Investigation of the Effects of Some Variables on Middle School Students' Problem-Solving Skills, Science Process Skills and Learning Styles[1]

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Abstract

The aim of the study is to investigate the effects of gender, type of the school attended and mother/father's educational background on middle school students' problem-solving, science process skills and learning styles. The population of the present study consists of all the 4th-grade students in the secondary schools in the city of Muğla in the 2012-2013 school year while the sample consists of 569 middle school fourth grade students. As the data collection tools, "The Problem-Solving Inventory", "The Science Process Skills Test", "The Kolb Learning Styles Inventory" and a student information form were used. The data were analyzed by using a variety of statistical techniques such as descriptive statistics, independent sample t-test, One way ANOVA and Chi-Square test. As a result of the study were found that middle school students mostly use the "Avoidance" sub-dimension. Also, there isn't any difference was found between problem-solving skills and gender, the school attended, mother and father's education level. Also, it was found that the students frequently used "Basic Science Process Skills" and that there is not any statistically significant difference between science process skills and gender and maternal education level yet there is a significant difference between science process skills and the school attended and father's education level and "Integrated Process Skills" were found to be correlated with father's education level. On the other hand, learning styles were found to be varying significantly depending on the school attended but not depending on gender and maternal education level and father's education level and it was also found that the highest number of students has the "Diverging" learning style while the lowest number of students has the "Accommodating" learning style. Thus, it can be said that planning instructional and educational activities in such a way as to give feedbacks to individual students can increase efficiency of learners.

Keywords: Problem- Solving Skills, Science Process Skills, Learning Styles, Secondary School 4th-Grades, Kolb Learning Styles Inventory

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Introduction

Finding solutions to problems is one of the skills that humanity has used since ancient times. Nowadays, problem-solving skill has become important in every field of life and for all branches of science (Özsoy, 2005). According to Dewey (1933), one of the experts on problem-solving in the field of education, thinking ability is actually a problem-solving behaviour, but information can only be obtained through problem-solving. For this reason, it is among the aims of educators to educate individuals who can use problem-solving skills (PSS) effectively and systematically in today's world where information is constantly updated.

The new conception of education aims to help people solve the problems they face through science, correctly understand cause and effect relationships in phenomena and events, attain the accurate and scientific ability of judging and questioning, learn the ways of using their intelligence, gain the habit of working in an organized and systematic manner and live in harmony with nature (Temizyürek, 2003). This has necessitated a lot of research on this subject in the field of science education (Çepni, Ayas, Johnson & Turgut, 1997).

In science education, inculcation of science process skills (SPS) in students is as important as the inculcation of PSS because SPS are basic skills that facilitate on learning science and make learning more permanent (Çepni, Ayas, Johnson & Turgut, 1996). In the literature, it is emphasized that PSS can be developed through training (Hsiao, Lin, Chen & Peng, 2018; Kaya & Kablan, 2018; Petersen, McAuliffe & Vermeulen, 2017; Ulu, Tertemiz & Peker, 2016; Uyar & Bal, 2015). Individuals' adapting to the speed of age and growing up successfully, depending on the extent to which they have mastered these skills. Education, on the other hand, is the basic step that enables individuals to keep up with social change. As such, the acquisition and development of these skills by students are among the goals of all educational institutions (Şahin, 2004).

Taşar (2001) defines SPS as skills that facilitate learning in science, help students learn ways and methods of researching, make students more effective, develop the sense of taking responsibility in students and increase retention. Besides PSS and SPS, students' learning styles are also important in terms of designing instructional and educational activities. When individuals are instructed in settings suitable for their learning styles, their learning efficiency increases. There may be negative changes in the self-confidence and achievement of a person taught in an area which is incompatible with his/her learning style. Learning style allows an individual to obtain information about why he/she learns differently from another person and to take his/her learning process under control. In this way, the individual can take responsibility for his/her learning and obtain constantly changing and increasing information without waiting for help from others (Güven, 2004). An education process that is carried out without taking the learning characteristics of students causes many students to be

unsuccessful or to get alienated from the school. In order to prevent such situations from occurring today, educational and instructional processes should be structured by taking into account students' learning styles and intelligence types (Ekici, 2003). In general, the development of SPS makes students better in solving problems, thinking critically, making decisions and satisfying their curiosity because SPS are thought to be closely related to PSS (Germann, 1994). Thus, the relationship between SPS and PSS seems to be worth investigating. SPS can be said to be the skills demonstrated in the solution of any scientific problem or the skills required to perform a scientific study (Monhardt & Monhardt, 2006). SPS are one of the most significant objectives on education of science programs since they are used both in the correct interpretation of daily events and in scientific studies (Dönmez & Azizoğlu, 2010). Also, problem-solving ability is learned from childhood, and PSS are developed all education life (Miller and Nunn, 2001). Thus, teachers can improve the quality of education by preparing appropriate educational environments taking into account students' learning styles (Hein & Budny, 2000).

When we take a detailed look at the literature, it is seen that although various studies are investigating the relationships between PSS and learning styles, SPS and learning styles and SPS and PSS, there is no study investigating the relationships between SPS, PSS and learning styles and gender, the school attended and mother/father's education level together. In this regard, for this study can be said to be original. In the context, this research is aimed to investigate the effects of gender, type of the school attended, mother/father's education level on secondary school students' PSS, SPS and learning styles. Thus the main problem statement of the current study was set as follows: How are the secondary school fourth-grade students' PSS, SPS and learning styles concerning some variables?

To this end, answers to the following problems were sought:

1) What is the distribution of the secondary school 4th-grade students according to PSS?

2) Is there any statistically significant difference between the secondary school 4th-grade students' PSS and;

a) Gender, **b)** The school attended, **c)** Maternal education level, **d)** Father's education level?

3) What is the distribution of the middle school 4th-grade students according to SPS?

4) Is there any statistically significant difference between the secondary school 4th-grade students' SPS and;

a) Gender, b) The school attended, c) Maternal education level, d) Father's education level?

5) What is the distribution of the middle school 4th-grade students according to learning styles?

6) Is there any statistically significant difference between the secondary school 4th-grade students' learning styles and;

a) Gender, **b)** The school attended, **c)** Maternal education level, **d)** Father's education level?

Method

Research Model

This study is a survey model and also it is a type of descriptive study.

Sample

The population of the study is comprised of all the fourth grade students (15-year-olds) attending the seven middle schools in the central district of the city of Muğla in the 2012-2013 school year. The schools that are connected to Muğla city centre where the students constituting the research sample are studying are public schools with different qualifications, coded with the letters of A, B, C, D, E, F and G. School A is a public school where the students have high academic success and the children of families with high socio-economic level are educated. School B, on the other hand, has the highest academic achievement level and the highest number of enrolled students in Menteşe district. School C, on the other hand, has a moderate academic achievement compared to other schools and mostly children of civil servant families receive education. School D is a school with high academic success, mostly preferred by Muğla origined families and where children of families dealing with trade receive education.

