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A STEM ACTIVITY IN PRIMARY SCHOOL: WORKING WITH FOSSILS LIKE A PALEONTOLOGIST[1]

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ABSTRACT

This study presents a STEM activity titled "A Paleontologist's Task: Fossils" designed based on the 5E learning model. The activity was implemented within the unit of "Earth's crust and Earth" in a science lesson with 22 fourth grade students attending a public primary school in Düzce/Turkey in the 2020-2021 academic year. As part of the activity, the students created fossil models. Later, they uncovered the fossils buried in the schoolyard, working like paleontologists with the help of various tools. They used their knowledge and skills related to STEM disciplines in the role of a paleontologist and using the logic of a scientist. According to the observation notes taken during the lessons, the students had a fun and enjoyable learning experience by engaging in this STEM activity. In addition, it was observed that there was an improvement in students' cooperation skills as well as their interest in the paleontologist profession.
Keywords: STEM activities in primary school, earth and universe, active learning, hands on activities.

İLKOKULDA BİR STEM ETKİNLİĞİ: PALEONTOLOG OLARAK FOSİLLERLE ÇALIŞMAK

ÖZ

Bu çalışmada 5E eğitim döngüsü ile hazırlanmış "Bir Paleontolog Görevi: Fosiller" isimli STEM etkinliğinin sunulması amaçlanmaktadır. Etkinlik 2020-2021 eğitim öğretim yılında Düzce/Türkiye'de bir devlet ilkokulunda öğrenim gören 22 dördüncü sınıf öğrencisiyle fen bilimleri dersi "Yer kabuğu ve Dünya'mız" ünitesinde uygulanmıştır. Etkinlik ile fosiller konusu kapsamında öğrenciler fosil modelleri oluşturmuşlardır. Daha sonra okul bahçesine gömülü olan fosil modellerini, çeşitli araç gereçlerin yardımıyla paleontolog gibi çalışarak ortaya çıkarmışlardır. STEM disiplinlerine ilişkin bilgi ve becerilerini bilim insanı mantığı ile paleontolog rolünde kullanmışlardır. Dersler esnasında öğrenme ortamına dair tutulan gözlem notlarına göre öğrenciler bu STEM etkinliği ile dersi daha zevkli ve eğlenceli olarak işlemişlerdir. Ayrıca, öğrencilerin işbirliği ve takım çalışması becerilerinde gelişme olduğu gözlenmiştir. Bunun yanı sıra öğrencilerin paleontolog mesleğine ilgilerinin arttığı görülmüştür.
Anahtar kelimeler: ilkokulda STEM etkinlikleri, dünya ve evren, yaparak yaşayarak öğrenme, etkinliklerle öğrenme.

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INTRODUCTION

Although it is not known exactly when life began on Earth, which is approximately four and a half billion years old, many species existed on Earth, and some continue to live until this day. It is known that the number of known plant species is more than 300,000, and the number of animal species is more than 1,000,000. Some species existed for a certain period and got extinct at a certain time. Now, only the remains are found from the extinct species. These remains are called fossils, and the scientific field that studies fossils is called paleontology (Sür & Öner, 2014). In fact, paleontology which endeavors to obtain information about the past and interpret this information is studied in more than 30 universities in Turkey. However, there is a difference between the number of graduate students and the number of paleontologists. This causes geology not to develop in a country where paleontology is not researched at a sufficient level (Meriç, 2013). The need for more experts in this field can only be met by having knowledge about paleontology, getting to know this field, and being interested in and wanting to work in this field. In fact, when looking at the studies on fossils, it is found that students in the 9-11 age group have a great interest and curiosity about large reptiles (Trend, 1998, cited in Dal, 2007). Therefore, by benefiting from this interest and curiosity, students who are introduced to paleontology in an efficient and enjoyable classroom environment can make a career plan in this field in the future. Thus, in this period when scientific and technological developments are of critical importance, the desire to be successful necessitated having the requirements to achieve this success (Sarı & Katrancı, 2020). These requirements start with the 21st Century skills and proficiency in the science process skills. For this purpose, science, technology, engineering, and mathematics education has gained importance and popularity (Sarı, 2018).

STEM is an abbreviation consisting of initial letters of Science, Technology, Engineering, and Mathematics (Çorlu et al., 2012). STEM activities can be practiced in order to create a more efficient and enjoyable classroom environment. STEM, which deals with the fields of science, technology, mathematics, and engineering in a complex way, aims to promote problem-solving skills by adopting creativity and to educate individuals who are effective in cooperation, communication, and entrepreneurship (Korkmaz & Buyruk, 2016). With STEM education, countries aim to raise innovative individuals (Capraro et al., 2014).

STEM education approach is one of the effective teaching approaches being used starting from pre-school until higher education in many countries including the USA, Korea, China, and England (Yıldırım, 2016). In Turkey, it can be said that STEM education started as a result of getting low scores on international platforms such as PISA and TIMMS tests (Akgündüz et al., 2015). In this context, the Ministry of National Education (MNE) has conducted practices to integrate the STEM education approach into the curriculum. As a result of the practices, it is aimed to conduct STEM activities in the classroom for each unit under "Science, Engineering, and Entrepreneurship Applications" in the 2018 Science Curriculum (MNE, 2018).

When the literature is examined, it is seen that there are limited studies about STEM education practice with primary school students in Turkey (Acar et al., 2018). Considering STEM education and the interest in STEM fields, and the ability to direct careers in the coming years, it is thought that starting STEM education at an early age is more effective (Sarı & Katrancı, 2020). Therefore, providing STEM education at an early age and setting up immersive environments and activities in the classroom will enable students to discover connections between different STEM fields and practice this added information in their daily lives (MNE, 2018). Within the scope of this study, it is aimed to develop and practice a STEM activity for Earth and the Universe topics in primary schools.

The activity developed within the scope of the study is aimed to teach the formation process of fossils and how they are unearthed. The activity, which was designed based on the STEM education approach, is suitable for the fourth grade students. The activity was conducted with 22 fourth-grade students in a public school in Düzce. The students took part in the activity in groups of six. The study was found ethically appropriate by Düzce University Ethics Committee on 30/09/2021 in accordance with

the law no. 2021 and 231. The activity was conducted by the researcher (the first author), who is a teacher in the school and has sufficient knowledge about STEM activities.

