Optimum Science Journal

Journal homepage: https://optimumscience.org

Original Research Article

Investigation of Middle School Students' Scientific Curiosity Levels Affected by Various Variables

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ARTICLE INFO

Received 06 December 2024

Accepted 10 February 2025

Available Online 03 March 2025

Keywords:

Science

Scientific curiosity

Middle school students

ABSTRACT

The aim of this study is to determine whether the scientific curiosity levels of middle school students are affected by the variables of gender, grade level, parental education level, liking or disliking science course, achievement grade in science course and duration of studying science course. The sample of the study, which was conducted with the correlational research method, consisted of a total of 200 middle school students studying in the 5th, 6th, 7th and 8th grades. Data were collected using the Scientific Curiosity Scale and analyzed with different statistical techniques such as independent t-test, ANOVA, Tukey post-hoc test. Results show that the scientific curiosity levels of middle school students change as the grade level changes, with the highest level of scientific curiosity in the 7th grade and the lowest level in the 8th grade. When the change in the level of scientific curiosity according to different variables was analyzed, no significant relationship was found between scientific curiosity and gender and parental education level. A significant relationship was found between scientific curiosity and liking or disliking science course, achievement grade in science course and duration of studying science course.

OPEN ACCESS

To cite this article: Cındıl Kopan, T. & Özmen, H. (2025). Investigation of middle school students' scientific curiosity levels affected by various variables. *Optimum Science Journal, 3,* 16-35. http://doi.org/10.5281/zenodo.14877764

1. Introduction

Based on rapidly developing science and technology, all kinds of ideas and information are in circulation in daily life, which requires people to adapt to change, question and understand the sources from which they obtain information (Yenice, 2015). Raising individuals who can perceive this change in science and technology, keep up with change and contribute to it will be possible by providing a scientific perspective, that is, scientific literacy, from

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childhood. One of the most important characteristics of scientifically literate individuals is that they have sufficient knowledge and understanding of the nature of science (Bakırcı & Çiçek, 2017). It is stated that individuals who have knowledge about the nature of science will gain an understanding of how science and scientists work, what methods they use, and how scientific knowledge is produced (McComas et al., 1998).

The development and change in science and technology directs all countries to create a society that can participate in scientific discussions, interpret the claims put forward with a critical perspective, and make the right decisions by producing scientific ideas, in other words, to be scientifically literate (Soslu, 2021). Therefore, it is important that the education to be given to children from the basic education level should be in a content that will enable them to become scientifically literate and to comprehend nature, characteristics, power and limits of science and scientific knowledge (Driver et al., 1996). Indeed, the most important goal agreed upon by scientists, science educators and institutions interested in science education in relevant literature is to provide children with an understanding of the nature of science (Crowther et al., 2005; Lederman et al., 2002; Ministry of National Education [MoNE], 2018; Zeidler et al., 2002). Based on this idea, the necessity of including information about the nature of science in curricula has been advocated by many scientists (Bel et al., 2000; Cheung, 2020; Kurt & Kaya, 2023; Leden et al., 2015; Lederman & Lederman, 2014; Lin et al., 2004; Tatar et al., 2011; Yeh et al., 2019). This necessity is explained by the fact that the concept of Nature of Science [NOS] enables children to understand science, the scientific events they encounter in daily life and the results of science, has the potential to provide children with social, cultural, political and ethical perspectives, and enables them to understand subjects in a more permanent way (Driver et al., 1996).

The concepts of science, scientific knowledge and scientific literacy are closely related to science education. In many studies in literature, it is stated that the nature of science and scientific literacy are among the most important goals of science education (Bell et al., 2000; Leden et al., 2015; Moss et al., 2001; National Research Council [NRC], 2012; Schwartz & Lederman, 2008). Because understanding the nature of science, which is the most important element of scientific literacy, is recognized as an extremely important need for science education (Lederman, 2006; NRC, 2012). It is also stated that teachers should provide students with an understanding of the nature of science, the formation and development of scientific knowledge in science lessons (Crowther et al., 2005). Therefore, it is important to raise children as scientifically literate individuals through science courses in the formal education process (MoNE, 2018). The vision of “raising all individuals as science literate”, which is one of the most important issues expressed in the Science Curriculum, clearly reveals the importance given to the concepts of scientific literacy and the nature of science. Yücel Dağ (2015) mentions the importance of gaining an understanding of the nature of science for science literacy, while Bakırcı and Çiçek (2017) state that raising scientifically literate individuals can contribute significantly to the achievement of the goals of the science course.