School E has a high number of students, it is a school with a low level of academic success, where the children of families with low socio-economic and educational levels are educated. School F is a school located farther away from the Muğla center, close to the university area with a low number of students, low in academic success, and children of medium-level families in terms of socio-economic level and education level. School G, on the other hand, is a medium-level academic achievement, where mostly civil servants and children from families with higher education are educated. The sample of the study consists of 569 students (303 male, 266 female) randomly selected from the population.

Data Collection Tools

In order to test the sub-problems of the current study, "The Problem-Solving Inventory", "The SPS Test", "The Kolb Learning Styles Inventory" and a student personal information form were used as the data collection tools.

The Problem-Solving Inventory

"The Problem-Solving Inventory" was used in the current study which had been developed by Serin, Serin-Bulut and Saygılı (2010)". This is a five point Likert scale inventory and has three factors called "Confidence (twelve-items)", "Self-Control (seven-items)" and "Avoidance (five-items)"; thus, the total number of the items in the inventory is twenty-four. The Cronbach alpha reliability coefficient for the original scale was found to be .80. The test-retest reliability coefficient was found to be .84 for the sub-factor of "Confidence in PSS", .79 for the sub-factor of "Self-Control" and .70 for the sub-factor of "Avoidance" and .85 for the whole scale. In addition, the results of the confirmatory factor analysis confirmed the three-factor model (x^2/df= 2.49, RMSEA= .051, GFI= .92, CFI=.90). In the current study, the Cronbach alpha internal consistency coefficients found are as follows: .79 for the Problem-Solving Inventory, .82 for the sub-factor of "Confidence in Problem-Solving Skill", .77 for the sub-factor of "Self-Control" and .71 for the sub-factor of "Avoidance".

The Science Process Skill Test

In this study, "The Science Process Skill Test" developed by Aydınlı (2007) was used to measure the students' SPS. The test is comprised of a total of 22 questions designed to measure basic SPS such as making observations, making classifications, performing measurements, using numbers, making inferences, making predictions and establishing communication and integrated SPS such as defining and controlling variables, formulating hypotheses, interpreting data, generating and using models, conducting experiments and performing operational definitions.

The Kolb Learning Styles Inventory

The Kolb Learning Styles Inventory was developed by David Kolb (1971) and adapted to Turkish by Aşkar & Akkoyunlu (1993) was used to establish the learning styles of the students. This inventory was intended to have a better grasp of individuals' learning processes and individual approaches to learning through experiences. There are four main learning styles in Kolb Learning Styles Inventory: Concrete Experience, Reflective Observation, Abstract Conceptualization and Active Experimentation (Kolb, 2005, as cited in Genç & Kocaarslan, 2013). The inventory is comprised of a total of 12 items requiring the respondent to sequence four expressions in such a way as to best define his/her learning styles. Based on the scores taken from the inventory, the dominant learning style of the respondent is determined. Aşkar & Akkoyunlu (1993) adapted the Kolb Learning Styles Inventory to Turkish and conducted its reliability and validity studies and as a result they found the Cronbach alpha reliability value as .58 for "Concrete Experience", .70 for "Reflective Observation", .71 for "Abstract Conceptualization" and .76 for "Active Experimentation" (Denizoğlu, 2008).

In the current study, the following Cronbach alpha reliability values were obtained: 0.78 for Concrete Experience, 0.77 for Reflective Observation, 0.71 for Abstract Conceptualization and 0.77 for Active Experimentation. In the reliability values of the combined scores, the Cronbach alpha reliability coefficient was found to be .75 for "Abstract-Concrete" and .78 for "Active-Reflective". As the Cronbach alpha reliability values were found to be higher than .70, the inventory was accepted to be reliable enough to be used in this study.

The researcher developed a student personal information form to collect data about the participant students' gender, the school attended, maternal/ father's educational background level.

Data Analysis

At this point, in order to decide whether to use parametric or nonparametric analysis methods for 569 students, the data should be subjected to normality test and the most widely known when the sample is up to 50, Shapiro-Wilk test has been performed. Through this test, it is possible to determine whether the data meet the normal distribution conditions. If the significance level of this test (significance = p) is less than 0.05, it is interpreted that the data are not normally distributed, otherwise the data is normally distributed (Altunışık, Coşkun, Bayraktaroğlu & Yıldırım, 2012). When the obtained result was examined, it was concluded that the data had a normal distribution because the p values of Shapiro-Wilk tests (n = 569, p = 0.09) is higher than 0.05. Parametric analysis methods were preferred in the difference tests to be made according to this result.

The SPSS 20.0 program package was employed to analyze all the data collected from the students. Frequencies and percentages were calculated to analyze the general distributions of the data taken from the Problem-Solving Inventory, the SPS Test and the Kolb Learning Styles Inventory. Independent samples t-test was run to determine whether the students' PSS and SPS scores vary significantly depending on gender and One Way Variance Analysis (One-way ANOVA) was used to determine whether their PSS and SPS scores vary significantly depending on the school attended and maternal education/father's education level.

First the responses to the items in the sub-dimensions in the Kolb Learning Styles Inventory were analysed the scores calculated and combined scores were found. As a result of all getting combined scores, scores ranging from -36 to +36 were obtained and which learning style is possessed by each student was determined. A Chi-square test was conducted to determine the relationships of the learning styles with the independent variables.

Results

In this section, findings regarding the sub-problems of the current study are presented in tables and their interpretations are given in the discussion section.

3.1. Findings related to the 1ˢᵗ problem "What is the distribution of the middle school 4ᵗʰ-grade students according to PSS?

Table 1. Distribution of the middle school 4ᵗʰ-grade students' according to PSS

PSS Sub-dimensions	f	%
Confidence in PSS	147	25.8
Self-Control	93	16.3
Avoidance	329	57.8
Total	596	100

It can be seen in Table 1., the middle school 4ᵗʰ grade students most use the sub-dimension of "avoidance" (57.8%), followed by the sub-dimension of "confidence in PSS" (25.8%) and the sub-dimension of "self-control" (16.3%). In other words, more than half of the students tend to postpone rather than solve when confronted with a problem, to avoid problems, and to get away from the actual problem. While 25.8% of the students feel confidence in using PSS, some of them (16.3%) tend to manage themselves in the face of a problem, to develop autonomous behaviours and ideas and to establish internal control [$t_{(5118)} = .637$, p<.05].

3.2. Findings related to the 2ⁿᵈ problem "Is There any Statistically Significant Difference between the Secondary School 4ᵗʰ Grade Students' PSS and Gender?"

Table 2. Results of the t-test conducted to determine the effect of gender on the students' PSS

PSS sub-dimensions	Gender	N	$\bar{X}$	S	df	T	P
Confidence in PSS	Male	303	41.37	8.26		- .509	.611
	Female	266	41.74	9.13			
Self-Control	Male	303	21.99	5.55		-1.553	.121
	Female	266	22.75	6.20	567		
Avoidance	Male	303	18.37	4.40		-1.282	.200
	Female	266	18.83	4.21			
General PSS	Male	303	70.91	9.24		- .937	.349
	Female	266	70.16	9.71			

Table 2. shows that gender does not make a significant effect on the secondary school 4ᵗʰ grade students' PSS [$t_{(567)} = -.937$, p>.05]. Moreover, the students' scores taken from the sub-dimensions of "Confidence in PSS" [$t_{(567)} = -.509$, p>.05], "Self-Control" [$t_{(567)} = -1.553$, p>.05], "Avoidance" [$t_{(567)} = -1.282$, p>.05] did not vary significantly by gender. Although there is not any statistically significant difference between the mean score of the male and female students. Male students scores taken from the Problem-Solving Inventory ($\bar{X}=70.91$) is upper than that of the female students ($\bar{X}=70.16$). However, the female students' mean scores taken from the sub-dimensions of "Confidence in PSS" ($\bar{X}=41.74$), "Self-Control" ($\bar{X}=22.75$) and "Avoidance" ($\bar{X}=18.83$) are higher.