ACTIVITY IMPLEMENTATION

In the activity, the 5E instructional model developed by Bybee, one of the leaders of the Biological Science Curriculum Study (BSCS), was chosen. Developed by Bybee et al. (1989), the model's name is an abbreviation of the initials of the stages which make up the model. The stages of the model are Engagement, Exploration, Explanation, Elaboration, and Evaluation (Bybee, 2014). According to Bybee et al. (2006), in the first stage, "Engagement", the teacher activates the prior knowledge of the students. While doing this, the teacher conducts short activities that appeal to curiosity. In the "Exploration" stage, students try to produce ideas to gain new information by using their prior knowledge. The teacher guides the students at this stage. In the "Explanation" stage, the teacher directs the focus of the students to a particular subject. The teacher asks the students questions for them to share explanations. Students explain their understanding of the subject at this stage. In the next stage, "Elaboration," students are directed to deeper and broader explanations of the questions from the teacher. With new experiences, students develop further knowledge and skills. In the last stage, "Evaluation," students are encouraged to evaluate the process and their performance in line with the learning goal.

The activity was planned from an interdisciplinary perspective. While planning the activity, the students' practice and development of 21st-century skills (creativity and innovative thinking, critical thinking, decision making, self-evaluation and learning to learn, communication skills, teamwork, information literacy, life, and career skills) were taken into consideration. In addition, it requires students to use science process skills within the activity such as observing, classifying, predicting, inferring, recognizing, and controlling variables, collecting and interpreting data, and formulating hypotheses, verbal and written communication. In addition, mathematics classes (reading 4, 5, 6-digit natural numbers and sorting them according to their value), social studies classes (recognizing their interests and needs, and chronology), art classes (the creative process), and Turkish classes (making prepared and impromptu speeches) were integrated. In this way, it is aimed to contribute to the education of students according to the needs of the current century.

This study, which includes the activity of "A Paleontologist's Task: Fossils," addresses the curriculum standard "F.4.1.1.3. Explains the formation of fossils" within the unit of "Earth's Mantle and Its Movements" under the subject of "Earth and Universe" in primary school fourth-grade science class (MNE, 2018). In this context, it was planned as 1 week and 3-course hours in accordance with the curriculum and was completed in the specified time. This activity is aimed at students to gain proficiency in fossils. "A Paleontologist's Task: Fossils" activity was developed to make science classes fun, improve students' observation and cooperation skills, and enable them to act with the logic of scientists. With this activity, the students learned how paleontologists work by practicing and experiencing. In addition, it contributed to career awareness, which was also emphasized in the curriculum. Thus, it was suggested to be a basis for the students to make their career choices more consciously and successfully in the future. In addition, it is predicted that with STEM activities, the students will participate more actively in the class and create an enjoyable learning environment.

The activity was designed by the researchers. Before the activity was implemented, opinions and suggestions were received from a faculty member who works in the field of science and is an expert in STEM, and an experienced classroom teacher. As a result of the opinions and suggestions received, the activity was given its final shape and used with the students. Teachers can prepare a sample fossil to guide the students before the activity is conducted in the class. In fact, in the current implementation of the activity, the teacher prepared an exemplary fossil model and brought it to the classroom.

The study guide for the "A Paleontologist's Task: Fossils" activity used in the Elaboration step of the 5E instructional model is presented in Appendix 1, and an example of the fossil map

used in this activity is presented in Appendix 2. The concept map used in the evaluation step is presented in Appendix 3. The solutions to these concept maps given by the students are presented in Appendix 4 and Appendix 5. The self-evaluation form used in the Evaluation step is presented in Appendix 6. The self-evaluation form filled out by the students is presented in Appendix 7 and Appendix 8. The practice steps of the activity, which aims to address the curriculum standard "F.4.1.1.3. Explains the formation of Fossils" (MNE, 2018) are presented in detail below.

Tools and Equipment Used

The following materials are needed to implement the activity:

- Seashells,
- Stiff leaves with prominent veins
- Dinosaur toys
- A piece of playdough
- A small roller
- Quick-hardening plaster
- Water
- Oil
- Plastic container
- Hand mixer

1. Engagement/Preliminary Information Checking/Awakening Curiosity

At the beginning of the class, a question was asked to the students: "Scientists state that mammoths and dinosaurs once lived on our Earth. How do scientists know this?" Every answer from the students was listened. With these questions, it was possible to see what the students knew about paleontology. Most of the students answered, "Skeletons coming out of the ground." One of the students said, "They know from what came out from under the ice." Then, the children's book *The Dinosaur* (Milbourne, 2019) was read to the students. This book was published by the Scientific and Technological Research Council of Turkey (TÜBİTAK) and, it is widely accessible. The cover of the book is given in Figure 1.

After reading the book, questions were asked about the book: "How do dinosaurs reproduce?", "Do you know of any dinosaur species other than the one in the book? If yes, which species?" "Was that dinosaur eating the same or different way as the other dinosaurs in the book?", "If the dinosaurs had lived right now, what adverse events would happen in addition to those in the book?", "Have you seen dinosaur bones anywhere else?" With these questions, the teacher tried to keep the students' curiosity and attention alive.

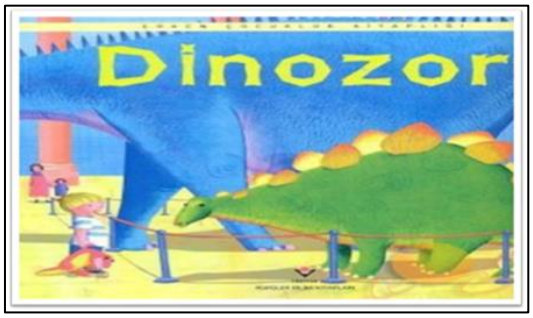

Figure 1. The Children's Book: Dinosaur (Milbourne, 2019)

After the book was read, most of the students stated that dinosaurs reproduced by laying eggs. In addition, the students knew that there were dinosaurs other than the ones in the book, some of them ate meat and some of them ate grass, and those born from the same mother ate the same food; if dinosaurs were to live now, people's lives might be in danger, people might perish, or their lives might be turned upside down. They also stated that they saw dinosaur bones in cartoons. The discussion uncovered what the students knew about fossils.

