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THE EFFECT OF CONCEPT MAP TECHNIQUE ON ACCURACY AND SPEED OF SERVING SKILLS IN TENNIS

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ABSTRACT

This study aims to investigate the effects of tennis training using technique concept maps on the speed and accuracy of tennis service skills. A semi-experimental design with pre-test and post-test control groups was used. Population of the study consists of female and male veteran or performance tennis players between the ages of 20-25. The sample of the study consists of a total of 40 tennis players, 23 male and 17 female, between the ages of 20-25, who have previously received tennis training or participated in tennis competitions, among the students taking the Tennis Specialization course at the Department of Coach Education of the Faculty of Sports Sciences of Çanakkale Onsekiz Mart University, using the simple random sampling selection method. For data collection, Dewitt-Dugan service test (Shooting to the Board) was applied to the experimental and control groups before and after the experiment, and thus the service speed and accuracy were measured. After the pre-test measurements, the experimental and control groups were formed by random method. While tennis training was done using traditional and modern methods in the control group, tennis training was done using concept maps technique together with traditional and modern methods in the experimental group. Results showed no significant difference in service accuracy between groups or between pre-test and post-test scores. However, both groups demonstrated significant improvements in service speed in the post-test. Additionally, male players exhibited higher service speeds than females in both groups, while accuracy remained consistent across genders. These findings suggest that concept maps do not enhance service accuracy beyond conventional training but that general training methods effectively improve serve speed, with gender playing a role in speed performance.
Keywords: Tennis, Service, Concept Maps.

INTRODUCTION

Although the pursuit of excellence is accepted in many fields, it seems to be more prominent in the field of sports (Baker, Cobley, Schorer & Wattie, 2017). Most national sports federations aim for the highest level with the ambition of winning medals in prestigious international sporting events such as the Olympic Games or the World Championships. Since the identification and development of talent has been proven to be important pillars of success (Bosscher, Bingham, Shibli, Bottenburg & Knop, 2007; Bosscher, Knop, Bottenburg, Shibli & Bingham, 2009), many countries have invested heavily in talent programs that seek out, guide and monitor young talented athletes (Abernethy, 2008; Vaeyens, Güllich, Warr, & Philippaerts, 2009). The increasing availability of spatial data in sports analytics applications has provided insights to analysts, coaches, players, and even fans. For tennis in particular, 3D ball and player tracking has become commonplace in major professional tennis tournaments. This technology is also appearing in non-professional venues in the form of "smart courts" that provide players with instant feedback on shot statistics and replays. However, as Kovalchik et al. (2018) note, tennis has been slow to fully utilize the analytics these technologies offer. Where these technologies are available, they are often used as training devices, focusing on developing and improving specific shots and providing summary-level statistics across a wide range of shots. We believe that tighter integration between spatio-temporal ball and player tracking data and match metadata will provide deeper insights to provide players and coaches with more effective, match-specific feedback on player strengths and weaknesses, and to identify strategies that are working or strategies that need improvement.

In current student-centered instructional formats based on the theoretical framework of social constructivism, students are encouraged to collaborate in well-structured, small, heterogeneous groups to master course content. They are held accountable for the acquisition of knowledge, performance, and social skills through instructional strategies characterized by positive interdependence, individual accountability, stimulating face-to-face interaction, interpersonal and small-group skills, and evaluation of group process (Antil, Jenkins, Wayne, & Vadasy, 1998). Tennis, a sport that challenges the technical, tactical, physiological and psychological abilities of a person, is one of the best sports that develops physical, mental, emotional and social development characteristics when done in a planned and programmed manner (Haşıl and Ataç, 1998). In order to be able to serve, the leg, hip and shoulder muscles must also be in harmony with the arm muscles. All of them must act simultaneously with the movement of the arm, so that the whole body can combine with the speed of the arm movement. A high-level serve depends on a powerful throwing movement (Urartu, 1996). Kermen (2002) stated that tennis training positively affects the technical skills of athletes if it is done regularly and with the correct technique. Similarly, it has been determined that one of the dimensions affecting the coach's behavior in tennis players is the athlete's age (Cengiz et al., 2019). Tennis is an individual sport, but it is an individual sport that requires physical capacity, high technical capacity and mental endurance. In addition to the use of technological tools and equipment in the teaching of such a sport branch, it is thought that the integration of teaching techniques used in different disciplines into the teaching field will make positive contributions to the learning, teacher and effective result-getting processes. In addition to providing positive contributions to learning, teaching and performance by transferring new and current techniques to the tennis training environment, it will also create a suitable learning and teaching environment in the training environment by arousing curiosity, increasing interest and attention among the athletes and trainees involved in this process. Concept maps were developed by Joseph Novak in the 1970s based on Ausabel's learning psychology approach. It is a visual design that consists of

