http://www.tayjournal.com
https://dergipark.org.tr/en/pub/tayjournal

Examining The Effects of the Project Titled "Mineral Hunters: An Adventure in the Footsteps of Geology"*

Funda Çıray Özkara, Dr.,
Corresponding Author
Ministry of National Education, Türkiye
fcry1085@gmail.com
Orcid ID: 0000-0001-7912-0563

Ersen Yoldaç, Teacher
Ministry of National Education, Türkiye
yoldace@gmail.com
Orcid ID: 0009-0009-1556-4507

Melih Ünlüer, R&D Personnel
Ministry of National Education, Türkiye
melihunluer@gmail.com
Orcid ID: 0009-0006-6878-4640

Hülya Erkoyun, Prof. Dr.
Eskişehir Osmangazi University, Türkiye
herkoyun@ogu.edu.tr
Orcid ID: 0000-0001-6523-0606

Gökhan Kayır, Assoc. Prof. Dr.
Manisa Celal Bayar University, Türkiye
gokhankayir@gmail.com
Orcid ID: 0000-0002-9830-0006

Engin Yılmaz, Asst. Prof. Dr.
Çanakkale Onsekiz Mart University, Türkiye
engin.yilmaz@comu.edu.tr
Orcid ID: 0000-0001-8390-9452

Article Type: Research Article
Received Date: 07.12.2024
Accepted Date: 22.03.2025
Published Date: 31.03.2025
Plagiarism: This article has been reviewed by at least two referees and scanned via a plagiarism software
Doi: 10.29329/tayjournal.2025.1080.05

Citation: Çıray Özkara, F., Yoldaç, E., Ünlüer, M., Erkoyun, H., Kayır, G., & Yılmaz, E. (2025). The effects of the project titled "Mineral Hunters: An Adventure in the Footsteps of Geology". *Türk Akademik Yayınlar Dergisi (TAY Journal), 9*(1), 115-140.

*This study was produced from the TÜBİTAK 4004 project and is the rearranged and expanded form of the oral presentation presented at the 6th International Cappadocia Scientific Research Congress held in Nevşehir on 10-12 August 2024.

Abstract

This study examines the impact of the TÜBİTAK-supported project, "Mineral Hunters: An Adventure on the Trail of Geology" on secondary school students in Eskişehir, Türkiye. The project aimed to increase students' curiosity about the region's underground resources, including semi-precious gemstones and minerals, and to provide hands-on experiences in geology. Conducted over six days with 41 sixth and seventh grade students, the Project works involved both theoretical and applied activities, such as workshops, field trips, and creative tasks. In the study designed with explanatory sequential design from mixed method models, pre-test and post-test were applied in order to measure the knowledge levels of the students before and after the project. Results showed a significant improvement in students' understanding of mineralogy and geology, with seventh-grade students showing higher achievement. The majority of students reported enjoying the project, particularly the hands-on activities and creative drama workshops. However, some students expressed dissatisfaction with the trip's conditions, such as high temperatures and poor internet connectivity. Overall, the project was effective in enhancing students' knowledge, skills, and interest in geology, suggesting the value of experiential learning in fostering deeper engagement with scientific topics. In light of the results obtained from the study, it is recommended that similar works, which allow students to learn by doing and observe on-site, be promoted.

Keywords: Geology, rocks, blue chalcedony, out of school learning, mineralogy, science literacy, TÜBİTAK.

Introduction

Geology is the scientific discipline that examines the formation and development of the Earth, minerals, rocks, earthquakes, volcanic activities, and all processes occurring within and on the surface of the Earth (Monroe & Wicander, 2007). Knowledge of geology helps students understand the relationship between environmental issues and human activities (Vallejo et al., 2019). Additionally, geology education is crucial for the discovery of petroleum, gas, and mineral resources, as well as for understanding natural disasters (Gogoi et al., 2016).

Studies conducted in the United States [USA] and Europe on secondary school students indicate that while they acquire conceptual ideas about rocks, minerals, and structural features (Blake, 1999; Ford, 2005), they face difficulties in understanding geological processes (Reid-Griffin, 2016). Secondary school students' knowledge about the structure and history of the Earth is based on their theoretical understanding, their ability to make experimental observations, and their capacity to describe rock formations. This knowledge can enhance students' observational skills and encourage them to engage more in scientific inquiry when dealing with information, observation, and conceptual questions (Ford, 2005; National Research Council, 1996; Reid-Griffin, 2016).

Curricula should be designed to meet students' needs by offering hands-on, inquiry-based Earth science activities that help them learn geological concepts (American Geological Institute, 2006; Blake, 2004; Johnson, 2004). Presenting geology through extracurricular activities such as fieldwork, laboratory experiments, museum visits, and workshops can help students better understand geological concepts, integrate theoretical and practical knowledge, and enhance their problem-solving skills (Makri et al., 2020). Field trips play a significant role

by providing opportunities for research, inquiry, and problem-solving, allowing students to examine phenomena on-site and fulfill their learning needs (Küçükoğlu, 2014).

Extracurricular learning, including activities like field trips, is defined as educational activities conducted in schoolyards, nearby areas, or off-campus locations (Saraç, 2017). These extracurricular applications include field observations, visits to scientifically functional locations such as school gardens, natural history museums, science and technology museums, as well as virtual reality applications, projects, sports activities, and social, cultural, and scientific programs such as exhibitions, meetings, congresses, panels, and symposiums (Henriksson, 2018; Saraç, 2017). Studies suggest that knowledge acquired in such out-of-school learning environments is retained for a long time and is often more substantial than what is learned in school (Anderson et al., 2006). The participation of students in fieldwork related to nature is considered one of the most effective learning methods in geology education, as field studies significantly contribute to student development (Buldur et al., 2020; Field et al., 2011; Van der Hoven Kraft, 2017). The United Nations and the European Union recommend integrating structured outdoor activities into educational programs (Fonseca, 2023).

Some projects initiated by the Scientific and Technological Research Council of Türkiye [TÜBİTAK], such as those coded 4004, 4005, and 2237-A, include components supporting extracurricular learning. These projects emphasize the necessity of reevaluating out-of-school environments innovatively for educational purposes (Şen, 2021). Projects typically emerge from real-life problems or needs (Arpacı, 2018) and follow a scientific method, beginning with problem identification and encompassing designed processes aimed at solving that problem (Çıray Özkara, 2024). Through the TÜBİTAK 4004 Nature Education and Science Schools Support Program, the Science and Society Directorate organizes scientific events offering residential or non-residential educational opportunities for a diverse audience, from students to teachers, to raise awareness of nature, science, and technology (TÜBİTAK, 2024). It is noted that TÜBİTAK 4004 projects, particularly those featuring hands-on learning experiences, play a crucial role in fostering an appreciation for science, promoting scientific work, and popularizing science among children (Orhan, 2022).

Eskişehir, located in Türkiye's Central Anatolia Region, is positioned within a geological and climatic transition zone and is considered rich in underground resources. Two semi-precious stones unique to Türkiye, meerschaum (lületaşı) and blue chalcedony, are exclusively found in Eskişehir (Gündoğan & Özbaş, 2017; Hatipoğlu et al., 2013; Kadir et al., 2016; Sarıiz, 2000). While meerschaum is widely recognized, blue chalcedony, which holds significant value in the Far Eastern gemstone market, is relatively unknown even within Eskişehir. Alongside these two semi-precious gemstones, Eskişehir hosts a variety of other minerals, including boron minerals, opal, agate, different chalcedony and quartz types, serpentine, and even emeralds, which, though not precisely located today, were mined during the Ottoman period (Erkoyun & Bozkurt, 2005). Many of these minerals can be easily found on the surface and distinguished from ordinary rocks with basic geological training and field experience.

Chalcedony is a type of chalcedonic quartz that is generally sky-blue but can also appear in purplish, pinkish, or whitish hues, forming large, nodular structures. It has been used as a gemstone since ancient times, with the largest and most significant deposit located in the Mayıslar-Sarıcakaya region (Hatipoğlu & Chamberlain, 2009; Hatipoğlu & Kibici, 2010). This deposit was formed by the precipitation of silica transported through fault zones within tectonic breccia and sandstone formations (Hatipoğlu et al., 2013). Meerschaum, a white-colored mineral found in nodules, is formed within ophiolitic units due to the dissolution and precipitation of magnesite pebbles in alkaline environments, with the mineral concentration increasing due to fluid circulation. Today, it is still mined in the Beyazaltın, Türkmentokat-Sarısu, and Nemli regions of Eskişehir (Ece & Çoban, 1994; Sarıız, 2000).

Although blue chalcedony has significant economic potential, unlike meerschaum, it is not legally protected. As a result, it is exported abroad, mainly to the Far East, as raw material. Once processed, its market value increases substantially. The lack of domestic processing of blue chalcedony in Türkiye leads to considerable economic losses. To raise awareness and educate the public about Eskişehir's valuable minerals and rocks, the "Mineral Hunters: An Adventure in the Footsteps of Geology" TÜBİTAK 4004 project was conducted. This project focused on blue chalcedony, highlighting its significance in contrast to meerschaum, which is already well-known and legally protected.