3.3. Findings related to the 3ʳᵈ problem "Is There any Statistically Significant Difference between the Secondary School 4ᵗʰ Grade Students' PSS and the School Attended?"

Table 3. shows that the highest number of middle school 4th-grade students is in school A (N= 204), followed by school B (N= 118), school E (N= 111), school D (N= 67), school G (N=32) and school F (N= 21). The smallest number of middle school 4th-grade students is in school C (N=16). School A is a public school where the students have high academic success and the population of the school is too high. School B has the highest academic achievement level and the highest number of enrolled students in Menteşe district. School C has mostly children of civil servant families receive education. School D is a school with high academic success, mostly preferred by Muğla origined families. School E has a high number of students, it is a school with a low level of academic success, where the children of families with low socio-economic and educational levels are educated. School F is a school located farther away from the Muğla center with a low number of students, low in academic success, and children of medium-level families in terms of socio-economic and education level. School G, on the other hand, is a medium-level academic achievement, where mostly civil servants families children' are decided to take educated. Moreover, the means shown in Table 3 are values obtained by dividing the total scores taken from the Problem-Solving Inventory by the number of items in the scale.

Table 3. Means and standard deviation of the scores taken from the problem-solving inventory in relation to the school attended

PSS sub-dimensions	School Name	N	$\bar{X}$	S
Confidence in PSS	A	204	3.52	.72
	B	118	3.42	.90
	C	16	3.51	.49
	D	67	3.40	.64
	E	111	3.35	.61
	F	21	3.79	.64
	G	32	3.55	.66
Self-Control	A	204	3.23	.85
	B	118	3.12	.97
	C	16	3.33	.82
	D	67	3.28	.74
	E	111	3.12	.74
	F	21	3.50	.76
	G	32	2.99	.85
Avoidance	A	204	3.81	.82
	B	118	3.67	1.00
	C	16	4.00	.44
	D	67	3.51	.93
	E	111	3.68	.75
	F	21	3.98	.78
	G	32	3.61	.94
General PSS	A	204	3.02	.39
	B	118	3.03	.51
	C	16	3.95	.26
	D	67	3.01	.41
	E	111	3.00	.34
	F	21	3.04	.37
	G	32	3.15	.43

Whether the difference seen between the means is statistically significant was tested with one-way ANOVA and the results of this analysis are shown in Table 4. The variance analysis revealed that the school attended did not any significant effect on the mean scores taken by the secondary school 4th-grade students from the Problem-Solving Inventory [$F_{(6-562)}$= .69, p>.05]. Although the qualifications of the schools are different, it can be stated that the situations such as the students coming from different families, having different socio-economic levels or having different education levels are not effective in terms of problem solving skills. The variable of the school attended was also found to haven't significant effect on the secondary school 4th-grade students' problem-solving inventory scores taken from the sub-dimensions of "Confidence in PSS" [$F_{(6-562)}$= 1.60, p>.05], "Self-Control" [$F_{(6-562)}$= 1.36, p>.05], "Avoidance" [$F_{(6-562)}$= 1.89, p>.05].

Table 4. Results of ANOVA conducted to determine the effect of the school attended on the students' problem-solving inventory scores

PSS sub-dimensions	Source of the Variance	Sum of Squares	Sd	Mean Square	F	P
Confidence in PSS	Between-groups	4.97	6	.83	1.60	.147
	Within-groups	291.93	562	.52		
	Total	296.90	568	-		
Self-control	Between-groups	5.69	6	.95	1.36	.233
	Within-groups	394.42	562	.70		
	Total	400.10	568	-		
Avoidance	Between-groups	8.36	6	1.40	1.89	.082
	Within-groups	416.35	562	.74		
	Total	242.70	568	-		
General	Between-groups	.70	6	.11	.69	.660
	Within-groups	95.64	562	.17		
	Total	96.34	568	-		

3.4. Findings related to the 4th problem "Is There any Statistically Significant Difference between the Secondary School 4th-Grade Students' PSS and Maternal Education Level?"

As can be seen in Table 5, the majority of the mothers of the middle school 4th-grade students are "high school" graduates (N=175) or "primary school" graduates (N=159). The smallest number of the mothers is in the "Others" group. The mothers in this group are either illiterate or do not have any diploma even if they are literate.

The means shown in Table 5 are values obtained by dividing the total scores taken from the Problem-Solving Inventory by the number of items in the scale.

Table 5. Means and standard deviation of the scores taken from the problem-solving inventory in relation to maternal education level

PSS Sub-dimensions	Maternal Education Level	N	$\overline{\chi}$	S
Confidence in PSS	Primary school	159	3.50	.70
	Secondary school	99	3.43	.70
	High school	175	3.45	.78
	University	114	3.44	.73
	Post-graduate	13	3.51	.63
	Others	9	3.50	.42
Self-control	Primary school	159	3.29	.85
	Secondary school	99	3.14	.75
	High school	175	3.11	.87
	University	114	3.23	.87
	Post-graduate	13	3.13	.82
	Others	9	3.20	.72
Avoidance	Primary school	159	3.81	.83
	Secondary school	99	3.61	.84
	High school	175	3.64	.93
	University	114	3.77	.85
	Post-graduate	13	4.00	.74
	Others	9	3.67	.67
General PSS	Primary school	159	2.99	.40
	Secondary school	99	3.04	.43
	High school	175	3.06	.41
	University	114	3.00	.41
	Post-graduate	13	3.01	.31
	Others	9	3.02	.28

One-way ANOVA analysis was conducted to test whether the difference seen between the means are significant and the results of this analysis can be seen Table 6. Table 6. shows that maternal education level has no significant effect on the middle school 4th-grade students' general PSS scores [$F_{(5-563)}= .66$, $p>.05$].

Table 6. Results of ANOVA conducted to determine whether the students' problem-solving inventory scores vary significantly depending on maternal education level

PSS Sub-dimensions	Source of the Variance	Sum of Squares	df	Mean Square	F	P
Confidence in PSS	Between-groups	.40	5	.080		
	Within-groups	296.50	563	.53	.15	.980
	Total	296.90	568	-		
Self-control	Between-groups	3.04	5	.61		
	Within-groups	397.10	563	.71	.86	.506
	Total	400.10	568	-		
Avoidance	Between-groups	5.12	5	1.03		
	Within-groups	419.58	563	.75	1.38	.231
	Total	424.70	568	-		
General PSS	Between-groups	.56	5	.11		
	Within-groups	95.79	563	.17	.66	.658
	Total	96.35	568	-		

3.5. Findings related to the 5th problem "Is There any Statistically Significant Difference between the Secondary School 4th-Grade Students' PSS and Father's Education Level

As can be seen in Table 7, the majority of the fathers of the middle school 4th-grade students are "university" graduates (N=181) or "high school" graduates (N=147). The smallest number of the fathers is in the "Others" group (N=6). The fathers in this group are either illiterate or do not have any diploma even if they are literate. The means shown in Table 7 are values obtained by dividing the total scores taken from the Problem-Solving Inventory by the number of items in the scale.

