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EXAMINATION OF STUDENTS' AND THEIR PARENTS' EXPERIENCES OF OUT-OF-SCHOOL SCIENCE EXPERIMENTATION WITHIN THE CONTEXT OF PARENTS' ROLES

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Abstract: The aim of the study was to examine parents' and their children's experiences of science experimentation in terms of parents' roles, science process skills assessed during the experiment and academic successes regarding science lessons. Realization of science activities by students and their parents is at the centre of this study. That is why its study group was constituted from 13 junior high school students and their parents who became participants on voluntary basis. Various data collecting tools such as questionnaire forms, observation forms and video records were used in order to obtain data diversity in this study. Parents participating in this study were mainly assumed three roles as assistant, learner and mentor during the science experimentation process. The most frequent role exhibited by participating parents was assistant role with frequency of five. Learner and mentor roles exhibited by parents had equal frequency of three. Co-participant and observer roles were exhibited only by 1 parent each. The mentor parents in the study knew or estimated how to conduct the experiment but they did not tell or explain how to do the experiment directly to the students. Instead, mentor parents guided the students positively to find out how to conduct the experiment. The co-participant parent studied just like a student during the experimentation process. It has been found out that parents' respective roles might be related to their educational backgrounds. It has also been confirmed that observer, learner and assistant parents were primary, secondary or high school graduates; there was only one assistant parent who had an associate degree.

Key words: parents' role, science experiments, science process skills

1. Introduction

The importance of putting knowledge into practice is the most sensitive point of science education studies. That is why issues like individuals associating science with daily life, earning scientific literacy and improving their science process skills are among the most fundamental aims of education programs. In studies testing scientific literacy (PISA), the level of scientific literacy in Turkey is below average among OECD members and ranks extremely low (Ministry of Education [ME], 2016). In PISA 2015, scientific literacy is defined as "the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen" and three competencies are emphasized for scientific literacy (ME, 2016). The first of these is the competency to explain phenomena scientifically, which requires efficiencies such as recalling and applying scientific knowledge, making appropriate predictions and offering hypotheses. The second is defined as to evaluate and planned scientific research, which involves identifying a question in a given scientific study, distinguishing questions that are possible to investigate scientifically and proposing ways to explore a given scientific question. The third and final competency is to interpret evidence and data scientifically, which requires analyzing data set and drawing appropriate conclusions, besides identifying evidence and arguments in science-related texts. A scientifically literate individual should have the capacity to seek and find answers to daily life-related questions and identify scientific foundations in these questions, access sources to create scientific knowledge and know about and use scientific method (NRC, 1996). This requires underlining the capacity to develop an approach related to scientific method, rather than recalling knowledge, regarding science classes at schools.

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In science education programs in Turkey, developing scientific literacy is regarded as the vision of these programs. The development of scientific process skills and 21st century skills are important outcomes of the program. But the table in question in PISA reports shows that other variables outside education programs are important in developing scientific literacy as well. Of course, many variables like the efficiency of teachers, states of learning environments and understanding the concept of assessment and evaluation can be regarded as the reasons for this. But another critical variable that should be considered is extramural activities, in which children can identify science they have learned at school and have the chance to practice them extramurally.

Learning activities must inarguably last lifelong. As Tuttle (2017) points out, science education is generally considered as a school-related attempt. However, people spend only 5% of their lives at school, and less than that is spared for science education. The majority of time out of school is generally spent with parents. Therefore, for children to be successful and interested in their science lessons, it is acknowledged to be highly important that parents should create environments that encourage children to engage in scientific dialogues and obtain scientific knowledge in places like museums and zoos (Falk & Dierking, 2010; Ghate, 2016; Ho, 2010; Tenenbaum & Callanan, 2008; Tuttle et al., 2017; Vedder-Weiss & Fortus, 2013; Yanowitz & Hans-Vaughn, 2016). Falk & Dierking (2010) point out that out of the school science education environments like science centers, zoos and planetariums will provide opportunities for families to motivate their children to learn more about science and create occasions to learn about science together. Tenenbaum and Callanan (2008) argue that daily life dialogues between parents and children can support children to understand science. In their longitudinal study, Alexander, Johnson and Kelly (2011) have revealed that science-related interactions and dialogues of parents with their children affect the development of children's fields of interest. Many researchers emphasize that parent participation supports cildren to be successful academically (Bhanot and Jovanovich, 2009; Cheung and Pomerantz, 2012; Fan and Chen, 2001; Fan and Williams, 2010; Lee and Shute, 2010; Pomerantz, Cheung and Qin, 2012; Vedder-Weiss and Fortus, 2013; Yanowitz and Hans-Vaughn, 2016). It is suggested that the development of children's fields of interest in science education is largely dependent on the ability of a parent to correctly answer science-related questions at home. Nevertheless, more research is needed to examine larger connections of various family support forms for science education to the interest in pedagogy and self-sufficiency.