graphically presenting events, facts and ideas and explaining the relationships between them (Kaptan & Korkmaz, 2001). Concept maps are tools used to show and organize concepts related to a subject and usually consist of concepts surrounded by boxes or circles and connected by lines. The explanations between the lines include the relationship between two concepts. The cross-links in the concept map show the relationship between different concepts. They are arranged hierarchically, with general concepts at the top and specific concepts at the bottom (Novak & Gowin, 1984). Using the above definitions, concept maps are maps where concepts related to the subject are arranged hierarchically from general to specific and the relationship between these concepts is shown with arrows to create propositions and provide meaningful learning. The general concept is at the top of the concept map. Relationships between concepts are shown horizontally, vertically and diagonally with arrows on the concept map. Propositions are created with the direction of the arrows (Demir 2006). The purpose of the research designed in line with these thoughts is to examine the effect of tennis training using the concept map technique on the speed and accuracy of tennis serve skills. In line with these explanations, the hypothesis of the research is the concept map technique used in tennis training will positively contribute to the speed and accuracy of tennis serve.

METHOD

In this study, the effect of tennis training with concept maps technique on the speed and accuracy of service skill in tennis was investigated. The problem statement of the research is; Does tennis training with concept maps technique have an effect on the speed and accuracy of service skill in tennis? The research was designed in a pre-test post-test control group semi-experimental design. According to Karasar (2003), the semi-experimental model is used in cases where the controls required by real experimental models cannot be provided or are not sufficient. Semi-experimental models are divided into five groups, one of which is the semi-experimental model with a pre-test, post-test control group used in this study. There are two groups in the semi-experimental model with a pre-test, post-test control group, one of which is the experimental group and the other is the control group. Which of these groups will be the control group and which will be the experimental group is determined by an unbiased selection. The groups are formed randomly, but care is taken to ensure that the subjects are as similar as possible. The sample of the study consists of 40 tennis players, 23 male and 17 female, who have previously received tennis training or participated in tennis competitions between the ages of 20-25, among the students taking the Tennis Specialization course at the Department of Coach Education of the Faculty of Sports Sciences of Çanakkale Onsekiz Mart University, by simple random sampling selection method. The average age of the participants in the study is 22.5 for women and 22.8 for men. In the study, the DeWitt-Dugan service test (Throw to the Board) was applied to the experimental and control groups before and after the experiment, and thus the service speed and accuracy were measured. After the pre-test measurements, the experimental and control groups were randomly formed by simple random method. While tennis training was performed using traditional and modern methods in the control group, tennis training was performed using the concept map technique together with traditional and modern methods in the experimental group. In the study, concept maps containing basic and advanced techniques related to service skills were created by an expert academician in the field. In the trainings conducted with the experimental group, the prepared concept maps were distributed to the participants and were applied with the participants using a blackboard in the first 20 minutes of the training. The athletes were provided to draw a concept map related to the subject. Then, 8-week tennis trainings for both groups lasted 24 hours in total, 2 days a week and each training was 90 minutes. At the end of the eight-week period, the post-test was applied to the

experimental and control groups again and the research was completed. A day was determined during the week for the participants who did not attend the test and trainings and compensation studies were carried out to eliminate the negative situations that could affect the research results. In the study, the DeWitt-Dugan Service Test, which was applied to the participants in the pre- and post-tests, was applied to each participant in the pre- and post-tests and their grades were recorded.

