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Investigation of the Effect of Learning Styles of 7th-Grade Students on Scientific Process Skills

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Abstract

The aim of the study is to examine the relationship between the learning styles of classroom students in the force and energy unit and their scientific process skills. In the study, pre-test and post-test weak experimental design without a control group was used. The research was carried out in 2 different secondary schools in the central district of a metropolitan province. In the study, a total of 59 seventh-grade students were studied. The study lasted 5 weeks. The lessons were planned taking into account the scientific process skill steps. In the study, Kolb's learning styles inventory and scientific process skills test were applied as pre-test and post-test. Arithmetic averages, standard deviations, and percentages were calculated for the analysis of the data, and unrelated t-tests and dependent-tests were performed to determine whether there was a significant difference between the pre-test and post-test results of the learning styles. Analysis of Variance analysis was performed to determine whether there was a difference in the scientific process skills of the learning styles. The obtained data have been analyzed with SPSS 22 packet program. As a result of the research, when the pre-test and post-test results of the students were compared, it was observed that there was an increase in scientific process skills in all learning styles. When the pre-test and post-test averages were examined, the students with the highest average assimilation learning style were the students with the least dissociation. When the pre-test and post-test results of the Scientific Process Skills within the groups were compared, no significant difference was found in the learning styles that separate and absorb, while a significant difference was found in the learning styles that place and change. It was observed that the students had different learning styles, but there was no significant difference in terms of scientific process skills. However, a significant difference was found in classifying, using space/time relations, and hypothesizing scientific process skills.

Keywords: Scientific process skills, science course, learning style

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Introduction

Today, it is important to raise individuals who can keep up with scientific and technological developments. It is necessary to educate future generations as individuals who can not only learn information but also produce and use it. The prepared training programs are structured and constantly updated according to the needs of people, the development and change of technology, today's conditions, and changes in the international scene. The aim of science education in 21st-century education programs is to raise individuals who closely follow these developments in the world, research, question, know the ways to access information and understand that they can solve these problems with this information (Başar, 2021). Individuals raised in this feature understand the events and produce solutions to the local or global problems encountered. It is more important for students to learn the processes of obtaining and applying knowledge rather than memorizing scientific knowledge (concepts, formulas, laws, theories) in science courses, in which they should learn to use Scientific Process Skills (SPSs). Using SPSs effectively for the individual is one of the most important gains. Tan & Temiz (2003) define SPSs as the thinking skills that scientists use to structure information, solve problems, and present results, while Vitti & Torres (2006) say that SPSs occur spontaneously in our minds when science and critical thinking are necessary, and also as skills used to logically divide our own thoughts into steps.

Padilla (1990) divided and categorized SPSs as the Basic SPSs; observing, classifying, predicting, inferring, measuring, and communicating, and as the Advance (Integrated) SPSs, controlling variables; defining operationally, formulating hypotheses, interpreting data, experimenting, and formulating models. American Association for the Advancement of Science (AAAS) has classified the SPSs into 15 activities; observing, measuring, classifying, communicating, predicting, inferring, using numbers, using space/time relationship, questioning, controlling variables, hypothesizing, defining operationally, formulating models, designing experiments, and interpreting data (AAAS, 1993) Over the years, many researchers have used different ways of classifying SPSS or have added some skills. The World Bank and Higher Education Institution of Turkey declared SPSs as Basic SPSs; observing, measuring, classifying, recording data, establishing number and space relations, Causal SPSs; prediction, identifying variables, data interpretation, deduction, and Experimental SPSs; hypothesizing, using data and formulating models, experimenting, changing and controlling variables, deciding, in the Education Development Project Pre-Service Teacher Training (Çepni et al., 1997; Turgut et al., 1997). Turkish Ministry of Education classified SPSs under 3 headings, Planning and Initiation SPSs; observation, classification, inference, estimation, estimation, and determination of variables, Applying SPSs; designing experiments, recognizing experimental materials, collecting data, measuring and recording data, and

Analysis and Inference SPSs; modeling, drawing conclusions and presenting skills, in the 2005 science and technology curriculum (MEB, 2005).

