AN ACTIVITY BASED ON INQUIRY DRIVEN SCIENCE IN NATURE: BIODIVERSITY IS UNDER THREAT AT NATIONAL PARK![1]

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ABSTRACT

The purpose of this study is to present an activity designed according to inquiry-based science approach and its implementation. The activity set up towards guided inquiry and was performed with participating 12 preservice science teachers and 24 eighth grade students. The activity started with a daily-life problem related to Yozgat Çamlık National Park. First, envelopes, presented as hidden documents signed by park chief, and a research kit were provided to learners. Then a nature trip was organized to identify species of plants listed in the distributed inventory. Learners expressed the problem (the national park's bio-diversity is decreasing) as a result of interpreting the data collected in a nature trip. Learners were asked to form hypotheses about factors effecting bio-diversity and determine investigation methods to test their hypotheses. At final, learners reported the results and research processes. The activity can be used both in science and biology courses.
Keywords: inquiry-based science, nature, bio-diversity.

DOĞADA TASARLANAN SORGULAMA TEMELLİ BİR BİLİM ETKİNLİĞİ: MİLLİ PARK'IN BİYOÇEŞİTLİLİĞİ TEHLİKEDE!

Bu çalışmanın amacı sorgulama temelli bilim yaklaşımına uygun olarak doğada tasarlanan bir etkinliği, etkinliğin uygulama basamaklarını ve gerekli dokümanları sunmaktır. Tasarlanan etkinlik, rehberli sorgulamaya yönelik geliştirilmiş olup, 12 fen bilgisi öğretmen adayı ve 24 ortaokul 8. sınıf öğrencisinin katılımı ile yürütülmüştür. Uygulama süreci günlük yaşam problemlerinden birinin Yozgat Çamlık Milli Parkı'na uyarlamasıyla başlatılmıştır. Bu süreçte öğrenci gruplarına içinde Milli Park Şefi imzalı gizli bir evrak bulunan zarflar dağıtılmış, ihtiyaç duyacakları gerekli doküman ve malzemelerin bulunduğu bir araştırma kiti de gruplarla paylaşılmıştır. Daha sonra öğrenciler ile dağıtılan envanterdeki bitkileri teşhis etmek üzere 30 dakikalık doğa gezisi gerçekleştirilmiştir. Öğrenciler bu geziden elde ettikleri verileri yorumlayarak ulaştıkları problemi (Yozgat Çamlığı Milli Parkı'nın biyoçeşitliliği azalıyor) sınıf ortamında paylaşmışlardır. Öğrencilerden biyoçeşitliliğe etki eden faktörlerle ilgili hipotezlerini yazmaları ve kurdukları hipotez/leri test edebilmek için yöntem/ler belirlemeleri istenmiştir. Finalde öğrenciler elde ettikleri sonuçları ve tüm süreci raporlaştırmıştır. Etkinliğin fen bilgisi ve biyoloji derslerinde uygulanabileceği düşünülmektedir.
Anahtar kelimeler: sorgulama temelli bilim, doğa, biyoçeşitlilik.

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INTRODUCTION

Inquiry-based learning involves students' hypothesizing and testing the hypotheses and then explaining them with evidence. In this process the objective is to reach conclusions in scientific ways by actively using mental skills such as critical thinking, reasoning, analyzing, and evaluating in a natural environment with proof and evidence (Kıngır, Geban & Günel, 2013). It is made possible for students to direct their own process of researching, discovering, and learning by using questions of scientific quality and problems instead of just presenting them scientific truths (Cremin, Glauert, Craft, Compton, & Stylianidou, 2015).

The most important feature of learning occurring in inquiry-based learning environments is that such learning helps students to gain experiences in learning processes and thus to learn more easily and more effectively in the long term in addition to developing their knowledge skills (Joyce, Weil, & Calboun, 2009). Inquiry-based learning plays significant roles in incurring critical thinking, communication, collaboration, and creativity skills- which were identified as learning and reformative abilities available within the scope of P21 Framework for 21st century learning by Partnership for 21st Century Learning (2007).