Students' understanding the nature of science, being interested in scientific research and scientists, conducting research-inquiry-based practices and participating in scientific knowledge generation processes are closely related to their sense of curiosity (Laçin Şimşek & Tezcan, 2008). Curiosity, which is considered one of the most important factors affecting individuals' learning (Harty et al., 1985), is defined as the desire to understand or learn something (Turkish Language Association [TDK], 2019). It is said that individuals who can make sense of the events they

observe in their environment and try to draw conclusions and need to learn about the natural events they observe are curious (Diker Coşkun & Demirel, 2012). In terms of children, it is important for them to be curious about learning scientific knowledge to explain the events that take place around them and have a scientific basis. Because it can be said that curiosity has a motivating effect on understanding events and explaining their causes. In fact, the sense of curiosity which is present in children from birth can be blunted and/or suppressed when it is not sufficiently satisfied over time. For this reason, one of the main goals of the education process should be to keep the sense of curiosity alive in children and support its development.

Ensuring that children are curious about looking at events from a scientific perspective is also important in terms of raising their environmental awareness, orienting them towards research and inquiry, and motivating them to learn. Scientific curiosity is different from the concept of curiosity in daily life when it is considered in the context of scientific inquiry, directing the learner to examine and discover new situations. Because scientific curiosity directs the learner to conduct research and investigation within a certain system and to explain what they have obtained. In other words, trying to see and learn the background of events and acting systematically while doing so transforms curiosity into scientific curiosity. In this sense, Bruner (1990) defines scientific curiosity as the intrinsic motivation required to explain events systematically and make them meaningful. Children with a low level of scientific curiosity may prefer to memorize and mostly repeat events exactly instead of explaining them scientifically. Therefore, teaching scientific curiosity to students should be among the primary goals of a teacher (Altunışık, 2016).

Since one of the most important goals of science education is to develop scientific attitudes in children (Dhatrak & Wanjari, 2011), this education makes an important contribution to children's scientific curiosity, scientific attitude and scientific behavior (Demirbaş & Yağbasan, 2008; Dhatrak & Wanjari, 2011; Yılmaz, 2005). In addition, students' curiosity towards science and scientific research has the potential to positively affect their success in science courses. In this context, scientific curiosity stands out as a characteristic that students should have and/or gain. This situation makes it felt as a need to determine the scientific curiosity levels of students. However, it is seen that there is a very limited number of studies directly on scientific curiosity in both national and international literature (Cındıl Kopan, 2020; Jirout & Klahr, 2012; Serin, 2010; Spektor-Levy et al., 2013; Subaşı, 2009; Ting & Siew, 2014). Whether children's scientific curiosity levels change according to different variables has not been sufficiently examined. In this context, gender, grade level, parental education level, liking or disliking science course, achievement grade in science course and duration of studying science course were selected as variables that may influence scientific curiosity.

Although there is no research in the literature on whether scientific curiosity varies according to gender, the perception that scientific research is generally male dominated led to the selection of gender as a variable in the study. Considering that the curricula implemented in schools have a spiral understanding and that the information is elaborated as the grade level increases, the grade level was chosen as another variable whose effect will be examined in the study with the idea that curiosity towards science may be affected by the grade level. It is stated in various studies in the literature that families' sharing students' course experiences, participating in out-of-school scientific activities together, and encouraging students' participation in scientific clubs and activities contribute to students'

scientific attitudes (Aksu & Karaçöp, 2015; Patrikakou, 2016; Tümkaya, 2017; Wilder, 2014). Ensuring this requires families to have a certain degree of scientific curiosity. Because it would be unlikely for families who do not have scientific curiosity to direct their children towards science and scientific research and to enable them to act with a spirit of research. In this context, considering that the educational level of the family may influence children's curiosity towards science, the educational level of the parents was chosen as one of the variables whose effect on scientific curiosity will be examined. Students' attitudes towards the science course, their study time and academic achievement may also be variables that can affect their scientific curiosity levels. Because liking the course, studying the course for a long time and being academically successful in the course are issues that can make students more curious at the scientific level about the research-inquiry style events that are mostly included in the content of the course. For this reason, liking and disliking the science course, study time and science achievement grade were selected as variables to be examined for their effects on scientific curiosity.

Science courses are taught from the third grade of primary school and in the third and fourth grades science courses are taught by classroom teachers. From the fifth grade onwards, when middle school begins, these courses are taught by science subject teachers. Considering that the content of science courses in middle school is more advanced than in primary school, it is considered that these courses in middle school may be more effective in guiding students towards science and making them curious. In addition, since middle school prepares students for physics, chemistry and biology courses in high school and forms the basis for science education, the study was conducted on middle school students.