SPSs are recognized as an important tool in many modern science education curricula to structure scientific knowledge and drive conceptual change (Chebii, Wachanga, & Kiboss, 2012). In this context, it is important to emphasize the specified qualities of the methods and techniques to be used in teaching and to make a plan that will ensure the active participation of students in the process (Sevinç, 2021). In addition, it should not be forgotten that educational activities should be carried out taking into account individual differences (Ekici, 2003). One of the most important reasons for individual differences affecting learning in students is the individual's learning styles. While the difference in the socio-cultural life processes of each individual differentiates the development process, his/her mood, the physical and mental structure create a different and unique situation. As a result, it gains a unique character. The most efficient and effective learning style of the individual determines his/her learning style. In this direction, each student should receive education in accordance with the learning style in the process of obtaining information. Many researchers emphasized that teachers should discover the learning styles of students and choose and apply teaching methods in this context. The concept of learning style was first introduced by Rita Dunn in 1960. Some of the learning styles studies can be given as examples; *Isabel Briggs Myers & Katharine Cook Briggs' Type Indicator* including16 distinctive personality types (1942, 1986); *Rita Dunn, & Kenneth J. Dunn Learning Style model* including Environment (sound, light, temperature, seating design), Emotionality (motivation, task persistence, responsibility/conformity, structure), Sociological preferences (learning alone, in pairs, in a small group of peers, as part of a team, with an adult, with variety or routines), Physiological characteristics (perceptual strengths, time of day, need for intake, mobility while learning), Psychological processing inclinations (global/analytical, impulsive/ reflective) (1978, 1993); *Charles S. Claxton &Yvonne Ralston Learning Styles* consist of three dimensions of cognitive styles (field dependence-independence, reflection-impulsivity and perceptive-receptive/intuitive), (1978); *Joseph S. Renzulli & Linda H. Smith*' *Learning Styles* includes Learning, Motivational, Creativity, Artistic Characteristics and Dramatics characteristics (1978); *Jim Keefe Taxonomy* focus on integration by identifying the three major dimensions of brain function: cognitive, affective (personality), and physiological (perceptual) (1979); *Bernice McCarthy 4MAT Learning Style Model* includes Experiencing, Conceptualizing, Applying and Refining types (1980-1987); *Anthony Gregorc model* presented 4 learning styles, Concrete Sequential, Abstract Sequential, Abstract Random and Concrete Random (1984); *Felder & Silverman Learning Style Model* consist of Sensing/Intuitive, Visual/ Verbal, Inductive/Deductive And Active/Reflectivetypes (1988); *David Kolb's Model* includes

Active Experimentation, Reflective Observation, Reflective Conceptualization, Concrete Experience (1984); *Anthony Grasha & Sheryl Reichmann Learning Style* consist of Avoiding, Independent, Collaborative, Competitive And Participant types(1996).

In this study, Kolb's learning style model was used. Kolb explained the learning styles of individuals in cycles. These cycles are classified as active experimentation, reflective observation, abstract conceptualization, concrete experience. The learning paths that symbolize these learning cycles differ from each other. Styles in the learning cycle are as follows.

Accommodator: Tangible life and active life planning are included in learning cycles. Applying decisions, being open to different experiences, being easy to adapt to, having clear vision and not being a passive listener are the main features**.**

Assimilator: Abstract conceptualization and reflective observation are among the learning cycles. Logical thinking is their dominant trait and they focus on ideas while learning. They like to form concepts.

Converger: It is between abstract conceptualization and active life learning styles. Learning by doing is the focus. They manage the process according to the plan in their work. Problem solving, logical thinking, analysis, decision-making and systematic work are the main features. They like to solve problems.

Diverger: Tangible experience and reflective observation are involved in learning styles. They exhibit an impartial approach, monitor the events found, make corrections by making detailed examinations. They rely on their judgment. They approach things cautiously (Mutlu & Aydoğdu, 2003).

