Rank	U	z	P
Tinkercad Usage Perception	Motivation	Male	298	285,57	85099,50	40548,50	-,943	,345
		Female	285	298,72	85136,50			
	Usefulness	Male	298	283,53	84492,50	39941,50	-1,243	,214
		Female	285	300,85	85743,50			
	Ease of Use	Male	298	298,59	88980,50	40500,50	-,968	,333
		Female	285	285,11	81255,50			

* p<.05

When looking at Table 5, there were no significant differences in students ' perceptions of motivation, usefulness and ease of use for Tinkercad use according to the gender (boys and girls) group (p>.05).

Findings Regarding Students' Perceptions of Motivation, Usefulness and Ease of Use by Class Levels

Kruskal Wallis H test was applied to determine whether the students' perceptions of Tinkercad motivation, usefulness and ease of use differ significantly according to their grade levels.

Table 6: Comparison of Tinkercad Perceptions According to Class Levels

		Grade	N	Average Rank	Kruskal Wallis-H	P
Tinkercad Usage Perception	Motivation	5	17	416,35	14,901	,002
		6	272	301,07		
		7	286	273,92		
		8	8	365,69		
	Usefulness	5	17	409,88	14,635	,002
		6	272	300,03		
		7	286	274,66		
		8	8	388,56		
	Ease of Use	5	17	293,53	4,404	,221
		6	272	301,29		
		7	286	280,58		
		8	8	381,25		

As seen in Table 6 (p <0.05), there is a significant difference between students' motivation and usefulness perceptions according to their grade levels. Tamhane's T2 analysis from Post Hoc analysis methods was used to determine which group this difference was in. In addition, when looking at Table 6, it was found that the ease of use of Tinkercad did not differ significantly according to the students ' class level (p>0.05).

Table 7: Perception of Motivation by Grade Level

(I) Grade	(J) Grade	Average difference (I-J)	Standard Error	P
5	6	,53257*	,15229	,014
	7	,66290*	,15265	,002

	8	,21471	,19461	,864
6	5	-,53257*	,15229	,014
	7	,13032	,07094	,339
	8	-,31787	,14001	,260
7	5	-,66290*	,15265	,002
	6	-,13032	,07094	,339
	8	-,44819	,14041	,062
8	5	-,21471	,19461	,864
	6	,31787	,14001	,260
	7	,44819	,14041	,062

When Table 7 is examined, it has been determined that the 5th grade level significantly differs according to the motivation perceptions of the 6th and 7th grades ($p < 0.05$). Accordingly, Tinkercad software significantly affects 5th grade students' motivations.

Table 8: *Usefulness Perception by Grade Levels*

(I) grade	(J) grade	Average difference (I-J)	Standard Error	P
5	6	,46717	,16103	,054
	7	,57888*	,16169	,012
	8	,09150	,19808	,998
6	5	-,46717	,16103	,054
	7	,11171	,06680	,451
	8	-,37566	,13250	,111
7	5	-,57888*	,16169	,012
	6	-,11171	,06680	,451
	8	-,48737*	,13330	,030
8	5	-,09150	,19808	,998
	6	,37566	,13250	,111
	7	,48737*	,13330	,030

When Table 8 is examined, it is determined that Tinkercad usefulness perceptions differ significantly in the fifth grade level according to the sixth grade and the seventh grade and that they differ significantly in the 7th grade level according to the 8th grade ($p<0,05$).

Research Findings on Tinkercad Usage Frequency of Students

Descriptive analysis was conducted to determine the approximate frequency of Tinkercad usage of students in computer lessons or during course training and outside of computer lesson or course training.