One of the project's key objectives was to increase children's awareness of the natural rocks and minerals in their surroundings using the principle of starting from the familiar and moving outward. Notably, while the secondary school science curriculum included rock-related topics in 2006, these topics were removed from the curriculum after 2013. Instead, they were integrated into secondary-level science education with different learning outcomes. The revised secondary school science curriculum in 2018 emphasizes scientific literacy and the development of research skills through interdisciplinary learning, including social studies. The activities designed within this project aimed to reintroduce the subject of rocks to secondary school students while also helping them explore their local environment and engage with nature.

This study aims to assess the impact of the "Mineral Hunters: An Adventure in the Footsteps of Geology" project by examining how it sparked curiosity and awareness about Eskişehir's underground treasure among secondary school students. The study explores the following research questions:

1. How did the educational process within the project affect students' knowledge levels?
2. Do students' test scores vary by gender?
3. Do students' test scores vary by grade level?
4. How do students evaluate their educational experience within the project?

Method

Research Model

The project examined in this study aims to enhance students' knowledge and skill levels through activities carried out within specific objectives. In this regard, it can be considered an

experimental initiative; however, since it also includes a data collection system where students share their experiences related to the process, it has been designed as a mixed-methods study. The explanatory sequential design provides information on how participants interpret the collected quantitative data (Creswell & Plano Clark, 2018).

The quantitative part of the study follows a weak experimental design, specifically a one-group pre-test post-test experimental design, due to the limitations of the project (sample, duration, observation). The selection of this method was significantly influenced by the fact that the target audience consisted of a single group and that the implementation was carried out only once. In a one-group pre-test post-test experimental design, the effect of the experimental intervention is tested through a single group (Cohen et al., 2002).

The qualitative data, on the other hand, were collected using a basic qualitative research approach with a semi-structured interview method (Özdemir & Tuti, 2023). The project, "Mineral Hunters: An Adventure in the Footsteps of Geology" supported by the TÜBİTAK 4004 Nature Education and Science Schools Program, was carried out between June 3-8, 2024, with six days of theoretical and practical activities.

Universe and Sample

The population of the study consists of 6th and 7th grade secondary school students studying in Eskişehir. Since the research included field trips and observations in different regions and was conducted in June, it was carried out with 41 students selected through quota sampling from various schools with parental permission. In cases where there were multiple applicants from the same school, a lottery method was used for selection. As part of the project, a WordPress website titled "Mineral Hunters: An Adventure in the Footsteps of Geology" was created as a free platform. The selected students were announced through this website. Information about the participating students is provided in Table 1 and Table 2.

Table 1.

Distribution of the Sample by Grade Level

Grade	*n*	*%*
6th grade	19	46.3
7th grade	22	53.7

As seen in Table 1, when examining the distribution of secondary school students participating in the project by grade level, it is observed that 19 students are in the 6th grade, while 22 students are in the 7th grade. Considering student participation in the project based on grade level, it can be said that 7th grade students showed slightly more interest in participating in the project.

Table 2.

Distribution of the Sample by Gender

Gender	*n*	*%*
Female	22	53.7
Male	19	46.3

As seen in Table 2, 22 of the participants in the study are female (53.7%), while 19 are male (46.3%). It can be observed that a balance between female and male students has been achieved in the study based on gender.

Data Collection Tools

In the study, data collection tools included a success test administered as a pre-test and post-test, a scientific fieldwork evaluation questionnaire, and a participant satisfaction survey. These tools were designed to measure students' changes in knowledge levels and their satisfaction with the project. The retention of the knowledge gained by the students was determined using field notes kept during activities such as field trips, the fieldwork evaluation questionnaire, competitions, fun games, designs, and exhibitions.

"Mineral Hunters: An Adventure in the Footsteps of Geology" Project Success Test

The success test, consisting of 15 questions, was prepared by geology engineers and an assessment specialist within the scope of the project topics. It was administered as a pre-test to 41 students on the opening day of the project. The first 10 questions of the success test are related to the theoretical knowledge provided during the training, while the last 5 questions focus on the knowledge to be gained through the activities carried out during the field trip. Therefore, the value of each question was set at 6 points for the first 10 questions and 8 points for the last 5 questions. As a result of the analysis of the items using the ITEMAN program, the item discrimination index was found to be .75, and the item difficulty index was .48. The internal consistency of the test was determined using the Kuder-Richardson-20 (KR-20) test, and the result was .71.

Scientific Fieldwork Evaluation Survey

It was prepared to evaluate the participants' assessment of the field trip to the Sarıcakaya site, where the focus was on finding and examining the blue chalcedony stone extracted from the specific location of the field trip. The form contains 25 criteria. Since there is no similar measurement tool in the literature, the project team developed this tool and presented it for review by the measurement and assessment specialist.

Participant Satisfaction Survey

The survey, prepared by the researchers to make a general assessment of the project activity period, measures the effects of the project on students and identifies the positive and negative aspects for future work in terms of implementation. The survey, consisting of two sections, includes 6 multiple-choice questions and 2 open-ended questions, in addition to a section for personal information.

Data Collection and Analysis

A pre-test success test was administered to the participating students before the introductory meeting on the first day of the project. During the research process, trainers and guides were asked to take field notes. On the last day of the research, the participant satisfaction survey was administered. The post-test was conducted within the week following the implementation. The collected data were analyzed using the SPSS software. The data obtained from the pre-test and post-test were analyzed for significant differences using a paired samples t-Test. The mean scores of the scale and sub-factors were examined for normality distribution, and descriptive statistics for the study group were presented.

In addition, for comparing quantitative data, a t-test was used for variables with two sublevels. The satisfaction survey and fieldwork evaluation form were subjected to descriptive analysis. As a principle of confidentiality, students participating in the research were asked to use pseudonyms, and their real names were not included in the data collection tools. In the findings section of the research, the students' names are not explicitly stated, and codes from P1 to P41 were used to represent each student participant in the study.

Ethical Permits of Research:

In this study, all the rules specified to be followed within the scope of "Higher Education Institutions Scientific Research and Publication Ethics Directive" were complied with. None of the actions specified under the heading "Actions Contrary to Scientific Research and Publication Ethics", which is the second part of the directive, have been taken.

Ethics Committee Permission Information:

In this study, all the rules that need to be followed within the scope of the "Regulations on Scientific Research and Publication Ethics of Higher Education Institutions" have been adhered to. None of the actions specified under the title "Actions Against Scientific Research and Publication Ethics" in the second section of the regulation have been performed.

Name of the committee conducting the ethical evaluation = Çanakkale Onsekiz Mart University Rectorate Graduate Education Institute Ethics Committee

Ethics Committee Date of the ethical review decision = 25.07.2024

Publication number of the ethical evaluation document = 11-16

Findings

Findings Related to the Success Test

The Shapiro-Wilk normality test performed on the pre-test and post-test data indicated that the data met the normality assumption. Therefore, in the experimental study, the paired samples t-test, a parametric test, was used to examine the effect of the intervention on the students' knowledge. The results of the paired samples t-Test comparing the students' pre-test and post-test mean scores are presented in Table 3.

Table 3.

Paired Samples t-Test Table (n=36)

		Test statistics	*SD*	*p*	Difference between means	*SE*
Pre-test	Post-test	-14.8	35.0	.000	-6.50	.43
Not. $H_a\ \mu_{\text{Measure 1 - Measure 2}} < 0$						

According to Table 3, a significant difference was observed between the students' pre-test and post-test scores, indicating a positive increase in their knowledge levels within the scope of the project.

Table 4.

Paired Samples t-Test Descriptive Statistics Table (n=41)

	n	*M*	Median	*SD*	*SE*
Pre-test	41	6.03	5.81	2.41	.402
Post-test	41	11.93	12.31	2.11	.351

According to Table 4, the students have learned about the topic through the project activities.

To analyze whether there is a difference in students' pre-test and post-test scores based on gender, the Mann-Whitney U Test was used because the data did not meet the normality assumption (p>.05). The test results are presented in Table 5.

Table 5.

Mann-Whitney U Test Table by Gender

	Test statistics	*p*
Pre-test	190	.82
Post-test	177	.56

According to Table 5, no significant difference was observed in the success scores of students based on gender.

In the analysis of the class level variable, it was found that the normality assumption was not met (p>.05), so the Mann-Whitney U Test was used. The test results are presented in Table 6.

Table 6.

Mann-Whitney U Test Table by Class Level

	Test statistics	*p*
Pre-test	114.5	.216
Post-test	70.0	.006

Not. $H_a\ \mu_{12} \neq \mu_{13}$

When Table 6 is examined, it can be seen that the pre-test and post-test scores of the 6th grade students significantly differ from those of their 7th grade counterparts.

Table 7.

