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INVESTIGATION OF SPATIAL VISUALIZATION AND SPATIAL ANXIETY OF FACULTY OF SPORT SCIENCES AND PRIMARY SCHOOL TEACHERS STUDENTS OF FACULTY OF EDUCATION

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Abstract:
Spatial skill is the ability to move or reconstruct objects and components of one or more parts in three-dimensional space in their mind. In other words, it is defined as the mental arrangement of spatial skills objects and their parts in two-dimensional and three-dimensional space. 500 volunteer students included from Faculty of Education Primary School Teaching Department and Faculty of Sports Sciences as voluntarily. 336 questionnaires were collected from 176 male and 153 female students from two faculties. For collecting data, Spatial Visualization Test (SVT) questionnaire was used that was developed by Loppan et al. (1983) adapted into Turkish by Dursun (2010). There was a statistically significant difference according to the scores from the spatial anxiety ($F=4.296$, $p<.005$) and spatial visualization test ($F = 3.964$, $p <.005$) in terms of the departments.

Keywords: spatial visualization, education, sport sciences, spatial anxiety

1. Introduction

Spatial ability is the ability to move or visualize the objects that consist of one or more parts and their components in three-dimensional space (Turgut, 2007). In another expression, spatial skill (ability) is defined as the mental arrangement of objects and their parts in two-dimensional (2D) and three-dimensional (3D) space (Olkun, 2003).

Students can develop many different characteristics while playing sports, using various intelligence types simultaneously. For example, a soccer player uses kinesthetic

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intelligence while running, and visual/spatial intelligence while capturing and kicking the ball (Armstrong, 1994).

In the study of Hosgorur and Katranci (2007) entitled "The dominant intelligence fields of the students in the department of primary school teaching and the physical education and sports teaching (Kırıkkale University Faculty of Education sample)", in the analysis of the data obtained from the students in the fourth grade of the primary school teaching program, it was seen that the students' spatial intelligence was the most developed one and the naturalistic intelligence was the least developed one. In the analysis of the 4th grade students at the department of physical education and sports teaching, however, it was seen that the students' bodily-kinesthetic intelligence was the most developed one. The field of visual/spatial intelligence (ability) is not limited only to the comprehension ability of objects in visual and spatial sense. The main element of this field is the ability to create mental images. Having the ability to think in the form of images also improves other intelligence areas (Selçuk, Kayılı and Okut, 2004).

In studies related to spatial ability, the effects of mathematics and geometry education on spatial ability were investigated more. Since spatial visualization ability is among the skills that must be possessed especially by the prospective teachers in primary school teaching and physical education departments, the interdisciplinary differences of the students will be investigated in this study, and thus, a contribution to the literature will be made.

2. Literature Review

There are studies regarding that spatial skill is affected by environmental conditions. Various sports also have an effective role in improving the spatial skills of athletes in this sense. Sorby (1999) stated that activities involving hand and eye coordination developed spatial skills, and listed some of them as follows: playing with toys that can be created in childhood, playing three-dimensional computer games, and doing some sporting activities.

Researches have shown that spatial ability is closely related with success in painting, physics and mathematics (McClurg et al., 1997). Spatial ability is a subject that needs to be investigated for two reasons. The first reason is that there is a positive relationship between spatial ability and the success in positive science branches and geometry, and the other is that the perception and comprehension efficiency of the relocation and restructuring of the objects for an individual living in the world surrounded by three-dimensional objects will become more effective by developing spatial skills. (Turgut, 2007) Lawton (1994) came to a conclusion, in his study, that spatial anxiety prevents focusing on the surrounding clues, and that individuals with a high level of spatial anxiety tend to disappear more. Therefore, it is thought that high level of spatial anxiety will adversely affect the individual's problem solving success.

3. Material and Methods

3.1 Participants

This study was carried out on a total of 329 volunteer students (176 males and 153 females) studying at Muğla Sıtkı Koçman University, Faculty of Education, Department of Primary School Teaching and Faculty of Sport Sciences (Departments of Physical Education and Sports, Coaching Education, Sports Administration and Recreation), and they were selected randomly from each department. In the study, the spatial visualization abilities and spatial anxiety levels of the students in different departments were compared.