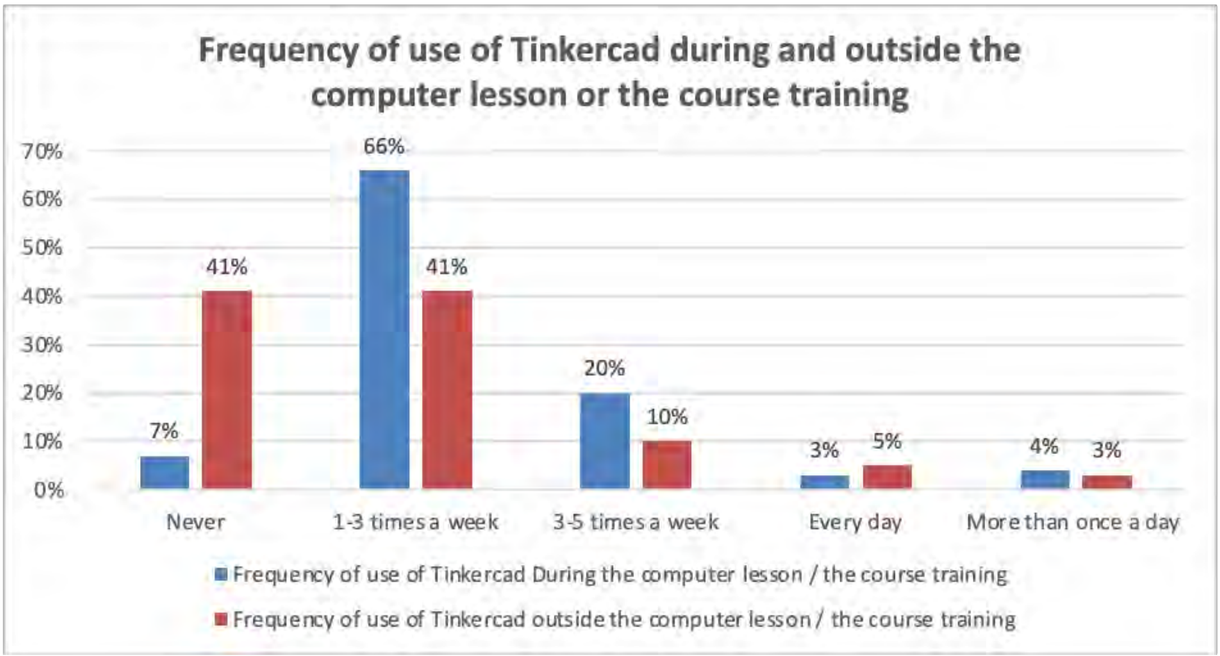

Figure 9.Students' Tinkercad Usage Frequency

When Figure 9 is examined, it was determined that 66% of the students used the Tinkercad "1-3 times a week" during the computer lesson or during the course training, and 41% of the students used the Tinkercad "1-3 times a week" outside the computer lesson or course training. About 40% (N=257) of the students who participated in the study responded to the cause of Tinkercad use frequency. When the answers given are examined, during training:

- Students who never used Tinkercad stated that they did not prefer to use Tinkercad in the education process because it was "unremarkable, uninterested, boring, incomprehensible, very difficult to learn, he/she was dealing with other lessons, he/she was listening only to the lecturer and preferring to learn from the book".
- Students who used Tinkercad 1-3 times a week stated that they prefer to “design and circuit, which they are interested in.”
- It has been stated that students who used Tinkercad 3-5 times a week were interested in the program and that they used Tinkercad because it is fun, as well as effective in their homework or tasks given to the student.
- Students who use Tinkercad every day stated that they are interested in the program, the program is fun, they are curious about the program, and the program improves their imagination. One student stated that he used Tinkercad for 3D printing.
- Two of the students who used Tinkercad more than once a day stated that they used it to be more successful, as well as for the reasons mentioned above.