Then, in order to find out what they knew about fossils, the students were asked "Can you guess what the remains of dinosaurs and other creatures that lived with them are called?" Most of the students gave the answer "fossil." Afterward, photographs of leaves, insects, sea creatures and dinosaur fossils were shown to the students. Examples are given in Figure 2. The teacher aimed to learn the knowledge level of the students about fossils. He asked the students what these photographs were and asked about their opinions. The students said that these were the bones of dead creatures. Then, the teacher asked the following questions: "Did you see anything like the ones in this photograph around you? If yes, what did it look like?" "If you haven't seen it around you, have you watched movies that had these objects in them? If yes, can you talk about it?" The students said that they did not see things like the ones in the photograph in real life, but they saw them in movies and documentaries. Indeed, as a result of all these questions, some of the students

stated that they were familiar with the concept of fossil from documentaries and movies. However, it was observed that they did not know the concept of fossils in general.

Figure 2. Fossil Photographs

2. Exploration

The students were shown the insect fossil model made of epoxy (Figure 3). They were asked to examine the fossil model. They were also asked what it was called. The students' answers included "a dead insect" and "ornate rosary bead". The students discussed and brainstormed among themselves. After the feedback from the students, they were shown other fossil photographs (sea creature, plant, dinosaur, and insect). They were asked to examine the photographs and point out their similarities and differences by paying attention to the details. The teacher expected the students to say sea creatures, dinosaurs, plants, and insects as in the photographs. Students quickly recognized the photographs of dinosaur and insect fossils and they told so. They had difficulty recognizing photographs of marine fossils.

Thus, the students realized that different species could fossilize in diverse ways and in different biomes. The teacher then waited for the students to point out the similarities and differences between dinosaur fossil photographs, such as height, length, number of bones or prominence. Visual richness was added to the class by ensuring that there were photographs from different-sized dinosaurs. At the same time, their understanding of the subject expanded by discovering that the dinosaurs they knew from cartoons, books, or documentaries were divided into different species.

Figure 3. Insect Fossil

3. Explanation

The students were asked, "You've seen many photos. How do you think they came to be? How long did it take them to fossilize?" After the teacher listened to the students' answers, the students started to study the subject of fossils in the class. Photographs were used extensively. Students began to talk about the formation process of fossils. They stated that "The soil covered the dead dinosaurs for so long and their bones were found by people now." In this context, the teacher showed the epoxy fossil model again and asked the students what it was composed of. Based on the epoxy fossil, one student said that "Some insects thought the resin on the trees was honey and got trapped inside when they tried to eat it and became fossils."

The teacher explained that ornaments are made from the natural form of the epoxy that he just showed to the students and, these are called amber, "Just like our friend, who just said ornate rosary bead." Based on this, the students were asked where else the fossils might have been formed. One of the students said, "There are also dinosaurs living in the sea. Then, fossils should form in the sea as well." Afterwards, the students were shown the photographs again and were told where they were formed. Then, a virtual tour was made to the Mineral Research and Exploration (MRE) Martyr Cuma Nature Museum website. An image from the museum website is shown in Figure 4.

Figure 4. Fossil Museum Website

4. Elaboration

The students were asked how the fossils were found. They were also asked about the people who works in this field: “Do the people who excavate for fossils have a special name? If yes, what is it?”, “Do you think there is a scientific field specific to fossils? If so, can you tell me the name of it? Have you heard of it?" All the students who gave an answer said that the people who made excavations were called archaeologists and that they found bones and fossils this way. In line with the answers, excavation works were explained.

The teacher presented the methods used in the excavations with photographs. Then, the students were asked, “You may have heard the scientist say that a fossil found is 5 million years old or 10 million years old. How do they calculate the age of the fossil?” After the students answered the questions, the teacher explained the carbon test method in accordance with the students’ knowledge level within the scope of the “Did You Know?” Corner (Figure 5). In addition, the subject of natural numbers with 4, 5 and 6 digits was mentioned, and it was stated that the concept of million is greater than the numbers expressed in hundreds of thousands. Therefore, it was emphasized that the fossils were much older than what they thought. In fact, the Allosaurus fossil they saw in the virtual museum was presented as an example of a dinosaur that lived 150 million years ago. It was reminded again that fossils can occur in tree resins as well as in the desert, seabed, and glaciers. In addition, the chronology subject from the Social Studies course was also mentioned. Within the scope of this subject, the ages of the fossils they saw in the virtual museum tour were compared and it was discussed which one was younger and which one lived in ancient times.

Scientists use a variety of methods to calculate the age of fossils. For fossils that are not older than 60 thousand years and contain carbon, a method called "carbon 14" is generally used. There are two common types of carbon, carbon 14 and carbon 12. Both are present in a certain amount in proportion to each other in all creatures. After the death of a creature, carbon 14 in their structures decreases over time, while the amount of carbon 12 does not change. To find the age of a fossil, the amount of carbon 14 that is present is compared with the amount of carbon 12. This ratio is compared to the carbon 14 found in the atmosphere and find out how much carbon 14 has decreased. Thus, the age of the fossil is revealed because it is known how much carbon 14 will decrease over time.

Figure 5. “Did You Know?” Corner

After all this, by asking the following questions “Do you know any archaeologists? Have you ever heard of what a paleontologist is? Do you know any paleontologists? What is a paleontologist? What do they do?", it was ensured that the students established a link between the excavation and the paleontologist. The students stated that they did not know any archaeologists and that they had never heard of the word paleontologist before. Then, the students were shown photographs of “Paleontologists,” (Photograph 1) and they were guided to guess that they were experts in the fossil field.

Photograph 1. Paleontologists at Work

After making sure that the students listened to each other critically and came to a consensus regarding the concept of paleontologist, the fossil photographs shown at the beginning of the class were shown again and the students were asked, "Who finds these fossils and

presents them to us?" The students' answer to this question was "a paleontologist." In addition, the students were shown a video clip from a documentary titled "Dino Trails" (DW, 2017). They were provided with deeper information about paleontologists and fossils. Then, questions about the clip were asked. Questions were asked about what the woman in the clip does, where she works, and what tools she uses. Inspired by the video, the students said that the woman in the video is a paleontologist, and she searches for fossils in the ground and in rocky areas where fossils can be found by using tools such as picks, shovels, hammers, and brushes. They were prompted to think about the similarities and differences between paleontologists and archaeologists. Students answered that paleontologists searched for and unearthed fossils. According to the answers received, the similarities and differences between the paleontologist and the archaeologist were explained. Then, the students were asked, "Would you like to be a paleontologist?" Almost all the students answered yes. Thus, the subject of "individual interests and needs" in the Social Studies course was also mentioned. In this context, it was emphasized that people can choose various professions according to their interests and abilities.