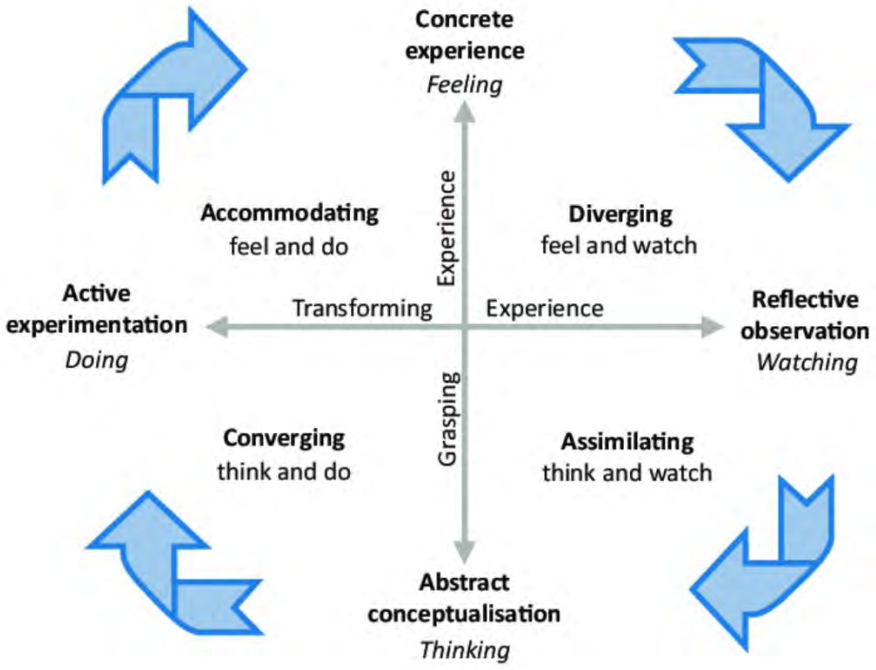

Figure 1. *Kolb's experiential learning model*

Developed countries have made changes in science curricula over the years to raise individuals who can use 21st century skills. In our country, as of 2005-2006, it has switched to a structuralist learning approach. The constructivist learning model states that students can understand the new situations they encounter using their previous experiences and knowledge. According to this model, the individual's knowledge development is evaluated in their own terms. With the information structured in the mind of the individual, students create (Canpolat vd., 2004) their own knowledge. The main purpose of structuring is to provide students with learning tools and materials by allowing them to direct their learning as they want without dictating. It is very important to give them the opportunity to create their own learning environment. In these learning environments, individuals can create their own concepts and participate in the process dynamically.

There are many methods, techniques and approaches in which you create your own concepts for learning; one of them is the Learning Cycle. The Learning Cycle teaching model derives from Piaget's mental functioning theory (Renner & Marek, 1988).The Learning Cycle consists of stages of teaching model Exploration, Term Introduction or Explanation, and Concept Application (Bevevino, Dengel, & Adams,

1999, Lawson, 2000; Türkmen, 2006). This student-centered model is a model that can be applied in the development of SPSs in science education because it is a model that is guided by the teacher and offers opportunities for the student's own experiences.

There are many studies have conducted on learning styles in various dimensions with different methods in the literature examining especially the relationship between students' learning styles and academic achievement (Bilgin & Bahar, 2008; Durdukoca & Arıbaş, 2011; Kaya, Bozaslan & Durdukoca, 2012; Mutlu, 2008; Tatar, Tüysüz & İlhan, 2008). However, the inadequacy of studies investigating the relationship between SPSs and secondary school students with different learning styles is striking. In this study, it was aimed to determine the effect of strength and energy on students with different learning styles in 7th grade secondary school students. 10 basic SPSs, which are Observing, Classifying, Using Space/Time Relationships, Predicting, Inferring, Analyzing the Problem, Hypothesizing, Identifying& Controlling Variables, Experimenting, Interpreting Data, were used.

Objectives of the Study

The researchers aim to accomplish following research objectives in this research study: The following questions were addressed in the study in order to achieve this goal:

1. Is there a significant difference between SPSs pre-test results and post-test results according to Kolb's learning styles?
2. Is there a significant difference between the SPSs of Kolb's learning styles?
3. Is there a significant difference between the SPSs of the students according to Kolb's learning styles?

Method

Research Design

In the research, one group pre-test post-test pre-experimental design was used, which is one of the quantitative research methods. Experimental research patterns are used to measure the cause-effect relationship (Büyüköztürk, 2008). In the one group pre-test post-test model we used for the research, the change is analyzed by applying the independent variables to the group before and after the practice (Cohen & Manion, 2005; Gay & Ariasian, 2000).