Figure 1. Concept Map on Service

PONTE
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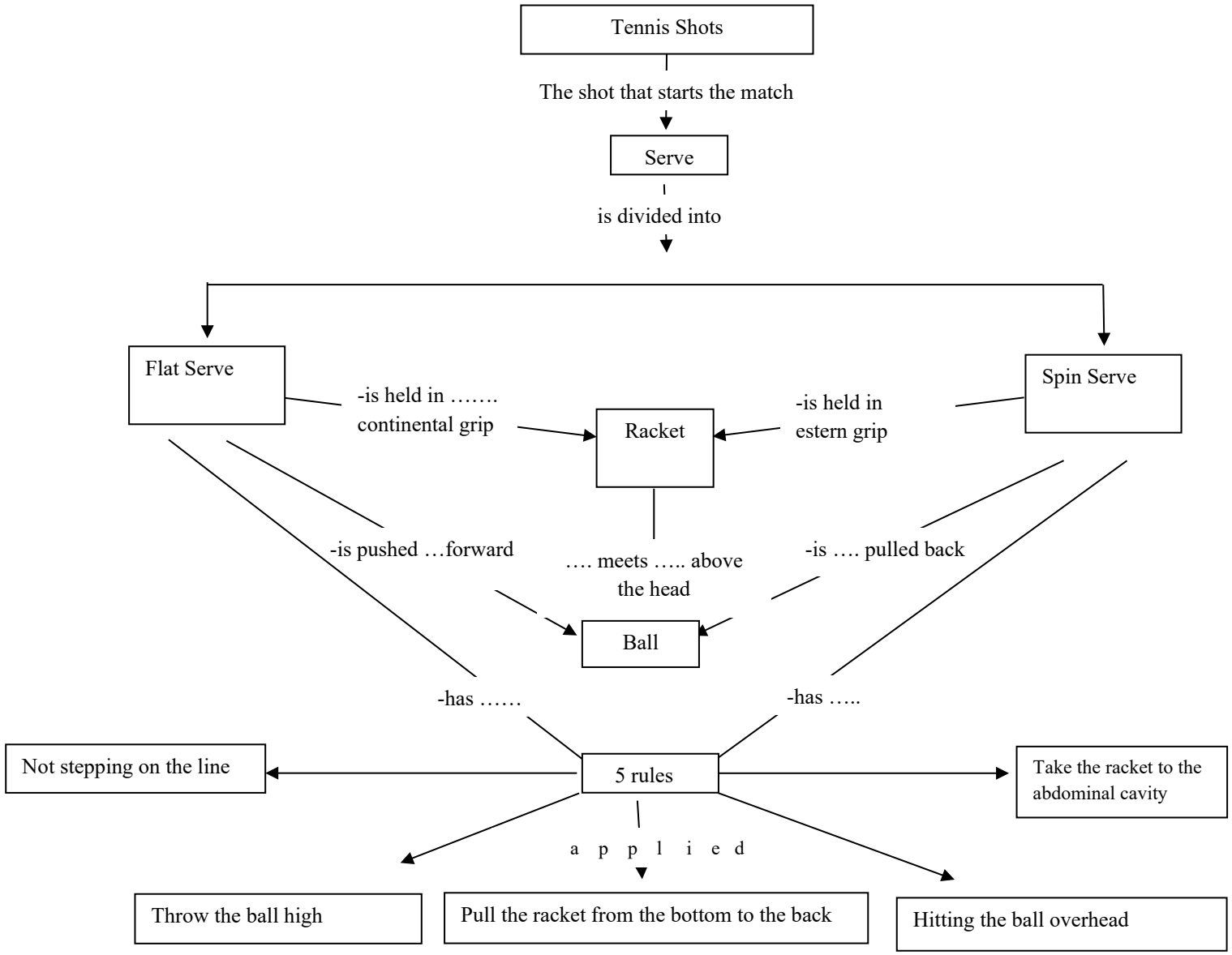

