



Factors Affecting the Development of Science Process Skills in the Students of the Middle School

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Abstract

The term “science process skills” (SPS) is used to describe skills that facilitate learning, help learners gain the ability to do research and allow them to be active in the learning environment, and increase retention of knowledge. One of the goals of science education is to develop these science process skills.

With the aim of exploring the factors affecting the development of science process skills, this research was carried out with a total number of 147 students studying in a middle school.

Such science process skills of students as observation, measurement-classification, time-space relationships, predicting (forecasting), controlling variables, making hypothesis, experimenting, control-decision making, interpreting data and making inferences are discussed in the current paper.

Through observations which were made by teachers during the activities carried out in the lessons, each student was given scores ranging from 1 to 5 points depending on their science process skills and the total SPS score was obtained for each student by summing these points up.

The relationships between the students’ SPS levels and such variables as their gender, pre-school education, parents’ education levels, family background, and also the ages of the mother and the father were examined. Moreover, the impacts of students’ SPS levels on their success in the lessons were identified. The data obtained from the study were statistically analyzed through a software package called SPSS 15.

The findings of the data analysis showed that gender, the mother’s education level, family background, ages of the mother and the father does not have any significant effect on the SPS ($p > 0.05$). It has been found out that preschool education and fathers’ higher education levels increase the students’ levels of SPS of ($p < 0.05$). It has been also identified that the students with high levels of SPS get higher grades from the courses ($p < 0.05$).

This study showed that fathers’ education level has an effect on the students’ development of SPS and thus mothers’ education level may also be influential. In our country, the 12-year compulsory education should be taken into account for raising future generations with advanced science process skills

The results obtained through this study show that students with developed SPS are more successful in their classes. When this evidence is taken into consideration, it has been concluded that it will be useful to take necessary steps in order to develop and adapt instructional activities or tasks starting from students’ pre-school education, which will contribute to improve their SPS levels.

Furthermore, the study suggests that some in-service training activities regarding SPS might be organized for teachers as they are influential in the activities which they will conduct, and materials or resources which they will choose for their classes.

1. Introduction

Education has never lost its importance since the existence of mankind and will continue it increasingly in the future as well. Today’s world is developing rapidly in terms of technology and



science. Knowledge, attitudes and skills that individuals get in education process should help them make sense of these improvements. For this reason, individuals should be raised as good science literates in the education process.

Science process skills are identified as the skills which facilitate learning, help learners have research skills, make students active in the learning environment and increase retention of knowledge [1]. One of the goals of science education is to develop science process skills [2].

Science and technology literacy is defined as a compound of skills, attitudes, values, understanding and knowledge related with science which is necessary for individuals to develop their investigating and questioning, critical thinking, problem solving and decision making skills, and to be lifelong learners and maintain their curiosity about their environment and the world. One of the dimensions of science and technology literacy is Science Process Skills [3].

At the core of doing scientific researches lies the requirement of science process skills. Scientific thinking and research is not specific only to scientists. On the contrary, these skills include the abilities for each individual to be science literate and to be able to use in each phase of daily life in order to increase the quality and standard of life [4].

It is only possible to make daily life scientific by putting scientific thought into practice. In order to achieve this, it is necessary to help students acquire science process skills, enable them to see how scientific knowledge comes up, and adjust their thoughts, attitudes and understanding accordingly [5]. This study examined the variables that affect levels of students' Science Process Skills (SPS) and the effects of science process skills on their end-of-year average scores of their lessons. These factors are; gender, pre-school education, education level of mother, education level of father, family background, mother's age, father's age and average grades of students which show levels of their achievement.

2. Method

2.1. Sample in the study

The study sample is composed of 147 students studying at the 6th, 7th and 8th grades in Ortahisar, Fatih and Mazıköyü Secondary Schools in Ürgüp, Nevşehir. The distribution of students in terms of their grade and gender is presented in Table 1.

Table 1: Distribution of students in terms of their grade and gender

Gender	Grade			Total
	6th grade	7th grade	8th grade	
Girls	24	21	26	71
Boys	24	26	26	76
Total	48	47	52	147

2.2. Data collection tool

As a data collection tool, a rubric was adapted from a rating scale of science process skills which was used in a study conducted with 7th grade students in 2007 [6].

As far as the relevant literature was reviewed, it was seen that science process skills were listed with different names [1, 7, 8, 9, 10, 11, 12]. Science process skills concerned in this study are: observation, measurement-classification, time-space relationships, predicting (forecasting), controlling variables, making hypothesis, experimenting, control-decision making, interpreting data and making inferences.