There are many studies in the literature to determine the levels of scientific inquiry, scientific attitude and scientific creativity of middle school students (Çelik & Onay, 2014; Gai et al., 2022; İnel Ekici, 2017; İnel Ekici & Tanır, 2020; Kahyaoğlu & Saraçoğlu, 2018; Kılıç & Tezel, 2012; Lederman et al., 2013; Rönnebeck et al., 2016). However, as far as can be reached, there are only a few scale development/adaptation studies in areas such as curiosity, scientific curiosity, and curiosity towards science. In this context, a scale adaptation study conducted to measure curiosity towards science in early childhood (Sarışan Tungaç & Yaman, 2023), a study conducted to measure the curiosity of 7^{th} grade students towards science with an adapted scale (Serin, 2010), a study to develop a curiosity and exploration scale for university students (Acun et al., 2013), and a study aiming to adapt the scientific curiosity scale in learning environments into Turkish (Yolcu, 2022) are the first ones that stand out. There is only one study directly developed in Turkey that measured the scientific curiosity of middle school students and compared them in terms of various variables (Cındıl Kopan, 2020). Students' curiosity about science is important for them to learn, to grow up with a researcher-inquisitive approach and to be successful in science courses. In addition, one of the most important tasks of both the education system and science courses is to increase students' scientific curiosity levels. This situation makes the lack of determining the scientific curiosity levels of middle school students and determining whether they vary according to some variables felt as a problem situation. Based on this data, the study aimed to compare the scientific curiosity levels of middle school students in terms of various variables. Within the scope of this purpose, answers to the following questions will be sought in the study. How do scientific curiosity levels of middle school students;

1. change according to gender?

2. change according to grade level?
3. change according to parental education level?
4. change according to liking or disliking science course?
5. change according to the duration of studying science course?
6. change according to science course achievement grade?

2. Methodology

2.1. Research Model

In this study, correlational research method was used. Correlational research is conducted to determine the relationship between variables that are likely to be related, that is, whether the variables affect each other (Özmen & Karamustafaoğlu, 2024). Since this study aims to examine the relationship between the scientific curiosity levels of middle school students and different variables, the correlational research method was determined as the most appropriate method for the purpose.

2.2. Research Population and Sample

The sample of the study consisted of a total of 200 students studying in the 5th, 6th, 7th and 8th grades of a middle school in the center of Erzurum. The students were selected by simple random sampling method among those who voluntarily wanted to participate in the study. The distribution of the students participating in the study according to the levels is given in Table 1.

Table 1. Distribution of students in the sample

Variable	Category		N	Total
Grade levels	Grade 5	Female	31	64
		Male	33	
	Grade 6	Female	28	49
		Male	21	
	Grade 7	Female	36	36
		Male	-	
	Grade 8	Female	28	51
		Male	23	
	Total	Female	123	200
		Male	77	

2.3. Data Collection Tools

In this study, data were collected using the Scientific Curiosity Scale developed by Cındıl Kopan (2020). The scale consists of two parts. The first part includes the participants' personal information such as gender, grade level, parental education level, liking or disliking of science course, daily study time for science course, and previous year's science course achievement grade. The second part was designed to determine the level of scientific curiosity of the participants and included 29 items gathered under seven factors. In the Likert-type scale, a five-point scale was used as “never”, “rarely”, “sometimes”, “most of the time” and “always”. Participants are expected to choose the most

appropriate option from the options on this five-point scale. The factor loadings of the scale items ranged between 0.419-0.786 and explained 58.228% of the total variance. In the literature, an analysis explaining 50-75% of the total variance is considered valid (Çakır, 2014, p.19). The Cronbach's Alpha reliability coefficient of the scale is 0.864. The scale was scored as “always” 5 points, “most of the time” 4 points, “sometimes” 3 points, “rarely” 2 points and “never” 1 point. Four examples of the items in the Scientific Curiosity Scale are given in Table 2.

Table 2. Sample items of scientific curiosity scale

Item No	Item	Never	Rarely	Sometimes	Mostly	Always
3	I feel the need to question the reasons for the situations I encounter.	O	O	O	O	O
10	I enjoy learning about scientific phenomena.	O	O	O	O	O
17	I think that it is enough to research topics I am curious about from only one source.	O	O	O	O	O
27	I think it is necessary to go to a museum to see fossils up close.	O	O	O	O	O

2.4. Data Collection and Analysis

The data were collected face-to-face from the students in the sample. Before the application, the students were informed in detail about the purpose of the research and the process of filling out the scale. Personal information was requested in the introduction part of the scale form. It took approximately 20-25 minutes to fill out the scale. The data obtained were first uploaded to excel and then transferred to the SPSS 25.0 package program after appropriate coding and analyzed. Independent variables were analyzed according to the scores obtained from the scale using one way ANOVA, Tukey post-hoc test and independent sample t-test. The relationship between independent variables was analyzed with Pearson correlation coefficient. Correlation analysis is used to determine the relationship of one variable with another variable or variables and the degree of the relationship, if any (Kalaycı, 2010). The main purpose of correlation analysis is to see the level of change of the independent variable on the dependent variable. Statistical significance value was accepted as $p < 0.05$.