PONTE
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DATA COLLECTION

The data in the study was obtained by applying the DeWitt-Dugan Service test to the participants. The NET PLAYZ Smart Pro TGU brand tennis speed radar measuring device was used to measure the ball speed during the serve. DeWitt-Dugan Service Test (Shooting to Board) Measurement: The subject makes 10 serves from a distance of 12.5 m in accordance with the rules. The board where the serve is made is 1.5 meters high. The dimensions of the targets on the board are the diameter of the middle circle is 30 centimeters, the diameter of the second circle is 90 centimeters, the diameter of the circle outside is 150 centimeters, the diameter of the circle outside is 210 centimeters and the diameter of the outermost circle is 270 centimeters. The innermost circle is evaluated as 9 points and 7, 5, 3 points towards the outside (Kamar, 2003). In order to measure the service accuracy and speed, the participants were given a 10-minute general warm-up and then a 10-minute period for a special warm-up specific to the serve in tennis (hits in the court, rally on the wall, etc.). Each participant made 12 serves from the specified distance and the worst 2 shots were excluded from scoring. Participants were given their own rackets, which they regularly preferred and used continuously, in the pre-test and post-test. The same brand of new balls was used in the pre-test and post-test measurements (Wilson Trainer). A NET PLAYZ Smart Pro TGU brand/model ball speed measuring device was used for ball speed measurements during the serve (The speed measuring device can measure speeds in miles and km and can measure ball speeds from 5 km/h to 199 km/h). The ball speed measuring device was positioned by the researcher at the center point of the lower edge of the target board (50 cm above the ground and approximately 60 degrees to the ground). After each hit, the hit speed was read from the device audibly and visually and recorded on the hit form by another assistant.

Figure 2. DeWitt-Dugan Panel Service Test

Figure 3. Weekly Service Work Schedule

PONTE
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Week	Working day	Working Group	Study Content
WEEK 1	1	Control	Starting Period 20': Warm-up- Theoretical information transfer about the course content and subject Main Period 50': Service definition, service technique and rules information Finishing Period 20': Service technique and rules and question-answer game
		Experiment	Starting Period 20': Warm-up- Theoretical information transfer about the course content and subject Main Period 50': Concept map about service technique and rules Finishing Period 20': Question-answer game about service technique and rules
	2	Control	Starting Period 20': Warm-up- Theoretical information transfer about the course content and subject Main Period 50': Service hand-eye coordination exercises Finishing Period 20': Service hand-eye coordination developing game
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 60': Concept maps and application studies on hand-eye coordination in service Finishing Period 20': Game to develop service hand-eye coordination
2. WEEK	3	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Ball throwing and racket ball meeting exercises Finishing Period 20': Game with ball throwing exercises
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on bringing the ball and racket together in the service Finishing Period 20': Game with ball throwing exercises
	4	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Racket swing exercises in service Finishing Period 20': Games supporting racket swing in service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on racket swing in service Finishing Period 20': Games supporting racket swing in service
3. WEEK	5	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Works for effective service Finishing Period 20': Game on effective service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject

			Main Period 50': Concept map and exercises on effective service Finishing Period 20': Game on effective service
	6	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Works for effective service Finishing Period 20': Game on effective service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on effective service Finishing Period 20': Game on effective service
4. WEEK	7	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Flat service exercises Finishing Period 20': Game with flat service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on flat service Finishing Period 20': Game with flat service
	8	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Flat service exercises Finishing Period 20': Game with flat service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on flat service Finishing Period 20': Game with flat service
5. WEEK	9	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Spin service exercises Finishing Period 20': Game with spin service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on spin service Finishing Period 20': Game with spin service
	10	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Spin service exercises Finishing Period 20': Game with spin service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on spin service Finishing Period 20': Game with spin service
6. WEEK	11	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Kick service exercises Finishing Period 20': Game with kick service

		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on kick service Finishing Period 20': Game with kick service
	12	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Kick service exercises Finishing Period 20': Game with kick service
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and exercises on kick service Finishing Period 20': Game with kick service
7. WEEK	13	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Works covering service types Finishing Period 20': Who is the king game covering all service types
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and comprehensive studies about service types Finishing Period 20': Who is the king game covering all service types
	14	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Works covering service types Finishing Period 20': Who is the king game covering all service types
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map and comprehensive studies about service types Finishing Period 20': Who is the king game covering all service types
8. WEEK	15	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Serving in the match Finishing Period 20': King game with a single game
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map on service in competition and serving Finishing Period 20': King game with a single game
	16	Control	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Serving in the match Finishing Period 20': King game with a single game
		Experiment	Starting Period 20': Warm-up - Theoretical information transfer about the course content and subject Main Period 50': Concept map on service in competition and serving Finishing Period 20': King game with a single game

PONTE
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ETHICS COMMITTEE

Ethical permission was granted prior the study 04.04.2024 dated with 05/46 decision number. All students in the study participated voluntarily and consent form was taken.

FINDINGS

Table 1: Characteristics of Participants

		Experimental Group		Control Group	
Variable	**Grup**	**Frequency (n)**	**Percentage (%)**	**Frequency (n)**	**Percentage (%)**
Gender	Male	12	60.00	11	55.00
	Female	8	40.00	9	45.00
Tennis age	1 Year	5	25.00	5	25.00
	2 Year	10	50.00	10	50.00
	3 Year	5	25.00	4	20.00
	4 Year	-		1	5.00
Having a tennis license	Yes	6	30.00	6	30.00
	No	14	70.00	14	70.00
Performance or veteran tournament	Yes	6	30.00	6	30.00
	No	14	70.00	14	70.00

In the study, 17 (% 42.5) of the participants were female and 23 (% 57.5) were male tennis players. When the participants' tennis age was evaluated, it was seen that 10 people (% 25) had played tennis for 1 year, 20 people (% 50) for 2 years, 9 people (% 22.5) for 3 years and 1 person (% 2.5) for 4 years. In terms of having a tennis license, 12 of the participants (% 30) had a tennis license while 28 of them (% 70) did not have a tennis license. While 12 of the participants (% 30) participated in a performance or veteran tournament, it was seen that 28 of them (% 70) did not participate in any tournament.

DATA ANALYSIS

Before the data was analyzed, it was subjected to extreme value analyses and no extreme or outlier values were found in the data set. Then, descriptive analyses were performed to determine the frequency, percentage, minimum, maximum and arithmetic means of the experimental and control groups from the demographic characteristics of the research groups. Afterwards, the suitability and assumptions of the parametric tests were tested and the Kolmogorov-Smirnov and Shapiro Wilk values, which were the prerequisites of the tests, were examined and it was seen that the use of parametric tests was appropriate. Based on this, paired samples t-test (dependent groups t-test) was applied in within-group (pre-test-post-test) comparisons and independent samples t-test (independent groups t-test) was applied in between-group (experiment-control) comparisons. All analyses in the study were performed with the SPSS 25.0 program and the variables were examined at a 95% confidence level.