Descriptive Statistics Table According to Class Variable

	Group	*n*	*M*	Median	*SD*	*SE*
Pre-test	6th grade	19	5.53	5.00	2.44	.559
	7th grade	22	6.56	7.00	2.50	.626
Post-test	6th grade	19	11.37	12.00	2.27	.520
	7th grade	22	13.38	13.00	1.36	.340

According to Table 7, students in the 7th grade have higher average pre-test and post-test scores. Additionally, 7th grade students have made more progress compared to 6th grade students.

Findings Related to the Participant Satisfaction Survey

Table 8.

Findings Regarding Students' General Evaluation of the Project Process

Question 1	*f*	%
Avarage	3	7.3
Very bad	1	2.4
Good	11	26.8
Very good	26	63.4

According to Table 8, it is observed that 26 students evaluated the project process as very good, 11 students as good, while three students rated it as average, and one student gave a very bad evaluation.

Table 9.

Findings Regarding Students' Willingness to Recommend the Project to Others

Question 2	*f*	%
I would not recommend it at all.	1	2.4
I would partially recommend it.	1	2.4
I would recommend it.	13	31.7
I would definitely recommend it.	26	63.4

According to Table 9, 26 students stated that they would definitely recommend participating in this type of project to their friends, while 13 students said they would recommend it. One student each stated they would partially recommend it and definitely would not recommend it.

When examining the answers students gave to the question of what aspects of the project they did not like, it was found that their complaints were mainly focused on the instructors not being able to present the lessons in a student-appropriate way and the field trip activities not meeting their expectations. The issues students disliked were related to factors outside the project itself. Some examples of student expressions are:

S15: The date for outdoor activities should be specified according to the weather conditions. Since most of the instructors were from universities, it was boring. If they bring instructors more suited to our age, it wouldn't be so boring.

S31: We couldn't enter the place where the chalcedony was mined in May.

S35: The water was hot, the weather was hot, there were insects, the internet didn't work, there was no internet.

After the project announcement, students applied with certain expectations. The findings regarding how well these expectations were met by the end of the project are presented in Table 10.

Table 10.

Findings Regarding the Project's Ability to Meet Student Expectations

Question 3	*f*	%
No	1	2.4
Partially	10	24.4
Yes	30	73.2

As seen in Table 10, 30 students answered "yes" to the question about whether the project met their expectations, while 10 students answered "partially", and one student answered "no".

Table 11.

Findings Related to Students' thoughts on the Contributions of the Instructors

Question 4	*f*	%
No	1	2.4
Partially	7	17.1
Yes	33	80.5

According to Table 11, it is seen that the students who participated in the training thought that the instructors contributed to their learning processes.

Table 12.

Findings Regarding Students' Thoughts on the Usability of the Knowledge They Gained During the Project at School.

Question 5	*f*	%
No	4	9.8
Partially	13	31.7
Yes	24	58.5

According to Table 12, 24 students believe that the knowledge they gained during the project can be used at school, 13 students think it can be partially used, and 4 students think it cannot be used.

Table 13.

Findings on Students' thoughts Regarding the Usability of the Knowledge They Gained during the Project Outside of School

Question 6	*f*	%
No	2	4.9
Partially	8	19.5
Yes	31	75.6

Table 13 shows that 31 students believe the knowledge they gained during the project is usable outside of school. Eight students think the knowledge is partially usable, while two students have expressed that it is not usable.

Table 14.

The Reasons why Students liked the Training

Reason for liking	*f*
Acquiring new knowledge/skills	21 (13, 14, 15, 16, 17, 20, 21, 22, 23, 24, 25, 28, 29, 30, 38, 39, 40)
Having fun	15 (11, 12, 13, 16, 21, 22, 23, 24, 30, 39)
Making new friends	9 (12, 14, 15, 21, 27, 34, 39, 40)
Quality of instructors	5(15, 17, 18, 22, 34)
Seeing new places	5 (17, 18, 26, 27, 28)
Having many activities	3 (24, 34, 37)
Receiving various rewards	3 (24, 9, 11)
Quality of food	3 (3, 12, 23)
Reinforcing existing knowledge	3 (10, 19, 37)
Learning by doing	1 (6)
Not going to school	1 (14)
Closely examining nature	1 (4)
Feeling special	1 (21)

According to Table 14, it is observed that students were highly satisfied with the training because they gained new knowledge and skills, had fun, and made new friends. Overall, students seem to have a positive attitude toward motivating and innovative practices. Examples of answers from students about why they liked this training are as follows:

S9: "I think it was a great project from the beginning. The nature walk on Tuesday and the blue chalcedony collecting activity were great. I learned different new things. I got various natural stones. The games and other activities were nice… I think it was a good project."

S21: "We were all special, separate from everyone else. That's why we had so much fun. The gifts, the knowledge, and the friends were all great. I am very thankful to everyone.

I gained new knowledge for 6 days. It was the best day of my life. A day like that would never have come my way. That's why I liked it so much."

S24: "They welcomed us very well. We went to the Rock Park. We went to the Mayıslar village of Sarıcakaya. I collected chalcedony there because I was very curious about them. We took a walk, they welcomed us well, they paid attention to us, they made us play games, they treated us well, they showed us gemstones from all 81 districts of Türkiye. They had a fruit activity, gave us special gemstones as gifts, gave us natural gemstones that could be made into bracelets. Whenever we were thirsty, they gave us water."

Table 15.

Shortcomings seen by Students in Educational Activities

Shortcomings	*f*
Temperature	18
No s*hortcomings*	12
Theoretical explanation of lessons	5
Walking duration and route during the trip	5
Bugs	4
Long lessons	3
Random assignment of groups	2
Lack of internet/no signal on phones	2
Physical inadequacy of the educational environments	2
Shortcomings in the food organization	2
Some activities being found to be boring	1

When students were asked about the shortcomings they observed in the educational activities they participated in within the project as part of the Student Satisfaction Survey, Table 15 shows that the students most frequently complained about the temperature. The mining area where the field trip took place is located in the hottest part of the region due to its microclimatic climate. Additionally, walking distances and insect issues encountered during the field trip were also considered shortcomings. In 12 responses, no shortcomings were mentioned. With the exception of the theoretical teaching of the lessons (f=5) and the long lesson durations (f=1), the shortcomings were related to the field trip activities.

Table 16.

Activities that were not liked by the Students

Disliked activities	*f*
Theoretical lessons.	5
Trips	4
Mineral collecting	1

According to Table 16, when students were asked about the activities they did not like, it was generally observed that the activities were liked. However, some students stated that they did not enjoy theoretical lessons (f=5), the field trip (f=4), and the mineral collecting (f=1) activity.

When students were asked why they did not like this training, the following responses were given:

S3: "In some places, they tired us by explaining the topic. However, it was very fun. The only problem was that some of the information and topic explanations were a bit boring."

S16: "The heat made us very uncomfortable. It would have been better if it were cooler. The food was delicious…"

S21: "More field trips could have been made, and we could have gone to Sarıcakaya at a time when the weather was cooler."

Findings Related to the Scientific Fieldwork Evaluation Survey

One of the prominent aspects of this project is that students observe the subject in the field and engage in hands-on, experiential learning. To gather students' opinions about the fieldwork, a fieldwork evaluation survey was used. The responses from the students to this survey are presented in Table 17.

Table 17.

Findings Regarding the Fieldwork Evaluation Form

Evaluation criteria	*M*
1. The fieldwork activities helped in understanding the topics learned.	1.68
2. The fieldwork was a waste of time.	.32
3. The thing I liked most during the field trip was the nature walk.	1.10
4. The thing I liked most during the field trip was collecting stones.	1.77
5. I would like to participate in more field trips because it helped me learn the topics more easily.	1.15
6. I would like to participate in more field trips because they were fun.	1.45
7. What I observed during the field trips did not help in understanding the topics taught in the activities.	.57
8. I like field trips that include nature walks.	1.35
9. The thing I liked most during the field trip was making observations.	1.35
10. I enjoy participating in field trips to understand my surrounding environment.	1.50
11. I gained a lot of experience during the field trip.	1.55
12. Field trips increase people's awareness of environmental issues.	1.40
13. Field trips are important for visualizing the topics learned.	1.77
14. The topics I learned during field trips stay in my mind for a long time.	1.40
15. I would like more field trips to be held because of the knowledge I gained in mineralogy.	1.20
16. I do not like field trips that have too many nature walks.	.62
17. I would like more field trips to be held because they strengthen teamwork.	1.32
18. Learning in the classroom is more effective than learning in the field.	.55
19. Field trips make me more interested in the topics taught in class.	1.50
20. Getting to know the underground resources of my region and country excited me.	1.52
21. The fieldwork did not increase my interest in the science of mineralogy.	.65

One of the most important features of this project is the provision of on-site observation opportunities to students through fieldwork. When the fieldwork evaluation form is examined, as seen in Table 17, it is observed that students better understood the region's underground resources through such a study (M=1.75), got to know the region better (M=1.52), became more interested in theoretical topics (M=1.50), reinforced their learning (M=1.68), and showed increased interest in such activities. It has been observed that the hands-on experiences gained by the students increased the retention of theoretical lessons, creating awareness among the students about its effectiveness.