In this study, based on the observations during the activities of the unit titled "Electricity in our lives" with 6th and 7th grade students, and those of the unit titled "Sound" with 8th grade students, each student was given scores ranging from 1 to 5 points for their science process skills by the same teacher and the total SPS score was obtained for each student by summing these points up.



2.3. Data Analysis

With these SPS levels gathered from observations, the relationships between gender, pre-school education, parents' education levels, family background, the ages of parents and average scores of lessons were examined statistically. The data gathered from the research were analysed through SPSS 10 package software. In data analysis, SPS levels were tested by using t-test and analysis of variance at a level of $p < 0,05$.

3. Findings

In Table 2, the relationship between scores of students' science process skills and their gender was given. It can be understood from Table 2 that there is not a significant relationship between SPS levels and gender ($P > 0,05$). However, SPS levels of girls are statistically higher than boys.

Table 2: Effect of gender on students' science process skills

		N	Mean	Sd	P
SPS Level	Girls	71	34,00	± 1,24	0,07
	Boys	76	30,95	± 1,19	
	Total	147	32,42	± 0,86	

However, it can be seen that SPS levels of students who received preschool education are significantly higher than those who did not receive it ($P < 0,05$) (Table 3). This finding shows us that there is a significant relationship between SPS level and pre-school education. SPS levels of students who received pre-school education are higher.

Table 3: Effect of pre-school education on students' science process skills

		N	Mean	Sd	P
SPS Level	Those who had preschool education	55	35,40	± 1,27	0,007
	Those who didn't have preschool education	92	30,64	± 1,11	
	Total	147	32,42	± 0,86	

As seen in Table 4, mothers' education level does not have a significant effect on SPS scores of students ($P > 0,05$), but fathers' education level, on the other hand, increases SPS scores significantly (Table 5).

Table 4: Effect of mothers' education level on students' science process skills

	Mother's education level	N	Mean	Sd	P
SPS Level	Primary school graduate	105	31,50	± 1,02	0,211
	Secondary school graduate	23	33,91	± 2,05	
	High school graduate	19	35,68	± 2,44	
	Total	147	32,42	± 0,86	



Table 5: Effect of father's education level on students' science process skills

Father's education level		N	Mean	Sd	P
SPS Level	Primary school graduate	74	30,54	± 1,22 ^b	0,031
	Secondary school graduate	35	32,51	± 1,52 ^{ab}	
	High school graduate	38	36,00	± 1,79 ^a	
	Total	147	32,42	± 0,86	

It has been pointed out that students' living in a core family (mother, father, siblings) or a large family (mother, father, siblings, grandfather, grandmother and cousins) does not have a significantly effect on their SPS levels ($P > 0,05$) (Table 6).

Table 6: Effect of family background on students' science process skills

Family background		N	Mean	Sd	P
SPS Level	Core family	91	33,74	± 1,13	0,052
	Large family	56	30,29	± 1,29	
	Total	147	32,42	± 0,86	

It has been found out that ages of the mother (Table 7) and the father (Table 8) do not have a significant effect on the SPS levels of the students ($P > 0,05$).

Table 7: Effect of mother's age on students' science process skills

Mother's age		N	Mean	Sd	P
SPS Level	35 and below	76	33,38	± 1,19	0,099
	36 - 40	32	29,31	± 1,68	
	41 - 45	17	36,18	± 2,65	
	46 and over	22	30,73	± 2,32	
	Total	147	32,42	± 0,86	

Table 8: Effect of father's age on students' science process skills

Father's age		N	Mean	Sd	P
SPS Level	35 and below	17	29,82	± 2,74	0,700
	36 - 40	67	32,91	± 1,25	
	41 - 45	31	31,97	± 1,82	
	46 and over	32	33,22	± 1,94	
	Total	147	32,42	± 0,86	

It can be seen from Table 9 that as students' SPS scores go up, their school achievement also rises significantly ($P < 0,05$).



Table 9: Effect of students' SPS levels on their school achievement

		Levels of School Achievement			
		N	Mean	Sd	P
SPS Level	19,9 and below	17	56,46	± 1,69 ^d	0,000
	20,0-29,9	55	63,99	± 1,08 ^c	
	30,0-39,9	36	71,76	± 1,69 ^b	
	40,0 and over	39	85,04	± 1,06 ^a	
	Total	147	70,61	± 1,05	

It is seen in Table 9 that students' school success averages rise in a parallel with the rising of their SPS levels.