PONTE
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Table 2: Data Mean, Standard Deviation, Minimum, Maximum, Kolmogorov Smirnov and Shapiro Wilks Normality Values

	Variable	Min.-Max	$\underline{X}$±Ss	KS	Statistic	SW	Statistic
Experiment	Pre- Service Speed	25.00-76.50	51.84±14.98	.200	.105	.659	.966
	Post Service Speed	43.00-103.70	65.95±14.48	.200	.149	.400	.952
	Pre-Service Accuracy	5.00-64.00	34.00±13.96	.200	.121	.888	.977
	Post Service Accuracy	17.00-64.00	39.40±13.33	.200	.141	.298	.945
Control	Pre Service Speed	21.90-89.90	56.44±17.56	.192	.160	.624	.964
	Post Service Speed	31.40-102.70	66.27±20.61	.118	.173	.120	.924
	Pre-Service Accuracy	10.00-62.00	29.30±13.71	.200	.123	.251	.941
	Post Service Accuracy	10.00-62.00	35.05±14.96	.200	.107	.785	.970

Table 3: Pre-test-Post-test Comparison of Service Speeds of Experimental and Control Groups (Within Group)

Variable	Test	n	$\bar{X}$	SS	t	p
Experiment	Pre-test	20	51.84	14.98	-7.775	**.000***
	Post Test	20	65.95	14.48		
Control	Pre-test	20	56.44	17.56	-4.097	**.001***
	Post Test	20	66.27	20.61		

***p<0.05**

In the study, a dependent t-test was applied to compare the pre- and post-tests of the service speeds of the experimental and control groups. According to the test results, it was determined that the post-test averages of both the experimental group (t=7.775, p<.05) and the control group (t=-4.097, p<.05) were statistically significantly higher than the pre-test averages.

Table 4: Pre-test-Post-test Comparison of Service Accuracy of the Experimental and Control Groups (Intra-Group)

Variable	Test	n	$\bar{X}$	SS	t	p
Experimental	Pre-test	20	34.00	13.96	-1.654	.115
	Post Test	20	39.40	13.33		
Control	Pre-test	20	29.30	13.71	-2.237	.038*
	Post Test	20	35.05	14.96		

***p<0.05**

In the study, a dependent t-test was applied to compare the pre- and post-test service hits of the experimental and control groups. According to the test results, it was determined that there was no statistically significant difference in the pre- and post-test averages of the experimental group (t=-1.654, p>.05) and the control group (t=-2.237, p>.05).

PONTE
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Table 5: Pre-test Comparison of Serve Speeds and Serve Accuracy of the Experimental and Control Groups (Between Groups)

Variable	Group	n	$\bar{X}$	SS	t	p
Service Speed	**Experimental**	20	51.84	14.98	-.891	-.378
	Control	20	56.44	17.56		
Service Accuracy	**Experimental**	20	34.00	13.96	1.074	.290
	Control	20	29.30	13.71		

***p<0.05**

As a result of the independent t-test conducted to compare the pre-tests of the participants' serve speeds and serve hits by group, it was seen that there was no statistically significant difference in the pre-tests of the groups in terms of serve speeds (-.891, p>.05) and serve hits (t=1.074, p<.05).

Table 6: Post-test Comparison of Serve Speeds and Serve Accuracy of the Experimental and Control Groups (Between Groups)

Test	Group	n	$\bar{X}$	SS	t	P
Service Speed	**Experimental**	20	65.95	14.48	-.056	.956
	Control	20	66.27	20.61		
Service Accuracy	**Experimental**	20	39.40	13.33	.970	.338
	Control	20	35.05	14.96		

***p<0.05**

According to the analysis conducted to compare the post-tests of the participants' serve speeds and serve hits by group, it was determined that there was no statistically significant difference in the pre-tests of the groups in serve speeds (-.056, p>.05) and serve hits (t=970, p<.05).