3.2 Data Collection Tools

In the study, survey technique was used for data collection. Spatial Visualization Test (SVT) developed by Loppan et al. (1983) was adapted into Turkish by Dursun (2010). As a result of the adaptation, the reliability coefficient of the test was obtained as KR20 = 0.73. SVT consists of 32 multiple-choice items of 10 different types (mental decomposition and integration of an image, mental rotation etc.) The highest score that can be obtained from the test is 32 while the lowest score is zero.

Spatial Anxiety Scale (SAS) developed by Lawton (1994) was adapted into Turkish by Dursun (2010). The scale consists of one factor and eight items in total. As a result of adaptation of the scale into Turkish, the Cronbach's alpha value was found to be 0.87. The highest score that can be obtained from the spatial anxiety scale is 40, while the lowest score is eight. The higher the score on the scale, the higher the anxiety level of the person, while the lower the score, the lower the level of anxiety.

3.3 Analysis of Data

Statistical calculations were done in SPSS (version 16.0) program. The obtained data were calculated with standard deviation and arithmetic mean values. One-way analysis of variance was used to test the differences of variables. The level of significance was taken as 0.05.

4. Results and Discussion

Table 1 shows the demographic information of the participants by their departments and genders. 153 (46.5%) of the students who participated in the study were female, and 176 (53.5%) were male. When looking at the departments of the students who voluntarily participated in the study, it is seen that 85 (25.8%) students from the Department of Physical Education Teaching, 80 (24.3%) students from the Department of Primary School Teaching, 72 (21.9%) students from the Department of Coaching Education, 56 (17.0%) from the Department of Sports Administration and 36 (10.9%) students from the Department of Recreation participated in the study.

Table 1: Frequency and Percentage Values of Participants by Departments and Genders

		Frequency	Percentage
Departments	Physical Education Teaching	85	25.8
	Primary School Teaching	80	24.3
	Coaching Education	72	21.9
	Sports Administration	56	17.0
	Recreation	36	10.9
	Total	329	100.0
Gender	Male	176	53.5
	Female	153	46.5
	Total	329	100.0

Table 2: Mean and Standard Deviations of Spatial Visualization and Spatial Anxiety Tests of Female University Students

Variables	Departments	N	Mean(X)	Standard Deviation (SS)
Spatial Visualization	Physical Education Teaching	40	10.35	4.39
	Primary School Teaching	60	11.68	4.80
	Coaching Education	21	12.52	3.44
	Sports Administration	17	9.52	4.19
	Recreation	15	10.46	3.22
	Total	153	11.09	4.37
Spatial Anxiety	Physical Education Teaching	40	14.90	6.39
	Primary School Teaching	60	18.11	5.48
	Coaching Education	21	12.80	2.89
	Sports Administration	17	17.11	6.94
	Recreation	15	15.20	5.97
	Total	153	16.15	5.94

Table 2 shows the mean and standard deviation values of the spatial visualization and spatial anxiety tests of the female university students, depending on their departments. It is seen that the students with the lowest mean in spatial visualization score are the students from the Department of Sports Administration with X = 9.52, while the ones having the highest mean are the students from the Department of Coaching Education with X= 12.52. It is seen that the students with the lowest mean in spatial anxiety score are the students from the Department of Coaching Education with X = 12.80, while the ones having the highest mean are the students from the Department of Primary School Teaching with X= 18.11. It means that participants have a high level of anxiety as the mean increases, while they have a low level of anxiety as the mean decreases.

Table 3: One-way ANOVA Results of Spatial Visualization Test Scores of Female University Students by Departments

Source of Variance	Sum of Squares	sd	Mean Square	F	p	Significant difference
Between groups	133.429	4	33.357	1.775	.137	-
Within Groups	2781.290	148	18.793			-
Total	2914.719	152				

It was seen in One-Way ANOVA table that there was no statistically significant difference in terms of the scores of the spatial visualization test, depending on the departments (p>.005).

Table 4: ANOVA Results of Spatial Anxiety Test Scores for Female University Students by Departments

Source of Variance	Sum of Squares	sd	Mean Square	F	p	Significant difference
Between groups	558.356	4	139.589	4.296	.003	2-1.2-3
Within Groups	4809.186	148	32.495			
Total	5367.542	152				

It was seen in One-way ANOVA table that there was statistically significant difference in terms of the scores of the spatial anxiety test, depending on the departments (F=4.296, p<.005). The groups were compared with each other to determine between which groups there was this difference. Tukey test results can be seen in the Multiple Comparisons table. As a result of this test, there were significant differences between the Department of Primary School Teaching (X = 18.11) and the Department of Physical Education (X = 14.90) and Department of Coaching Education (X = 12.80) against the Department of Primary School Teaching. As the mean of the test lowers, anxiety decreases.