Sha, Schunn, Bathgate and Eliyahu (2016) point out the importance of research with practical studies on what kind of roles parents should play in extramural learning environments in order to support their children as best as they can. Alexander et al. (2012) propose that the relationship between parents' roles and children's interest in science should be examined in order to support science learning. Parents are supposed to maintain an investigating attitude along with their children in order for them to learn about science or gain positive scientific experiences (Allen and Gutwill, 2009; Gaskins, 2008; Kaya and Lundeen, 2010). Tuttle et al. (2017) have found out that parents interact with their children more in open-ended activities than in close-ended ones. Researchers point out that cooperation between parents and children for the same purposes will help create positive scientific experiences and put forward unique outputs. On the other hand, various studies show that parent participation does not always increase academic success especially in the case of teenagers (Pomerantz, Moorman and Litwack, 2007; Ho, 2003 a, b). In this context, it becomes highly important to investigate what kinds of parent roles provide the greatest benefit (Tuttle et al., 2017).

Within this conceptual framework in the body of literature, an activity, in which parents and children could earn experiences of extramural science experimentation, was designed for them in this study. Aim of the study was to examine parents' and their children's experiences of science experimentation in terms of parents' roles, science process skills assessed during the experiment and academic successes regarding science lessons.

2. Methodology

In this study conducted by qualitative research methodology. Qualitative methodology makes it possible to examine open-ended problems through data too deep and too substantial to be obtained

with quantitative methods. The research design was conducted in holistic single case study model (Yin, 2009). Case study is used in research focused in detail on the evaluation of a program or the in-depth look at an incident (Marshall and Rossman, 2006). The holistic design is advantageous when no logical subunits can be identified or when the relevant theory underlying the case study is itself of a holistic nature (Yin, 2009). Related sections are explained in detail presented in the following headings.

2.1. Study group

Realization of science activities by students and their parents is at the center of this study. That is why its study group was constituted from 13 elementary school students and their parents who became participants on voluntary basis. Demographic features of the participants are shown in Table 1.

Table 1. *Demographic Features of the Participants*

Students			Parents	
Nick	**Gender**	**Class level**	**Relationship**	**College Degree**
S1	Male	8	Mother	Primary school
S2	Female	8	Mother	Primary school
S3	Male	6	Mother	Junior college
S4	Female	7	Father	Master degree
S5	Female	5	Father	Junior college
S6	Male	5	Mother	High school
S7	Female	5	Father	High school
S8	Female	5	Father	Elementary school
S9	Female	5	Father	Elementary school
S10	Female	5	Father	Graduate-master degree
S11	Female	5	Father	Primary school
S12	Female	8	Father	Primary school
S13	Male	7	Mother	Primary school

As presented in the Table 1, 9 of the students are female and 4 are male. Students are enrolled in fifth to eighth grade. 5 of the parents are mothers and 8 are fathers.

2.2. Context

Within the scope of the study, an environment was created in which children and their parents could conduct a scientific activity. Students and their parents were invited to a school and activity tools were readily given to them in accordance with grade levels and achievements of the students. These activity tools allowed the students to conduct more than one experiment. However, they were not given any directions of experimentation. What kind of experiment they would conduct was completely left to their own choices. In this way, any kind of limitation was prevented. Each of the students settled onto a table along with their parents as a couple so that they would not be affected by another couple's table; consequently, 13 activity tables were created and without any time limit, they were asked to conduct their activities together.