Table 7. Serve speed and serve Accuracy rate comparisons of the experimental and control groups by gender: Independent sample t-test results

Group	Variable	Time	Gender	X±*SS*	*t*(18)	*p*
Experimental	Service Speed	Pre-Test	Female	41.34±11.44	-3.08	.006*
			Male	58.85±13.06		
		Post-Test	Female	55.52±9.32	-3.21	.005*
			Male	72.91±13.25		
	Accuracy Rate	Pre-Test	Female	2.77±1.47	-1.71	.10
			Male	3.82±1.24		
		Post-Test	Female	4.03±1.33	0.26	.80
			Male	3.87±1.39		
Control	Service Speed	Pre-Test	Female	43.44±10.18	-4.01	.001*
			Male	67.08±15.05		
		Post-Test	Female	51.89±9.83	-3.84	.002*
			Male	78.04±19.79		
	Accuracy Rate	Pre-Test	Female	2.42±1.58	-1.55	.14
			Male	3.34±1.07		
		Post-Test	Female	3.29±1.49	-1.49	.16
			Male	3.68±1.55		

***p<0.05**

Finally, Independent sample t-test was performed to compare the service speed and accuracy rate (pre-test and post-test) of gender (experimental group). In the experimental group, a significant difference was determined between the service speed pre-test Female (X=41.34, SD=11.44), and Male (X=58.85, SD=13.06; t=(18)=-3.08,p=0.006) and post-test values and gender (Female, M=55.52, SD=9.32), and Male (M=72.91, SD=13.25; t=(18)=-3.21,p=0.005). However, no significant difference was found between the service accuracy rate and gender in the pre-test values of Male (X=3.82, SD=1.24), and Female (X=2.77, SD=1.47; t=(18)=-1.71,p=0.10) and in the post-test values of Male (X=3.87, SD=1.39), and Female (X=4.03, SD=1.33; t=(18)=0.26,p=0.80). In the control group, a significant difference was determined between the service speed pre-test Female (X=43.44, SD=10.18), and Male (X=67.08, SD=15.05; t=(18)=-4.01,p=0.001) and post-test values and gender (Female, X=51.89, SD=9.83), and Male (M=78.04, SD=19.79; t=(18)=-3.84,p=0.002). However, no significant difference was found between the service accuracy rate and gender in the pre-test values of Male (X=3.34, SD=1.07), and Female (X=2.42, SD=1.58; t=(18)=-1.55, p=0.14) and in the post-test values of Male (X=3.68, SD=1.55), and Female (X=3.29, SD=1.49; t=(18)=-1.49, p=0.16).

ARGUMENT

In the study, it was determined that the service accuracy scores of the experimental and control groups did not differ statistically significantly as a result of the analysis of pre-test and post-test scores. However, it was concluded that the pre-test average was 34 points in the experimental group, while the post-test average was 39.40 points, but no significant difference was observed (t=-1.654, p>.05). Again, it was observed that the pre-test average was 29.30 points in the control group, while the post-test average was 35.05 points, but no significant difference was observed (t=-2.237, p>.05). In the study conducted by Gül et al. (2017) with male sedentary tennis players aged 22-24, it was determined that 8-week polymetric training did not have a positive effect on the athletes' serve accuracy. However, in the study conducted by Demir (2006) with primary school students for badminton basic skills such as service and net-drop accuracy skills and (2008) for basketball pass, layup and rebound skills, a significant difference was found in favor of the post-test. Again, in the teaching of service skills to high school students using the concept map technique by Demir et al. (2015), a significant difference was found in favor of the post-test as a result of the evaluation of the service pre-test and post-test scores. In the study designed by Taşkın (2010) using traditional teaching methods and concept maps technique in teaching sports techniques to students studying at a physical education and sports college, concept maps technique was used in the experimental group and traditional methods were used in the control group and as a result of the research, it was concluded that the post-test scores of the experimental group were significantly different from the control group scores. In the study conducted by Ertem et al. (2013), it was determined that coordination development trainings had a positive effect on forehand-backhand stroke skills in 12-14 year old female tennis players. Ölçücü (2011), in his study titled "Investigation of the Effect of Plyometric Training on Arm and Leg Strength, Serve, Forehand, Backhand Stroke Speeds and Target Accuracy Percentages in Tennis Players", it was observed that polyometric trainings improved shot and stroke accuracy rates. Again, in the study titled "Investigation of the Effect of 8-Week Core Training on Ground Stroke Speeds and Some Motoric Characteristics in 12-14 Age Group Tennis Players" by Eren (2019), it was observed that core