When the answers given beyond the training process are examined:

- Students who have never used Tinkercad have stated that their reasons were “due to the fact that they do not have a computer and do not find Tinkercad fun.” Instead of dealing with Tinkercad, other students chose to play “games” on the computer, deal with “other lessons” and do their “homework”, use “other applications” or not use them because they “don't need them”. Four of the students stated that they did not use Tinkercad because it was “difficult” to learn.
- Students who used Tinkercad 1-3 times a week stated that they preferred Tinkercad because they “liked it very much”, “wondered about it”, “found it fun”, and “liked it”. Some students use Tinkercad to “improve themselves”, "repeat what they do in class” and “do their homework”. Some noted that they only use it for reasons that “they don't have a computer,” “they can't log in from the phone,” “a parental ban,” and “they don't need it.”
- Students who used Tinkercad 3-5 times a week stated that they used the program because they “liked it very much” and because it was “fun.” Again, some of them stated that they used Tinkercad to do their homework.
- The students who use Tinkercad "Everyday" and "More than once a day" beyond their education period stated that they used Tinkercad as "very entertaining", "enjoyable", "nice program" and "easy".

Findings Regarding the Relationship Between Students' Tinkercad Usage Frequency and Tinkercad Perceptions

In this context, Spearman test was used to determine the relationship between Tinkercad usage frequency and Tinkercad perception of students.

Table 9: Findings Regarding the Relationship Between Tinkercad Usage Frequency and Tinkercad Perceptions (TYHÖA-A)

Correlations				
			TYHÖA-A Average	Usage Frequency Avg.
Spearman's rho	TYHÖA-A Average	Correlation Coefficient	1,000	,241**
		Sig. (2-tailed)	.	,000
		N	583	583
	Usage Frequency	Correlation Coefficient	,241**	1,000
		Sig. (2-tailed)	,000	.
		N	583	583

**. Correlation is significant at the 0.01 level (2-tailed).

Accordingly, when Table 9 is examined, it is seen that there is a relationship (r=, 241) between the frequency of Tinkercad use of students and their perception of Tinkercad software. This relationship is positive. However ,it is stated that if this value is greater than 0.70, it shows a high level of relationship and if it is less than 30, it shows a low level of relationship. Therefore, it was determined that there was a positive low correlation between the frequency of Tinkercad use of students and their perception of Tinkercad.

Findings On Students ' Computational Thinking Skills

The reflection level of each factor in the Information Processing Thinking Scale (for Secondary School Level), which is used to determine the computational thinking skills of students, was scored from the most positive (5) to the most negative (1). Items scored "4" and "5" in the scale reflect positive / high skill characteristics, items "1" and "2" reflect negative / low skill characteristics. (Güler, 2019).

Table 10: Students' Computational Thinking Skill Levels

Variable	N	$\bar{X}$	S	Levels					
				Low		Intermediate		High	
				F	%	F	%	F	%
Creativity	583	3.82	0.98	90	15.4	159	27,3	334	57.3
Algorithmic Thinking		3.44	0.98	148	25.4	224	38.4	211	36.2
Collaboration		3.74	1.08	114	19.6	155	26.5	314	53.9
Critical Thinking		3.51	0.98	147	25.2	206	35.3	230	39.5
Problem Solving		3.37	1.05	166	28.5	221	37.9	196	33.6
Total		3.56	0.66	107	18.4	315	54	161	27.6

When Table 10 is examined, the students' computational thinking skill average is $\bar{X}$ = 3.56. It was determined that the students have intermediate level computational thinking skills. When the averages of the other themes of the scale are examined, it is seen that the highest average score is related to "creativity ($\bar{X}$ = 3.82)" and "collaboration ($\bar{X}$ = 3.74)" skills. At the lowest skill level, there are "problem solving ($\bar{X}$ = 3.37)" and "algorithmic thinking ($\bar{X}$ = 3.44)" skills.

Findings for Comparing Computational Thinking Skills of Students According to Their Gender

Mann Whitney U test was applied to determine whether there is a significant difference between the computational thinking perceptions of the students according to their gender.

Table 11: Comparison of Students' Computational Thinking Skills by Gender

Gender	N	Average Rank	Total Rank	U	Z	P
Male	298	281,17	83790,00	39239,00	-1,587	,112
Female	285	303,32	86446,00			

* p<.05
When Table 11 is examined, it is seen that there is no significant difference (p> 0.05) between the computational thinking skills of the students participating in the study.

Findings for Comparing Computational Thinking Skills of Students According to their Grade Levels
Kruskal Wallis H test was conducted to determine whether there is a significant difference between the computational thinking skills of the students according to their grade levels.