2.3. Data Collection Tools and Data Analysis

Intensive and thorough data collecting is essential in qualitative studies in order to grasp a subject, a situation or an issue. Therefore, various data collecting tools such as questionnaire forms, observation forms and video records were used in order to obtain data diversity in this study. These tools are explained in detail in the following headings.

2.3.1. Questionnaire forms

Questionnaire forms, created by researchers and intended for students and parents, were used in the study. Through the forms intended for the students, their interactions with their parents were tried to be found out; while through the forms intended for the parents, just like the forms for the students, their personal thoughts with their interactions with their children were tried to be examined. In both forms, 15 5-Likert-scale questions and 3 open-ended questions were asked. Of the Likert questions which were created to examine the perceptions of the students and their parents of various topics, 3 were about "Spending Quality Time Together", 5 were about "Enjoying Spending Time Together", 4 were about "Participating in Social Activities", 1 was about "Interaction Specific to Science Lessons" and 2 were about "Interaction". Through open-ended questions, whether the students and their parents conducted any extramural scientific activities was tried to be found out. The forms filled by the students were coded at first step. The coding was performed by renaming each student. Then, values ranging from 1 (never) to 5 (always) were assigned to the 5-Likert-scale questions. An average point for every dimension was calculated by the average of these values. Open-ended questions were analyzed through content analysis method.

2.3.2. Observation Forms

Observation forms, developed by researchers, were used in order to find out Science Process Skills (SPS) and attitudes that the participant students and parents used and maintained. Experimental Design Assessment Form Based on Science Process Skills, developed by Benzer, Muşlu Kaygısız and Uçar (2017), was used to assess SPS levels of the students. This form comprises of 6 stages; namely, writing a problematic, constituting a hypothesis, determining variables, designing an experiment, drawing graphics and tables and lastly, drawing conclusions and making comments. Skills that the students performed during the experiment process were assessed with 3 assigned values, namely "unacceptable (0)", "partly acceptable (1)" and "acceptable (2)", in the form. The SPS points of the students were given by researchers by watching video records both during and after the experiment and determining general average.

The participants were recorded while they were conducting their science experiments. In this way, researchers were provided with the opportunity to repeatedly watch each process being experienced in each of 13 activity tables in detail.

5 types of parent roles were determined for behaviors that the participant parents exhibited during the experiment primarily for researchers to create a descriptive analysis framework. These roles and behaviors projected for them are shown in Table 2.

Table 2. *Parent Roles and Behavior Patterns*

Roles	**Behavior Patterns**
Mentor	Knows or estimates how to conduct the experiment but does not explain it to the student, directs the student positively
Master	Knows or estimates how to conduct the experiment and commands the student what to do
Co-participant	Studies just like a student during the experimentation process
Learner	Learns how to conduct the experiment from the student
Assistant	Only performs commands from the student during the experimentation process
Observer*	Does not at all engage in and is merely an observer to the experimentation process

**After analyzing video records, another behavior pattern was added to 5 patterns determined in order to create a descriptive analysis framework, and the number of parent roles was increased to 6.*

Behaviors exhibited by the parents were determined by watching video records both during and after the experimentation process, and their roles were determined through categories that were thought to represent these behaviors. One of the researchers made observations to determine parents' roles during the experimentation process. The other two researchers analyzed parents' roles by separately watching

video records. These researchers compared their categories by meeting together, and reached an agreement by arguing about similarities and differences.

3. Findings

In this study in which parents were examined while conducting science experiments with their children, their roles, determined through behaviors they exhibited during the experiment, are shown in Table 3.