Inquiry-based learning, which also contributes to learning and implementing scientific processes, helps students act like scientists and engage them in solving problems by using cognitive processes (Öğreten & Sağır, 2014). It was found in inquiry-based learning that students who are involved in the process of solving a problem from real life thought and acted like scientists while making inquiry (Morris, Croker, Zimmerman, Gill, & Romig, 2013). It was revealed that students also developed skills in evaluating the explanations in addition to becoming aware of cause and effect relations, recognizing the processes of reasoning and using the data as evidence in inquiry-based learning environments (Wu & Hsieh, 2006). Inquiry-based learning leads to a rise in students' self-confidence and to gaining a sense of responsibility beside influencing their learning in positive ways (Memiş, 2014).

Studies available in the literature demonstrated that students' achievement in science increased (Akpullukçu & Günay, 2013; Gençtürk & Türkmen, 2007; Wu & Hsieh, 2006), their scientific process skills improved (Erdoğan, 2005; Gül, 2011; Ulu & Bayram, 2015; Yaşar & Duban, 2009) and their positive attitudes towards science and technology increased (Çelik & Çavaş, 2012; Duban, 2008; Gibson & Chase, 2002) in inquiry-based learning environments. It can be said in the light of the findings obtained that inquiry-based learning affects achievement in and attitudes towards science in positive ways. In addition to that, inquiry-based learning was found to contribute to the development of students' scientific process skills. Inquiry-based teaching can be in different forms (National Research Council [NRC], 2000; Sadeh & Zion, 2012): i. Structured-inquiry- in which the teacher gives the problem and the process and students find the solution. ii. Guided-inquiry- in which the teacher gives the problem and the students go through the process and find the solution. iii. Open-inquiry- in which students themselves develop the problem for the research and they design the process. The activity introduced in this paper was prepared based on guided inquiry. Inquiry-based learning can be done in and outside the classroom.

One of the environments in which inquiry-based learning can be performed can be nature in which we live. Nature has been frequently used as an area of learning since the 19th and 20th centuries. The content for science is described as "anything available and observable in the natural environment" (McComas, 2008, p.24). Several elements available in nature have found a place in the curricula. For example, vegetation, animals, stones, air, astronomy and all the experiences gained in nature constitute a part of the curricula. Besides, learning environments enriched by such elements are influential in inquiry-based learning.

Some of the studies conducted in relation to learning science in nature were concerned with academic achievement, attitudes towards science, transforming scientific process skills into behaviors, environmental awareness and literacy, awareness of the environment, and perception of the environment and positive effects were found (Berberoğlu, 2015; Erdoğan, 2011; Ertaş, Şen, & Parmaksızoğlu, 2011; Kahyaoğlu & Yetişir, 2015; Kıyıcı, Yiğit, & Darçın, 2014; Kutru & Soran, 2012; Tekbıyık,

Şeyihoğlu, Vekli, & Konur, 2013). Another study concerning learning in nature found that students motivation rose through their curiosity and eagerness to learn and thus retention in learning was influenced in positive ways (Birinci, 2013).

Biological diversity and its preservation are humans' responsibility. Therefore, individuals should be inculcated the responsibility and capability in preserving biological diversity. Bio-diversity education, which is one of the issues of environmental education, is also one of the important subjects available in the conceptual framework of science education. Thus, standards in relation to questioning the importance of biodiversity in natural life and discussing the factors threatening biodiversity are included in the Humans and the Environment unit in the science curriculum (Ministry of National Education, 2018). However, it was observed that sample activities about how to teach those standards were not available in the curriculum. Therefore, providing sample activities in the subject of biodiversity can guide science teachers.

In accordance with what is said above, this study aims to provide educators and researchers with an inquiry-based sample activity in nature about biodiversity. The activity mainly aims to adapt a mystery into a natural event and thus to turn science into an entertaining activity of learning and exploring.

Guided Inquiry

Models with involving different stages are available in the literature to be able to configure the process in applications of inquiry-based science. The model on which this study is based is the one suggested by Bayram (2015) based on the study of Jussaume, Lardeau, and Mardelle (2006) and it is a guided inquiry-based model with eight stages. The model was chosen due to the fact that it directed students through questions and that it guided the inquiry process. The stages in the model are as in the following: 1. planning- the starting point, 2. the preliminary inquiry, 3. writing down the

problem, 4. preliminary explanations and hypothesizing, 5. method recommendations, 6. doing the activities, 7. comparing the results with the hypotheses, and 8. writing the synthesis. The process of implementing the model is explained below through the activity that was developed in the current study. Thus, Table 1 shows the activity called the Biodiversity of the National Park in in Danger which was developed by the researcher in accordance with a project.