4. Discussion

In the current paper, the variables that affect students' science process skill (SPS) levels (gender, pre-school education, parents' education levels, family background, and the ages of parents) and their effects of SPS on their end-year average of lessons were examined.

In the statistical analysis, it was seen that there is not a significant relationship between students' SPS levels and gender. It was pointed out that there is not a meaningful relationship between SPS levels and gender according to the studies which were done among 1st year students in a high school [13], seventh grade students [14], fifth grade students [15], 1st year students in vocational high schools [16] and secondary school students [17].

Although there is not a statistical difference, the average SPS score of girls (34.00) is mathematically higher than that of boys (30.85). In some relevant studies [15, 16, 17], it was found out that girls have higher averages of SPS scores than boys do.

SPS scores of girls are generally higher than boys. Evidence for this situation in primary education is provided by the fact that the number of girl students is higher than that of boy students in high schools, which accept students through exams (Science High School, Social Sciences High School, Anatolian Teachers Training High School, Anatolian High School) [18].

In this study, a significant relationship ($P < 0,05$) between SPS scores of students and receiving pre-school education was found out (Table 3). SPS scores of students who received pre-school education are higher. In a relevant study conducted with the students of 9, 10 and 11 grades, it has been seen that SPS scores of students who received pre-school education are higher than those who did not have pre-school education [19].

Even though SPS scores of students whose mothers are high school graduates are higher than those of students whose mothers are either a primary or secondary school graduate, it was seen that education levels of mothers do not have a statistically significant effect ($P > 0,05$) (Table 4). A significant relationship was seen between mothers' education level and SPS in previous studies carried out with secondary school students [14, 17]. The results of these studies show that the SPS levels of students whose mothers received university, vocational school or high school education are higher than those of the students whose mothers are primary school graduate.

As seen in Table 5, father's education level has a significant effect on the SPS scores of the students ($P < 0,05$). The highest average scores of SPS was obtained from the students whose fathers are high school graduates, and it was revealed that there was a difference between this highest score and the lowest average score of SPS of those whose fathers are primary school graduate ($P < 0,05$). Some similarities were seen between the average SPS scores of students whose fathers are secondary school graduates and those of the students whose fathers are high school and primary school



graduates ($P>0,05$). In some previous studies conducted with secondary school students on the relationship between level of father's education and SPS scores of students [14, 17], it was seen that the students whose fathers are university, vocational school or high school education graduate have higher SPS scores than others whose fathers are primary school graduate.

It was determined that students' living in a core family (mother, father, siblings) or a large family (mother, father, siblings, grandfather, grandmother and cousins) doesn't significantly affect their SPS levels ($P>0,05$). However, it was seen that the average SPS scores of students who were raised in a core family is relatively higher. In a study carried out with secondary school students, it was found out that the number of family members does not affect the SPS scores of the students [17].

It has been found out that ages of the mother and the father do not have a significant relationship with the SPS scores of the students ($P>0,05$).

It was identified that there is a significant relationship between students' SPS scores and the averages of their course grades (Table 9). As the SPS scores decrease, their averages significantly go down accordingly ($P<0,05$).

5. Conclusion

In this present paper, the aim has been to identify the factors affecting secondary school students' development of Science Process Skills. With this aim, the relationships between the students' SPS scores and their gender, pre-school education, education levels of mothers and fathers, family background, ages of mother and father and the averages of students' course grades have been examined. It has been revealed that among these factors, pre-school education and father's education level have positive effects on SPS scores. Also, it has been found out that students with higher SPS levels are more successful than the others, taking into account the fact that the mean of the grades they got from their lessons was higher.

Pre-school education improves students' science process skills. It is recommended to take necessary actions and include at least one year pre-school education in compulsory education in our country in order to reach a rate of 100% of students having pre-school education, which was 65,69 % at the end of 2011-2012 education period [18].

This study has shown that father's education level is influential in students' SPS development, and mother's education level might have an effect as well. The fact that high school education in our country has become compulsory since 2013 should be taken into consideration for raising future generations with advanced science process skills.

The results obtained through this study show that students with developed SPS are more successful in their classes. In line with this finding, instructional activities starting from pre-school education should be examined by a committee of experts in order to contribute to develop SPS of students. Activities are suggested to be planned in a way which will cover all science process skills mentioned earlier. Furthermore, the study suggests that some in-service training activities regarding SPS might be organized for teachers as they are influential in the activities which they will conduct, and materials or resources which they will choose for their classes.

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