Table 3. *Parents' Roles*

Students' nick	Parents' role	Relationship	Degree of college	Do science activity together
S7	Learner	Father	High school	Some times
S9	Learner	Father	Elementary school	Some times
S11	Learner	Father	Primary school	Always
S3	Mentor	Mother	Junior college	Some times
S4	Mentor	Father	Graduate school-master degree	Some times
S6	Mentor	Mother	High school	Some times
S5	Assistant	Father	Junior college	Some times
S8	Assistant	Father	Elementary school	Mostly
S12	Assistant	Father	Primary school	Always
S13	Assistant	Mother	Primary school	Some times
S1	Assistant	Mother	Primary school	Never
S10	Co-participant	Father	Master's degree	Never
S2	Observer	Mother	Primary school	Never

Upon examining Table 3, it can be seen that learner and mentor roles were exhibited by 3 participants each, while co-participant and observer roles were exhibited by 1 participant each. The most common role to be observed was that of assistant, and 5 of the participants exhibited behaviors associated with this role. There was not any parent who exhibited the master role which had been proposed by researchers during the experiment. Upon examining parents' roles and their educational background, we can see that 1 of the assistant parents was an associate degree graduate, while the others were primary or secondary school graduates. Those exhibiting mentor roles had either an associate or a bachelor's degree. The learner parents were primary, secondary or high school graduates. The observer parent was a primary school graduate, while the co-participant parent had a master degree.

Among those who learned how to conduct the experiment from the students, S11's father was a primary school graduate, while S9's and S7's fathers were secondary and high school graduates respectively. In the answers they gave to the questions in the questionnaire, S7's and S9's fathers stated that they sometimes conducted science experiments at home, while S11's father said that they conducted every science experiment together. In the questionnaire, parents and their children were also asked about how they conducted science experiments at home.

> *"...I try to explain the questions my daughter asks"* (S11's father).
>
> *"...I do not like doing my science homework with my father, because I want to solve problems by myself"* (S9).
>
> *"...I explain to him where he can learn about the topics he does not understand"* (S7's father).

Considering answers given by both the students and their parents, we can see that the learner parents evaluate science experiments with a perception of school science, i.e. as accumulation of knowledge that needs to be learned.

Among 3 parents who exhibited mentor roles, S4's father had a master degree education, while S3's and S6's mothers were associate degree and high school graduates respectively. Based on Table 3, it can be seen that the mentor parents had higher education levels compared to the learner parents. However, S6's, S4's and S3's parents stated that they sometimes conducted science experiments with their children. In this context, it can be said that respective frequencies of the learner parents and the mentor parents conducting science experiments with their children are close to each other. Some of the views from both the students and their parents regarding science experimentation at home are as follows;

"...He does not ask questions a lot. If he does, I explain it to him. If I do not know the answer, I try to find it on the internet and then explain it." (S3's mother)

"...by explaining what I know, and suggesting him to obtain what I do not know from different sources" (S4's father)

"...When I ask a science-related question to my mother, she says that my teacher probably had me write the answer down on my notebook" (S6's mother).

Upon examining answers given on the questionnaire, it can be seen that the mentor parents maintained a similar attitude to the learner parents and evaluate science experiments with a perception of school science, i.e. as accumulation of knowledge that needs to be learned.

The most common role to be observed during the experiment process was that of assistant. In this behavior pattern that 5 parents exhibited, they performed commands from the student. Upon examining educational backgrounds of these parents, we can see that S5's and S8's fathers were associate degree and secondary school graduates respectively, while remaining 3 parents had primary school level education. In light of these findings, it can be said that educational levels of the assistant parents are slightly lower than the learner ones, but highly lower than the mentor ones. From answers on the questionnaire, it is understood that S1 and his mother do not conduct any science experiments at home, while others do so, albeit at different frequencies.

"...My mother only explains as much as she knows" (S13).

"...I thoroughly explain the subjects he does not understand" (S12's father).

"He expresses his opinion on a subject he knows about, and he explains a subject he does not know about after researching it from related sources" (S8).

"...He explains it by giving examples" (S5).

Upon examining sample answers given by the parents regarding how they conducted science experiments, it is seen that the assistant parents also have a school science perception, just like other participants. They regard science merely as accumulation of knowledge to be learned from various sources, and try to assist their children accordingly.