ACTIVITY IMPLEMENTATION

The activity was done with the participation of 12 pre-service science teachers and 24 secondary school students (eighth graders) in a science camp supported by The Scientific and Technological Research Council of Turkey (TUBITAK) 4004 Nature Education and Science Schools Programme. The legal permissions were obtained to work with the students. The preservice teachers participating in the activity functioned as observers in the process as in other activities- as they had been informed of it prior to the project.

The area of implementation of the activity was Yozgat Çamlık National Park and the Centre of Nature Education located in the area. The students worked in six groups- each group having four students and two preservice teachers as observers. Care was taken in choosing the group members to include the project participants coming from different schools in the same groups. The activity lasted for about 3 hours.

The data for evaluating the activity were obtained from reflective diaries the students had written during the camp at the end of each day, from the observation control list of inquiry skills completed by two project guides observing the activity process, and from the field notes they had taken in the process. The worksheets that the participants had completed during the activity were also used to evaluate the students' performance in the activity process.

Table 1. The Stages of Guided Inquiry and A Sample Activity

Stages	What to Do?	The Activity Called "the Biodiversity of the National Park is in Danger"
1- Planning- The starting point	Students are exposed to a problem area related to daily life and reflecting the real world.	• Students are divided into groups of six. • Envelopes containing a secret document signed by Yozgat Çamlık National Park chief and a research kit containing other documents and materials they will need in the process are distributed to the groups. • Students go on a 30-minute nature tour by using the inventory available in the research kit to identify the plants in the national park in accordance with the instructions in the secret document. • This stage and the following stages are observed by using the "Observation Control List of Inquiry Skills."
2- Preliminary inquiry	Students explore the problem/problems in the problem area through observations, experiments, etc.	• At this stage the activity worksheet entitled "Biodiversity is Under Threat at Yozgat Çamlık National Park!" is distributed to the groups. • The lecturer asks the groups such questions as "How many of the plants available in the inventory were you able to identify?", "Which plants did you identify?", "Why couldn't you identify other plants?" and "Why couldn't you see all types of plants available in the inventory?" • The groups re-permitted 10 minutes for brainstorming, and then they are asked to note down the results in the relevant part of the worksheet. • After each group's views about the subject are obtained, consensus is reached on the decrease in biodiversity in the national park- which is the main problem. • At the final stage, the second secret document signed by Yozgat Çamlık National Park Chief is distributed to the students by the lecturer and the students are asked to research the factors causing a decrease in the biodiversity in the national park in accordance with the instructions in the document.
3- Writing down the problem	Students interpret the data obtained from the problem area and they identify and list the problem/problems.	• At this stage the students are asked to configure the factors influencing the decrease in biodiversity in the form of questions. For example, "Might the deterioration in the structure of soil in the national park have diminished biodiversity?", "Is the pollution in lake water diminishing biodiversity?"
4-Preliminary explanations and hypothesizing	Students hypothesize about the problem/problems they explore and they list them.	• At this stage, the students are asked to list the hypotheses which they can test to determine the factors causing a decrease in biodiversity in the national park. • They form hypotheses such as "little water in the soil diminishes biodiversity", "decrease in pH value causes a decrease in biodiversity", and so on. • Each group chooses three of their hypotheses about which they are curious and which they can test. In this process the lecturer guides the students in choosing the hypotheses which can be tested. After that, the groups move on to the stage of choosing a method.

Table 1 (continued).

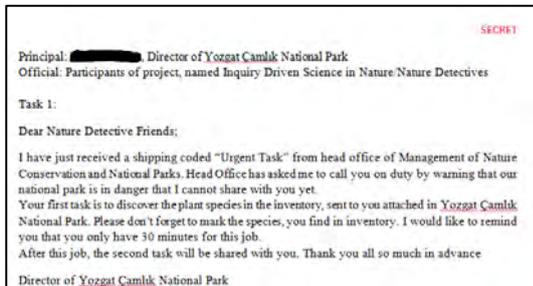|		
5- Method recommendations	Students design observations, research, experiments, etc. to test their hypotheses.	• At this stage, the students are asked what they can do to test their hypotheses about the decrease in biodiversity, and they are told to write down their recommendations for methods. For instance, "Let us take a sample from lake water and analyze its content", "Let us find whether or not there is excessive hunting by interviewing the officials in the national park."
6- Doing the activities	Students employ the methods they have chosen to test their hypotheses, and then they record their data.	• The students do experiments to test their hypotheses and they record their data. • For example, they analyzed the content of soil and water samples they had taken from the national park. They record their results.
7-Comparing the results with the hypotheses	Students interpret the results they have obtained from the activities they do (experiments, observations, research, etc.), and they test the validity of their hypotheses.	• At this stage, the students are expected to compare their results with their hypotheses they had formed at the beginning.
8- Writing the synthesis	Students report the whole process after testing their hypotheses about the problems.	• The students are asked to organize their conclusions in the form of reports.