Study Group

The study group of the research consists of 59 people consisting of 7th grade students in two different secondary schools in the central district of Izmir in the 2022-2023 academic year. The two schools were chosen because they were students with similar

characteristics and were easily accessible to the researcher. The appropriate sampling method was chosen for the researcher because it prevents the loss of time and money and is easily accessible. According to Kolb's learning style inventory III of the students in the study group, 18 students are classified as Converging, 9 students as Assimilating, 17 students as Diverging, and 15 students as Accommodating.

Data Collection Tools

Kolb's learning styles inventory III, which was translated into Turkish by Gencel (2007), was applied to students to determine the learning styles of the students before the practice started. In order to determine the language validity, the correlation coefficient between the English and Turkish forms of the scale was calculated as 0.77. The reliability coefficients of the Turkish form vary between 0.71 and 0.80. In this study, Kolb's learning styles inventory III reliability coefficient (Cronbach's alpha), which consists of 12 questions, was calculated between 0.70 and 0.78. Students are asked to rank the statements in each question in the inventory, giving 4 to the closest and 1 to the farthest. After that, the scores of four learning models in each of the 12 items are added. Then, reflective observation score is subtracted from the active experimentation score (Active Experimentation-Reflective observation), and then concrete experience score is subtracted from the abstract conceptualization score (Abstract Conceptualization-Concrete Experience). The intersection of the two scores shows which learning style the student has. Before and after the practice, the 27-question SPSs test, developed by Aydoğduet. al. (2012) was applied to the students. Equivalent Science Process Skills test reliability coefficient (Croncbach alpha) was found to be 0.85.

Table 1
Questions Representing SPSs in Scale

Science Process Skills	Scientific Process Skills	Test question items
	Observing	1.2
	Classifying	3.4
Basic Skills	Using Space/Time Relationships	14:27
	Predicting	7
	Inferring	5.6
	Analyzing the Problem	16,22
High-level skills	Hypothesizing	10,11,17,23
	Identifying & Controlling Variables	18,19,20,24,25
	Experimenting	8,12,13,15,21
	Interpreting Data	9.26

(Aydoğdu et al.., 2012)

Applying the Study

In both schools, the lessons were taught with 5 experimental activities on strength and energy based on the Learning Cycle teaching model and active learning activities such as question-answer (Q-A), discussion, demonstration, case study, problem situations, simulation, brainstorming, group discussion. The questions in the experimental activities were arranged to cover the SPSs. The application is planned as 5 weeks and 4 hours a week. Table 2 shows the SPSs targeted to be taught and developed according to the subjects.

Table 2
Applying the Study

Subjects	Exploring	Concept Introduction	Concept Application	SPSs
Mass and Weight	1. Experiment	Based on the experiment, mass and weight definitions are made with the group discussion.	Problem solving	Using space/time relationships, Predicting, Inferring, Analyzing the Problem, Hypothesizing, Identifying and controlling variables, Experimenting, Interpreting data
Kinetic Energy	2. Experiment	Based on the results of the experiment, kinetic energy definition is made with Q-A and discussion.	Problem solving	Using space/time relationships, Predicting, Inferring, Analyzing the Problem, Hypothesizing Identifying and controlling variables, Experimenting, Interpreting data
Pulling& Elasticity Potential Energy	3. Experiment 4. Experiment	Q-A about the experiment, sample videos on the subject	Problem solving	Observing, Classifying, Using space/time relationships, Predicting, Inferring, Analyzing the Problem, Hypothesizing Identifying and controlling variables, Experimenting, Interpreting data
Energy Conversions	Demonstratio, Visuals and Q&A	The simulation is monitored and the definition of energy conversion is made with Q-A	Problem solving	Observing, Classifying, Using space/time relationships, Predicting, Inferring
Energy & Friction	Case study and Problem scenario	Based on the results of experiment, friction force is defined.	5. Experiment & Problem solving	Observing, Classifying, Using space/time relationships, Predicting, Inferring, Analyzing the Problem, Hypothesizing Identifying and controlling variables, Experimenting, Interpreting data

Data Analysis

The related t-test was used to determine whether there was a significant difference between each learning style regarding the SPSs pre-test post-test. Because the "Shapiro Wilks" test was applied to understand whether the results of the scientific process skills test of the students were normally distributed and the result is given in Table 3. As a result of the test, $p>0.05$ value told us that we could use parametric hypothesis tests.