Discussion and Conclusion

It has been understood that secondary school students who actively participated in the TÜBİTAK 4004 project "Mineral Hunters: An Adventure in the Footsteps of Geology" for six days in different locations and environments acquired basic knowledge related to mineralogy. In TÜBİTAK 4004 projects conducted between 2016-2020, secondary school students were also targeted as the primary audience, and the projects were generally written with goals such as "establishing interdisciplinary relationships," "raising environmental awareness," and "developing scientific process skills" (Bostan Sarıoğlan et al., 2022).

In the "Mineral Hunters: An Adventure in the Footsteps of Geology Project," a significant difference was observed between the pre-test and post-test scores, indicating that the students' knowledge level increased during the project. It can be said that the training sessions provided by expert instructors in areas such as Basic Geology Training and Basic Mineralogy Training were effective in achieving this result. During these sessions, students were introduced to general geology terms that are not included in the elem secondary school science curriculum for 5th, 6th, 7th, and 8th grades. Information was provided on topics such as the formation of the Solar System and the universe, plate tectonics and the formation of the Earth, subfields of geology, geological time periods, rock types and cycles, minerals, fossils, faults, and folds, all of which had different content and visuals compared to the 5th, 6th, and 7th grade science textbooks. Yoloğlu and Uçar (2015) in their study evaluating the contributions of the TÜBİTAK-4004 project they implemented, reported that students showed progress in their knowledge levels and that the project had positive effects on students' social and behavioral development. Karakoç Topal (2022) also noted that after participating in TÜBİTAK 4004 projects, elementary secondary school students' awareness of environmental protection increased, their knowledge of various disciplines improved, and they learned to use certain basic scientific processes and life skills.

In this study, it was found that the gender variable did not have an effect on students' success scores. In a study conducted by Uğraş et al. (2021) with fourth-grade secondary school students, it was stated that students' success scores related to microorganisms did not vary based on gender, and a similar result was obtained in this study.

A significant difference was observed in the pre-test and post-test scores of students in the 6th grade compared to their peers in the 7th grade. Additionally, the 7th grade students made more progress in terms of their pre-test and post-test average scores compared to the 6th grade students. This situation may be attributed to the developmental stage of 7th-grade students. According to Piaget, individuals enter the stage of formal operations at the age of 11 and beyond, and at this stage, they reach a higher level of logical thinking (Sezen & Bülbül, 2011; as cited in Başarer, 2021).

According to Mahgoup (2014), field trips are an essential tool for understanding events and situations more easily and for facilitating learning. Field trips provide students with the opportunity to learn through practical experiences, ensuring that learning becomes more permanent. Additionally, field trips enhance students' social interactions by allowing them to interact in a social environment and share their experiences. In this study, it was observed that

students were able to distinguish semi-precious gemstones and minerals, gained awareness of geology and mineralogy, and achieved the targeted digital competencies through field trips and hands-on activities. This result aligns with one of the objectives of the TÜBİTAK 4004 program, which is to provide participants with an interdisciplinary perspective through observations and applications in various fields (TÜBİTAK, 2024). Out-of-school learning environments, such as field trips, are learning settings that demonstrate the connection between theoretical knowledge and real life, offering students opportunities for skills development such as observation, data collection, and drawing conclusions from the data they gather, as well as experiential learning (Baygül, 2023; Kır et al., 2021). Studies by Tortop (2012), Topçu and Atabey (2016), and Baygül (2023) have also highlighted the significant impact of field trips on increasing students' knowledge levels and scientific awareness on various topics.

A large number of students who indicated that they learned while having fun during the process expressed in the satisfaction survey that they liked the project, that it met their expectations, and that they would recommend it to their friends. Through the creative writing and creative drama workshops conducted on the two days following the field trips, students had the opportunity to express their emotions and thoughts both about the project and the new field of mineralogy. Supporting this result, the statement "Drama activities frequently included in projects have developed the scientific creative thinking skills of participating students and made them enjoy science and scientific work" (Orhan, 2022) is also a point mentioned in many TÜBİTAK 4004 projects. Avcı et al. (2015), in their evaluation of a TÜBİTAK-4004 project conducted with secondary school students, stated that students achieved certain outcomes after the activities, and the poems and activities students prepared as part of the project had a significant impact on them. They concluded that students both had fun and enjoyed the project. It can be said that TÜBİTAK 4004 projects foster positive effects by ensuring active participation of students in the process, especially for secondary school students.

It is evident that students who were introduced to a new field through the project were positively influenced by the hands-on activities they participated in after receiving theoretical training, allowing them to express themselves. These activities provided data for the project's evaluation and assessment phase and contributed to the interdisciplinary structure of the project. However, some students pointed out aspects they didn't like about the project, such as theoretical lessons, high temperatures, insects, and poor internet connection, which caused the field activities to fall short of expectations. Karakoç Topal's (2022) TÜBİTAK-4004 project with secondary school students includes similar results. After the implementation of the project, students evaluated most of the activities as fun, but considered those where the instructor used a straightforward explanation or activities that took place toward the end of the day to be boring.

In another question, students stated that the instructors involved in the project were sufficient, contributed to their learning, and helped them with their school lessons. It was also found that students believed they could use the knowledge gained through the project more effectively outside of the school environment. This statement could be interpreted as indicating

that the topics presented in the project were not fully aligned with the school environment and the teaching programs offered in schools.

Students have liked the project training because they gained new knowledge and skills, had fun, and made new friends during the project. A similar result was reached in the TÜBİTAK 4004 project "7/24 Science Camp" by Tatlı and Eroğlu (2021). Orhan (2022) also supports this result in his study, stating that students coming from different places participated in activities with their peers, were influenced by the opinions of others, gained new knowledge and skills, and thus developed a love for science and scientific work. Metin et al. (2023) also highlighted the positive aspects of TÜBİTAK 4004 projects in their study with seventh-grade secondary school students. They observed that students' ability to deepen existing knowledge, socialize, gain experiences on the topics, have fun, and gain different perspectives on the subject increased.

When students were asked about the activities they did not like in the project, it was generally observed that the activities were well received by the students. However, some students mentioned that they did not like the theoretical lessons, the field trip, and the mineral collecting activity. Upon examining the fieldwork evaluation form, it was noted that students gained a better understanding of the region's underground resources, became more familiar with the area, showed increased interest in theoretical subjects, reinforced their learning, and grew more interested in such activities. These results align with the findings of Dilli et al. (2018), who indicated that out-of-school learning environments, in collaboration with schools, can raise students' awareness of natural resources and how they are used. This can create a foundation for introducing and properly utilizing resources that will guide the future.

Recommendations

In light of the results obtained from the study, it is recommended that similar works, which allow students to learn by doing and observe on-site, be promoted. The need to increase interactive activities and field trips, which are not included in the teaching program related to minerals and mining and are not found in the textbooks of subjects like secondary school science and social studies, has been understood through this project. It has been observed and understood that the drama activities offered to students within the scope of the project were also effective. More activities can be conducted in schools using the creative drama method. Students have developed awareness of topics such as the physical properties and economic value of minerals in a geological context. Therefore, it is believed that increasing such project-based works will be important.

The project was limited to the province of Eskişehir. TÜBİTAK 4004 projects could be developed in different provinces, taking into account the mineral structure of those provinces and expanding the content of the project. Additionally, similar studies could be conducted with students at different levels of education or in different educational stages. In this project, conditions such as high temperatures during the planning process of field trips affected the students. In this context, for future projects, changes in the dates can be made, considering the high temperatures during the implementation process. Based on the fact that students preferred practical and interactive processes, it is suggested that future project work involve

discussions with academics who conduct theoretical teaching, to explore the possibility of transferring theoretical content to students using different techniques, or limiting the time allotted for such lectures in the process.

The project can be evaluated using different assessment tools, such as success tests and field evaluation forms, along with other diverse evaluation methods. The opinions of the instructors and experts who participated in the project implementation process can also be gathered, expanding the evaluation efforts and allowing the effects of the project to be examined from different perspectives. To determine the long-term impacts of the project, follow-up evaluations can be conducted after a period of six months to a year following the implementation process. For the long-term effectiveness of TÜBİTAK 4004 projects, the progress of students who participated in the project can be monitored through feedback conducted at specific intervals. Additionally, it is suggested that the scope of the study be expanded and applied to a broader audience in different contexts.

References

American Geological Institute (2006). *Curriculum materials for teachers.* Retrieved October 30, 2024, from http://www.agiweb.org/education/teachers/curriculum_materials.html

Anderson, D., Kisiel, J., & Storksdieck, M. (2006). Understanding teachers' perspectives on fielstrips: Discovering common ground in three countries. *Curator, 49*(3), 364-386.

Arpacı, İ. (2018). Üniversite öğrencilerinin inovasyon profilleri ile proje geliştirme dersindeki akademik başarıları arasındaki ilişkinin incelenmesi [An investigation of the relationship between university students' innovativeness profile and their academic success in the project development course]. *Journal of Entrepreneurship and Innovation Management, 7*(2), 79-95.