The Materials and Equipment

The materials and equipment were provided to the students within the scope of the project. The materials used are:
- the book entitled "The Inventory of the Flora and the Passeriformes in Yozgat Çamlık National Park and in Fatih Nature Park",
- articles about the subject,
- magnifying glasses,
- hoes,
- gloves,
- water test kit,
- soil test kit,
- nylon bags to carry the samples,
- spatula, and
- plastic cups.

Stage One: Planning- The Starting Point

Envelopes containing a secret document (Appendix 1) signed by the director in Yozgat Çamlık National Park, is distributed to the groups of students at the first stage of the inquiry process suggested by Jussaume et al. (2006). It is presented Photograph 1. Additionally, a research kit containing the documents and materials they will need in the process is also distributed to the groups. The recommended length of time for the stage is 40 minutes.

Principal: ████████, Director of Yozgat Çamlık National Park
Official: Participants of project, named Inquiry Driven Science in Nature/Nature Detectives

Task 1:

Dear Nature Detective Friends;

I have just received a shipping coded "Urgent Task" from head office of Management of Nature Conservation and National Parks. Head Office has asked me to call you on duty by warning that our national park is in danger that I cannot share with you yet.
Your first task is to discover the plant species in the inventory, sent to you attached in Yozgat Çamlık National Park. Please don't forget to mark the species, you find in inventory. I would like to remind you that you only have 30 minutes for this job.
After this job, the second task will be shared with you. Thank you all so much in advance

Director of Yozgat Çamlık National Park

Photograph 1. The Secret Document Signed by the Director in the National Park 1

The students go on a 30-minute nature tour to identify the plants mentioned in the book entitled "The Inventory of the Flora and the Passeriformes in Yozgat Çamlık National Park and in Fatih Nature Park" (Photograph 2). They return to nature educational center with the data they collect. This stage and all other stages following it are observed by using the "Observation Control List of Inquiry Skills" given in Appendix 2.

Photograph 2. Tour of Nature in Yozgat Çamlık National Park and in Fatih Nature Park

Stage Two: Preliminary Inquiry

The worksheet entitled "Biodiversity is Under Threat at Yozgat Çamlık National Park!" is distributed to the groups at this stage (Appendix 3). The lecturer asks the questions "How many of the plants available in the inventory were you able to identify?", "Which plants did you identify?", "Why couldn't you identify other plants?" and "Why couldn't you see all types of plants available in the inventory?" The groups are allowed 10 minutes for brainstorming, and then they are asked to write down their results in the part available in the worksheet. After each group's views about the subject are obtained, consensus on the main problem- the decrease in biodiversity in the national park- is reached. At the final stage, the lecturer distributes the second secret document signed by the chief of the national park to the students and she asks the students to research the factors causing a decrease in biodiversity in the national park (Photograph 3). The recommended length of time for this task is 15 minutes.
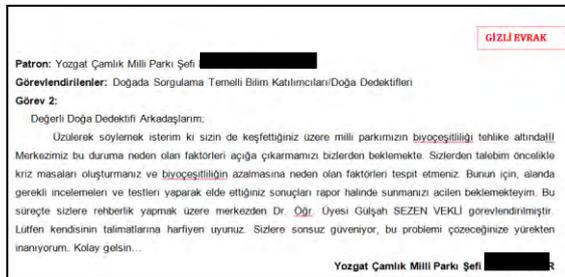

Photograph 3. The Process of Groups' Identifying the Problem

Stage Three: Writing Down the Problem

The students are allowed 15 minutes at this stage. They are asked to share their conclusions with their classmates. Examples for the questions they put forward were as in the following:

- Might the deterioration in the structure of the soil in the national park have diminished biodiversity?
- Is the pollution in lake water diminishing biodiversity?
- Is excessive hunting in the national park influential in the decrease in biodiversity?