Next, the students were asked to do the activity called *"A Paleontologist's Task: Fossils"* with the materials listed hereinabove. The class is divided into groups. First, each group decided on the fossil that they wanted to create. The groups decided on what type of fossil they wanted to create by brainstorming ideas collaboratively and considering the materials they had. At this stage, they were reminded of the creative process (idea, material selection, design, and product) in the Arts class, and they were asked to create their fossils. After the fossils were created, they were collected for the next class. The aim here is for the teacher to bury the created fossils at certain points in the garden without the students knowing. In the next class, each group searched for the fossils buried in the garden with the map which the teacher gave them. However, since the groups did not know which fossil they would find, they had to work meticulously like paleontologists (Figure 6). Throughout this process, the teacher guided the students with questions and hints: "How does a paleontologist work? What tools does the paleontologist work with?" "What is required to transport the discovered fossils to the museum with precision?" The teacher told the students that they should use tools such as hammers, shovels, screwdrivers, and brushes, and carry the fossils like a fragile vase or a newborn baby, and put them in a box.

Figure 6. Students Excavating

The reason that the main activity is conducted in the elaboration stage is that the content of the lesson, the science process skills, and the related career awareness are to be examined and experienced in depth. In fact, the students mostly gave correct and logical answers to the questions asked by the teacher during the activity. In addition, it was observed that the students were very willing to answer the questions. When the conversations they had among themselves were examined, it was found that they were able to explain the fossil formation process and give examples without assistance. For example, one of the students said, "Fossils are formed when dinosaurs or other creatures died in the ancient times and remained under the ground." and gave examples of glaciers, resin, and oceans as places where the fossils were formed.

5. Evaluation

The fossil models that were created and buried in the garden were located and excavated by the students working as paleontologists. Then, they were asked to choose a spokesperson and a writer from each group to introduce the fossils they found to the classroom. It was ensured that they created and presented scenarios for the place where the creatures lived before fossilization, the age of the fossil, and the fossilization process they went through after they died. The students introduced their fossils in this context. For example, one of the groups stated that the dinosaur fossil they found had

large and sharp teeth and that it might belong to a carnivorous species (Figure 7). They also stated that, within the scenario, they determined that the fossil lived 200 million years ago. They stated that the excavation area was taken under protection since the area they excavated was open to the public, and the fossil was excavated using various excavation tools. All groups presented their scenarios and introduced their fossils. In this way, the students had the opportunity to critically evaluate their work.

Figure 7. An example from the examined fossils

Towards the end of the lesson, the students redesigned their fossil by painting them in appropriate colors to make them more realistic. At the end of the class, the students evaluated themselves with a self-evaluation form and a concept map designed specifically for the activity. When the answers given to the concept map were examined, it was seen that the students gave correct answers in general.

CONCLUSION and SUGGESTIONS

This study shared the design and implementation processes of a STEM activity that was developed according to the 5E instructional model within the framework of the *"Earth's Mantle and Its Movements"* unit of the fourth grade primary school science class. With the STEM activity, it was aimed for the students to learn the subject more entertainingly and in depth within the curriculum.

With this activity, the importance of students' cooperation and working as a team was shown. Most of the students stated that they worked in cooperation with their friends in the self-evaluation form that they filled at the end of the activity. In fact, Karakaya et al. (2019) similarly concluded in their study that STEM activities improve cooperation. In the study conducted by Özcan and Koca (2019) with secondary school students, it was determined that STEM activities benefit cooperation and group work. Again, Uğraş and Genç (2018) state that STEM activities support students in collaborating.

According to the teacher's observations, a positive learning environment was created in the classroom during the lessons. According to what the students said during the class, the lesson was fun, enjoyable, and intriguing. In addition, there was no instance during the activity where the students had difficulty. On the contrary, the process of creating fossils and excavating for them with the help of maps as a paleontologist was instructive and entertaining. The teacher stated that the students had a lot of fun and learned the subject much better. The teacher also emphasized that the course was more effective with an interdisciplinary structure. It was seen that active participation of the students during the activity, having an environment where they can use their creativity, and experiencing meaningful learning affected their conceptual understanding positively. In fact, the answers written by the students on the concept map at the end of the activity indicated that the content was well understood. In addition, the fact that the students were active in the process and that their sense of curiosity was used in general enabled the students to answer the questions correctly at a high rate. These findings are aligned with the related literature reporting that STEM activities increase academic success as they contribute to the development of cognitive, affective, and psychomotor skills of students (Acar et al., 2018; Dedetürk et al., 2020; Ercan & Şahin, 2015; Gülhan & Şahin, 2016; Yıldırım & Selvi, 2018).

According to the unstructured observation notes taken by the teacher, the students developed a positive perspective towards paleontologists and this profession as a result of this activity. An example observation note pointing to this finding is as follows: "The fossil-making activity was very popular and they got very excited. They all thought of themselves as paleontologists. Many said they wanted to be paleontologists in the future." It can be claimed

that the activity helped students develop a positive view of paleontology. Parallel to this result, there are also studies in the literature that reveal that STEM activities done in the classes develop a positive attitude towards the related STEM professions (Baran et al., 2016; Gülhan & Şahin, 2016). In order to guide the students to STEM professions, it is suggested that teachers include STEM activities in their classes as in this study.

The teacher stated that he was worried about the time during the STEM activity. Studies conducted with teachers have also found results supporting this finding (Bozkurt, 2014; Hacıoğlu et al., 2016). The time issue can be resolved by adjusting the recommended durations for other curriculum standards. In addition, due to the interdisciplinary nature of the activity, this problem can be solved by allocating time from another class. For example, since the activity has an interdisciplinary structure, extra time can be obtained by allocating time from visual arts class.