Avcı, E., Özenir, Ö. S., Kurt, M., & Atik, S. (2015). TÜBİTAK 4004 doğa eğitimi ve bilim okulları kapsamında ortaokul öğrencilerine yönelik gerçekleştirilen "Bizim Deniz Akdeniz" projesinin değerlendirilmesi [Evaluation of the "Our Sea is the Mediterranean" project carried out for secondary school students within the scope of TÜBİTAK 4004 nature education and science schools]. *Amasya Education Journal*, *4*(2), 312-333.

Başarer, D. (2021). Mantıksal düşünmeyi geliştiren etkinlik örnekleri [Activity examples that develop logic thinking]. *Millî Eğitim Dergisi, 50*(231), 335-352.

Baygül, A. (2023). Okul dışı öğrenme ortamlarında yapılan etkinliklerin öğrencilerin enerji kaynaklarına yönelik farkındalıklarına ve bilgi düzeylerine etkisi [The effects of activities in out-of-school learning environments on students' awareness and knowledge levels regarding energy resources]. *Journal of Uludag University Faculty of Education*, *36*(3), 840-865.

Blake, A. (1999). *Children's understanding of aspects of earth science at key stage 2: Conceptions and conceptual change* [Unpublished doctoral dissertation]. University of Newcastle.

Blake, A. (2004). Helping young children see what is relevant and why: Supporting cognitive change in earth science using analogy. *International Journal of Education, 26*, 1855-1873.

Bostan Sarıoğlan, A., Dolu, G., & Sevim, N. (2022). Thematic content analysis for TÜBİTAK 4004 science projects. *Educational Academic Research, 44*(1), 11-19.

Buldur, S., Bursal, M., Erik, N. Y., & Yucel, E. (2020). The impact of an outdoor education project on middle school students' perceptions and awareness of the renewable energy. *Renewable and Sustainable Energy Reviews, 134,* 110364.

Çıray Özkara, F. (2024). Afet farkındalığı için proje yazımı [Project writing for disaster awareness]. In İ. Usta (Ed.). *Acil durum ve afet farkındalık eğitimi* [Emergency and disaster awareness training] (pp. 130-161). Anadolu Üniversitesi Açıköğretim Fakültesi.

Cohen, L., Manion, L., & Morrison, K. (2002). *Research methods in education*. Routledge.

Creswell, J. W., & Plano Clark, V. L. (2018). *Karma yöntem araştırmaları: Tasarımı ve yürütülmesi* [Mixed methods research: Design and conduct] (Y. Dede & S. B. Demir, Trans.). Anı.

Dilli, R., Bapoğlu Dümenci, S., & Turgut Kesebir, G. (2018). Müzede çevre eğitimi kapsamında okul öncesi dönemi çocuklarına yenilenebilir enerji kaynaklarının anlatılması [Explaining renewable energy sources to preschool children as part of environmental education in the museum]. *Electronic Journal of Social Sciences*, *17*(66), 421-432.

Ece, Ö. I., & Çoban, F. (1994). Geology, occurrence and genesis of Eskişehir sepiolites, Turkey. *Clays and Clay Minerals*, *42*, 81-92.

Erkoyun, H., & Bozkurt, R. (2005, April 29-30). *Değerli taş aramalarına bir örnek*: *Zümrüt* [An example of gemstone searches: Emerald]. Uluslararası Değerli Taşlar ve Metaller Sempozyumu, İstanbul, Türkiye.

Fonseca, R. P. (2023). The impacts of animal farming: A critical review of secondary and high school textbooks. *Cultural Studies of Science Education, 18,* 829-852.

Ford, D. J. (2005). The challenges of observing geologically: Third graders' descriptions of rock and mineral properties. *Science Education, 89*, 276-295.

Gogoi, K., Deshmukh, B., & Mishra, M. (2016). Challenges and opportunities in geoscience education in open and distance learning: Indian scenario. *Learning Community-An International Journal of Educational and Social Development*, *7*(2), 117-126.

Gündoğan, İ., & Özbaş, Ü. (2017, April 10-14). *Sarıcakaya (Eskişehir) kalsedon oluşumların mineralojisi-petrografisi ve kökeni* [Mineralogy-petrography and origin of Sarıcakaya (Eskişehir) chalcedony ocurrence]. 70th Geological Congress of Turkey, Ankara, Türkiye.

Hatipoğlu, M., & Chamberlain, S. C. (2009). Ancient deposits of blue chalcedony in Turkey. *The Australian Gemmolist*, *23*, 566-573.

Hatipoğlu, M., & Kibici, Y. (2010, June 3-6). *Türkiye'deki mavi kalsedonların özellikleri ve madensel üretimi* [Charecteristics and mining production of blue chalcedonies in Turkey]. 2nd Jewellery Design and Education Symposium with International Participants, Kütahya, Türkiye.

Hatipoğlu, M., Kibici, Y., & Chamberlain, S. C. (2013). Characterization of the Sundikendagi deposit of moganite-rich, blue chalcedony nodules, Mayislar-Sarıcakaya (Eskişehir), Turkey. *Ore Geology Reviews, 54,* 127-137.

Henriksson, A. C. (2018). *Primary school teachers' perceptions of out of school learning within science education* (EJ1227643). ERIC. https://eric.ed.gov/?id=EJ1227643

Johnson, C. J. (2004). NANA "Rocks" problem-based learning. *Science Scope, 28*, 48-49.

Kadir, S., Erkoyun, H., Eren, M., Huggett, J., & Önalgil, N. (2016). Mineralogy, geochemistry, and genesis of sepiolite and palygorskite in Neogene lacustrine sediments, Eskişehir Province, West central Anatolia, Turkey. *Clays and Clay Minerals*, *64*(2), 144-165.

Karakoc-Topal, O. (2022). Ortaokul öğrencilerinin gözünden bir TÜBİTAK 4004 projesi: Bilimleri birleştir, doğayı güzelleştir! [A TÜBİTAK 4004 project through the eyes of secondary school students: Combine sciences, beautify nature!]. *Buca Faculty of Education Journal*, (53), 638-666.

Kır, H., Kalfaoğlu, M., & Aksu, H. H. (2021). Mathematics teachers' opinions on the use of out-of-school learning environments. *International Journal of Educational Studies in Mathematics, 8*(1), 59-76.

Küçükoğlu, A. (2014). Okulöncesi eğitim kurumlarında program geliştirme [Program development in preschool education institutions]. In R. Y. Kıncal (Ed.). *Okulöncesi eğitim kurumlarında program uygulamaları* [Program applications in preschool education institutions] (pp. 2-22). Atatürk Üniversitesi Açıköğretim Fakültesi.

Lutgens, F. K., & Tarbuck, E. J. (2013). *Genel jeoloji temel kavramlar* [Basic concepts of general geology]. Nobel.

Mahgoup, Y. (2014). The impact of field trips on students' creative thinking and. practices in arts education. *American Journal of Science, 10*(1), 46-50.

Makri, K., Danaskos, F., & Tzima, M. (2020). Out-of-classroom activies for geosciencen education. *European Geologist*, *50,* 25-28.

Metin, M., Serin, H. K., Korkman, N., Oner Armağan, F., & Kolomuç, A. (2023). Yedinci sınıf öğrencilerinin gözünden bir TÜBİTAK 4004 projesi: Araştırıyorum, sorguluyorum bilimi çok seviyorum [A TÜBİTAK 4004 Project through the eyes of seventh grade students: I research, I question, I love science]. *Maarif Mektepler International Journal of Social and Human Sciences*, *6*(1), 1-18.

Monroe, J. S., & Wicander, R., (2005). *Fiziksel jeoloji yeryuvarının araştırılması* [Physical geology the study of the earth]. TMMOB Jeoloji Mühendisleri Odası [TMMOB Chamber of Geological Engineers].

National Research Council (1996). *National science education standarts*. National Academy.

Orhan, M. (2022). TÜBİTAK 4004 doğa eğitimi ve bilim okulu projelerinin bilimin, bilimsel çalışmaların, popüler bilimin çocuklar arasında sevilmesine, yaygınlaşmasına katkısı [TÜBİTAK 4004 nature education and science school projects' contribution to the popularization and spread of science, scientific studies and popular science among children]. *Journal of Continuous Vocational Education and Training*, *5*(1), 17-31.

Özdemir, M., & Tuti, G. (2023). Nitel araştırma desenleri: Metodolojik bir temellendirme [Qualitative research designs: A methodological foundation]. *Cankiri Karatekin University Journal of Faculty of Letters*, *11*(2), 217-235.

Parlak, B. (2016). *Mayıslar (Sarıcakaya-Eskişehir) polimetalik cevher oluşumlarının jeolojik incelenmesi* [Geological investigations on polymetallic ore formations of Mayıslar (Sarıcakaya-Eskişehir)]. (Publication No.434769) [Doctoral dissertation, Ankara University]. National Thesis Center.

Reid-Griffin, A. (2016). Learning the language of earth science: Middle school students' explorations of rocks and minerals. *European Journal of STEM Education, 1*(2), 45-51.