The most frequently stated problems are chosen from the problems that the students have identified. After that, the second envelope of mission signed by the chief in Yozgat Çamlık National Park is distributed to the students (Photographs 4-5).

Photograph 4. The Secret Document Signed by the Chief in the National Park 2

Photograph 5. The Process of Groups' Hypothesizing

Stage Four: Preliminary Explanations and Hypothesizing

At this stage, the students are asked to list the hypotheses which they can test to identify the factors causing a decrease in biodiversity in the national park. Each group chooses three hypotheses that they are the most curious about and that can be tested within their

possibilities from the ones that they have developed. In this process, the lecturer guides students in choosing the hypotheses that can be tested within their possibilities. Then, the groups move on to the stage of choosing a method (Photograph 6). The recommended length of time for the activity is 15 minutes. Some of the examples for students' hypotheses were as in the following:

- An increase in the amount of phosphorous in soil decreases biodiversity.
- A decrease in pH value causes a decrease in biodiversity.
- Hunting out of the season (excessive hunting) causes a decrease in biodiversity.
- Scarcity of water in soil decreases biodiversity.
- Excessive hardness of lake water causes a decrease in biodiversity.

Photograph 6. The Process of Groups' Choosing Methods

Stage Five: Method Recommendations

It is the stage at which students plan such activities as observations, water test, soil test, and research to test their hypotheses. An image of this process, which lasted approximately 15 minutes, is presented in Photograph 7. Some of the samples for what the participants had written down at this stage were as in the following:

- Let us research the ideal values for the minerals in the soil from articles.
- Let us identify the amount of minerals in the soil through soil test.
- Let us take samples of water from the lake and test the water content.
- Let us interview the officials of the national park and find whether or not there is excessive hunting.

Photograph 7. The Process of Groups' Taking Samples from the Soil

Stage Six: Doing the Activities

Students do the activities they plan to test their hypotheses and then they record the data at this stage (Photographs 8-9). They, for example, tested content for the water and soil samples they had taken from the national park. They record their results. The recommended length of time for this stage is 50 minutes.

Photograph 8. The Process of Groups' Analyzing the Lake Water
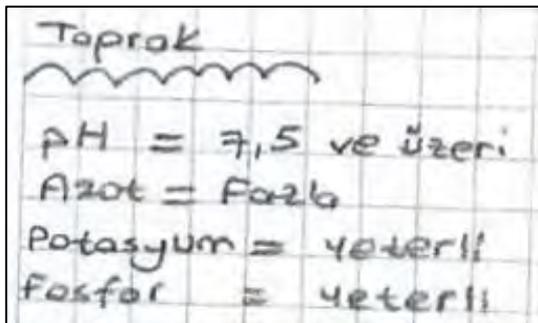
Photograph 9. Group Three's Results for Soil Analysis

Stage Seven: Comparing the Results with the Hypotheses

Students interpret the results they have obtained from activities (observations, water

test, soil test, document analysis, research) and they test the validity of their hypotheses. The recommended length of time for this stage is 10 minutes.

Stage Eight: Writing the Synthesis

This stage was planned for 20 minutes. At this stage, students report the whole process after testing their hypotheses that they have developed for the problems (Photograph 10).

Photograph 10. The Process of Groups' Reporting Their Results

CONCLUSIONS and SUGGESTIONS

This activity aims to turn science into an entertaining learning/discovery activity by adapting mystery into a natural event. The data for the evaluation of the activity were collected from the participants' reflective diaries, from project guides' notes they had taken in the field, from their observation list, and from the worksheets the students had completed during the activities.

The findings from the reflective diaries demonstrated that most of the pre-service teachers and students thought the activity was fun and that they felt they were in a research-based game throughout the activity. For example, the student coded as Ö17 stated that: "I liked the activity very much because I felt as if I was a scientist. Doing experiments was enjoyable. It was an activity through which we learnt science. So, it was fun." Similarly, a preservice science teacher said that "Children had fun in this activity because they made observations and experiments and

did research to resolve the mystery in the park. In fact, they had roles as scientists in the game." (ÖA4). An examination of the project guides' observation notes showed that pre-service teachers stated that the activity could also be used in different natural environments by adapting it into daily problems and that the materials needed for the activity were easy to reach.