trainings had a positive effect on ground stroke speeds in tennis. In the study, as a result of the comparison of the pre- and post-tests of the serve speeds of the experimental and control groups, a statistically significant difference was determined in favor of the post-tests in the experimental and control groups. In the study conducted by Öçücü (2011), it was concluded that polymetric exercises applied in addition to classical tennis training had positive effects on the shoulder and leg strength of tennis players and improved their stroke speeds. However, in the study conducted by Hayes et al. (2021) on the relationship between Sprint, Change of Direction, Jump and Hexagon test performance in young tennis players, it was concluded that anthropometric measurements such as height and various isometric and dynamic performance measurements such as maximum strength were strongly related to maximum tennis serve speed.

As a result of the evaluation of the data obtained in the study according to the gender variable, while there was a significant difference in favor of the post-tests between the service speed and gender in the pre-test and post-test measurements of the experimental group, but no significant difference was found between the two measurements in the service accuracy rate. The study supporting the result of the service speed was conducted by Keskin and colleagues (2016) and concluded that tennis-specific training applied for 8 weeks to female and male tennis players who had played tennis for at least 2 years had a positive effect on the service speed. While a significant difference was found in favor of the post-test as a result of the analyses conducted for the service speed in the control group, no statistically significant difference was found in the service accuracy score analyses. As a result of the study conducted by Demir, Kırca and Belik (2015), no significant difference was found between the tennis accuracy scores according to gender. In the study titled "The Effect of General Strength Training Applied to Female Tennis Players in the 12-14 Age Group for 8 Weeks on Tennis Skills and Some Physical Fitness Features" conducted by Büyük and Gül (2013), the finding that there was no significant difference in the ITN sensitivity power test averages supports the result obtained in our study.

CONCLUSION

In our research, the effect of tennis training with concept maps, which is a teaching technique, on service accuracy and service speed in tennis and the difference according to the gender variable were evaluated; while there was a significant difference in service speed in favor of the post-tests, there was no significant difference in service accuracy. According to gender, while there was a significant difference in service speed in favor of the post-test, there was no significant difference in service accuracy score. Therefore, as a result of the evaluation of the service speed of the experimental and control groups, it can be said that the average tennis age of the participants was 2 years and the frequency of playing tennis or training period did not create a significant difference for the two groups, and as a result, the concept maps technique has a specific effect on the speed of meeting the ball and serving. Again, when we look at the service accuracy rate of the experimental and control groups, we think that the fact that the control group's accuracy rate is significantly higher than the experimental group is due to the fact that tennis age and training target work do not create a difference in terms of concept map. In addition to, when we examine the Service Speeds and Service Accuracy of the Experimental and Control Groups in terms of pre-test and evaluate them in terms of concept map, we can say that the difference can occur with the

service skill, years of tennis playing experience, time and correct phase work in terms of service phases, and that being at the beginner level is also effective here. It is thought that the experimental group, in addition to traditional and modern methods, has carried out tennis training supported by the concept map technique, contributing to the increase in their technical skills as well as their cognitive awareness. It is thought that the increase in service speed in particular is related to the effect of concept maps on technical focus and movement analysis. The improvement in service accuracy indicates that concept maps help tennis players develop a better strategy in the game and increase their ability to make the right decisions.

As a result of these findings, it is thought that the use of concept maps technique in tennis training and the combination of traditional and modern methods can increase both technical and cognitive performance. In future studies, it is recommended that this method be applied to different age groups and skill levels and its effectiveness be examined from a broader perspective.

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