Table 12: Computational Thinking Kruskal Wallis Test Results by Grade Levels

Grade	N	Average Rank	Kruskal Wallis-H	P
5	17	367,76	8,050	,045
6	272	296,72		
7	286	280,14		
8	8	394,69		

When Table 12 is examined, it is found that there is a significant difference (p <0.05) in computational thinking skills according to the grade levels of the students. LSD analysis from Post Hoc analysis was conducted to determine which group favored this difference.

Table 13: Comparison of Computational Thinking Skill According to Grade Level

(I) Grade	(J) Grade	Average Difference (I-J)	Std. Error	P
5	6	,27266	,16495	,099
	7	,34033*	,16472	,039
	8	-,08316	,28289	,769
6	5	-,27266	,16495	,099
	7	,06766	,05588	,226
	8	-,35582	,23668	,133
7	5	-,34033*	,16472	,039
	6	-,06766	,05588	,226
	8	-,42349	,23652	,074
8	5	,08316	,28289	,769
	6	,35582	,23668	,133
	7	,42349	,23652	,074

In Table 13, it was determined that the computational thinking skills of fifth grades differ significantly compared to seventh grades.

Findings On The Relationship Between Students ' Perceptions Of Tinkercad Use And Their Computational Thinking Skills
Spearman correlation test was conducted to determine the relationship between Tinkercad usage perceptions of students and their computational thinking skills.

Table 14: Findings Regarding the Relationship Between TYHÖA-A and Computational Thinking Skills

Correlations

			TYHÖA-A Average	Average Frequency of Use
Spearman's rho	TYHÖA-A Average	Correlation Coefficient	1,000	,405**
		Sig. (2-tailed)	.	,000
		N	583	583
	Computational Thinking Test Average	Correlation Coefficient	,405**	1,000
		Sig. (2-tailed)	,000	.
		N	583	583

**. Correlation is significant at the 0.01 level (2-tailed).

When Table 14 is examined, it is seen that there is a relationship (r =, 405) between students' general perception of Tinkercad software and their perceptions of computational thinking skills. Therefore, it can be said that there is a medium-level positive relationship between students' perceptions of Tinkercad software and their computational thinking skills.

RESULT AND DISCUSSION

According to the results obtained for the students 'perception of motivation, usefulness and ease of use of Tinkercad, it was determined that the students' perception of motivation when using Tinkercad was generally positive. In addition, it is seen that the items for interest and appreciation in the motivational theme have the highest average ($\bar{X}$ = 3.82). This situation also affects the frequency of students' use of Tinkercad during and beyond the computer lesson or course training (r=,241). That is to say, students who are more interested in Tinkercad spend more time on the program than others during or outside of education. In addition, it affects the frequency of Tinkercad usage in the homework given to the student. However, it is observed that external reasons such as lack of computer or internet in students' homes, parental restriction, and internal reasons such as lack of interest in Tinkercad negatively affect the frequency of Tinkercad use outside of computer or course education. In addition, it was determined that students perceive Tinkercad as a useful and easy-to-use software in general.

It seems that there is a moderate positive directional relationship (r=,405) between students ' perceptions of Tinkercad software and their computational thinking skills. It was determined that students have intermediate level ($\bar{X}$ = 3.56) computational thinking skills. Looking at the averages of the other themes of the scale, it is seen that the highest average score is related to "creativity ($\bar{X}$ = 3.82)" and "collaboration ($\bar{X}$ = 3.74)" skills. "Problem solving ($\bar{X}$ = 3.37)" and "algorithmic thinking ($\bar{X}$ = 3.44)" skills constitute the lowest skill level.