2.5. Ethical Considerations Related to Research

In the study, research ethical principles were followed, ethics committee approval and National Education permissions were obtained. Ethics committee permission was obtained from Trabzon University Social and Human Sciences Scientific Research and Publication Ethics Committee with the document dated 18.06.2019 and numbered 61039982-000-E.9. In addition, the necessary official permissions to carry out the applications were obtained from Erzurum Provincial Directorate of National Education. Volunteerism was taken as a basis for the students participating in the study, and no coercion was applied to the students who wanted to fill out the scale. Since the names of the students were not requested while collecting the data, the identities of the students were not revealed.

3. Results

In this section, the data obtained from the application of the Scientific Curiosity Scale are presented.

3.1. Findings Related to Student Characteristics

The data obtained from the analysis of the demographic information of the students participating in the survey and their answers to the survey questions are presented in the table below. In the table, the findings regarding the number of students participating in the study, grade levels, genders, parental education levels, science course achievement grades, daily study time for science course, and liking disliking of science course are combined and presented in Table 3.

Table 3. Findings on demographic characteristics of students

Variable		Category	N	Total	%
Education Level	Mother	High school and below	159	200	80
		Bachelor's degree	35		17
		Master's degree	6		3
	Father	High school and below	85	200	43
		Bachelor's degree	75		37
		Master's degree	37		18
		Doctorate degree	3		2
Daily Study Time for Science		Less than 1 hour	76	200	38
		Between 1 - 2 hours	114		57
		Between 2 - 3 hours	10		5
Liking - Disliking of Science Course	Yes	Female	97	169	57
		Male	72		43
	No	Female	26	31	84
		Male	5		16
Science Course Achievement Score		**Average**	**Min.**	**Max.**	**Sd.**
		89.33	58	100	9

When the education levels of the mothers of the students participating in the study are examined, it is seen that 80% of them have high school and below, 17% have bachelor's degree, and 3% have master's degree. When the education level of the fathers was examined, it was seen that 43% of them had high school and below, 37% had bachelor's degree, 18% had master's degree and 2% had doctorate degree. When the daily study time of the students was analyzed, it was determined that 38% of them studied less than 1 hour, 57% studied between 1-2 hours, and 5% studied between 2-3 hours. When the liking-disliking of science course was analyzed, it was seen that 57% of those who liked the course were girls and 43% were boys, while 84% of those who disliked the course were girls and 16% were boys. When the descriptive statistics of the students' achievement grade in the science course are analyzed, it is seen that the lowest achievement grade is 58, the highest achievement grade is 100, the average achievement grade of the students is 89.33 and the standard deviation is 9.

3.2. Scientific Curiosity Level Findings According to Student Characteristics

Students' scientific curiosity levels were calculated by summing the scores given to each question and dividing the result by the total number of questions. While determining the scientific curiosity levels, reverse coded questions were re-coded. The scientific curiosity levels of the students according to demographic data are given in Table 4.

Table 4. Students' level of scientific curiosity according to their demographic data

		Scientific Curiosity Level			
		Average	**Sd**	**Min.**	**Max.**
Gender	Female	3.66	0.59	2.14	4.93
	Male	3.65	0.52	2.52	4.79
Grade	Grade 5	3.78	0.50	2.52	4.79
	Grade 6	3.61	0.61	2.14	4.48
	Grade 7	3.88	0.42	2.69	4.45
	Grade 8	3.43	0.59	2.24	4.93
Mother's Education Level	High school and below	3.62	0.56	2.14	4.93
	Bachelor's degree	3.80	0.57	2.52	4.69
	Master's degree	3.72	0.53	3.03	4.45
Father's Education Level	High school and below	3.54	0.52	2.24	4.79
	Bachelor's degree	3.73	0.53	2.72	4.93
	Master's degree	3.76	0.65	2.14	4.79
	Doctorate degree	3.75	0.11	2.52	4.69
Liking-Disliking of Science Course	Yes	3.69	0.55	2.14	4.93
	No	3.46	0.59	2.34	4.45
Daily Study Time for Science	Less than 1 hour	3.56	0.59	2.14	4.79
	Between 1 - 2 hours	3.69	0.55	2.24	4.93
	Between 2 - 3 hours	4.00	0.30	3.38	4.28
General		3.65	0.56	2.14	4.93

When the scientific curiosity levels of the students are analyzed, it is seen that the scientific curiosity level of female students is 3.66 and the scientific curiosity level of male students is 3.65. Among the grade groups, the highest level of scientific curiosity belongs to 7th grade students (3.88) and the lowest level of scientific curiosity belongs to 8th grade students (3.43). Among the mother's education levels, the highest level of scientific curiosity belongs to undergraduate (3.80) graduates. Among the father's education levels, the highest level of scientific curiosity was observed among undergraduate (3.76) graduates. Students who liked the science course (3.69) had higher levels of scientific curiosity than students who did not like the course (3.46). The lowest level of scientific curiosity among the students who spent less than 1 hour (3.56) and the highest level of scientific curiosity was between 2-3 hours (4.00). The mean scientific curiosity level of the students in the sample was found to be 3.65. The mean scores and standard deviation scores obtained from each item of the scientific curiosity scale are given in Table 5.