S10's father, exhibiting co-participant role and having a master's degree, stated that he did not conduct any science experiments with his daughter, even though he studied just like a student during the experiment process and virtually worked as a team with his daughter.

S2's mother, who did not engage in the experimentation at all and virtually watched as if seeing a TV show, was categorized as an observer, a type not proposed before the experiment. S2 stated that she did not conduct any extramural science experiments with her mother, a primary school graduate.

"...She only tells me how and where I can learn subjects I do not understand" (S2).

In the study, the participants' perceptions regarding their interactions with one another were also examined. These perceptions are shown in Table 4 through the roles they exhibited.

Table 4. *Participants' perceptions regarding their interactions with one another*

Parents' Role	Spending Quality Time Together		Enjoying Spending Time Together		Participating in Social Activities		Interaction Specific to Science Lessons		Interaction	
	S*	P**	S	P	S	P	S	P	S	P
Learner	4,11	3,78	3,73	3,93	2,25	2,50	2,67	3,00	4,33	4,33
Mentor	2,98	3,78	3,93	3,80	2,92	2,17	4,33	4,00	4,17	4,83
Assistant	3,53	3,80	4,08	4,04	2,20	2,20	4,80	4,40	4,60	4,50
Co-participant	4,67	4,67	4,60	4,60	3,00	2,50	4,00	3,00	5,00	4,00
Observer	3,67	3,33	4,00	4,00	1,50	2,00	4,00	3,00	5,00	4,50

*S: Student, **P:Parent

Based on Table 4, we can see that regarding spending quality time with parents, 3 students whose parents exhibited learner roles (S7, S9 and S11) have an average of 4.11, while 3 students whose parents exhibited mentor roles (S3, S4 and S6) have an average of 2.98, 5 students who parents exhibited assistant roles (S1, S5, S8, S12 and S13) have an average of 3.53, S10 whose parent exhibited a co-participant role has an average of 4.67, and Hilal whose parent exhibited an observer role has an average of 3.67. In light of these findings, it can be said that S10 has the highest satisfaction level regarding spending quality time with her parent who exhibited a co-participant role, followed by the students whose parents exhibited learner roles. The lowest average regarding spending quality time belongs to the students whose parents exhibited mentor roles. Their average points regarding participation in social activities are close to each other, but lower than other dimensions in the questionnaire. Inefficiency of places in which activities like cinema, theatre etc. could be enjoyed in the district in which the experiment was conducted can be given as the reason why. In the dimension of interactions specific to lessons, the highest average belongs to the assistant parents and their children, followed by the mentor parents and their children. The lowest average in this dimension belongs to the learner parents and their children. In the mutual interaction dimension, averages are both high and close to each other, with the highest average among parents belonging to the mentor ones.

Students' average SPS points from the experiment and their science class and overall performance points in their respective mainstream schools are shown in Table 5.

Table 5. *Students' SPS, Science Class and Overall Performance Points*

Parents' Role	Students							
	Nick	Score of Science Process Skills		Score of Science Achievement		General GPA	
		Individual	Average	Individual	Average	Individual	Average
Learner	S7	0,4	0,33	96,91	88,40	97,87	95,62
	S9	0,1		74,97		90,66	
	S11	0,5		93,33		98,34	
Mentor	S3	0,9	1,33	74,88	89,35	87,41	93,95
	S4	1,7		97,66		96,52	
	S6	1,4		95,52		97,91	
Assistant	S5	0,7	0,5	94,97	86,68	87,67	87,79
	S8	0,6		83,57		89,66	
	S12	0,7		89,66		86,79	
	S13	0,3		75,50		82,25	
	S1	0,2		89,69		92,59	
Co-participant	S10	0,6	0,6	94,15	94,15	88,52	88,52
Observer	S2	0,3	0,3	80,77	80,77	79,54	79,54

Upon examining Table 5 in general terms, we can see that the students' SPS points center on between values of 0 (unacceptable) and 1 (partly acceptable). Only S4 and S6 reached a point above the partly acceptable value. It is an important finding that parents of these students exhibited mentor roles during the experiment. The other student whose parent exhibited a mentor role, S3, reached an average of 0.9, close to the partly acceptable value, which is higher than other students whose parents exhibited different roles. The mentor parents' children obtained a higher average than other students with 1.33. Considering science class success levels at their schools, S4 whose parent exhibited a mentor role has the highest success point regarding science class, similar to his SPS point. Nevertheless, the fact that the science class success point of S3 whose parent exhibited a mentor role is lower than the other 2 students with mentor parents gives rise to the thought that apart from parent roles in the experiment, academic successes of children are very important as well.