The students stated in their reflective diaries that the stages of research which were included in the activity contributed to the development of scientific process skills (making observations, hypothesizing, experimenting, making inferences themselves). The student coded as Ö6 expressed that "I acquired hypothesizing skills and experimenting skills." Another student, Ö14 claimed that "We had difficulty in hypothesizing, mainly in … but we learned how to do it." Also, Ö2 wrote that "After that activity, I felt that I was more open to experiments. I promised for myself to protect nature more and to be more careful about nature."

On examining the worksheets that the students were required to complete during the activity, it was found that they could accurately identify the problems. However, they were found to have difficulty in forming valid hypotheses. For example, some groups did not express their hypotheses as a testable sentence. The data coming from the observation control list of inquiry skills also demonstrated that only one of the student groups could form valid hypotheses. The researcher guided the students in this process so that the groups could re-arrange their hypotheses. Teachers need to encourage and lead students in this process so that they can form valid hypotheses.

On examining the worksheets, it was found that the students learnt through their research how the scarcity or abundance of such minerals as nitrogen, phosphorous, and potassium might affect the growth of plants. In a similar way, they were also found to have learnt how the scarcity or abundance of certain minerals in water might affect the growth of plants. Besides, they were also found to have learnt that the changes in the pH of water and soil was influential in the

growth of plants. It was demonstrated in relevant literature that inquiry-based learning approach had positive effects on participants' conceptual understanding (Akpullukçu & Günay, 2013; Gençtürk & Türkmen, 2007). Another conclusion reached in this paper was that the majority of the students tended to write the part about methods in the worksheet superficially. Therefore, teachers can add more details into this part in the worksheet and they can guide students more in this part.

REFERENCES

Akpullukçu, S., & Günay, Y. (2013). Fen ve teknoloji dersinde araştırmaya dayalı öğrenme ortamının öğrencilerin akademik başarı, hatırda tutma düzeyi ve tutumlarına etkisi [The effect of inquiry based learning environment in science and technology course on the students' academic achivements, attitudes, and retention level]. *Ege Eğitim Dergisi*, *14*(1), 67-89.

Bayram, Z. (2015). Öğretmen adaylarının rehberli sorgulamaya dayalı fen etkinlikleri tasarlarken karşılaştıkları zorlukların incelenmesi [Investigating difficulties that preservice science teachers encounter while designing guided inquiry activities]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *30*(2), 15-29.

Berberoğlu, E. O. (2015). Ekopedagoji temelli sınıf dışı çevre eğitiminin çevre farkındalığı üzerine etkisi [The effect of ecopedagogy-based outdoor environment education on environmental awareness]. *Hasan Ali Yücel Eğitim Fakültesi Dergisi, 12-1*(23), 67-81.

Birinci, O. (2013). *İlkokul 3. sınıf hayat bilgisi dersine yönelik geliştirilen doğa eğitimi etkinliklerinin öğrencilerin doğa algılarına etkisi [Development of nature study activities based on elementary school 3rd grade life sciences lesson, and it's effects on children's conceptions of nature]* (Yayımlanmamış yüksek lisans tezi). Recep Tayyip Erdoğan Üniversitesi Sosyal Bilimler Enstitüsü, Rize.

Cremin, T., Glauert, E., Craft, A., Compton, A., & Stylianidou, F. (2015). Creative little scientists: Exploring pedagogical

synergies between inquiry-based and creative approaches in early years science. *Education 3-13: International Journal of Primary, Elementary and Early Years Education, 43*(4), 404-419.

Çelik, K., & Çavaş, B. (2012). Canlılarda üreme, büyüme ve gelişme ünitesinin araştırmaya dayalı öğrenme yöntemi ile işlenmesinin öğrencilerin akademik başarılarına, bilimsel süreç becerilerine ve fen ve teknoloji dersine yönelik tutumlarına etkisi [The effect of inquiry based learning method for the teaching for reproduction, growth and development in the living things unit on the students' academic achievements, science process skills and attitudes toward science and technology course]. *Ege Eğitim Dergisi, 13*(2), 50-75.

Duban, N. (2008). *İlköğretim fen ve teknoloji dersinin sorgulamaya dayalı öğrenme yaklaşımına göre işlenmesi: Bir eylem araştırması [Conducting science and technology course through inquiry-based learning approach in primary education: An action research].* (Yayımlanmamış doktora tezi). Anadolu Üniversitesi, Eğitim Bilimleri Enstütüsü, Eskişehir.