Table 5. Descriptive statistics of scientific curiosity scale items

Item No	**Items**	**Mean Score**	**Standard Deviation**
13	I think it is not a waste of time to investigate the causes of the events I encounter.	4.32	1.01
19	I listen with more interest to new topics in the lesson.	4.27	0.91
27	I think it is necessary to go to a museum to see fossils up close.	4.26	1.18
3	I feel the need to question the reasons for the situations I encounter.	4.06	1.11
8	I often ask the question "Why?"	3.95	1.12
16	I find it necessary to make observations within the school.	3.95	1.21

28	I don't think it is a waste of time to watch programs with fictional content.	3.84	1.33
24	I would like to hear from the scientists themselves about their work.	3.82	1.38
7	I try to understand the reasons for things, even if it takes a long time.	3.78	1.06
15	I like to examine objects/materials/plants etc. I pick up.	3.78	1.49
10	I enjoy learning about scientific phenomena.	3.74	1.21
5	I try to think about the events I encounter from multiple perspectives.	3.72	1.06
18	I try to establish cause and effect.	3.71	1.09
6	I try to include original examples in my explanations.	3.70	1.13
11	I like to study natural phenomena.	3.70	1.24
4	I ask in-depth questions to better understand the causes of events	3.65	1.19
9	I question the past by saying, “When did this happen?”	3.57	1.16
25	I am curious about the lives of scientists.	3.52	1.42
26	I like to watch science-related publications (TV programs or internet).	3.45	1.31
20	I like to follow scientific developments related to space.	3.44	1.40
14	I try to relate the events I encounter with my previous knowledge.	3.42	1.10
12	I enjoy observing living things in my environment.	3.41	1.37
21	At night, I try to understand the movement of the stars and the moon.	3.30	1.41
22	I like to ask questions about the planets and the sun.	3.26	1.38
23	I enjoy reading scientific journals.	3.25	1.28
2	I enjoy reading scientific journals.	3.10	1.31
1	I like to conduct experimental research on things I encounter for the first time.	3.07	1.11
29	I follow innovations in the world of science.	3.02	1.27
17	I think that it is enough to research topics I am curious about from only one source.	2.00	1.22

When the mean scores of the students according to their answers to the items of the scientific curiosity scale are analyzed; the lowest score (2.00) of the middle school students is for the item numbered 17 (I think it is enough to investigate the subjects I am curious about from only one source), the highest score (4.32) is for the item numbered 13 (I think it is not a waste of time to investigate the causes of the events I encounter). The higher the score, the higher the frequency with which the students perform the action. The higher the score, the higher the frequency of students performing the action mentioned in the item, and the higher the score, the higher the frequency of students performing the action.

3.3. Findings on the Relationship between Variables and Scientific Curiosity

Under this heading, the findings on how the level of scientific curiosity changes according to the variables expected to affect it are presented.

3.3.1. The relationship between gender and level of scientific curiosity

An independent sample t-test was conducted to determine whether the scientific curiosity levels of the students changed statistically significantly according to gender and the results are presented in Table 6.

Table 6. The relationship between gender and level of scientific curiosity

		N	Mean Score	Standard Deviation	t	*df*	*p*
Gender	Female	123	3.66	0.58976	0.172	198	0.863
	Male	77	3.65	0.51628			

When the results in the table are examined, it is seen that the scientific curiosity levels of the students do not differ significantly according to their gender ($t_{(200)}$=0.172; p > .05).

3.3.2. The relationship between grade level and level of scientific curiosity

One-way analysis of variance was performed to determine whether the scientific curiosity levels of the students changed statistically significantly according to the grade level and the results are presented in Table 7.

Table 7. The relationship between grade level and level of scientific curiosity

		N	Mean Score	Standard Deviation	*F*	df	*p*
Grade	Grade 5	67	3.78	0.50331	5.733	3	0.001
	Grade 6	47	3.61	0.61379			
	Grade 7	36	3.88	0.42464			
	Grade 8	50	3.43	0.59249			
	Total	**200**	**3.66**	**0.56423**			

When the data in the table are analyzed, it is seen that the scientific curiosity levels of the students differ significantly according to their grades (F = 5.733; p < .05). In other words, the fact that students are in the 5th, 6th, 7th and 8th grades significantly affects their scientific curiosity levels. Tukey post-hoc test was performed to determine between which grades the differentiation occurred and the results obtained are presented in Table 8.