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Appendix 1

Fossil Activity of the Elaboration Step

A Paleontologist's Task: Fossils

Materials

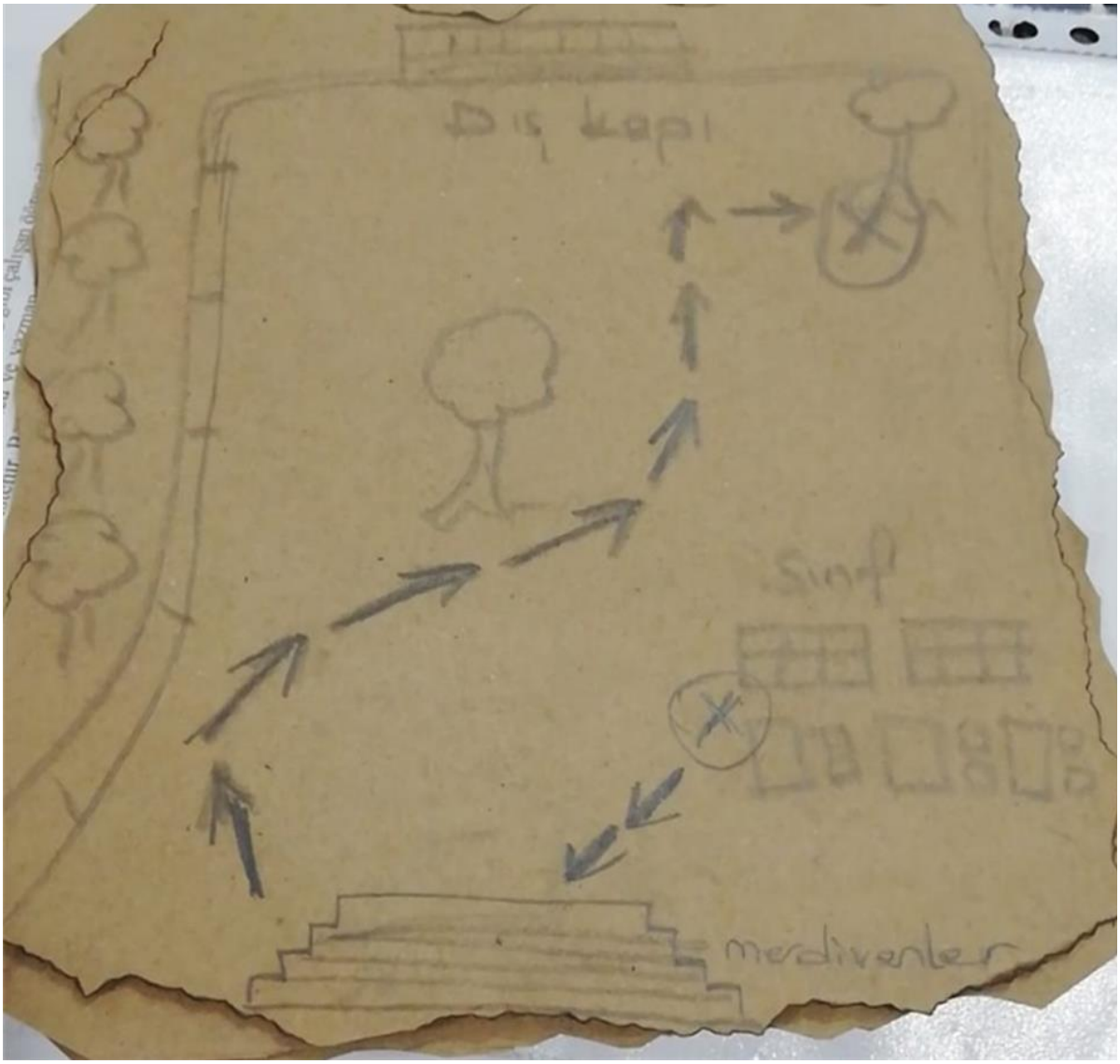
•Seashells, stiff leaves, dinosaur toys
• Playdough
• A small roller
• Quick-hardening plaster
• Water
• Oil
• Plastic container
• Hand mixer

Steps to Follow

1. Let's roll the playdough with a rolling pin until it is flat.
2. Let's press the seashell, leaf, or dinosaur toy on the dough.
3. Let's remove the shell, leaf, or dinosaur toy from the dough.
4. Let's put a little bit of oil in the cavity of the press.
5. Let's prepare the plaster mixture by adding two measures of plaster and one measure of water.
6. Let's pour the plaster over the cavity enough to overflow at least one centimeter high.
7. Let the plaster dry for 20 minutes.
8. Let's lift the play dough off the mold.