Table 3
Shapiro Wilks Normality test

	Learning Styles	Statistics	*df*	*p*
SPSs Pre-Test	Converging	.904	18	.066
	Assimilating	.915	9	.352
	Diverging	.946	17	.397
	Accommodating	.951	15	.539
SPSs Post-Test	Converging	.929	18	.187
	Assimilating	,944	9	.626
	Diverging	.949	17	.434
	Accommodating	.951	15	.536

Then, ANOVA test was performed to see whether SPSs pre-test results differ according to learning styles. When the difference between the averages was determined as a result of the analysis of variance, LSD test, one of the Post Hoc Multiple Comparisons tests, was applied to determine the source of the difference. The obtained data have been analyzed with SPSS 22 packet program.

Findings

It is seen that there is a significant difference between the SPSs pre-test and post-test results of all students participating in the study at the end of the application.

Table 4
Students' SPSs pre-test post-test related t-test Results

	N	Mean	Standard deviation	*t*	*p*
Pre-test	59	12.24	3.53	4/23	.00
Post-test	59	14.25	4.94		

When scientific process skills are analyzed according to each learning style, the situation changes. When Table 5 was examined, although there was an increase in the SPSs mean grades of all groups, a significant difference was found in the SPSs pre-test post-test related t-test results of students with only the Diverging style, $t(16) = -3,360$,

p>.004. In addition, it is seen that there is a significant difference even if there is a small difference in the students with the Accommodating style *t*(16) = -2,167, *p*>.048,Converging, (*t*(17) = -1,160, *p*<.225) and Assimilating (*t*(8) = -1.921, *p*<.091), there was no statistically significant difference in the related t-test results of students with learning styles.

Table 5
Related T-Test Results of Students with Different Learning Styles

	N	Pre-test mean	Standard deviation	Post-test mean	Standard deviation	*t*	*p*
Diverging	17	12.88	3.295	15.294	4.4549	-3.360	.004*
Accommodating	15	13.13	2.031	15.200	3.7834	-2.167	.048*
Converging	18	10.56	2.619	11.722	5.4536	-1.160	.225
Assimilating	9	12 89	4.6174	15.78	5.286	-1.921	.091

*p<0.005

To examine the SPSs, the associated t-test was applied for the SPSs results of students in all learning styles. The related t-test results of the SPSs of the students in the Diverging style are given in Table 6. *Observing*, *t*(16) = -2.400,*p < .004*, *analyzing the problem*, *t*(16) = -2.384, *p > .004*, *experimenting t*(16) =-2.991, *p > .004* and *interpreting data t* (16) = -2.219, *p > .004*of SPSs showed significant differences. There was no significant difference in the steps of classifying, using space/time relationships, predicting, inferring, hypothesizing, identifying and controlling variables.

Table 6
Relationship T-Test Results of SPSs in the Diverging Learning Style

	Average	Standard deviation	t	df	p
Observing	.17647	.30317	2 400	16	.029*
Classifying	.08824	.26430	1 376	16	.188
Using space/time relationships	.17647	.35094	-2.073	16	.055
Predicting	.17647	.52859	1 376	16	.188
Inferring	00000	.43301	.000	16	1.000
Analyzing the Problem	.20588	.35614	-2.384	16	.030*
Hypothesizing	.05882	.28681	-.0.846	16	.410
Identifying & Controlling Variables	.09412	26568	-1.461	16	.163
Experimenting	.18824	.25952	-2.991	16	.009*
Interpreting data	.11765	.21862	-2,219	16	.041

*p<0.005

The related t-test results of the SPSs of the students in the Accommodating style are given in Table 7. A significant difference was found in the *experimenting*, $t(14) = -2.347$, $p > .034$, *analyzing the problem,* $t(14) = -2.358$, $p > .033$, *inferring*, t (14) = -3.162, p > .007of SPSs. There was no significant difference in the interpreting, classifying, using space/time relationships, predicting, hypothesizing, identifying & controlling variables, and observing of SPSs.