4. Discussion and Conclusion

Parents participating in the study mainly exhibited assistant, equifrequent learner and mentor roles during the science experimentation process. Co-participant and observer roles were exhibited by 1 parent each. Extramural experiences earned with parents are important in terms of granting children with positive scientific experiences (Falk and Dierking, 2010; Ghate, 2016; Ho, 2010; Yanowitz and Hans-Vaughn, 2016). But another important issue is regarding attitudes maintained and roles exhibited by parents while such experiences are being created (Tuttle et al., 2017). Researchers point out that they should maintain an investigating attitude while interacting with their children about science (Allen and Gutwill, 2009; Gaskins, 2008; Kaya and Lundeen, 2010). It can be said that among the participant parents, those having exhibited mentor and co-participant roles are closer to maintaining an investigating attitude. The mentor parents in the study knew or estimated how to conduct the experiment but did not explain it to the student and directed the student positively. The co-participant parent studied just like a student during the experimentation process. It has been found out that parents' respective roles might be related to their educational backgrounds. It has also been confirmed that observer, learner and assistant parents were primary, secondary or high school graduates; there was only one assistant parent who had an associate degree. On the other hand, mentor and co-participant parents were high school, associate degree or master degree graduates.

There were no findings whatsoever to suggest that frequencies of conducting extramural science experiments together had any relation to educational backgrounds of the parents. The parent who had master degree stated that he did not conduct any science experiments with his child, while another parent who was a primary school graduate stated that they always did so, and another parent who was a secondary school graduate expressed that they frequently did so. However, it has been found out that the learner parents among participants perceive conducting a science experiment merely as helping with science homework. It has also been found out that the mentor parents sometimes conduct science experiments with their children, which is close to the learner parents in terms of frequency, since it has also been confirmed that the mentor parents perceive science experimentation as science homework, as in the case of the learner parents. Likewise; assistant, co-participant and observer parents perceive science activities as school science. Both the co-participant parent who had a master's degree and the observer parent who was a primary school graduate stated that they did not conduct any science experiments. Parents' perception of conducting a science experiment together as school science gives rise to the thought that they do not establish dialogues about science in their daily lives. Considering the importance of parents establishing a dialogue about science with their children in their daily lives (Tenenbaum and Callanan, 2008), this goes to show that children do not have access to environments in which they can be aware of science extramurally. Another issue is regarding scientific literacy of parents themselves. Their perception of science as merely a class at school proves that it is necessary and important for them to gain scientific literacy (Şahin, Sanalan, Bektaş and Kaygısız, 2010). At this juncture, it will be beneficial to underline the importance of every citizen gaining basic scientific literacy, emphasized by the concept of "scientific literacy for everyone" (Turgut, 2007). Indeed, scientific literacy for everyone is of vital importance to make future generations scientifically literate. Şahin et al. (2010) suggest that scientific literacy levels of parents affect academic success levels of their children. Besides, it has been proved by various studies that scientific success levels of students

in Turkey in international exams (PISA, TIMMS), are affected by familial variables such as educational backgrounds of parents, cultural richness of the family and socio-economic levels (Anıl, 2009; Özdemir, 2003).