Table 7. Means and Standard deviation of the scores taken from the problem-solving inventory in relation to father's education level

PSS Sub-dimensions	Father's Education Level	N	$\bar{X}$	S
Confidence in PSS	Primary school	116	3.53	.72
	Secondary school	92	3.39	.60
	High school	147	3.44	.71
	University	182	3.52	.74
	Post-graduate	26	3.17	.96
	Others	6	3.22	.78
Self-control	Primary school	116	3.26	.85
	Secondary school	92	3.12	.76
	High school	147	3.20	.88
	University	182	3.16	.84
	Post-graduate	26	3.20	.93
	Others	6	3.62	.49
Avoidance	Primary school	116	3.71	.90
	Secondary school	92	3.77	.76
	High school	147	3.64	.89
	University	182	3.75	.87
	Post-graduate	26	3.75	.88
	Others	6	3.83	.69
General	Primary school	116	3.04	.42
	Secondary school	92	3.00	.37
	High school	147	3.03	.40
	University	182	3.06	.40
	Post-graduate	26	3.88	.61
	Others	6	3.76	.50

One-way variance analysis was carried out to determine whether the difference between the means is significant, and the results are presented in Table 8.

Table 8. Results of ANOVA conducted to determine the effect of father's education level on the students' problem-solving inventory scores

PSS Sub-dimensions	Source of the Variance	Sum of Squares	Sd	Mean Square	F	P
Confidence in PSS	Between-groups	4.26	5	.85		
	Within-groups	292.63	563	.52	1.64	1.147
	Total	296.90	568	-		
Self-control	Between-groups	2.24	5	.44		
	Within-groups	397.87	563	.71	.63	.675
	Total	400.10	568	-		

Avoidance	Between-groups	1.54	5	.31		
	Within-groups	423.17	563	.75	.41	.843
	Total	424.70	568	-		
General	Between-groups	1.31	5	.27	1.56	.171
	Within-groups	95.03	563	.17		
	Total	96.34	568	-		

The data in Table 8 show that father's education level does not have any significant effect on the middle school 4th-grade students' general PSS scores [$F_{(5-563)}$= 1.56, p>.05]. Thus, it can be said that father's education level does not lead to a significant difference in the middle school 4th-grade students' PSS. Similarly, father's education level was found to have no significant effect on the middle school 4th grade students' PSS scores taken from the sub-dimensions of "Confidence in PSS" [$F_{(5-563)}$= 1.64, p>.05], "Self-Control" [$F_{(5-563)}$= .63, p>.05] and "Avoidance" [$F_{(5-563)}$= .41, p>.05]. In other words, father's education level does not have any significantly affect on the middle school 4th grade students' PSS in the sub-dimensions of "Confidence in PSS", "Self-Control" and "Avoidance"

3.6. Findings related to the Sub-problem "What is the Distribution of the Middle School 4th-Grade Students according to SPS?"

As can be seen in Table 9, 351 (61.7%) of the students have basic SPS while 218 (38.3%) of the students have integrated SPS. Thus, it can be said that the majority of the middle school 4th-grade students have basic SPS.

Table 9. Distribution of students according to SPS

Sub-dimension	f	%
Basic	351	61.7
Integrated	218	38.3
Total SPS	569	100.0

3.7. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' SPS and Gender?"

The data presented in Table 10 show that gender does not have any significant effect on the middle school 4th-grade students' SPS [t (567) = -.970, p>.05]. Moreover, the scores taken from the sub-dimensions of "Basic SPS" [t (567) = 1.280, p>.05] and "Integrated SPS" [t (567) = .936, p>.05] were also found to be not varying significantly depending on gender. Thus, it can be argued that gender is not a factor that can create significant effects on SPS. As can be seen in Table 10, the mean scores taken by the male students from the SPS Test (=14.43) and its sub-dimensions of "Basic SPS" and "Integrated SPS" (=7.39) are higher than those of the female students.

Table 10. Results of the t-test conducted to determine the effect of gender on the students' SPS

SPS	Gender	N	$\bar{X}$	S	df	T	p
Basic	Male	303	7.04	1.90		1.280	.201
	Female	266	6.82	2.12			
Integrated	Male	303	7.39	2.96	567	.936	.350
	Female	266	7.14	3.22			
General	Male	303	14.43	4.33		- .970	.333
	Female	266	14.04	5.10			

3.8. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' SPS and the School Attended?"

Table 11. Means and standard deviation of the scores taken from the SPS test in relation to the school attended

SPS	School Name	N	$\bar{X}$	S
Basic	A	204	.70	.21
	B	118	.73	.23
	C	16	.71	.19
	D	67	.71	.18
	E	111	.65	.17
	F	21	.72	.17
	G	32	.61	.66
Integrated	A	204	.63	.19
	B	118	.64	.30
	C	16	.63	.27
	D	67	.61	.30
	E	111	.56	.21
	F	21	.63	.22
	G	32	.55	.24
General	A	204	.66	.23
	B	118	.69	.23
	C	16	.67	.17
	D	67	.65	.21
	E	111	.59	.16
	F	21	.68	.15
	G	32	.64	.18

The means shown in Table 11 were obtained by dividing the total scores taken from the "SPS Test" by the number of items in the test. One-way variance analysis was conducted to determine whether the difference seen between the means is significant and the results of this analysis are presented in Table 12.

Table 12. Results of ANOVA conducted to determine whether the students' scores taken from the SPS Test vary significantly depending on the school attended

SPS	Source of the Variance	Sum of Squares	df	Mean Square	F	P	Scheffe Test
	Between-groups	.68	6	.11			
Basic SPS	Within-groups	22.23	562	.04	2.86	.009	B-E
	Total	22.91	568	-			
	Between-groups	.54	6	.09			
Integrated SPS	Within-groups	39.47	562	.70	1.28	.267	-
	Total	40.00	568	-			
	Between-groups	.59	6	.09			
General SPS	Within-groups	25.47	562	.04	2.15	.046	B-E
	Total	26.05	568	-			

The data presented in Table 12 show that the school attended has a significant effect on the middle school 4th grade students' scores taken from the SPS Test and its sub-dimension of "Basic SPS" [$F_{(6-562)}$= 2.86, p<.05, $F_{(6-562)}$= 2.15, p<.05]. In order to determine the source of the difference, Scheffe test was conducted. The results of this test show that the source of the difference is the difference between the students attending school B and school E. The reason for this difference may be the profiles of the students attending these schools and their families' socio-economic levels.

3.9. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' SPS and Maternal Education Level?"