Table 5: Analysis of Female University Students' Spatial Anxiety by Post-hoc Test

Tukey HSD		**Multiple Comparisons**			
Dependent Variable	**(I) Department**	**(J) Department**	**Mean Difference (I-J)**	**Std. error**	**p**
Spatial Anxiety	1.Physical Education Teaching	Primary School Teaching	-3.21667*	1.16359	.049
		Coaching Education	2.09048	1.53614	.654
		Sports Administration	-2.21765	1.65040	.664
		Recreation	-.30000	1.72588	1.000
	2.Primary School Teaching	1.Physical Education Teaching	3.21667*	1.16359	**.049**
		3.Coaching Education	5.30714*	1.44531	**.003**
		4.Sports Administration	.99902	1.56621	.969
		5.Recreation	2.91667	1.64556	.394
	3.Coaching Education	Physical Education Teaching	-2.09048	1.53614	.654
		Primary School Teaching	-5.30714*	1.44531	.003

		Sports Administration	-4.30812	1.85978	.145
		Recreation	-2.39048	1.92709	.728
	4.Sports Administration	Physical Education Teaching	2.21765	1.65040	.664
		Primary School Teaching	-.99902	1.56621	.969
		Coaching Education	4.30812	1.85978	.145
		Recreation	1.91765	2.01934	.877
	5.Recreation	Physical Education Teaching	.30000	1.72588	1.000
		Primary School Teaching	-2.91667	1.64556	.394
		Coaching Education	2.39048	1.92709	.728
		Sports Administration	-1.91765	2.01934	.877

*. Level of Significance 0.05 level.

Table 6: Mean and Standard Deviations of Spatial Visualization and Spatial Anxiety Tests of Male University Students

Variables	**Departments**	**N**	**Mean(X)**	**Standard Deviation (SS)**
Spatial Visualization	Physical Education Teaching	45	12.93	5.43
	Primary School Teaching	20	8.20	3.22
	Coaching Education	51	12.49	5.49
	Sports Administration	39	13.33	5.81
	Recreation	21	**14.09**	5.72
	Total	176	12.49	5.55
Spatial Anxiety	Physical Education Teaching	45	14.33	5.18
	Primary School Teaching	20	16.10	8.90
	Coaching Education	51	12.76	5.46
	Sports Administration	39	13.15	4.32
	Recreation	21	13.71	6.73
	Total	176	13.74	5.85

Table 6 shows the mean and standard deviation values of the spatial visualization and spatial anxiety tests of the male university students, depending on their departments. It is seen that the students with the lowest mean in spatial visualization score are the students from the Department of Primary School teaching with X = 8.20, while the ones having the highest mean are the students from the Department of recreation with X= 14.90. As the mean increases, the spatial visualization ability also increases. It is seen that the students with the lowest mean in spatial anxiety score are the students from the Department of Coaching Education with X = 12.76, while the ones having the highest mean are the students from the Department of Primary School Teaching with X= 16.10

Table 7: ANOVA Results of Spatial Visualization and Spatial Anxiety Test Scores for Male University Students by Departments

	Male	Sum of Squares	sd	Mean Square	F	p	Significant Difference
Spatial Visualization	Between Groups	458.773	4	114.693	3.964	.004	2-1.2-3.2-4
	Within Groups	4947.221	171	28.931			
	Total	5405.994	175				
Spatial Anxiety	Between Groups	189.155	4	47.289	1.394	.238	-
	Within Groups	5800.339	171	33.920			-
	Total	5989.494	175				-

It was seen in ANOVA table that there was statistically significant difference in terms of the scores of the spatial visualization test, depending on the departments (F=3.964, p<.005). The groups were compared with each other to determine between which groups there was this difference. Tukey test results can be seen in the Multiple Comparisons table (Table 8). As a result of this test, there were significant differences between the Department of Primary School Teaching (X = 8.20) and the Department of Physical Education and Sports Teaching (X = 12.93), the Department of Coaching Education (X = 12.49), the Department of Sports Administration (X = 13.33) and the Department of Recreation (X = 14.09) against the Department of Primary School Teaching. As the test mean increases, the spatial visualization ability also increases.