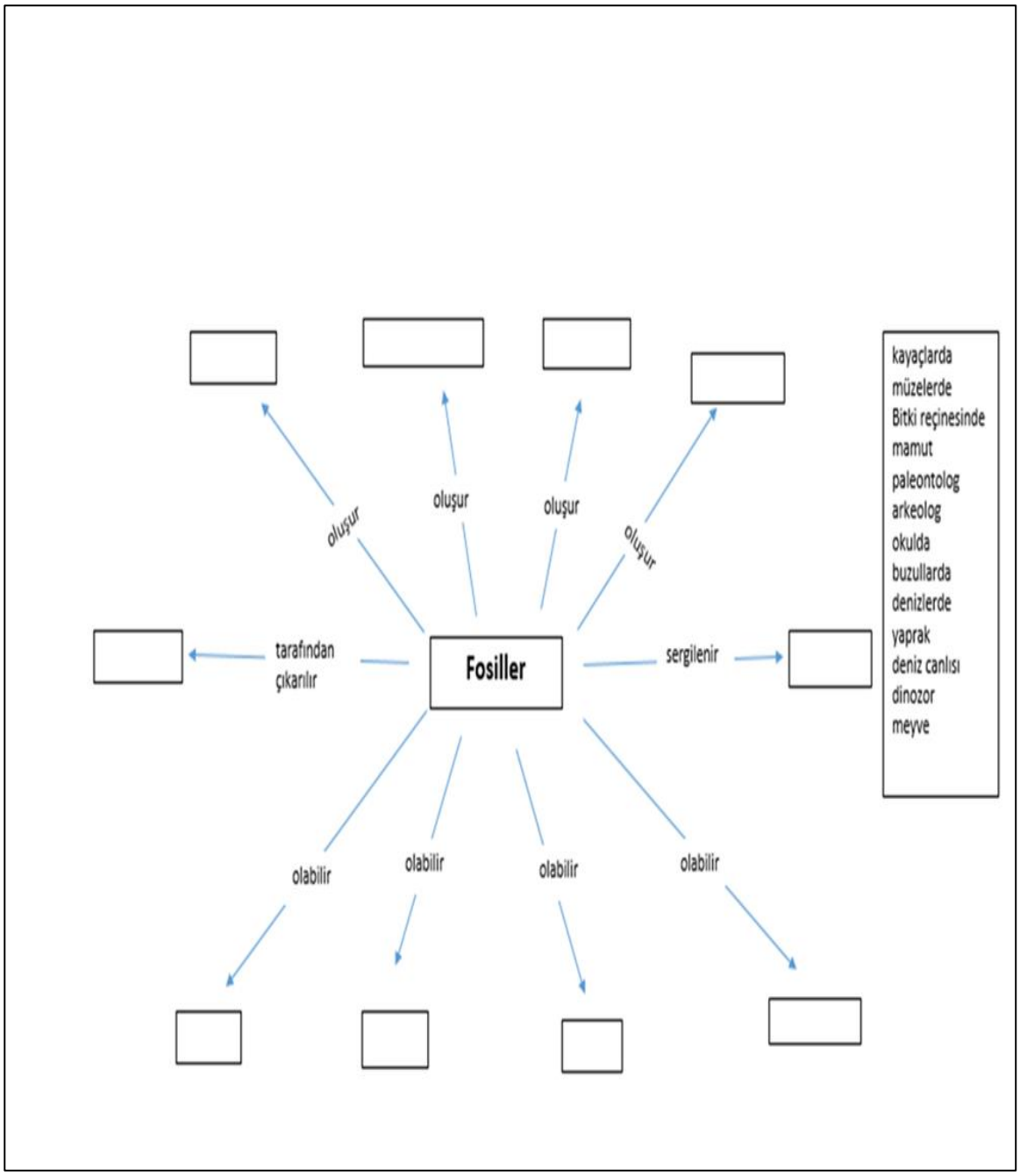
Appendix 2

Fossil Map of the Elaboration Step



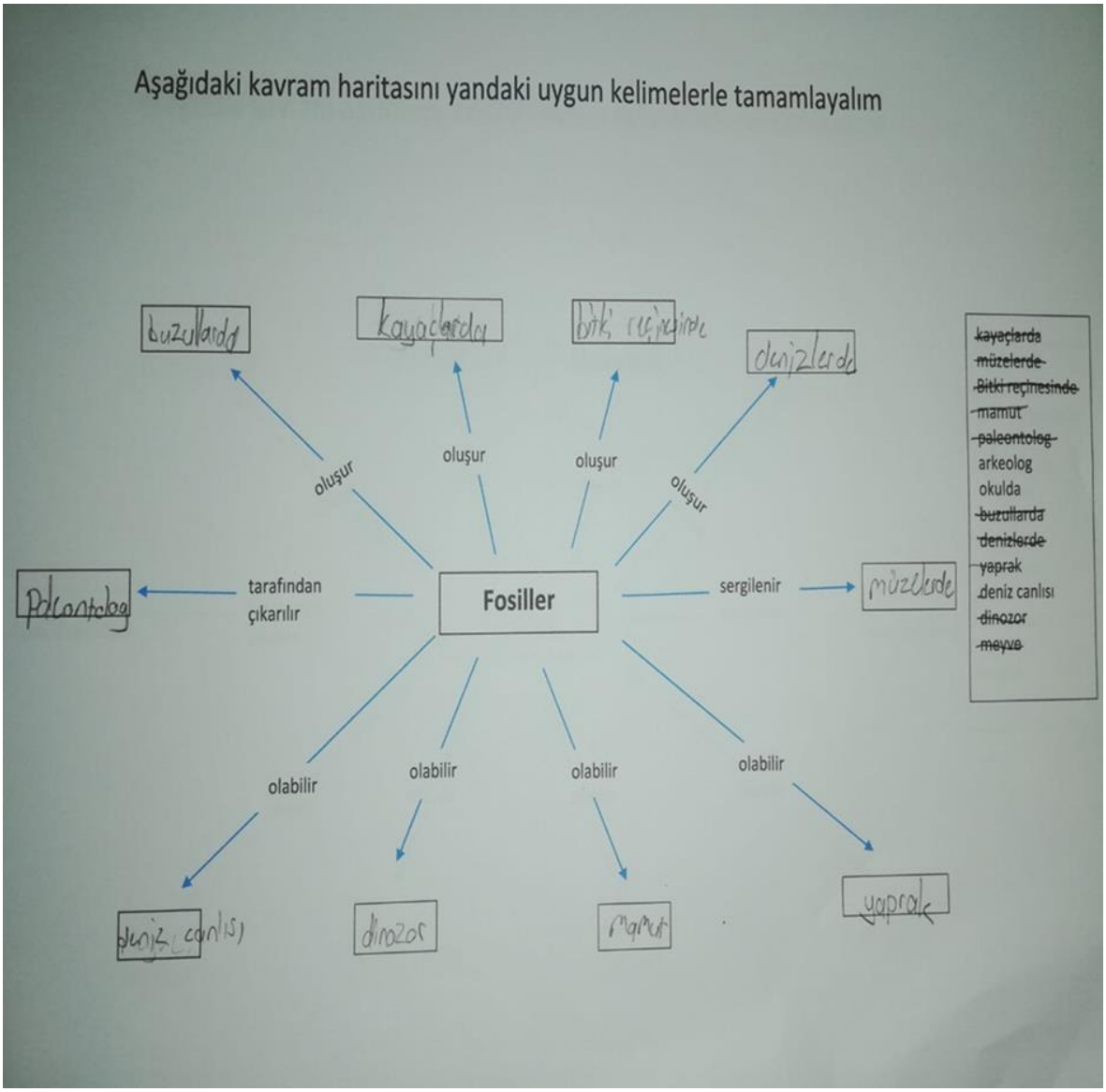
Appendix 3

Concept Map of the Evaluation Step



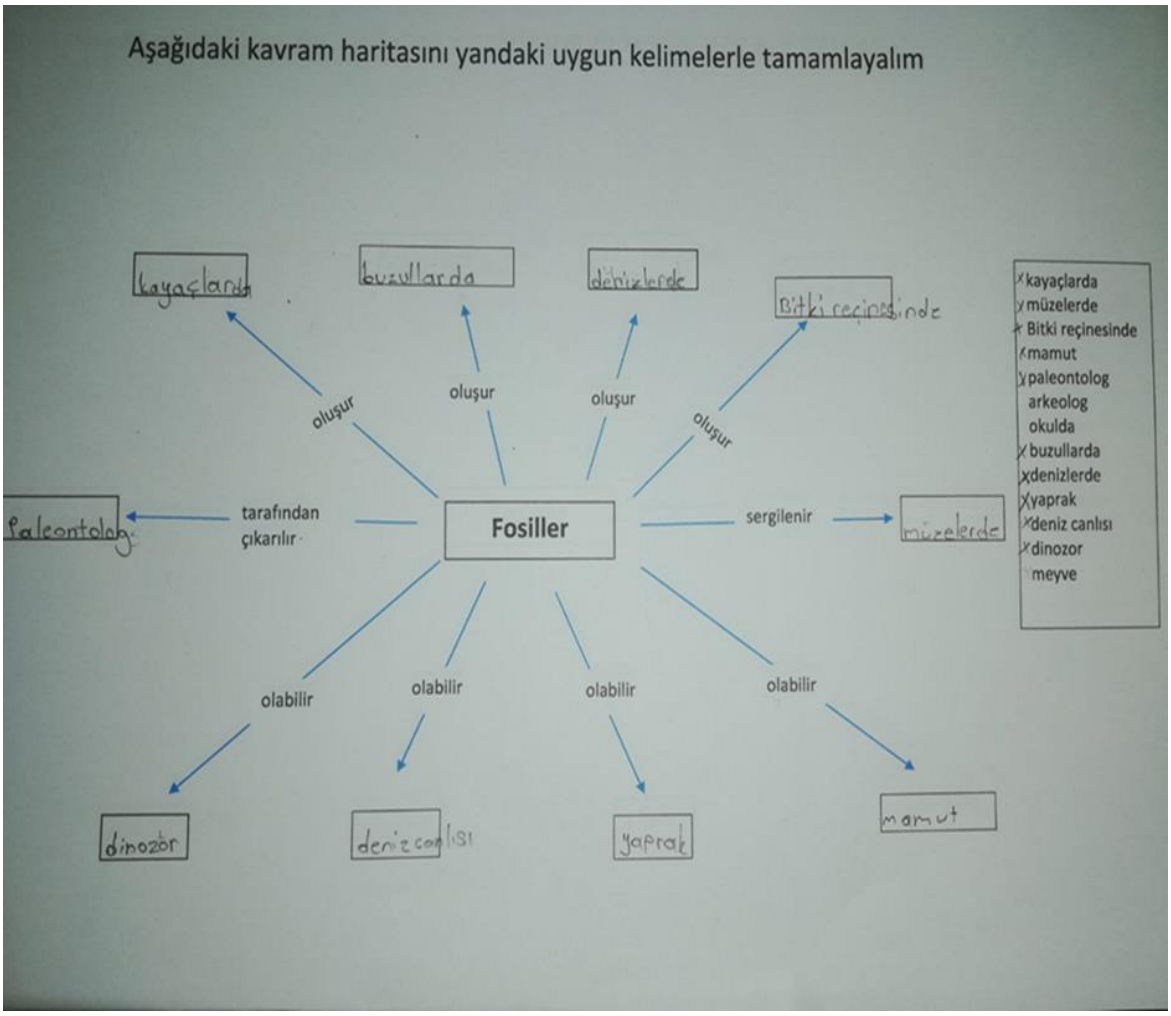
Appendix 4

Concept Map Example of the Elaboration Step 1



Appendix 5

Concept Map Example of the Elaboration Step 2



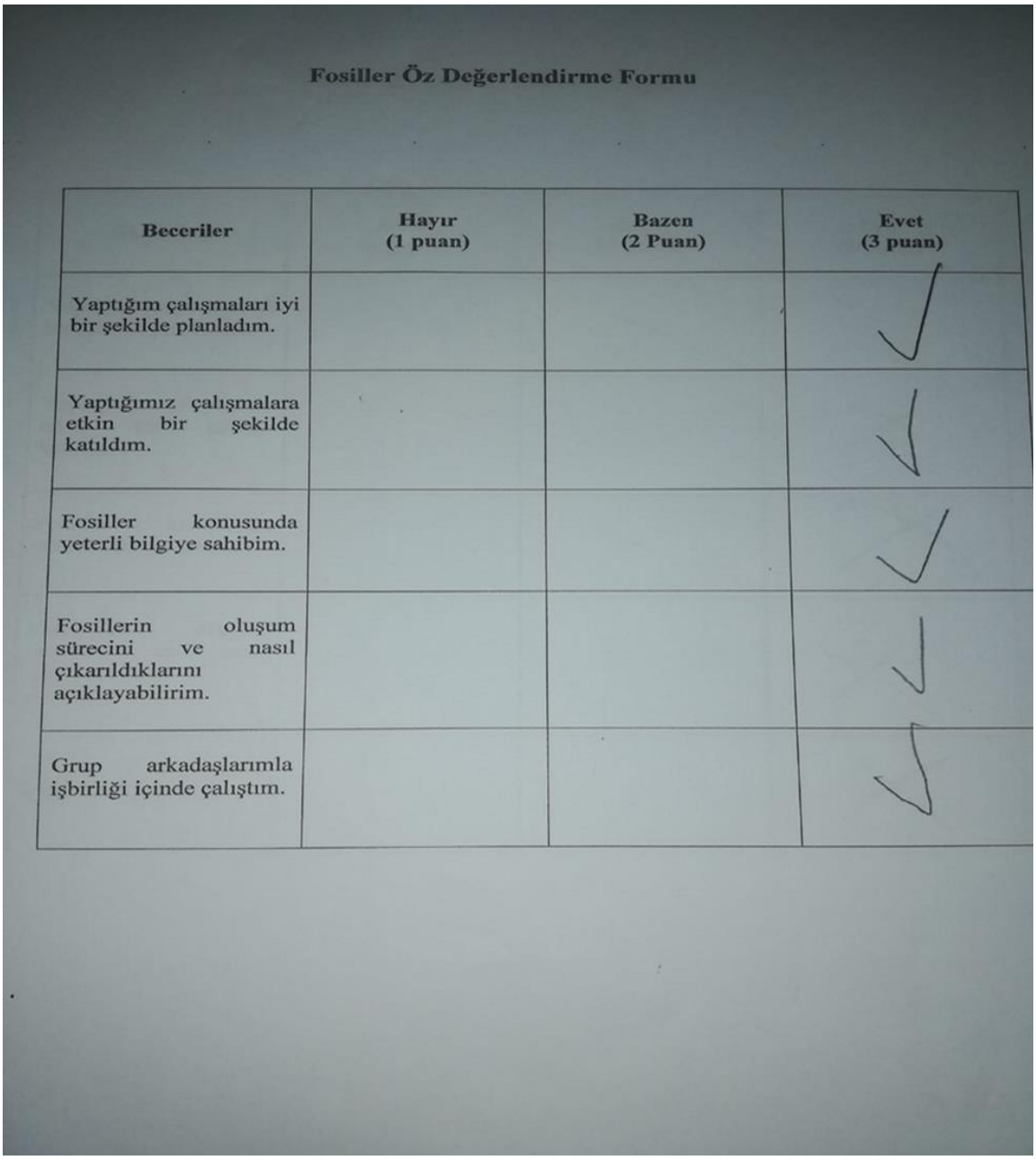
Appendix 6

Self-Assessment Form for the Evaluation Step

Skills	**No (1 point)**	**Sometimes (2 Points)**	**Yes (3 points)**
I planned my work well.			