The means shown in Table 13 are values obtained by dividing the total scores taken from the SPS Test by the number of items in the test. In Table 13, it is seen that nearly one-fourth of the students' mothers are high school" graduates (N=175) and 159 of them are primary school" graduates, 114 of them are university graduates, 98 are middle school graduates (N=99), 13 hold a post-graduate degree and 9 are in the group of others. The mothers in the group of others are either illiterate or do not have any diploma even if they are literate.

Table 13. Means and standard deviation of the scores taken from the SPS test in relation to maternal education level

SPS	Maternal Education Level	N	$\bar{X}$	S
	Primary school	159	.70	.20
	Middle school	99	.67	.20
Basic	High school	175	.71	.19
	University	114	.70	.21
	Post-graduate	13	.77	.13
	Others	9	.66	.26
	Primary school	159	.62	.27
	Middle school	99	.57	.25
Integrated	High school	175	.61	.28
	University	114	.62	.26
	Post-graduate	13	.63	.24
	Others	9	.55	.23

	Primary school	159	.65	.20
	Middle school	99	.61	.20
General	High school	175	.65	.19
	University	114	.65	.21
	Post-graduate	13	.68	.13
	Others	9	.59	.26

One-way variance analysis was conducted to determine whether the difference seen between the means is significant, and the results of this analysis are presented in Table 14.

Table 14. Results of ANOVA conducted to determine whether the students' scores taken from the SPS Test vary significantly depending on the maternal education level

SPS	Source of the Variance	Sum of Squares	Sd	Mean Square	F	P
	Between-groups	.22	5	.04		
Basic	Within-groups	22.69	563	.04	1.10	.363
	Total	22.91	568	-		
	Between-groups	.26	5	.05		
Integrated	Within-groups	39.74	563	.07	.74	.595
	Total	40.00	568	-		
	Between-groups	.21	5	.04	.91	.468
General	Within-groups	25.84	563	.04		
	Total	26.05	568	-		

The data presented in Table 14 show that maternal education level does not have any significant effect on the middle school 4th-grade students' science process skill test scores [$F_{(5-563)}$= .91, p>.05]. Thus, it can be argued that the middle school 4th-grade students' maternal education level does not affect their SPS.

Moreover, the middle school 4th-grade students' scores taken from the sub-dimensions of "Basic SPS" [$F_{(5-563)}$= 1.10, p>.05] and maternal education level was found to have no significant effect on "Integrated SPS" [$F_{(5-563)}$= .74, p>.05].

3.10. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' SPS and Father's Education Level?"

The means shown in Table 15 are values obtained by dividing the total scores taken from the SPS Test by the number of items in the test. As can be seen in Table 15, the majority of the students' fathers are "University" graduates (N=182) and "High school" graduates (N=147), followed by "Primary school" graduates (N=116), "Middle school" graduates (N=92), "Post-graduate" (N=26) and "Others" (N=9). The fathers in this group are either illiterate or do not have any diploma even if they are literate.

Table 15. Means and standard deviation of the scores taken from the SPS test in relation to father's education level

SPS	Father's Education Level	N	$\bar{\chi}$	S
Basic	Primary school	116	.71	.20
	Middle school	92	.65	.21
	High school	147	.68	.19
	University	182	.71	.20
	Post-graduate	26	.75	.31
	Others	6	.63	.20
Integrated	Primary school	116	.66	.27
	Middle school	92	.58	.26
	High school	147	.57	.25
	University	182	.63	.27
	Post-graduate	26	.61	.29
	Others	6	.61	.30
General	Primary school	116	.69	.21
	Middle school	92	.61	.22
	High school	147	.62	.20
	University	182	.67	.21
	Post-graduate	26	.66	.23
	Others	9	.65	.28

One-way variance analysis was conducted to determine whether the difference seen between the means of the scores taken from the SPS Test is significant, and the results are given in Table 16

Table 16. Results of ANOVA conducted to determine whether the students' scores taken from the SPS Test vary significantly depending on the father's education level

SPS	Source of the Variance	Sum of Squares	df	Mean Square	F	P	Scheffe Test
Basic	Between-groups	.43	5	.09	2.17	.056	-
	Within-groups	22.48	563	.04			
	Total	22.91	568	-			
Integrated	Between-groups	.85	5	.17	2.43	.034	University- -Others, Postgraduate-Others
	Within-groups	39.16	563	.07			
	Total	40.00	568	-			
General	Between-groups	.56	5	.11	2.48	.030	University-Others
	Within-groups	25.49	563	.05			
	Total	26.05	568	-			

The data in Table 18 show that father's education level has a significant effect on the middle school 4th-grade students' general SPS test scores and integrated SPS scores [$F_{(5-563)}= 2.48$, p<.05] and [$F_{(5-563)}= 2.43$, p<.05] .

In order to find the source of this difference, Scheffe test was conducted and it was found that there are significant differences between the integrated SPS mean scores of the students whose fathers are "University" graduates and those of the students whose fathers are in the "Others" group and between the integrated SPS mean scores of the students whose fathers are in the "Post-graduate" group and those of the students whose fathers are in the "Others" group and that there are significant

differences between general SPS of the students whose fathers are in the "Post-graduate" group and those of the students whose fathers are in the "Others" group. Thus, it can be concluded that that while father's education level is not significantly correlated with basic SPS, it is significantly correlated with the integrated SPS and general SPS. Father's education level was found to have no significant effect on the middle school 4th-grade students' basic SPS [$F_{(5-563)}$= 2.17, p>.05] .

3.11. Findings related to the Sub-problem "What is the Distribution of the Middle School 4th-Grade Students according to Learning Styles?"

Table 17. Descriptive statistics for the students' learning styles

Learning Styles	f	%
Diverging	241	42.4
Assimilating	167	29.3
Converging	92	16.2
Accommodating	69	12.1
General	569	100.0

The data presented in Table 17 show that the most popular learning style among the middle school 4th-grade students is the diverging learning style (42.4%) while the least popular one is the accommodating learning style (12.1%).

3.12. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' Learning Styles and Gender?"

Table 18. The relationship between the students' learning styles and gender

Gender		Learning Style				
		Diverging	Assimilating	Converging	Accommodating	Total
Male	N (%)	122 (40.3)	99 (32.7)	50 (16.5)	32 (10.6)	303 (100.0)
Female	N (%)	119 (44.7)	68 (25.6)	42 (15.8)	37 (13.9)	266 (100.0)
General	N (%)	241 (42.4)	167 (29.3)	92 (16.2)	69 (12.1)	569 (100.0)

χ^2= 4.463; sd = 3; p = .216; p>.05

The data presented in Table 18 show that gender does not have any significant effect on the middle school 4th-grade students' learning styles ($X^2_{(3)}$= 4.463; p>.05). Both among the male and female students, the most popular learning style is diverging learning (40.3% and 44.7%, respectively) while the least popular learning style is the accommodating learning style (10.6%,and 13.9%, respectively). Thus, it can be said that the gender variable does not significantly affect learning styles.

3.13. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' Learning Styles and the School Attended?"