Saraç, H. (2017). Türkiye'de okul dışı öğrenme ortamlarına ilişkin yapılan araştırmalar: İçerik analizi çalışması [Researches related to outdoor learning environments in Turkey: Content analysis study]. *Journal of Education, Theory and Practical Research, 3*(2), 60-81.

Sarıız, K. (2000). The geology, mineralogy, and occurrence of bedded sepiolite deposits in the Akçayır-Yürükakçayır (Eskişehir) lacustrine basin, central Turkey. *Exploration Mining Geology*, *9*(3-4), 265-275.

Scientific and Technological Research Council of Türkiye (TÜBİTAK). (2024). *TÜBİTAK 4004 doğa eğitimi ve bilim okulları destekleme programı* [TÜBİTAK 4004 nature education and science schools support program]. Retrieved November 13, 2024, from https://tubitak.gov.tr/tr/destekler/bilim-toplum/ulusal-destek-programlari/4004-doga-egitimi-ve-bilim-okullari-destekleme-programi

Şen, A. İ. (2021). Okul dışı öğrenme nedir? [What is out-of-school learning?] In. A. İ. Şen (Ed.), *Okul dışı öğrenme ortamları* [Out-of-school learning environments] (pp. 2-21). Pegem.

Tatlı, E., & Eroğlu, D. (2021). TÜBİTAK 4004 doğa ve bilim okulları: Burdur "7/24 bilim" kampı [TÜBİTAK 4004 nature and science schools: Burdur "7/24 science" camp]. *Mehmet Akif Ersoy University Journal of The Institute of Educational Sciences, 9*(11), 87-106.

Topçu, M. S., & Atabey, N. (2016). Alan gezilerinin ortaokul öğrencilerinin çevre konusundaki bilgi ve tutumları üzerine etkisi [The effects of field trips on secondary school students' knowledge and attitudes towards the environment]. *Van Yüzüncü Yıl University Journal of Education, 13*(1), 494-513.

Tortop, H. S. (2012, October 17-21). *Using [of] the meaningful field trip in renewable energy education: Its effects on students' learning and attitudes.* 9th International Conference on Hands-on Science, Antalya, Türkiye.

Uğraş, S., Sipahi, N., Dursun, H., Keçeli, F., Eriş Hasırcı, H. M. & Fidan, A. (2021). An activity-based teaching model: Microworld journey-3 project. *International Journal of Turkish Educational Sciences, 10*(17), 31-44.

Vallejo, J. R., Calaco, A., & Costillo, E. (2019, March 11-13). *Methodological strategy in a seminar on "Knowledge of the environment": A bibliographic review conducted by primary teacher training students from a model based on an educational experiment.* 13th International Technology, Education and Development Conference, Valencia, Spain.

Van der Hoeven Kraft, K. J. (2017). Developing student interest: An overview of the research and implications for geoscience education research and teaching practice. *Journal of Geoscience Education, 65*(4), 594-603.

Yoloğlu, A., & Uçar, M. (2015). Kültür varlıkları ve koruma konusunda aktif öğrenme temelli tasarlanan bir TÜBİTAK-4004 projesi değerlendirmesi [Evaluation of a TÜBİTAK-4004 project designed based on active learning on cultural heritage and conservation]. *Mersin University Journal of the Faculty of Education*, *11*(3), 1043-1062.

BIOGRAPHICAL NOTES

Contribution Rate of Researchers

Author 1: 21%

Author 2: 19%

Author 3: 18%

Author 4: 17%

Author 5: 15%

Author 6: 10%

Support and Thanks

This research was supported by the TÜBİTAK-4004 Nature Education and Science Schools Program with project number 123B776.

Conflict Statement

There is no conflict of interest that the authors will declare in the research.

Notice of Use of Artificial Intelligence

The authors did not utilise any artificial intelligence tools for the research, authorship and publication of this article.

"Mineral Avcıları: Jeolojinin İzinde Bir Macera" İsimli Projenin Etkilerinin İncelenmesi

Özet

Bu çalışma, TÜBİTAK destekli "Mineral Avcıları: Jeoloji İzinde Bir Macera" projesinin Eskişehir'deki ortaokul öğrencileri üzerindeki etkisini incelemektedir. Proje, öğrencilerin bölgedeki yer altı kaynaklarına, özellikle yarı değerli taşlar ve minerallere olan meraklarını artırmayı ve jeoloji konusunda pratik deneyimler sunmayı hedeflemiştir. Altı gün süren proje çalışmaları 41 altıncı ve yedinci sınıf öğrencisiyle gerçekleştirilmiş ve teorik ile uygulamalı etkinlikler, atölye çalışmaları, saha gezileri ve yaratıcı etkinlikler içermektedir. Karma yöntem modellerinden açımlayıcı sıralı desen ile desenlenen çalışmada, öğrencilerin projeden önce ve sonra bilgi düzeylerini ölçmek amacıyla ön test ve son test uygulaması yapılmıştır. Sonuçlar, öğrencilerin mineraloji ve jeoloji konusundaki bilgilerinde anlamlı bir artış olduğunu göstermiş, yedinci sınıf öğrencilerinin daha yüksek başarı gösterdiği görülmüştür. Öğrencilerin çoğu, özellikle uygulamalı etkinlikler ve yaratıcı drama atölyelerinden keyif aldıklarını belirtmiştir. Ancak bazı öğrenciler, alan gezilerinde karşılaşılan hava koşulları ve internet bağlantısının zayıf olması gibi nedenlerle aktivitelerinden memnun kalmadıklarını ifade etmiştir. Genel olarak proje, öğrencilerin jeolojiye olan ilgisini ve bilgilerini artırmada etkili olmuş ve deneyimsel öğrenmenin bilimsel konulara daha derinlemesine ilgi uyandırmada değerli olduğu sonucuna varılmıştır. Çalışmadan elde edilen sonuçlar ışığında; öğrencilerin yaparak yaşayarak öğrenmelerine ve yerinde gözlem yapmalarına imkân tanıyan benzer çalışmaların yaygınlaştırılması önerilmektedir.

Anahtar Kelimeler: Jeoloji, kayaçlar, mavi kalsedon, okul dışı öğrenme, mineraloji, bilim okuryazarlığı, TÜBİTAK.

Giriş

Jeoloji, yerkürenin oluşumu ve gelişimi ile, mineralleri, kayaçları, depremleri, volkanik aktiviteleri, yerküre içinde ve yüzeyinde gelişen bütün süreçleri inceleyen bilim dalıdır (Monroe & Wicander, 2007). Jeoloji bilgisi, öğrencilerin çevre sorunları ile insan faaliyetleri arasındaki ilişkiyi anlamada yardımcı olur (Vallejo vd., 2019). Aynı zamanda jeoloji eğitimi, petrol, gaz ve mineral kaynakların bulunması ve doğal afetlerin anlaşılmasında da önemlidir (Gogoi vd., 2016). Ortaokul öğrencileri üzerinde Amerika Birleşik Devletleri [ABD] ve Avrupa'da yürütülen araştırmalara göre kayaçlar, mineraller, yapısal unsurlar hakkında kavramsal fikirler edindikleri (Blake 1999; Ford 2005) fakat jeolojik süreçleri anlamada zorluk yaşadıkları ortaya konulmuştur (Reid-Griffin, 2016). Ortaokul öğrencilerinin dünyanın yapısı ve tarihi hakkındaki bilgisi, teorik bilgilerine, deneysel gözlemler yapma ve kayaç oluşumlarının özelliklerini tanımlama yeteneklerine dayanır ve öğrencilerin gözlem becerilerini geliştirmelerine, bilgi, gözlem ve fikir sorularında bilimsel araştırmayı daha çok kullanmalarına neden olabilir (Ford, 2005; National Research Council, 1996; Reid-Griffin, 2016).

Öğretim programları öğrencilerin jeoloji ile ilgili kavramları öğrenmeleri için uygulamalı, sorgulamaya dayalı yer bilimi etkinlikleri sunarak, öğrencilerin ihtiyaçlarını karşılayacak şekilde düzenlenmelidir (American Geological Institute, 2006; Blake, 2004;

Johnson, 2004). Jeolojiyi okul dışı aktivitelerle (arazi çalışması, laboratuvar faaliyetleri, müze gezileri, atölye çalışmaları vb.) destekleyerek sunmak, öğrencilerin jeolojik kavramları daha iyi anlamalarına, teorik ve pratik bilgileri birleştirerek problem çözme yeteneklerinin artırılmasına yardımcı olacaktır (Makri vd., 2020). Alan gezileri öğrencilerin araştırma, sorgulama, problem çözme gibi birçok becerilerinin kullanımına fırsat vererek olayın yerinde incelenmesi ve buna bağlı olarak öğrenme gereksinimlerinin karşılanması açısından çok önemli bir işleve sahiptir (Küçükoğlu, 2014).