I actively participated in our work.			
I have sufficient knowledge about fossils.			
I can explain the formation process of fossils and how they were extracted.			
I worked in collaboration with my groupmates.			

Appendix 7

Example of Self-Assessment Form for Evaluation Step 1

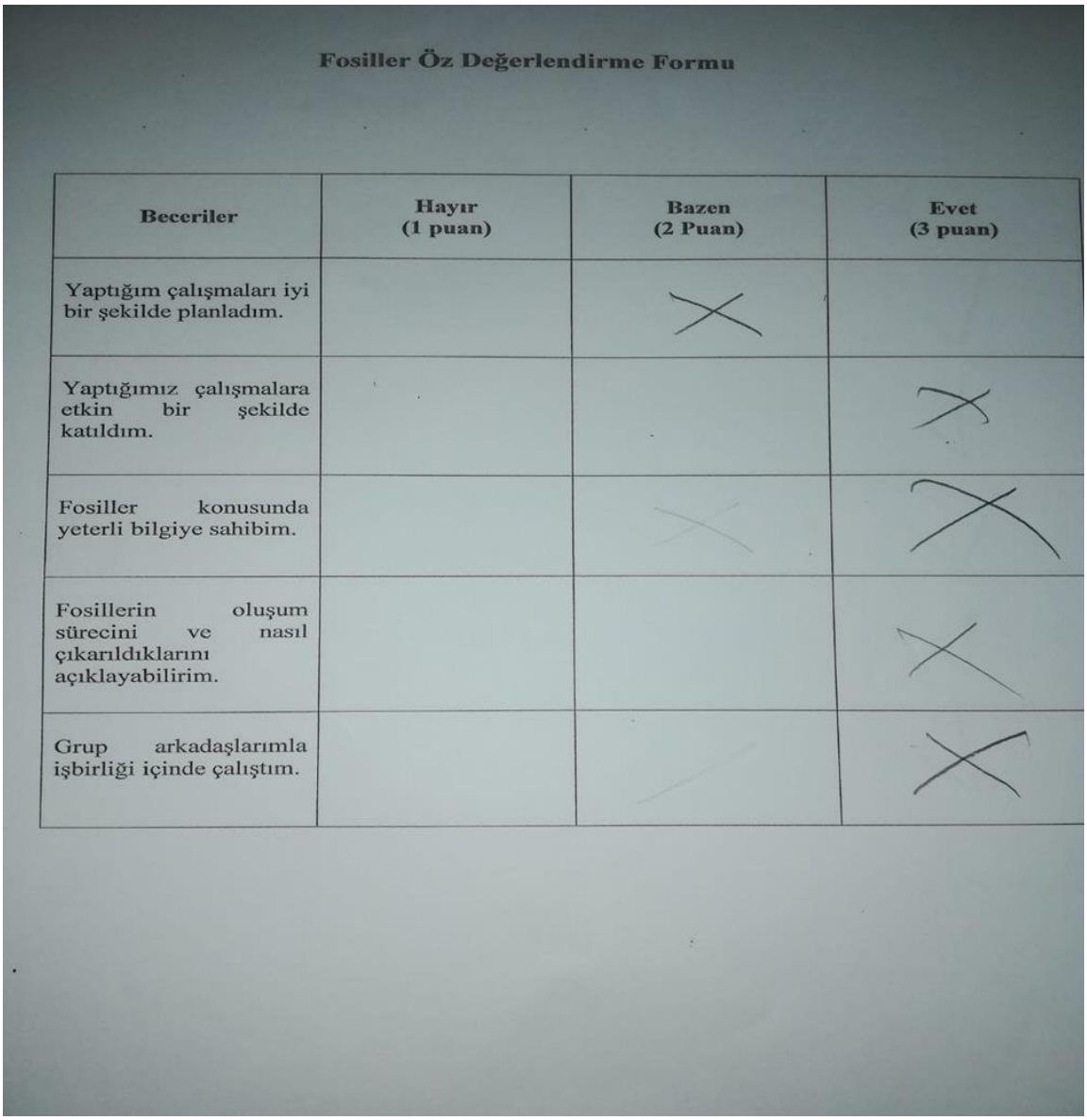


Fosiller Öz Değerlendirme Formu

Beceriler	Hayır (1 puan)	Bazen (2 Puan)	Evet (3 puan)
Yaptığım çalışmaları iyi bir şekilde planladım.			✓
Yaptığımız çalışmalara etkin bir şekilde katıldım.			✓
Fosiller konusunda yeterli bilgiye sahibim.			✓
Fosillerin oluşum sürecini ve nasıl çıkarıldıklarını açıklayabilirim.			✓
Grup arkadaşlarımla işbirliği içinde çalıştım.			✓

Appendix 8

Example of Self-Assessment Form for Evaluation Step 2



Fosiller Öz Değerlendirme Formu

Beceriler	Hayır (1 puan)	Bazen (2 Puan)	Evet (3 puan)
Yaptığım çalışmaları iyi bir şekilde planladım.		X	
Yaptığımız çalışmalara etkin bir şekilde katıldım.			X
Fosiller konusunda yeterli bilgiye sahibim.			X
Fosillerin oluşum sürecini ve nasıl çıkarıldıklarını açıklayabilirim.			X
Grup arkadaşlarımla işbirliği içinde çalıştım.			X