Table 19. The relationship between the students' learning styles and the school attended

School Name		Diverging	Assimilating	Converging	Accommodating	Total
			Learning Style			
A	N (%)	83 (40.7)	61 (29.9)	24 (11.8)	36 (17.6)	204 (100.0)
B	N (%)	39 (33.1)	43 (36.4)	24 (20.3)	12 (10.2)	118 (100.0)
C	N (%)	9 (56.2)	4 (25.0)	3 (18.8)	0 (0.0)	16 (100.0)
D	N (%)	29 (43.3)	26 (38.8)	7 (10.4)	5 (7.5)	67 (100.0)
E	N (%)	62 (55.9)	19 (17.1)	21 (18.9)	9 (8.1)	111 (100.0)
F	N (%)	7 (33.3)	7 (33.3)	4 (19.0)	3 (14.3)	21 (100.0)
G	N (%)	12 (37.5)	7 (21.9)	9 (28.1)	4 (12.5)	32 (100.0)
General	N (%)	241 (42.4)	167 (29.3)	92 (16.2)	69 (12.1)	569 (100.0)

χ^2= 38.015; sd = 18; p = .004; p<.05

As can be seen in Table 19, there is a statistically significant difference between the middle school 4th students' learning styles and the school attended ($\chi^2_{(18)}$= 38.015; p<.05). When the data of the students participating in the current study are examined in terms of the school attended, while schools A, C, D, E and G largely have students having the diverging learning style (40.7%, 56.2%, 43.3%, 55.9%, 37.5%, respectively), school B largely has students having the assimilating learning style (36.4%) and school F largely has students having both the diverging learning style (33.3%) and the assimilating learning style (33.3%). On the other hand, school A has the smallest number of students having the converging learning style (11.8%) while schools B, C, D, E, F and G have the smallest number of students having the accommodating learning style (10.2%, 0.0%, 7.5%, 8.1%, 14.3%, 12.5%, respectively). In other words, while the number of students who adapt different viewpoints towards concrete situations and who prefer making observation rather than immediately getting into action is high in schools A, C, D, E and G, students in school B are highly successful in concerting comprehensive information into a logical whole. On the other hand, school F has equal amounts of these two different types of students.

3.14. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' Learning Styles and the Maternal Education Level?"

Table 20. The relationship between the students' learning styles and the maternal education level

Education Level		Diverging	Assimilating	Converging	Accommodating	Total
			Learning Style			
Primary school	N (%)	76 (47.8)	35 (22.0)	29 (18.2)	19 (11.9)	159 (100.0)
Middle school	N (%)	42 (42.4)	29 (29.3)	17 (17.2)	11 (11.1)	99(100.0)
High school	N (%)	69 (39.4)	59 (33.7)	26 (14.9)	21 (12.0)	175 (100.0)
University	N (%)	46 (40.4)	40 (35.1)	12 (10.5)	16 (14.0)	114 (100.0)
Post-graduate	N (%)	4 (30.8)	3 (23.1)	5 (38.5)	1 (7.7)	13 (100.0)
Others	N (%)	4 (44.4)	1 (11.1)	3 (3.3)	1(11.1)	9 (100.0)
General	N (%)	241 (42.4)	167 (29.3)	92 (16.2)	69 (12.1)	569 (100.0)

χ^2= 17.722; sd = 15; p = .278; p>.05

As can be seen in Table 20, there is no significant difference between the middle school 4th-grade students' learning styles and their maternal education levels ($\chi^2_{(15)}$= 17.722; p>.05). In the table,

it is seen that the students whose mothers are "Primary school" graduates (47.8%), "Middle school" graduates (42.4%), "High school" graduates (39.4%), "University" graduates (40.4%) and "Others" (44.4%) largely have the diverging learning style while the students whose mothers are in the "Post-graduate" group largely have the converging learning style (38.5%). On the other hand, the learning style adopted by the smallest number of students whose mothers are "Primary school" graduates (11.9%), "Middle school" graduates (11.1%), "High school" graduates (12.0%) and "Post-graduate" (7.7%) is the accommodating learning style. On the other hand, among the students whose mothers are "University" graduates, the converging learning style is adopted the least and among the students whose mothers are in the "Others" group, the accommodating learning style (11.1%) and the assimilating learning style (11.1%) are adopted the least.

3.15. Findings related to the Sub-problem "Is There a Statistically Significant Difference between the Middle School 4th-Grade Students' Learning Styles and Father's Education Level?

Table 21. The relationship between the students' learning styles and father's education level

Education Level		Diverging	Assimilating	Converging	Accommodating	Total
			Learning Style			
Primary school	N (%)	51(44.0)	31 (26.7)	25 (21.6)	9 (7.8)	116 (100.0)
Middle school	N (%)	43 (46.7)	25 (27.2)	11 (12.0)	13 (14.1)	92 (100.0)
High school	N (%)	61 (41.5)	41 (27.9)	23 (15.6)	22 (15.0)	147 (100.0)
University	N (%)	75 (41.2)	58 (31.9)	26 (14.3)	23 (12.6)	182 (100.0)
Post-graduate	N (%)	8 (30.8)	12 (46.2)	6 (23.1)	0 (0.0)	26 (100.0)
Others	N (%)	3 (50.0)	0 (0.0)	1 (16.7)	2 (33.3)	6 (100.0)
General	N (%)	241 (42.4)	167 (29.3)	92 (16.2)	69 (12.1)	569 (100.0)

$\chi^2 = 19,466$; sd = 15; p = .193; p>.05.

As can be seen in Table 21, there is no significant difference between the middle school 4th-grade students' learning styles and their fathers' education levels ($\chi^2_{(15)}$= 19,466; p>.05). In the table, it is seen that the students whose fathers are "Primary school" graduates (44.0%), "Middle school" graduates (48.7%), "High school" graduates (41.5%), "University" graduates (41.2%) and "Others" (50.0%) largely have the diverging learning style while the students whose fathers are "University" graduates largely have the assimilating learning style (46.2%). On the other hand, the learning style adopted by the smallest number of students whose fathers are "Primary school" graduates (7.8%), "High school" graduates (15.0%) and "University" graduates (12.6%) is the accommodating learning style. The least adopted learning style by the students whose fathers are middle school graduates (12.0%) is the converging learning style. There are no students who have the accommodating learning style and whose fathers are in the post-graduate group and there are no students who have the assimilating learning style and whose fathers are in the "Others" group.