Table 7
Correlated T-Test Results of SPSs in the Accommodating Learning Style

	Average	Standard deviation	t	df	p
Observation	.23333	.49522	-1.825	14	.089
Classifying	.03333	.22887	.564	14	.582
Using space/time relationships	.26,667	.49522	-2.086	14	.056
Predicting	.00000	.53452	.000	14	1.000
Inferring	.33333	.40825	-3.162	14	.007*
Analyzing the Problem	.30000	.49281	-2.358	14	.033*
Hypothesizing	.13333	.24761	-2.086	14	.056
Identifying & Controlling Variables	.08000	.30984	1 000	14	.334
Experimenting	.16000	.26403	-2.347	14	.034*
Interpreting data	.03333	.22887	-.564	14	.582

*p<0.005

The relationship t-test results of the SPSs of the students in the Converging learning style are given in Table 8. When the table is examined, a significant difference was found in *analyzing the problem*, $t(17) = -3.289$, $p > .004$ and *experimenting* $t(17) = -2.236$, $p > .039$ of SPSs. No significant difference was found in the observing, classifying, using space/time relationships, predicting, inferring, hypothesizing, identifying & controlling variables, and interpreting data of SPSs (Table 8).

Table 8
Relationship T-Test Results of SPSs in the Converging Learning Style

	Average	Standard deviation	t	df	p
Observation	-.16667	.42008	-1.683	17	.111
Classifying	-..05556	.33820	-.697	17	.495
Using space/time relationships	-.13889	.44740	-1.317	17	.205
Predicting	-.11111	.58298	-.809	17	.430
Inferring	-.02778	.40118	-.294	17	.772
Analyzing the Problem	-.19444	.25082	-3.289	17	.004*
Hypothesizing	-..05556	.29149	-.809	17	.430
Identifying & Controlling Variables	-..05556	.13382	1 ,761	17	.096
Experimenting	-.16667	.31623	-2.236	17	.039*
Interpreting data	-..05556	.29149	-.809	17	.430

*p<0.005

The relationship t-test results of the SPSs of the students in the Assimilating learning style are given in Table 9. When the table 9 was examined, a significant difference was found only in the *predicting* $t(8) = -2.530$, $p > .035$ of SPSs.

Table 9
Correlated T-Test Results of SPSs in the Assimilating Learning Style

	Average	Standard deviation	t	df	p
Observing	-.278	.363	-2.294	8	.051
Classifying	-.056	.464	-.359	8	.729
Using Space/Time Relationships	-.222	.363	-1.835	8	.104
Predicting	-.444	.527	-2.530	8	.035*
Inferring	-.111	.333	-1.000	8	.347
Analyzing the Problem	-.278	.507	-1.644	8	.139
Hypothesizing	-.250	331	-2.268	8	.053
Identifying & Controlling Variables	-.133	.300	-1.333	8	.219
Experimenting	-.200	.316	-1.897	8	.094
Interpreting Data	-.111	.333	-1.000	8	.347

*p<0.005

ANOVA was applied to compare the post-test results of the SPSs in terms of 4 learning styles. The ANOVA analysis results, which give the significance results of the SPSs, are given in Table 10. The significant difference were found only in *the classifying, using space/time relationships*, and *hypothesizing* of SPSs, $f(3,55)$, $p < .05$.

Table 10
ANAVO Post-Test Results of SPSs by Learning Styles

		Sum of squares	*df*	Average of Squares	*f*	*p*
Observing	Intergroup	.124	3	.041	.363	.780
	Intragroup	6.282	55	.114		
	Total	6.407	58			
Classifying	Intergroup	1.093	3	.364	3.562	.020*
	Intragroup	5,627	55	.102		
	Total	6,720	58			
Using space/time relationships	Intergroup	1,173	3	391	3.074	.035*
	Intragroup	6.996	55	.127		
	Total	8.169	58			
Predicting	Intergroup	1,310	3	.437	2.225	.096
	Intragroup	10.792	55	196		
	Total	12.102	58			
Inferring	Intergroup	.577	3	.192	1,481	.230
	Intragroup	7.135	55	.130		
	Total	7.712	58			

Analyzing the	Intergroup	.797	3	.266	2.172	.102
Problem	Intragroup	6.728	55	.122		
	Total	7.525	58			
Hypothesizing	Intergroup	1 229	3	410	3.560	.020*
	Intragroup	6.327	55	.115		
	Total	7,555	58			
Identifying &	Intergroup	.124	3	.041	.629	.599
Controlling	Intragroup	3.605	55	,066		
Variables	Total	3.729	58			
Experimenting	Intergroup	.616	3	.205	2,554	.065
	Intragroup	4.425	55	0.080		
	Total	5.041	58			
Interpreting data	Intergroup	.295	3	.098	.703	.555
	Intragroup	7.705	55	.140		
	Total	8,000	58			