Türkiye Bilimsel ve Teknolojik Araştırma Kurumu'nun [TÜBİTAK] 4004, 4005, 2237-A vb. kodlu bazı projelerinde okul dışı öğrenmeyi destekleyici içerikler bulunmaktadır. Bu projelerle okul dışı ortamların yenilikçi olarak eğitim-öğretim amaçlı yeniden ele alınması gerekliliği ortaya çıkarılmıştır (Şen, 2021). TÜBİTAK 4004 projelerinin; özellikle yaparak yaşayarak öğrenmeyi temel alan uygulamalı etkinlikleriyle, bilimin ve bilimsel çalışmaların sevdirilmesinde, popüler bilimin çocuklar arasında yaygınlaştırılmasında etkin rol oynadığı belirtilmektedir (Orhan, 2022).

Eskişehir; İç Anadolu Bölgesi'nde yer alan, jeolojik ve iklimsel bir geçiş bölgesi üzerine konumlanmış, yer altı kaynakları açısından zengin bir il olarak görülmektedir. Türkiye'ye özgü birkaç yarı değerli taş ve mineralden iki tanesi olan lületaşı ve mavi kalsedon ise yalnızca Eskişehir'de çıkarılmaktadır (Gündoğan & Özbaş, 2017; Hatipoğlu vd., 2013; Kadir vd., 2016; Sarıiz, 2000). Bu iki taştan lületaşı toplumca tanınıyor olsa da özellikle Uzakdoğu değerli taş piyasasında önemli bir yeri olan mavi kalsedon, çıkarıldığı Eskişehir ilinde yeterince bilinmemektedir. Dünyaca ünlü olan mavi kalsedon gibi yalnızca Eskişehir'de çıkarılan lületaşı başta olmak üzere, bor minerali, opal, akik, çeşitli kalsedon ve kuvars türleri, serpantin ve hatta konumu tam olarak bilinmese de Osmanlı döneminde çıkarıldığı bilinen zümrüt gibi birçok türe ev sahipliği yapan Eskişehir'de bu türlerin birçoğu toprak yüzeyinde kolaylıkla bulunabilmekte, sıradan kayaçlardan temel bir eğitim ve basit bir saha tecrübesi ile ayırt edilebilmektedir (Erkoyun & Bozkurt, 2005).

Bu çalışmada Eskişehir ilinin yeraltı zenginlikleri konusunda ortaokul öğrencilerinde merak ve bilinç uyandırılması, öğrencilerin mineraller ve yarı değerli taşlar konusunda temel bilgileri yaparak yaşayarak edinmeleri ve bu kazanımların uygulamalı farklı yöntem ve tekniklerle öğrencilere aktarılması amacıyla gerçekleştirilen "Mineral Avcıları: Jeolojinin İzinde Bir Macera" projesinin etkilerinin incelenmesi amaçlanmaktadır. Bu amaç kapsamında araştırmada yanıt aranan sorular şöyledir:

1. Proje kapsamında gerçekleştirilen eğitim süreci öğrencilerin bilgi düzeylerinde ne gibi bir değişime yol açmıştır?

2. Öğrencilerin test puanları cinsiyete göre değişmekte midir?

3. Öğrencilerin test puanları sınıf düzeyine göre değişmekte midir?

4. Öğrenciler proje kapsamında katıldıkları eğitim sürecini nasıl değerlendirmektedir?

Yöntem

Araştırmanın Modeli

Bu çalışmada etkileri incelenen proje, belirli amaçlar çerçevesinde yapılan etkinlikler ile öğrencilerin bilgi ve beceri düzeylerini arttırmayı hedeflemektedir. Bu açıdan deneysel bir girişim olarak görülebileceği gibi aynı zamanda öğrencilerin süreç ile ilgili deneyimlerini aktardıkları bir veri toplama sistematiğine sahip olduğundan karma yöntem olarak tasarlanmıştır. Proje, açımlayıcı sıralı desen kullanılarak karma yöntemle yürütülmüş; "Mineral Avcıları: Jeolojinin İzinde Bir Macera" adlı TÜBİTAK 4004 projesine katılan öğrencilerin bilgi düzeyindeki değişimi ölçmek amacıyla tek grup ön test-son test desenine dayalı nicel veri analizi gerçekleştirilmiştir.

Evren ve Örneklem

Araştırmanın evreni Eskişehir ilinde öğrenim görmekte olan ortaokul 6 ve 7. sınıf öğrencileridir. Araştırma farklı bölgelerde gezi gözlem çalışmalarını içerdiği ve haziran ayında yapıldığı için veli iznine sahip farklı okullardan kota örnekleme yoluyla seçilen 41 öğrenci ile yürütülmüştür.

Veri Toplama Araçları

"Mineral Avcıları: Jeolojinin İzinde Bir Macera" adlı TÜBİTAK 4004 projesi kapsamında 41 ortaokul öğrencisiyle altı gün süren etkinlikler gerçekleştirilmiştir. Etkinlikler; teorik eğitimler, yaratıcı drama ve yazarlık atölyeleri, laboratuvar çalışmaları, doğa yürüyüşleri, arazi gözlemleri ve taş toplama etkinlikleri gibi çok yönlü uygulamalı süreçlerden oluşmuştur.

Bu araştırmada veri toplama araçları olarak ön test ve son test şeklinde uygulanan başarı testi ile bilimsel arazi çalışması değerlendirme anketi ve katılımcı memnuniyet anketi kullanılmıştır. Bu araçlar, öğrencilerin bilgi düzeyindeki değişimlerini ve proje ile ilgili memnuniyetlerini ölçmek amacıyla hazırlanmıştır. Öğrencilerin edindikleri bilgilerin kalıcılığı, saha gezilerinde uygulanan arazi çalışması değerlendirme formu ve yarışmalar, eğlenceli oyunlar, tasarımlar, sergi gibi etkinliklerde tutulan alan notları kullanılarak belirlenmiştir.

Mineral Avcıları: Jeolojinin İzinde Bir Macera Projesi Başarı Testi

Jeoloji mühendisleri ile ölçme ve değerlendirme uzmanı tarafından proje konuları kapsamında hazırlanan ve 15 sorudan oluşan başarı testi, ön test olarak 41 öğrenciye projenin açılış gününde uygulanmıştır. Başarı testinin ilk 10 sorusu eğitim kapsamında verilen kuramsal bilgi ile ilgiliyken, son 5 sorusu alan gezisinde yapılan uygulamalar sonucu edinilecek bilgi üzerinedir. Bu nedenle her sorunun değeri ilk 10 soruda 6 puan, son 5 soruda ise 8 puan olarak belirlenmiştir. ITEMAN programı ile maddelerin analizi sonucunda madde ayırt edicilik indeksi .75; madde güçlük indeksi ise .48 olarak bulunmuştur. Madde analizlerinden elde edilen değerler ile testin iç tutarlılığını belirlemek için yapılan Kuder-Richardson-20 (KR-20) testinde sonuç olarak .71 bulunmuştur.

Bilimsel Arazi Çalışması Değerlendirme Anketi

Arazi gezisinin yapıldığı spesifik konumda çıkarılan mavi kalsedon taşını bularak incelemeye odaklanılan Sarıcakaya saha gezisinin katılımcılar tarafından değerlendirilmesi amacıyla hazırlanmıştır. Formda 25 ölçüt yer almaktadır. Literatürde benzer ölçme aracı bulunmadığından, proje ekibi bu ölçme aracını geliştirmiş ve ölçme ve değerlendirme uzmanı görüşüne sunmuştur.

Katılımcı Memnuniyet Anketi

Araştırmacılar tarafından proje etkinlik döneminin genel bir değerlendirmesini yapmak amacıyla hazırlanan anket ile projenin öğrenciler üzerindeki etkileri ölçülerek daha sonraki çalışmalar için uygulama boyutunda olumlu ve olumsuz yönler ortaya konulmuştur. İki bölümden oluşan anket çalışmasında kişisel bilgiler bölümüne ek olarak 6 çoktan seçmeli ve 2 açık uçlu soru yer almaktadır.

Verilerin Toplanması ve Analizi

Katılımcı öğrencilerle projenin açılış gününde yapılan tanışma toplantısından önce ön-test olarak başarı testi uygulanmıştır. Araştırma sürecinde eğitmenler ve rehberlerden alan notları tutmaları istenmiştir. Araştırmanın son günü katılımcı memnuniyet anketi uygulanmıştır. Uygulamadan sonraki hafta içerisinde de son test uygulaması yapılmıştır. Elde edilen veriler SPSS paket programı yardımıyla analiz edilmiştir. Ön test ve son testten elde edilen veriler için anlamlı fark olup olmadığı eşleştirilmiş örneklemler t-testi aracılığıyla analiz edilmiştir. Ölçek ve alt faktör ortalamaları, normallik dağılımına bakılmış, çalışma grubuna ilişkin tanılayıcı istatistiklere yer verilmiştir.

Ayrıca niceliksel verilerin karşılaştırılmasında, iki alt düzeyi olan değişkenler için t-testi kullanılmıştır. Memnuniyet anketi ve arazi çalışması değerlendirme formu ise betimsel analize tabi tutulmuştur. Gizlilik esası gereği araştırmaya katılan öğrencilerin takma adlar kullanmaları istenmiş, veri toplama araçlarında gerçek isimlerine yer verilmemiştir. Araştırmanın bulgular bölümünde öğrencilerin isimleri açık olarak belirtilmeyerek araştırmanın katılımcıları olan her bir öğrenciyi ifade eden Ö1'den Ö41'e kadar kodlar kullanılmıştır.