Discussion, Results and Suggestions

The results of the study have shown that the most preferred dimension by the middle school 4th-grade students is "avoidance" and which is followed by the sub-dimensions of "confidence in problem-solving skill" and "self-control". It has also been revealed that gender, the school attended, parents' educational background can make no significant effect on the students' PSS. In their study conducted to investigate university students' problem-solving skills, Kelleci, Gölbaşı, Doğan & Tuğut (2011) found that the university students preferred the "Approaching Avoiding" style referring to revision of attempts to solve problems and conducting research actively for different, alternative solutions, followed by the "Confidence in PSS" referring to the individual's trusting in his/her PSS and "Self-Control" meaning that people's maintaining their control in problematic situations. These findings support the finding of this study. In the current study, the gender variable was found to have no significant effect on the middle school 4th-grade students' PSS. In their study conducted on the pre-service science teachers' PSS, Üstündağ & Beşoluk (2012) found that gender is not a factor significantly affecting PSS. Güçray (2003) reported that PSS do not vary significantly by gender. Ateş (2008), Dündar (2009), Serin (2001), Özkütük, Silkü, Orgun &Yalçınkaya (2003), D'Zurilla et al. (1998), Basmacı (1998) and Aydın (1999) also found that gender does not gave a significant effect on PSS. These findings reported in the literature support the finding of the current study. In the literature, there are studies reporting different findings. Korkut (2002) conducted a study on the PSS of high school students and found that the PSS of the students varied significantly depending on gender in favour of the male students. Graybill (1975), Dinçer (1995), Saracaloğlu, Serin & Bozkurt (2002), Serin & Derin (2006), İnce & Sen (2006), Germi & Sunay (2006), Çağlayan (2007) & Ertek (2014) stated that PSS vary significantly depending on gender. Haykır (2012), Nas (2015), Tezel & Tezgören (2019) found that female students' PSS are significantly better that those of male students. On the other hand, the finding reported by Güler (2019) that female students' level of problem solving is lower than that of male students contradicts with that of this study.

In the current study, it was found that there is no significant difference between maternal education level and the middle school 4th-grade students' PSS. Akpınar & Akpınar (2017) investigated university students' PSS in terms of different demographic variables and found that the maternal education level did not cause any significant difference in their PSS. Moreover, in another study investigating the high school students' PSS and factors affecting these skills, Yıldırım, Hacıhasanoğlu, Karakurt & Türkleş (2011) found no significant difference between maternal education level and PSS. In their study investigating the primary school students' perceptions of interpersonal PSS and factors affecting their locus of control levels, Serin & Derin (2008) found no significant difference between maternal education level and PSS. Moreover, Basmacı (1998), Aslan &

Uluçınar Sağır (2012), Çağlayan, Taşğın & Yıldız (2008), Tümkaya & İflazoğlu (1999) and Korkut (2002) found similar results.

In the literature, there are studies reporting similar or different results. Deniz, Aslan & Hamarta (2002) found that the total scores taken from the problem solving inventory did not vary significantly depending on maternal education level yet, the scores taken from the sub-dimensions of the problem solving inventory were found to be varying significantly depending on the maternal education level. On the other hand, Avcı & Gülbahçe (2019) investigated the PSB of high school students in terms of different variables and they found that maternal education level caused a significant difference in their PSS. Eroğlu (2001) also stated that there is a significant difference between children's PSS and maternal education level. Moreover, Ünüvar (2003), Saygılı (2000) and Dönmez & Demirtaş (2007) reported that maternal education level created significant differences in PSS.

In the current study, it was concluded that the middle school 4th-grade students' PSS do not vary significantly depending on father's education level. Korkut (2002) investigated the high school students' PSS in relation to some variables and concluded that their PSS did not vary significantly depending on father's education level. Yet, the findings obtained by Tümkaya & İflazoğlu (1999), Basmacı (1998) and Güzel (2004) are not parallel to this finding of the current study. However, in the study conducted by Saygılı (2000), a significant difference was found between the high school students' fathers' education levels and their PSS. In their study, Dönmez & Demirtaş (2007) found that father's education level has a significant effect on the teachers' perceptions of PSS. Çağlayan, Taşğın & Yıldız (2008) found that while father's education level has a significant effect on the students' problem solving inventory skills in some sub-dimensions, it does not any significant effect on them in some other sub-dimensions. These findings reported in the literature do not concur with the finding of the current study. In the study conducted by Çelik (2016), pre-service elementary school teachers' PSS were examined and found that father's education level has a significant effect on their PSS in the sub-dimension of avoidant.

In the current study, it was found that the middle school 4th-grade students largely used basic SPS. In general, while no significant differences were found between SPS and gender and maternal education level, significant differences were found between SPS and the school attended and father's education level. The fact that public schools connected to the city center have different qualifications (families from different departments, different education levels, different socio-economic levels…) may also be a factor in reaching this result.

Moreover, a significant difference was found between the sub-dimension of integrated SPS and father's education level. Şen (2019); in her study entitled "Determination of Fifth-Grade

Students' SPS and Self-Efficacy Beliefs" found that the students' basic process skills are high while their experimental skills are low. Öztürk (2008) aimed to determine seventh-grade students' level of SPS and found that their basic process skills are high while their experimental skills are low. Böyük, Tanık & Saraçoğlu (2011) found that although the achievement level of middle school students in basic SPS (observation, time-space relationship, classification, use of numbers, measurements, association, prediction) is high, their level of achievement in higher-order SPS (controlling variables, interpreting data, formulating hypotheses, conducting experiments) is low. In other words, while the participating students had the highest achievement in the skill of using numbers, they had the lowest achievement in the skill of conducting experiments. The findings of this study seem to concur with the findings of the current study related to the use of the sub-dimensions of SPS by the students.

In the current study, it was concluded that the gender variable did not have any significant effect on the middle school 4th-grade students' SPS. However, Aydınlı (2007) reported that gender had a significant effect on the students' basic and integrated SPS. This finding does not support the finding of the current study. In their study investigating SPS, Öztürk (2008) and Hazır & Türkmen (2008) found no significant difference between the male and female students' levels of SPS but the mean score of the female students was found to be higher than that of the male students. While this finding supports the finding of the current study as no statistically significant difference was found, it is contrary to the finding of the current study as the female students' mean score was found to be higher. Karar (2011) determined that seventh grade students' SPS vary significantly depending on gender. This difference was found to be in favour of the female students in the sub-skills of identifying and controlling variables, formulating and defining a hypothesis, drawing and interpreting graphs. Karataş, Delen, Cengiz, İkto & Birinci (2018) found that Anatolian high school tenth-grade students' SPS are related to their gender but the effect size is small. In their studies, Aydoğdu (2006), Tatar (2006) and Arslan (1995) also concluded that the students' SPS did not vary significantly depending on gender. Kuru & Akman (2017) did a study on pre-school children and found that SPS were not significantly affected by gender. These findings support the finding of the current study.