$*p<0.005$

LSD results from post-hoc tests were examined to see which learning styles differed significantly. In the classifying of SPSs, a significant difference was found between the students with the learning style that Converging and Diverging, p>0.03; between the students with the learning style that Converging and Accommodating, *p*>0.023. In the using space/time relationship of SPSs, a significant difference was found between students with a Converging and Assimilating learning style, p>0.016; between students with a Converging and Accommodating learning style, *p*>0.014. In the Hypothesizing of SPSs, a significant difference was found between the students with Converging and Assimilating learning style, p>0.005; between the Converging and Diverging, p>0.029; and between the Converging and Accommodating, p>0.024 (Table 11).

Table 11
LSD Analysis Results of SPSs in the Learning Styles

SPSs	(I) Learning Style	(J) Learning Style	Mean difference (I-J)	Standard Deviation	p
Classifying	Converging	Assimilating	-.25000	.13058	.061
		Diverging	-.33170*	.10818	.003*
		Accommodating	-.26111*	.11182	.023*
	Assimilating	Converging	.25000	.13058	.061
		Diverging	-.08170	.13185	.538
		Accommodating	-.01111	.13486	.935
	Diverging	Converging	.33170*	.10818	.003*
		Assimilating	.08170	.13185	.538

		Accommodating	.07059	.11331	.536
	Accommodating	Converging	.26111*	.11182	.023*
		Assimilating	.01111	.13486	.935
		Diverging	-.07059	.11331	.536
Using	Converging	Assimilating	-.36111*	.14560	.016*
Space/Time		Diverging	-.23039	.12062	.061
Relationships		Accommodating	-.31667*	.12469	.014*
	Assimilating	Converging	.36111*	.14560	.016*
		Diverging	.13072	.14703	.378
		Accommodating	.04444	.15038	.769
	Diverging	Converging	.23039	.12062	.061
		Assimilating	-.13072	.14703	.378
		Accommodating	-.08627	.12634	.498
	Accommodating	Converging	.31667*	.12469	.014*
		Assimilating	-.04444	.15038	.769
		Diverging	.08627	.12634	.498
Hypothesizing	Converging	Assimilating	-.40278*	.13846	.005*
		Diverging	-.25735*	.11470	.029*
		Accommodating	-.27500*	.11857	.024*
	Assimilating	Converging	.40278*	.13846	.005*
		Diverging	.14542	.13981	.303
		Accommodating	.12778	.14300	.375
	Diverging	Converging	.25735*	.11470	.029*
		Assimilating	-.14542	.13981	.303
		Accommodating	-.01765	.12015	.884
	Accommodating	Converging	.27500*	.11857	.024*
		Assimilating	-.12778	.14300	.375
		Diverging	.01765	.12015	.884

*$p < .005$

Discussion

When we examined the SPSs pre-test post-test results of the students grouped according to their learning styles, there was a significant difference in the students in the Accommodating and Diverging learning styles; while no significant difference was found in the students in the Assimilating and Converging learning styles. Moreover, students with a learning style that Accommodating and Diverging are sufficient to develop the SPSs of experimental activities and applied active learning techniques. Students with a Diverging learning style have the opportunity to learn through teacher descriptions and visual presentations by discussing case studies. They like individual activities. It can be said that case studies, experimental activities, simulations and the teacher's explanations affect the increase in SPSs for students with this learning style.

Students with Accommodating learning style like to actively participate in the lesson, be open to new ideas, research and explore. They support their learning by listening and sharing the discussions they have with their peers to solve the problem. It can be said that question and answer activities related to classroom discussion, problem situation and experimental results contribute positively to SPSs.

Although the SPSs post-test results of the students who Assimilating and Converging increased, no statistical difference was found. It was observed that the activities applied were not effective in improving the SPSs of the students in this learning style. The students who Assimilating learning style may have liked the learning environments such as teacher expression, monitoring and concept modeling. On the other hand, the lack of activities supported by group work and active life in Converging students may be the reason why their SPSs do not develop adequately. This shows us that we need to do more in-depth research to improve the SPSs of students who Assimilating and Converging learning styles. The activities will be more useful in developing these skills in an easier and permanent way according to the characteristics of the students in these learning styles.