Table 8. Tukey post-hoc test results between classes

Grade (I)	Grade (J)	Mean Difference (I-J)	Standard Error	*p*
Grade 5	Grade 6	0.17228	0.10363	0.347
	Grade 7	-0.09475	0.11831	0.854
	Grade 8	0.34730*	0.10179	0.004
Grade 6	Grade 5	-0.17228	0.10363	0.347
	Grade 7	-0.26703	0.12602	0.510
	Grade 8	0.17502	0,.11066	0.392
Grade 7	Grade 5	0.09475	0.11831	0.854
	Grade 6	0.26703	0.12602	0.151
	Grade 8	0.44205*	0.12451	0.003
Grade 8	Grade 5	-0.34730*	0.10179	0.004
	Grade 6	-0.17502	0.11066	0.392
	Grade 7	-0.44205*	0.12451	0.003

According to the table, when the statistical significance values (p) are analyzed, there is a difference between 5th and 8th grade students (p=0.004) and between 7th and 8th grade students (p=0.003) in terms of scientific curiosity levels. No significant difference was found between other grade levels. In general, the average scientific curiosity scores of

8th grade students (x̃=3.43) are statistically significantly lower than those of 5th grade students (x̃=3.78) and 7th grade students (x̃=3.88).

3.3.3. The relationship between parental education level and level of scientific curiosity

One-way analysis of variance was performed to determine whether the scientific curiosity levels of the students showed a statistically significant change according to their parents' education levels and the results are presented in Table 9.

Table 9. The relationship between parental education level and level of scientific curiosity

		N	Mean Score	Standard Deviation	*F*	*df*	*p*
Mother's Education Level	High school and below	159	3.62	0.55807	1.580	2	0.209
	Bachelor's degree	35	3.80	0.57187			
	Master's degree	6	3.72	0.52613			
	Total	**200**	**3.65**	**0.56132**			
Father's Education Level	High school and below	85	3.54	0.51963	2.108	3	0.101
	Bachelor's degree	75	3.73	0.52680			
	Master's degree	37	3.76	0.64637			
	Doctorate degree	3	3.75	1.11435			
	Total	**200**	**3.65**	**0.56132**			

When the one-way analysis of variance results in the table are analyzed, it is seen that the mother's education level variable does not have a significant effect on the scientific curiosity levels of the students ($F_{(2.198)}$ = 1.580; p > .05). It was determined that the average scientific curiosity scores of the students were close in the "high school and below", "undergraduate" and "graduate" variables, which are sub-variables of the mother's education level variable. Students' scientific curiosity levels did not differ significantly according to their fathers' education levels ($F_{(3.197)}$=2.108; p > .05).

3.3.4. The relationship between liking or disliking science courses and level of scientific curiosity

An independent sample t-test was conducted to determine whether the scientific curiosity levels of the students varied statistically significantly according to their liking for the science course and the results are presented in Table 10.

Table 10. The relationship between liking science courses and level of scientific curiosity

		N	Mean Score	Standard Deviation	t	*df*	*p*
Liking Science Lesson	Yes	169	3.69	0.54899	2.185	198	0.030
	No	31	3.46	0.59418			

According to the results in the table, the scientific curiosity levels of the students differed significantly according to their liking of the science course ($t_{(200)}$= 2.185; p < .05). The mean scientific curiosity scores of the students who liked the science course (x̃=3.69) were statistically significantly higher than the mean scores of the students who did not like the course (x̃=3.46).

3.3.5. The relationship between duration of studying science course and level of scientific curiosity

One-way analysis of variance was performed to determine whether the students' scientific curiosity levels varied statistically significantly according to their duration of studying science course and the results are presented in Table 11.

Table 11. The relationship between duration of studying science course and the level of scientific curiosity

		N	Mean Score	Standard Deviation	*F*	*df*	*p*
Daily Study Time for Science	Less than 1 hour	76	3.56	0.59174	3.298	2	0.039
	Between 1 - 2 hours	114	3.69	0.54536			
	Between 2 - 3 hours	10	4.00	0.29816			
	Total	**200**	**3.65**	**0.56132**			

When the results of the one-way analysis of variance in the table are analyzed, it is seen that the scientific curiosity levels of the students differed significantly according to their duration of studying science course ($F_{(2.198)}$=3,298; p<.05). Tukey post-hoc test was performed to determine which groups the difference was between, and the results are presented in Table 12.

Table 12. Tukey post-hoc test results between working hours

Study Periods (I)	Study Periods (J)	Mean Difference (I-J)	Standard Deviation	*p*
Less than 1 hours	Between 1 - 2 hours	-0.12958	0.08218	0.258
	Between 2 - 3 hours	-0.44276*	0.18668	0.049
Between 1 - 2 hours	Less than 1 hour	0.12958	0.08218	0.258
	Between 2 - 3 hours	-0.31319	0.18303	0.204
Between 2 - 3 hours	Less than 1 hour	0.44276*	0.18668	0.049
	Between 1 - 2 hours	0.31319	0.18303	0.204

According to the table, when the statistical significance values (p) are analyzed, it is seen that there is a statistically significant difference between the students with “less than 1 hour” study time ($\tilde{x}$=3.56) and the students with “between 2-3 hours” study time ($\tilde{x}$=4.00) in terms of their scientific curiosity levels (p=0.049). No significant difference was found in other study time intervals. As a result, the scientific curiosity levels of those who study “less than 1 hour” daily ($\tilde{x}$=3.56) are statistically significantly lower than those who study “between 2-3 hours” ($\tilde{x}$=3.65).