In the current study, it was found that maternal education level did not lead to any significant effect on the middle school 4th year students' SPS. In their study entitled "Evaluation of the Degree to Which the Science and Technology Course Imparts SPS to Primary School 5th-Grade Students", Gürbüztürk & Katrancı (2010) found that maternal education level did not lead to any significant difference in the acquisition of SPS by students. This finding is in compliance with the finding of the current study. In the literature, there are studies reporting different findings. Aydınlı (2007) found that students' basic and integrated SPS varied significantly depending on maternal education level. Karataş, Delen, Cengiz, İkto & Birinci (2018) concluded that with increasing education level of mothers who take an active role in children's education, children's SPS also increase. Saraçoğlu,

Böyük & Tanık (2012) found that students' SPS were significantly affected by maternal education level and that the students whose mothers are university graduates had a significantly higher mean score than the students whose mothers are primary school and middle school graduates. Öztürk (2008) found that the mean SPS scores of the students whose mothers are university and high school graduates are significantly higher. Moreover, it was also found that mothers' increasing level of education led to increasing science process scores on the part of the students. Germann (1994) and Aydınlı (2007) also concluded that maternal education level had a significant effect on the students' acquisition of SPS. In the current study, the middle school 4th-grade students' SPS were found to be varying significantly depending on father's education level. Aydınlı (2007) found significant differences among basic and integrated SPS of the students whose fathers have different education levels. Aydoğdu (2006) also reported that the students' scores taken from the SPS test varied significantly depending on their fathers' education levels. Doğan (2018) investigated the SPS of middle school seventh-grade students and found that with increasing education level of fathers, the scores taken from the SPS test also increased and that this variable created a significant difference. Saraçoğlu, Böyük & Tanık (2012) found that the students whose fathers are university graduates had a significantly higher mean score than the students whose fathers are in the "Others" group. In their study investigating elementary school second level students' SPS in relation to different variables, Böyük, Tanık & Saraçoğlu (2011) found that father's education level caused significant differences in SPS. The findings of these studies concur with the finding of the current study. There are also some other studies reporting different findings. Zorlu, Zorlu, Sezek & Akkuş (2014) compared the relationship between middle school 4th-grade students' SPS and achievement test scores and found no significant difference between SPS and father's education level.

In the current study, the highest number of the middle school 4th-grade students was found to have the diverging learning style, while the smallest number of students was found to have the accommodating learning style. Moreover, the school attended was found to have a significant effect on the students' learning styles but not maternal education level and father's education level. Biçer (2010) tried to determine the relationships between grade levels, genders, academic achievements and the school subjects of the sixth, seventh and eighth grade students and their learning styles and found that the students most preferred diverging learning style in math, Turkish, English and Science and Technology classes. Kaya (2007) conducted a study on elementary school 6th, 7th and 8th-grade students and found that the learning style most preferred by the students is the diverging learning style. Suliman (2006) found that the most preferred learning style among university students is the diverging learning style. These findings support the finding of the current study. However, in the literature there are studies reporting different findings. Denizoğlu (2008) found that while the most preferred learning styles among pre-service science teachers are diverging and assimilating learning styles, accommodating and converging learning styles are the least preferred ones. Mutlu (2008)

investigated the learning styles of the education faculty students and found that the students largely have the assimilating learning style. Karakış (2006) and Kılıç (2002) reported that the participants mostly preferred the assimilating learning style. Although Can (2011) found the age did not have any significant effect on the pre-service teachers' learning styles, with increasing age, thinking ability, awareness of values and meanings, focusing on abstract concepts and ideas, decision making and planning ideas were found to have developed more. Moreover, she found that the individuals in the age group 17-23 prefer the assimilating learning style while those who are 23 years old or older prefer the converging learning style. As a result, it can be concluded that while higher graders adopt assimilating learning style more, lower graders adopt diverging learning style more. Dikmen, Tuncer & Şimşek (2018) found that the dominant learning style among university students is assimilating learning style.

In the current study, the gender variable was found to have no significant effect on the learning styles of the middle school 4th-grade students. While Başbay, Bıyıklı & Demir (2018) found that gender may have small-medium effect on middle school students' learning styles, Denizoğlu (2008) conducted a study on the pre-service science teachers and found that there is no significant difference between learning styles and gender. Mutlu (2008) and Can (2011) stated that there is no significant difference between the learning styles and gender of the education faculty students. Moreover, findings reported by Güzel (2004), Bahar, Özen & Gülaçtı (2007), Numanoğlu & Şen (2006) also support the findings of the current study.

In the current study, maternal education level was found to have no significant effect on the middle school 4th-grade students' learning styles. Yenilmez & Çakır (2005) also found that there is no significant difference between the primary school students' learning styles and their maternal education levels. Çağlayan & Şirin (2009) also reported that the high school students' learning styles did not vary significantly depending on their maternal education levels. Gürol (2010), Demir (2010), Gürpınar, Batı & Tetik (2011), Topuz & Karamustafaoğlu (2013) concluded that there maternal education level is not significantly correlated with learning styles of their children. The findings reported in these studies concur with the finding of the current study.

In the literature, there are studies reporting different results. Tazegül & Ülker (2009) investigated the learning styles of the blind students and found a significant difference between the students' learning styles and their maternal education levels. Similarly, Ortar (2006), Baran (2000) and Merter (2009) found that maternal education level is an important variable leading to differences in students' learning styles. Bakır & Mete (2014) concluded that while elementary education second level students' independent learning style scores vary significantly depending on maternal education level, their passive, cooperative, dependent, competitive and participatory learning style scores do not vary significantly.

In the current study, the middle school 4th-grade students' learning styles were found to be not varying significantly depending on father's education level. Yurtseven (2010) investigated the relationship between the primary school 5th-grade students' academic achievement in the social studies course and learning styles and concluded that there is no significant difference between the students' learning styles and their fathers' education levels. Bakır & Mete (2014) found that independent learning style scores of the elementary education second level students vary significantly depending on father's education level while their passive, cooperative, dependent, competitive and participatory learning style scores do not vary significantly. Yenilmez & Çakır (2005) and Güzel (2004) also found no significant difference between father's education level and learning styles. These findings support the finding of the current study. However, Ortar (2006), Baran (2000) and Merter (2009) found a significant difference between learning styles and father's education level. On the basis of the results of this study, these suggestions can be made:

- Qualitative research to be conducted to explore the reasons for the changes in the levels of using PSS and SPS in different schools in the same school district will help fill the void in the literature.

- Students' learning styles can be determined at the beginning of the school year and the instruction can be delivered in compliance with the students' learning styles. Thus, students can learn more effectively.

- As the majority of the students have the diverging learning style, instructional activities should be planned to include group works and to provide feedbacks to individual students; thus, learning of students will be more permanent and effective.

- By designing the contents of education systems in such a way as to develop PSS and SPS, it is possible to improve these skills, but different learning styles can also be considered during this design process. Thus, it can be ensured that students learn subjects in a meaningful way and use them to solve problems they encounter in daily life.

Generally; the current study concluded that the middle school 4th-grade students used the avoidance sub-dimension the most, followed by the confidence in problem-solving skill and self-control sub-dimensions. No significant difference was found between the PSS and gender, the school attended, maternal education level and father's education level. The majority of the students were found to use the basic SPS. While no significant difference was found between the SPS and gender and maternal education level, a significant difference was found between the SPS and the school attended and father's education level. In the context of these results, it can be said that school difference may affect students' scientific process skills due to factors such as the effect of teacher

experience, the number of students in the school, on the academic achievement of students. Moreover, a significant difference was found between the SPS and the father's education level. The great majority of the students were found to have the diverging learning style while the accommodating learning style was possessed by the smallest number of students. The students' learning styles were found to be varying significantly depending on the school attended yet not depending on gender, the maternal education level and the father's education level. As a result of the current study, it is seen that 4th-grade students' PSS and scientific process skills are not at the desired level. Another result obtained in the study is that there is no significant effect of different variables on scientific process skills and learning styles. In fact, this can be interpreted as that students are prone to solving problems in line with the formal education they receive at school, while trying to find solutions in difficult situations, and that they try to cope with problems by using their own learning style.

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