When examined in terms of SPSs separately, a significant difference was found in the observing, analyzing the problem, experimenting and interpretingdata of SPSs in the Diverging Learning Style. The fact that students in the Diverging learning style are dominant in their ability to interpret observations and thoughts through concrete events may be the reason for the development in the SPSs mentioned above. There was no significant difference in the skills of classifying, using space/time relationships, predicting, inferring, hypothesizing, identifying & controlling variables. We see that the learning techniques and activities we apply in line with the lesson plan we have prepared for all SPSs are not sufficient for the development of them.

The reason why there are significant differences in the SPSs of experimenting, analyzing the problem, and inferring of the students in the Accommodating learning style may be effective, because they have the ability to produce solutions to problem situations by trial and error and to interpret the results of these. No significant difference was found in the SPSs of interpreting data, classifying, using space/time relationships, predicting, hypothesizing, identifying& controlling variables, and observing.

In the Assimilating learning style, there was a significant difference only in predicting; in the Converging learning style, there was a significant difference in analyzing the problem and experimenting of SPSs. When the characteristics of the students with a Converging learning style are examined, it is significant that there is an opposite result while waiting for the SPSs development to be high in the applied lesson plan. The difference in SPSs shows that experimental activities and problem situations

are effective. The weaknesses of the Converging students are that they make decisions quickly without testing their thoughts, that they focus on the wrong problem and produce solutions, and that they have disorganized thinking structures (Mutlu & Aydoğdu, 2003). Therefore, only the activities in which they will take an active role in the lessons may not have been enough.

When we examine whether there is a significant difference between the SPSs of students with different learning styles, it has been seen that although there is no significant difference, it has improved in a positive way. The reason for this is that the learning environment was enriched with various activities.On the other hand, when SPS sare examined separately, there was a significant difference between the averages of their classifying, using space/time relationships, and hypothesizing skills.

In the classifying skills, students with a learning style that Accommodating and Diverging have higher academic success than students who Converging learning style. The most important feature of individuals with a Divergent and Accommodating learning style is that they can categorize the connections between them in a meaningful way by examining different aspects of events. Therefore, they were more successful in classifying skill. When the using space/time relationships skill is examined, students with a learning style that Assimilating and Accommodating learning styles have higher academic success than students with a learning style that Converging learning styles. The reason why individuals with an Assimilating learning style are successful in this skill may have been that they were successful in integrating comprehensive and broad knowledge within the framework of logic. Individuals with Accommodating learning style may be more successful in learning environments where they have active role. In the hypothesizing skill, it was concluded that students with a Converging learning style have higher scores than students with a learning style that Assimilating, Accommodating, and Diverging learning style. Individuals with Converging learning style are dominant in characteristics such as making judgments, analyzing thoughts correctly, making logical analysis, and problem-solving skills, which may be the reason for their success in this skill.

Conclusion

The effect of middle school 7th grade students' learning styles on scientific process skills was analyzed by teaching the force and energy unit for 5 weeks. This study showed that it must be necessary to take into account the individual differences of students to create educational environments and plan teaching in this context (Ataseven & Oğuz, 2015; Erdem & Kaf, 2023). In the process, it was examined whether there was a significant difference in the learning styles of the SPSs pre-test and post-test results. As a result, it will guide researchers about the effect of learning styles on scientific process skills. This

research shows that the methods and techniques that support individual differences were not at the same level for our students, whom we classified according to Kolb learning style While choosing the learning techniques and activities for lesson plan that will improve students' SPSs, the lesson plan should be shaped by evaluating the characteristics of students' learning style. Learning techniques and activities should not be selected and implemented just to develop SPSs. It is one of the important inferences of our study that an application should be made considering the characteristics of students' learning styles from this point of view. The examinations in the every SPSs in each learning style also support this inference.

Recommendation

- In this research study, the researcher focused only on a limited number of 7^{th} grade secondary school students. It will be beneficial that future studies would focus on higher number of 7^{th} grade students or 5^{th} 6^{th} 8^{th} grade students and also on the elementary level as well as high school level.
- This research has done only one science subject, force and energy, future research can be done for different science subjects and even for courses in different disciplines, such as social science, earth science, math etc...
- In this research, the intervention was carried out based on the Learning Cycle teaching model, future studies can be carried out by choosing different student-centered models, such as 5E, 7E, REACT, ASSURE, etc...

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