Creativity is closely related to computer science and plays a central role in developing motivation and interest in this field (Hershkovitz et al., 2019). Teachers' freeing students while designing can be interpreted as influencing the development of creativity skills of students who are interested in 3D design. Miller et al. (2013) found that adding creative thinking activities to a computer science course increased the learning of computer-related knowledge and skills. Moreover, it is thought that the activities carried out by forming groups within the scope of the project studies are also effective in the development of the collaboration skills of the students. However, the reason for the low problem solving and algorithmic thinking skills of the students can be given as an example of the students not doing enough design work with codes by using the circuit and code blocks menus. According to Selby and Woollard (2014), the concept of algorithms is key to computational thinking. Erdem (2018) and Sırakaya (2019) determined that programming education is effective in the development of students' problem solving and algorithmic thinking skills. The fact that students did not do design work using Tinkercad's menus of circuits and code blocks can be interpreted as causing students to have low skills in the lower dimensions of computational thinking and algorithmic thinking.

Taşçı, Avcı, Yücel and Yalçınalp (2015) concluded that Tinkercad may be preferred due to its features such as ease of use, easy accessibility and free of charge in order to facilitate students ' learning in courses with abstract concepts such as mathematics, physics. In addition, it contributes to the development of students ' ability to create a whole relationship with parts and design (Çetin, Berikan and Yüksel (2019). It has been determined that this program affects spatial visualization and mental rotation skills, where students can see the shape in detail by looking at a shape from different angles, think in 3 dimensions, and translate the new shape in the mind, which will be formed by combining multiple shapes (Dere, 2017). However, a study emphasized that students use Tinkercad for communication and entertainment purposes and do not realize its production potential, so activities that allow students to produce should be prepared (Özdemir, Çetin, Çelik, Berikan and Yüksel, 2017).

When the international literature is examined, it is seen that Tinkercad has different uses in different areas. Cherry (2016) taught students how to design three-dimensional characters through Tinkercad to be used in short film animation. Kuo, Laiy, and Kao (2018), on the other hand, enabled students to create their own desserts by printing out the dessert designs they designed in Tinkercad using 3D Food printers. Madar, Goldberg and Lam (2018) aimed to combine the connection between computer science, Virtual Reality (VR) and 3D printing with C3d.io, a special tool they developed. This tool enables students to see the designs they make in Tinkercad (such as home design) as a prototype by transferring them to the virtual reality environment, and allows them to share the latest developed version with their peers via the web environment. Ng (2017) used the effect of 3D CAD and 3D printing to make it easier for students to learn solid volume in mathematics class. Díaz, Hernández, Ortiz, and Lugo (2019) introduced Tinkercad's Codebloks to students studying in different undergraduate programs in a summer course. In the study, they stated that the students who previously thought that the codeblocks were difficult liked the tool very much after using the tool. However, the fact that the tool is new and has a limited scope of application (3D modeling only) causes insufficient information on its use. In their study, M. Vera, Vera, Vásquez, and Panez (2018) used TinkerCad to simulate the connection of a bell, proximity or other components such as bluetooth, led and other Arduino board and resistor to introduce how to manipulate and program electronic components. The results obtained in the study conducted by Silva, Malebran and Pereira (2019) using Scratch and Tinkercad to improve the programming and Arduino-based computational-electronics competencies of a group of primary school children in Valparaiso-Chile showed that these tools can effectively improve children's programming and computational-electronic theoretical and practical skills.

As a result, it has been found that using Tinkercad in 3D design education increases students ' motivation for the lesson, and Tinkercad is perceived as an easy and convenient program to use. In addition, Tinkercad has a significant impact on the development of students ' computational thinking skills.

RECOMMENDATIONS

In this study, recommendations for parents and programmers were included. Recommendations for parents stated that some of the students were unable to use Tinkercad at home (outside of school or course) due to parents ' restrictions on internet or computer use.

For this reason, parents should do so in a way that does not interfere with their education and development while restricting their children's use of the internet or computers. They should support their education by taking the necessary measures to ensure that their children use the internet safely.

Suggestions for software developers: The fact that the program is not used offline makes it necessary for students who do not have a computer or have internet problems to study only within the scope of Information Technologies and Software course. Considering the duration of the Information Technologies and Software course and the problems of the classroom environment, this situation prevents students from receiving an efficient education. Therefore, the program needs to be developed so that it can work offline or on other platforms (smartphones).

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