The child of the co-participant parent had the highest satisfaction rate of spending quality time with parents, followed by the students whose parents exhibited learner roles. Children of the mentor parents had the lowest satisfaction rate of spending quality time with parents. The average points of students and parents regarding enjoying spending time together are close to each other, with the highest belonging to the co-participant parent and his child. The average points regarding participating in social activities are both close to each other and lower than other dimensions in the questionnaire. Inefficiency of places in which activities like cinema, theatre etc. could be enjoyed in the district in which the experiment was conducted can be given as the reason why. It has been found that parent and their children like spending time together but think that they spend relatively less quality time. Parent-child activities are important in terms of children being interested in and feeling self-confident about any field and establishing positive interactions with their parents (Simpkins, Vest, Dawes, Neuman, 2010). It can be said that such interactions will enable parents to determine their roles and children to be aware of their fields of interest while performing activities together (Simpkins et al., 2010). The assistant parents and their children had the highest average in the dimension of interaction specific to lessons, followed by the mentor parents and their children. Frequencies of the assistant group regarding conducting science activities together support this finding. Parents in this group who perceive conducting science activities together as homework have stated that they conduct science activities with their children sometimes, usually or often. The lowest average in this dimension belonged to the children of the learner parents. In the mutual interaction dimension, averages are both high and close to each other, with the highest average among parents belonging to mentor ones.

Upon examining the experiment process in terms of science process skills, it can be seen that the mentor parents and their children reached a higher average than others. Regarding science success levels at school, it has been found out that among the students whose parents exhibited a mentor role, those who have high science success levels at their schools have relatively higher averages of science process skills. One of the students whose parents exhibited mentor roles had lower averages than the other students in this group in terms of both science success levels and science process skills. This result gives rise to the thought that academic success levels of students, besides parent roles, may affect the outcome of this experiment process as well. It has been found out that while close to each other, SPS points of co-participant, assistant, learner and observer parents descend in that order, and are low in general terms. A process was followed in which the experiments that the participants would design would be open-ended and unlimited. They were only given materials, and were asked to design the experiments themselves. Tuttle et al. (2017) suggest more open-ended activities to be organized on the grounds that following specific instructions just like a recipe will lead to fewer interactions in close-ended activities. Likewise, open-endedness of activities in this study complied with the roles of the mentor parents. In this way, they and their children could create high level interactions with one another. However, it can also be claimed that academic success levels of children whose parents had mentor roles could enable them to use their science process skills actively during the experiment process. On the other hand, some of the children whose parents exhibited assistant, learner, co-participant and observer roles had high success levels in science classes. In spite of this, they did not succeed in conducting the experiment successfully and using their science process skills as much as those with the mentor parents. This is in accordance with the body of literature, since various studies show that parent participation does not always increase success (Pomerantz, Moorman and Litwack, 2007; Ho, 2003 a, b). Thus, a good planning of parents' roles and their involvement in the process with their investigating and questioning attitudes play important roles (Allen and Gutwill, 2009; Gaskins, 2008; Kaya and Lundeen, 2010).

References

Alexander, J. M., Johnson, K. E., & Kelley, K. (2012). Longitudinal analysis of the relations between opportunities to learn about science and the development of interests related to science. Science Education, 96(5), 763–786.

Anıl, D. (2009). Factors effecting science achievement of science students in programme for international students' achievement (PISA) in Turkey. Education and Science, 34(152), 87-100.

Allen, S., & Gutwill, J. P. (2009). Creating a program to deepen family inquiry at interactive science exhibits. Curator, 52, 289–306

Bhanot, R. T. & Jovanovic, J. (2009). The links between parent behaviors and boys' and girls' science achievement beliefs. Developmental Science, 13(1), 42-59.

Cheung, C.S.-S., & Pomerantz, E. M. (2012). Why does parents' involvement enhance children's achievement? The role of parent-oriented motivation. Journal of Educational Psychology, 104(3), 820.

Falk, J. H., & Dierking, L. D. (2010). The 95 percent solution school is not where most Americans learn most of their science. American Scientist, 98(6), 486–493.

Fan, X., & Chen, M. (2001). Parental involvement and students' academic achievement: A meta-analysis. Educational Psychology Review, 13, 27–61.

Fan, W., & Williams, C. M. (2010). The effects of parental involvement on students' academic selfefficacy, engagement and intrinsic motivation. Educational Psychology, 30(1), 53.