Araştırmanın Etik İzinleri:

Bu çalışmada "Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi" kapsamında uyulması gerektiği belirtilen tüm kurallara uyulmuştur. Yönergenin ikinci bölümü olan "Bilimsel Araştırma ve Yayın Etiğine Aykırı Eylemler" başlığı altında belirtilen eylemlerin hiçbiri gerçekleştirilmemiştir.

Etik Kurul İzin Bilgileri:

Etik değerlendirmeyi yapan kurulun adı = Çanakkale Onsekiz Mart Üniversitesi Rektörlüğü Lisansüstü Eğitim Enstitüsü Etik Kurulu

Etik Kurul Etik inceleme karar tarihi = 25.07.2024

Etik değerlendirme belgesi konu numarası = 11-16

Bulgular

Nicel analizler, öğrencilerin ön test ve son test başarı puanları arasında istatistiksel olarak anlamlı bir artış olduğunu ortaya koymuştur. Bu bulgu, projenin öğrencilerin jeoloji ve mineralojiye ilişkin kavramsal bilgi düzeylerini geliştirmede etkili olduğunu göstermektedir. Sınıf düzeyine göre yapılan analizlerde, 7. sınıf öğrencilerinin 6. sınıf öğrencilerine kıyasla daha yüksek başarı düzeyine ulaştıkları görülmüştür. Bu durum, öğrencilerin bilişsel gelişim düzeylerinin ve daha önceki fen bilgisi kazanımlarının proje başarısı üzerinde etkili olabileceğini göstermektedir. Cinsiyet değişkeni açısından anlamlı bir farklılık tespit edilmemiştir.

Nitel veriler, öğrencilerin projeye karşı genel tutumlarının son derece olumlu olduğunu ortaya koymuştur. Öğrenciler, özellikle uygulamalı etkinliklerden, taş toplama ve sınıf dışı gözlem çalışmalarından büyük keyif aldıklarını belirtmişlerdir. Ayrıca yaratıcı drama ve yazarlık atölyelerinde edindikleri deneyimlerin bilimsel bilgiyi ifade etmelerinde ve sosyal iletişim becerilerinin gelişmesinde önemli katkılar sunduğunu ifade etmişlerdir. Bununla birlikte, bazı öğrenciler arazi çalışmalarında karşılaştıkları zorlu hava koşulları, ulaşım ve internet bağlantısı gibi çevresel sınırlılıkları olumsuz deneyimler olarak belirtmişlerdir.

Arazi çalışması değerlendirme anketi sonuçlarına göre, öğrenciler jeolojik yapıların ve yer altı kaynaklarının sahada gözlemlenmesinin öğrenmeyi somutlaştırdığını, doğayla kurdukları doğrudan temasın bilimsel farkındalıklarını artırdığını belirtmişlerdir. Bu bulgular, yerinde gözlem ve uygulamaya dayalı öğrenmenin geleneksel öğretim yöntemlerine kıyasla daha kalıcı ve etkili olduğu yönündeki literatürle uyumludur.

Proje, yalnızca öğrencilerin bilgi ve beceri düzeylerini artırmakla kalmamış; aynı zamanda yaşadıkları çevreye yönelik daha bilinçli bireyler olarak yetişmelerine de katkı sağlamıştır. Öğrencilerin mavi kalsedonun çıkarıldığı bölgeleri tanıması, bu taşın uluslararası pazarda değer görmesine rağmen ülkemizde yeterince işlenmemesinin oluşturduğu ekonomik kaybı fark etmeleri, çevre bilinci ve doğal kaynakların korunması konularında da düşünmelerini sağlamıştır.

Tartışma ve Sonuç

Araştırma kapsamında “Mineral Avcıları: Jeolojinin İzinde Bir Macera” adlı TÜBİTAK 4004 projesine altı gün boyunca farklı mekân ve yerlerde etkin olarak katılan ortaokul öğrencilerinin mineraloji ile ilgili temel kazanımları edindikleri anlaşılmıştır.

“Mineral Avcıları: Jeolojinin İzinde Bir Macera Projesi” başarı testi ön test ve son test puanları arasında anlamlı bir fark gözlemlenmiş olup, öğrencilerin proje kapsamında bilgi düzeylerinin arttığı görülmüştür. Bu sonucun ortaya çıkmasında proje kapsamında alanında uzman eğitmenlerin gerçekleştirdiği Temel Jeoloji Eğitimi, Temel Mineraloji Eğitimi gibi eğitimlerin etkili olduğu söylenebilir.

Bu araştırmada cinsiyet değişkenin öğrencilerin başarı puanlarında etkili olmadığı görülmüştür. Uğraş vd. (2021) ilkokul dördüncü sınıf öğrencileriyle gerçekleştirdikleri çalışmalarında öğrencilerin mikroorganizmalara ilişkin başarı puanlarının cinsiyete göre değişmediği ifade edilerek, bu çalışmadaki ile benzer bir sonuç elde edilmiştir.

6. sınıfta öğrenim gören öğrencilerin ön test ve son test puanlarında 7. sınıfta yer alan akranlarına göre anlamlı bir şekilde farklılık görülmüştür. Ayrıca 7. sınıftaki öğrenciler ön test ve son test puan ortalamalarıyla 6. sınıftaki öğrencilere göre daha fazla ilerleme sağlamışlardır. Bu durum 7. sınıf öğrencilerinin gelişim döneminden kaynaklanmış olabilir.

Mahgoup'a göre (2014) alan/saha gezileri, olay ve durumların kolaylıkla anlaşılmasında ve öğrenmenin kolaylaşmasında oldukça önemli bir araçtır. Alan gezileri öğrencilere uygulamalı olarak öğrenme şansı sunarak öğrenmenin kalıcı olmasını sağlamaktadır. Ayrıca saha gezileri öğrencilerin birbirleriyle sosyal bir ortamda etkileşim kurmalarını artırarak deneyimlerini paylaşmaları için etkileşimli bir sosyal ortam imkânı sunar. Bu araştırmada öğrencilerin arazi gezileri ve uygulamalı çalışmalar ile yarı değerli taş ve mineralleri ayırt edebildikleri, jeoloji ve mineroloji bilimi ile ilgili farkındalık kazandıkları, hedeflenen dijital yeterliliklere sahip oldukları görülmüştür. Bu sonuç TÜBİTAK 4004 programının amaçlarından biri olan farklı konularda gerçekleştirilen gözlem ve uygulamalarla katılımcılara disiplinler arası bir bakış açısı kazandırmak (TÜBİTAK, 2024) amacı ile örtüşmektedir.

Sonuç olarak, "Mineral Avcıları: Jeolojinin İzinde Bir Macera" projesi, fen eğitimi alanında okul dışı öğrenme ortamlarının etkili kullanımına güçlü bir örnek teşkil etmektedir. Proje, öğrencilerin bilimsel süreç becerilerini, doğaya karşı duyarlılıklarını, yerel kaynaklara yönelik farkındalıklarını ve disiplinler arası düşünme kapasitelerini geliştirmiştir. Projenin çıktıları, deneyimsel öğrenmenin hem kavramsal hem de duyuşsal alanlarda kalıcı kazanımlar sağladığını göstermektedir. Bu bağlamda benzer yapıdaki projelerin farklı bölgelere yaygınlaştırılması, farklı yaş gruplarına uyarlanması ve hava koşulları gibi çevresel faktörler dikkate alınarak zamanlamalarının planlanması önerilmektedir. Ayrıca, öğrenci merkezli etkileşimli etkinliklerin ve yaratıcı öğrenme yöntemlerinin fen eğitimine entegrasyonu, bilimin topluma daha etkili biçimde aktarılmasında önemli bir araç olarak değerlendirilmektedir.

Öneriler

Çalışmadan elde edilen sonuçlar ışığında; öğrencilerin yaparak yaşayarak öğrenmelerine ve yerinde gözlem yapmalarına imkân tanıyan benzer çalışmaların yaygınlaştırılması önerilmektedir. Mineraller ve madenlerle ilgili öğretim programında yer almayan ve ortaokul fen bilimleri, sosyal bilgiler dersleri gibi derslerin kitaplarında bulunmayan etkileşimli ve saha gezilerini içeren etkinliklerin artırılması gerekliliği bu proje ile anlaşılmıştır. Proje kapsamında öğrencilere sunulan drama etkinliklerinin de etkili olduğu gözlemlenmiş ve anlaşılmıştır. Okullarda yaratıcı drama yöntemi kullanılarak daha fazla sayıda etkinlik gerçekleştirilebilir. Çalışma kapsamında öğrencilerin jeolojik anlamda minerallerin fiziksel özellikleri, ekonomik değeri gibi konularda farkındalıkları oluşmuştur. Bu nedenle bu tür proje çalışmalarının artırılmasının önemli olacağı düşünülmektedir.