Erdoğan, M. (2011). Ekoloji temelli yaz doğa eğitimi programının ilköğretim öğrencilerinin çevreye yönelik bilgi, duyuşsal eğilimler ve sorumlu davranışlarına etkisi [The effects of ecology-based summer nature education program on primary school students' environmental knowledge, environmental affect and responsible environmental behavior]. *Kuram ve Uygulamada Eğitim Bilimleri, 11*(4), 2223-2237.

Erdoğan, M. N. (2005). *İlköğretim 7. sınıf öğrencilerinin atomun yapısı konusundaki başarılarına, kavramsal değişimlerine, bilimsel süreç becerilerine ve fene karşı tutumlarına sorgulayıcı araştırma (inquiry) yönteminin etkisi [The effects of inquiry method on middle school (level 7) students' achievement, conceptual change, scientific process skills and attitude toward science about the atomic structure]* (Yayımlanmamış

yüksek lisans tezi). Gazi Üniversitesi, Eğitim Bilmleri Enstütüsü, Ankara.

Ertaş, H., & Şen A. İ., & Parmaksızoğlu, A. (2011). Okul dışı bilimsel etkinliklerin 9. sınıf öğrencilerinin enerji konusunu günlük hayatla ilişkilendirme düzeyine etkisi [The effects of out-of school scientific activities on 9th grade students' relating the unit of energy to daily life]. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 5*(2), 178-198.

Gençtürk, H. A., &Türkmen, (2007). İlköğretim 4. sınıf fen bilgisi dersinde sorgulama yöntemi ve etkinliği üzerine bir çalışma [A study of effectiveness and application of inquiry method in a 4th grade science course]. *Gazi Eğitim Fakültesi Dergisi, 27*(1), 277- 292.

Gibson, H. L., & Chase, C. (2002). Longitudinal impact of an inquiry-based science program on middle school students' attitudes toward science. *Science Education, 86*(5), 693-705.

Gül, Z. (2011). *Sorgulamaya dayalı öğrenme sürecinde alternatif bir araç 't-diyagramı': Enzimler ve enzimlerin çalışmasına etki eden faktörler üzerinde örnek bir uygulama [An alternative tool 'T- diagram' during inquiry-based learning process: A sample study on the factors affecting enzymes and enzyme study]* (Yayımlanmamış yüksek lisans tezi). Gazi Üniversitesi Eğitim Bilimleri Enstütüsü, Ankara.

Joyce, B., Weil, M., & Calhoun, E. (2009). *Models of teaching* (8th ed.). Boston, MA: Pearson.

Jussaume, A., Lardeau, D., & Mardelle, P. (2006*). La démarche pédagogique des activités scientifiques [The pedagogical approach of scientific activities]*. Retrieved from http://www.fondation-lamap.org/

Kahyaoğlu, M., & Yetişir, İ. (2015). Doğa kavramı ve Çocukların doğadan uzaklaşmasına ilişkin fenomenografik bir çalışma [A phenomenographic study on the concept of nature and alienation of children from nature]. *Eğitim ve Bilim, 40*(182), 159-170.

Kıyıcı, B. F., Yiğit, E. A., & Darçın, E. S. (2014). Doğa eğitimi ile öğretmen

adaylarının çevre okuryazarlık düzeylerindeki değişimin ve görüşlerinin incelenmesi [Investigation of pre-service teacher's opinion and environmental literacy level change with nature education]. *Trakya Üniversitesi Eğitim Fakültesi Dergisi, 4*(1), 17-27.

Kingir, S., Geban, O., & Gunel, M. (2013). Using the science writing heuristic approach to enhance student understanding in chemical change and mixture. *Research in Science Education, 43*(4), 1645-1663.

Kutru, Z., & Soran, H. (2012, June). *Üniversite öğrencilerinin doğa algıları [University students' perceptions of nature].* Paper presented at the National Science and Mathematics Education Conference, Niğde, Turkey.

McComas, W. F. (2008). Back to the future? Reconsidering the role of 19th century nature-study in 21st century science teaching. *The Science Teacher*, *75*(2), 24-28.

Memiş, E. K. (2014). İlköğretim öğrencilerinin argümantasyon tabanlı bilim öğrenme yaklaşımı uygulamalarına ilişkin görüşleri [Elementary students' ideas about on implementation of argumentation based science learning approach]. *Kastamonu Eğitim Dergisi, 22*(2), 400-418.

Ministry of National Education. (2018). *İlköğretim fen bilimleri dersi (3-8. sınıflar) öğretim programı [Elementary science course (3-8th grades) curriculum].* Ankara: Ministry of National Education Press.