Gaskins, S. (2008). Designing exhibitions to support families' cultural understandings. Exhibitionist, 27, 11–19.

Ghate, D. (2016). From programs to systems: deploying implementation science and practice for sustained real world effectiveness in services for children and families. Journal of Clinical Child & Adolescent Psychology, 45(6), 812–826.

Ho, E. S. C. (2003a). Students' self-esteem in an Asian education system: Contribution of parental involvement and parental investment. The School Community Journal, 13(1), 65–84.

Ho, E. S. C. (2003b). Accomplishment and challenges of Hong Kong education system: What we have learned from PISA. Educational Journal, 31(2), 1–30.

Ho, E. S. C. (2010) Family influences on science learning among Hong Kong adolescents: what we learned from PISA. International Journal of Science and Mathematics Education, 2010(8), 409-428.

Kaya, S., & Lundeen, C. (2010). Capturing parents' individual and institutional interest toward involvement in science education. Journal of Science Teacher Education, 21, 825–841.

Lee, J., & Shute, V. J. (2010). Personal and social-contextual factors in k-12 academic performance: an integrative perspective on student learning. Educational Psychologist, 45(3), 185–202.

Marshall, C. & Rossman, G. B. [2006]. Designing qualitative research (4th Edition). USA: Sage Publications.

Ministry of Education [ME], (2016). PISA 2015 ulusal raporu uluslararası öğrenci değerlendirme programı. Turkey: Ankara.

National Research Council. (1996). National science education standards. Washington, DC: The National Academy Press.

Özdemir, E. (2003). Modeling of the Factors Affecting Science Achievement of Eighth Grade Turkish Students Based on the Third International Mathematichs and Science Study –Repeat (TIMMS-R) Data. Master Thesis. Middle East Technical University, Ankara: Turkey.

Pomerantz, E. M., Moorman, E. A., & Litwack, S. D. (2007). The how, whom, and why of parent's involvement in children's academic lives: More is not always better. Review of Educational Research, 77(3), 373–410.

Pomerantz, E. M., Cheung, C.S. -S., & Qin, L. (2012). Relatedness between children and parents: Implications for motivation. In R. M. Ryan (Ed.), The Oxford handbook of human motivation (pp. 579–349). NewYork, NY: Oxford University Press.

Sha, L., Schunn, C., Bathgate, M. & Eliyahu, A. B. (2016). Families support their children's success in science learning by influencing interest and self-efficacy. Journal of Research in Science Teaching, 53(3), 450-472.

Simpkins, S. D., Vest, A. E., Dawes, N. P. & Neuman, K. I.(2010) Dynamic relations between parents' behaviors and children's motivational beliefs in sports and music. Parenting: Science and Practice, 10(2), 97-118.

Şahin, R., Sanalan, V. A., Bektaş, Ö. & Kaygısız, Y. (2010). The effect of parent's science literacy on science and technology achievement of seventh grade students in elementary school. Erzincan University Journalof Science and Technology, 3(1), 125-143.

Tenenbaum, H. R. & Callanan, M. A. (2008). Parents' science talk to their children in Mexican-descent families residing in the USA. International Journal of Behavioral Development, 32(1), 1–12.

Turgut, H. (2007). Scientific Literacy for All. Ankara University Journal of Faculty of Educational Science, 40(2), 233-256.

Tuttle, N. et al. (2017). Exploring how families do science together: adult-child interactions at community science events. School Science and Mathematics, 117(5), 175-182.

Vedder-Weiss, D., & Fortus, D. (2013). School, teacher, peers, and parents' goals emphases and adolescents' motivation to learn science in and out of school. Journal of Research in Science Teaching, 50(8), 952–988.

Yanowitz, K. L. & Hahs-Vaughn, D. L. (2016). Adults' perceptions of children's science abilities and interest after participating in a family science night. School Science and Mathematics, 116(1), 55-64.

Yin R. K. (2009). Case study research: Design and methods (4th ed.). California: SAGE Pub. Thousand Oaks.

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