3.3.6. The relationship between science course achievement grade and level of scientific curiosity

Pearson correlation analysis was performed to determine whether there is a statistically significant relationship between students' scientific curiosity levels and their achievement grade in science course and the results are presented in Table 13.

Table 13. The relationship between science course achievement grade and level of scientific curiosity

		Achievement Score
Scientific Curiosity Level	Correlation Coefficient (r)	0.246
	p	0.000
	N	200

When the correlation coefficient and statistical significance value in the table are analyzed, it is seen that there is a statistically significant, low-severity and positive (r>0) relationship between the students' achievement score in the science course and their level of scientific curiosity ($r = 0.246$; $p < .05$).

4. Discussion and Conclusions

In the first question, which investigated whether the scientific curiosity levels of middle school students vary according to gender, it was determined that the scientific curiosity levels of the students were not affected by gender. In studies examining the change in the concept of scientific curiosity according to gender, there are results that support the findings of this study, that is, there is no significant effect of gender on scientific curiosity (Akgül, 2013; Aslan & Uluçınar Sağır, 2008; Engelhard & Monsaas, 1988). However, there are also studies in the literature indicating that female students have higher curiosity (Altunışık, 2016; Harty et al., 1985; Serin, 2010). Altunışık (2016) argues that this may be the result of the fact that boys in secondary school live more play-centered lives than girls and that girls mature mentally earlier because they enter puberty earlier. On the other hand, there are also results in the literature that the scientific curiosity levels of male students are statistically more significant than female students (Acun et al., 2013; Demirel & Diker Çoşkun, 2009; Litman & Spielberger, 2003). This result is explained by Acun et al. (2013) as the result of the active role attributed to boys by society in terms of being curious. Since the socio-cultural values and expectations attributed to boys and girls may differ, the level of scientific curiosity may also be shaped according to social structure and values. Since social structure and values change over time, it can be concluded that the factors affecting curiosity may also change over time. Indeed, Kashdan et al. (2004) state that curiosity may develop differently in individualistic and collective societies, and therefore, it should be studied according to these two societal structures. There are many factors that influence children's scientific curiosity. While some factors (higher motivation of girls, earlier completion of their mental development, etc.) increase the level of curiosity of girls, some factors (social values, giving more active roles to boys, etc.) increase the level of curiosity of boys. As a result of these factors balancing each other for the sample examined, it was evaluated that the curiosity levels of girls and boys did not differ.

In the second question, which examined the change in the level of scientific curiosity of middle school students according to grade level, it was determined that scientific curiosity increased only in transition from 6^{th} to 7^{th} grade and generally decreased at other levels. As the grade level of students increases, it is expected that they will be more curious about investigating the reasons for learning new information, hearing much information for the first time or observing new events in their environment. However, the results obtained in this study were contrary to expectations, and it was determined that the level of curiosity generally decreased as the grade level increased. Similar results were obtained in a study in which students' curiosity levels were measured (Altunışık, 2016). Although the studies directly

measuring curiosity levels are limited in the literature, it is stated in many studies that curiosity, interest and attitude towards science course decreases as the grade level increases (Aypay & Eryılmaz, 2011; Şerefhanoğlu et al., 2008; İnel Ekici, 2017; Kabakçı & Korkut, 2008). Among the various reasons for this situation are the use of ineffective teaching methods and techniques, inadequacy of curricula, perception of science as a difficult course, and the fact that factors such as adolescence affect children more (Murphy & Beggs, 2003; Osborne et al., 2003). In addition, it is stated in the literature that the progression of topics in science courses from concrete to abstract as the grade level increases leads to a decrease in students' curiosity towards abstract concepts (Bursal, 2013). The reason for the lowest level of scientific curiosity in 8th graders can be expressed as students focusing on the exam and constantly solving test questions due to the High School Transition Exam (LGS) (Altunışık, 2016). Because 8th grade students focus on solving faster and more correct questions since they are in the middle of a very important exam for them, and this situation negatively affects their interest and curiosity towards the subjects. As a matter of fact, Öztan (2014) also states that 8th grade students are more reluctant and uninterested than 6th grade students. In the study, it was evaluated that the reason for the increase seen between 5th and 7th grade students may be the increase in the sense of responsibility in students. It is stated in the literature that there is a linear relationship between sense of responsibility and curiosity (Kashdan & Steger, 2007).