Morris, B. J., Croker, S., Zimmerman, C., Gill, D., & Romig, C. (2013). Gaming science: The "gamification" of scientific thinking. *Frontiers in Psychology, 4,* 1-16.

National Research Council. (2000). *Inquiry and the national science education*

standards. Washington, DC: National Academy Press.

Öğreten, B., & Sağır, Ş. U. (2013). 4. sınıf fen ve teknoloji dersinde interaktif öğretimin akademik başarıya ve tutuma etkisi [The effect of interactive teaching on academic success and technology course for 4th grades]. *Batı Anadolu Eğitim Bilimleri Dergisi, 4*(7), 1-8.

Partnership for 21st Century Learning. (2007). *P21 framework for 21st century learning.* Retrieved from http://www.p21.org/our-work/p21-framework

Sadeh, I., & Zion, M. (2012). Which type of inquiry project do high school biology students prefer: Open or guided? *Research in Science Educatio*n, *42,* 831–848.

Tekbıyık, A., Şeyihoğlu, A., Vekli, G. S., & Konur, B. K. (2013). Aktif öğrenmeye dayalı bir yaz bilim kampının öğrenciler üzerindeki etkilerinin incelenmesi [Influence of a science camp based on active learning on students]. *The Journal Academic Social Science Studies, 6*(1), 1383-1406.

Ulu, C., & Bayram, H. (2015). Yaparak yazarak bilim öğrenme yaklaşımına dayalı öğretim yönteminin bilimsel süreç becerilerine etkisi [Effects of teaching method based on the science writing heuristic approach on science process skills]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 30*(1), 282-298.

Wu, H. K., & Hsieh, C. E. (2006). Developing sixth graders' inquiry skills to construct explanations in inquiry-based learning environments. *International Journal of Science Education, 28*(15), 1289-1313.

Yaşar, Ş., & Duban, N. (2009). Students' opinions regarding to the inquiry-based learning approach. *İlköğretim Online*, *8*(2), 457-475.

Citation Information

Appendix 1

Secret Document by Chief of National Park 1-2

SECRET

Principal: Director of Yozgat Çamlık National Park
Official: Participants of project, named Inquiry Driven Science in Nature/Nature Detectives

Task 1:

Dear Nature Detective Friends;

I have just received a shipping coded "Urgent Task" from head office of Management of Nature Conservation and National Parks. Head Office has asked me to call you on duty by warning that our national park is in danger that I cannot share with you yet.
Your first task is to discover the plant species in the inventory, sent to you attached in Yozgat Çamlık National Park. Please don't forget to mark the species, you find in inventory. I would like to remind you that you only have 30 minutes for this job.
After this job, the second task will be shared with you. Thank you all so much in advance.

Director of Yozgat Çamlık National Park

Task 2:

SECRET

Principal: Director of Yozgat Çamlık National Park
Official: Participants of project, named Inquiry Driven Science in Nature/Nature Detectives
Task 2:

I'm sorry to say that, as you've discovered, the biodiversity of National Park is hang by a thread!!! Our center expects us to determine the factors that cause this situation. I ask you to create crisis desks and examine the factors that cause decreasing biodiversity. For this, I urgently expect you to report the results by conducting the necessary examinations and tests in the field. In this process, ███████████ ████████████ has been tasked with guiding you. Please, follow her instructions. I completely trust on you, I sincerely believe that you will solve this problem.

Appendix 2

Observation Control List of Inquiry Skills

Observation Control List of Inquiry Skills			
Goals	**Acceptable**	**Need to be improved**	**Poor**
1.Hypothesis - building			
2.Desingning and doing an experiment			
3. Determining and defining variables			
4. Collecting accurately and editing data, inferring logical results			
5. Elaborating an unexpected result			
6. Supporting results by using valid argument			
7. Cooperating together towards common goals			
8. Discussing, criticizing and reporting results, giving feed back			

Appendix 3

Worksheet

BIODIVERSITY IS UNDER THREAT AT YOZGAT ÇAMLIK NATIONAL PARK!

Problem/s

Determine what the threat or threats, mentioned by Director of National Park as interpreting the observation data you obtained from the nature trip.

Hypothesis

Write hypothesis towards problem/s determining in the previous step.

Method/s

Write how you will test your hypothesis and which instruments you will need in detail.