Table 8: Analysis of Male University Students' Spatial Visualization by Post-hoc Test

Tukey HSD		**Multiple Comparisons**			
Dependent Variable	**(I) Department**	**(J) Department**	**Mean Difference (I-J)**	**Std. error**	**p**
	2.Primary School Teaching	1.Physical Education teaching	-4.73333*	1.44550	.011
		3.Coaching Education	-4.29020*	1.41910	.024
		4.Sports Administration	-5.13333*	1.47932	.006
		5.Recreation	-5.89524*	1.68054	.005

*. Level of Significance 0.05 level.

Schmidt et al. (2016) investigated the mental rotation abilities in the research that they performed on the groups having the athletes in various sports (orienteering (N = 20), running (N = 20), gymnastics (N = 20), and on the groups not doing any sports. According to the findings of the research, significant differences were found in the mental rotation between the athletes and the ones who did not play any sports. The biggest difference was seen between orienteering and gymnastics athletes and the individuals who did not play any sports. Similarly, the spatial visualization test results of the students in the Faculty of Sports Sciences were better than those of the students in the Department of Primary School Teaching.

Tuna and Balcı (2013) performed an application on 46 5th grade university students to investigate the effect of orienteering training towards geography teachers on self-efficacy perceptions. They applied the pre-test and post-test research model, and used a 17-question self-efficacy questionnaire developed by researchers. According to the research findings, the overall self-efficacy of the participants was increased by orienteering training.

Köşker (2012), in her study where 263 primary school prospective teachers voluntarily participated, created a questionnaire to determine the spatial cognitive adequacy of the participants, and indicated the thoughts of the prospective teachers on the spatial cognition adequacy, stated that they paid attention to certain spatial elements in the environment. Nevertheless, male prospective teachers were determined to be more optimistic towards spatial cognitive adequacy than female prospective teachers.

Atakurt, Şahan and Erman (2017) conducted a study to examine the effect of orienteering training on attention and memory. 20 children (with the average age of 12) who completed the activity, which was held as 2-hour sessions three times a week, were included in the survey. As a result of the research, they found that orienteering training had a positive effect on children's attention and memory level.

Özdemir, N., Güreş A, Güreş Ş. (2012) created the research sample with 105 people, 50 female and 55 male, in order to investigate the correlation between the different intelligence abilities of orienteering athletes. They collected data using multiple intelligence inventory and scale for problem solving skills. According to research findings, naturalistic intelligence scores were found higher, and it was determined that there was a correlation between problem solving skill and bodily kinesthetic intelligence scores.

Pulur and Akcan (2017), who investigated the correlation between visual reaction times and decision-making styles of elite orienteering athletes, applied the reaction test and Melbourne decision-making questionnaire to the 40 elite orienteering athletes over 21. As a result, they found that participants preferred careful decision-making style more in the correlation between visual reaction times and decision-making styles.

Eroğlu B. and Eroğlu A. K. (2016) investigated the problem solving styles of orienteering athletes depending on some variables. 300 orienteering athletes (157 women and 43 men) participated in their research. As a result, they indicated that male athletes had a higher level of assessment than female athletes, and the athletes' problem-solving ability also increased with age in the positive direction.

Tekin (2009) investigated the levels of male and female athletes in different types of intelligence according to grade and sport type variables in individual and team sports. A total of 500 high school students, 292 male and 208 female, voluntarily participated in the research. The visual spatial intelligence of the students in the 9th grade, who were playing sports, was found to be higher than that of the students in the 11th grade.

Ekici (2011) found, in the study entitled investigation of multiple intelligence levels of School of Physical Education and Sports students according to some demographic factors, that female students (X = 3.56 ± 582) had higher means than male students (X = 3.38 ± 650) in the visual-spatial intelligence sub-scale. In the interdisciplinary comparison, however, the mean of the visual-spatial intelligence sub-scale of the students of the Department of Physical Education and Sports was determined to be higher than that of the students from other departments.

6. Conclusion

As a result, dealing with sport has an important role in improving the spatial ability of individuals. Sports Activities and increasing the number of course hours for physical education lesson can have an important place in improving the spatial visualization and thus in reducing spatial anxiety.

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