In the third question, which investigated whether the scientific curiosity levels of middle school students were affected by the level of education of their parents, it was determined that the scientific curiosity levels of the students were not significantly affected by the level of education of their parents. Although it is not possible to express it as a general acceptance, it is expected that an increase in the level of parental education will have a positive effect on the follow-up and guidance of children and on enabling them to look at things more scientifically. There is an expectation, albeit at the level of perception, that children from families with higher levels of education will be able to provide more scientific explanations to events with the support and help of their families. However, the results of the study do not confirm this expectation. In the literature, studies on the effect of parental education levels on students' curiosity levels report similar results (Akgül, 2013; Altunışık, 2016; Aydın, 2007; Dökme et al., 2012; Uzun & Keleş, 2010). Altunışık (2016) explained this situation with the fact that curiosity is a personal emotion and stated that some feelings of curiosity may be waiting to be awakened and suggested that to develop a sense of curiosity in students, it is recommended to focus on exploring the subjects that the child is curious about rather than the level of parental education. The results obtained from the study show that even if the parents are educated, this does not necessarily mean that the child will also be curious. In addition, even if the parents are educated, they may not fully understand the importance of scientific curiosity and/or how it can be developed and therefore do not make efforts to increase their children's scientific curiosity.

In the fourth question examining the effect of students' liking or disliking the science course on their scientific curiosity, a relationship was found between liking the course and scientific curiosity. The scientific curiosity levels of students who liked the science course (3.69) were statistically significantly higher than those who did not (3.46). Science course examines nature and the events that take place in nature in terms of its content. The reasons for many events in nature are explained by science knowledge. For this reason, it is thought that the positive motivation towards science of students who like science courses may affect their curiosity in examining scientific events. In literature,

there is no research directly between liking science courses and scientific curiosity. In this respect, the data obtained in this study have an innovative feature. In addition, it is stated that as the level of liking science increases, interest and motivation to learn science increases and anxiety level decreases (Akçöltekin & Doğan, 2013; Avcı & Kırbaşlar, 2017; Yıldırım & Karataş, 2018; Yılmaz et al., 1998), and the high school entrance exam results of students who dislike science are significantly lower than the results of students who like science (Okutan, 2017). It is generally accepted that there is a strong relationship between the concepts of curiosity, interest, attitude and liking. Çakır et al. (2007) stated that positive attitude and interest towards a science or subject is the state of liking the lesson, showing positive affective characteristics by having positive thoughts towards that lesson or subject, and when a child likes and is curious about the lesson, he/she can associate that lesson or subject with daily life and learning becomes easier. Therefore, the results obtained from the study are in line with the literature.

In the fifth question, which examined the relationship between the scientific curiosity levels of middle school students and their science course grades, a statistically significant, low-severity and positive relationship was determined between the students' science course grades and their scientific curiosity levels. The fact that the science course is related to events in nature and science leads to the expectation that students who are successful in this course and who have high grades will have higher levels of scientific curiosity. In the literature, there are studies indicating that students with high academic achievement also have high scientific attitudes and curiosity (Altınok, 2004; Demirbaş & Yağbasan, 2008). There are also studies indicating that students with high achievement in science also have high levels of scientific curiosity (Ceylan et al., 2016). In general, it can be said that as students' interest and curiosity increase, their achievement also increases, and successful children are more interested and curious. It is thought that interest and curiosity about a subject can contribute to continuous and permanent research and learning about that subject and provide important gains to children in the long run.

In the sixth question, which examined the relationship between the scientific curiosity levels of middle school students and their duration of studying science course, it was determined that students' study time in the science course significantly affected their scientific curiosity levels. Students' success in science courses is also related to their study time. Naturally, students who study more will acquire more information and be more curious about questioning the reasons for the information they have learned. It can be said that the acquisition of new information further increases curiosity about scientific knowledge. On the other hand, it can also be evaluated those students with high scientific curiosity study more, do not get bored of studying, that is, they do not avoid studying, and enjoy acquiring new information on the subjects they are curious about.

5. Recommendations

Scientific curiosity is extremely important for students to approach the events they encounter with a scientific perspective and to understand the cause-and-effect relationships of events in a healthy way. Today's teaching approaches support this situation with their inquiry-based structure. In this context, transforming students' curiosity into scientific curiosity is also vital for the teaching process. However, scientific curiosity is not a skill that students can acquire on their own. Teaching children to be curious about the events that take place in nature and in their

environment, especially from the preschool period, will be possible only if teachers can provide them with a scientific perspective. This can be achieved by conducting the teaching process in an inquiry-oriented manner. Since today's curricula recommend inquiry-based teaching activities at all levels, conducting lessons in this context, confronting children with questions that will arouse curiosity about the causes of the events they observe around them and enabling them to conduct research will contribute significantly to the development of scientific curiosity skills. In this context, it would be beneficial to have students engage in inquiry-based practices from the preschool period onwards to help them gain scientific curiosity skills.

Acknowledgment

This study is based on a master's thesis conducted by the first author under the supervision of the second author.

Declaration of Competing Interest and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in OPS Journal belongs to the authors.

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