

A SCIENCE ACTIVITY: WHY? WHAT FOR? HOW?¹

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ABSTRACT

The aim of this activity is to improve students' inquiry skills through high cognitive questions and to introduce a new perspective on science courses. This activity was carried out in the first and second semester of 2016-2017 academic year. Volunteer students attending the science course in a Science and Art Center participated in the activity. Why? What for? How? Activity was organized as a competition. A question was put on the pin board each week about science. The students wrote their answers and their names on a piece of paper and then put it in a box attached to the pin board in a week. Students' responses were evaluated according to an evaluation scale, and the student with the highest score won the competition. It was observed that mainly girls participated in the activity and that the participants preferred the internet as the research tool.

Keywords: science education, questioning, inquiry skills, science activity.

BİR FEN BİLİMLERİ ETKİNLİĞİ: NEDEN? NİÇİN? NASIL?

ÖZ

Sorular ve cevaplar eğitim-öğretim ortamının vazgeçilmez unsurlarındandır. Ne ve nerede soruları düşük bilişsel seviyede, niçin ve nasıl soruları ise yüksek bilişsel seviyededir. Bu etkinliğin amacı yüksek bilişsel seviyede sorular aracılığıyla öğrencilerin araştırma-sorgulama becerilerini artırmak ve fen derslerine ilişkin bakış açılarını geliştirmektir. Bu etkinlik 2016-2017 eğitim-öğretim yılı I. ve II. döneminde gerçekleştirilmiştir. Etkinliğe bir Bilim ve Sanat Merkezi'nde fen bilimleri dersine devam eden ortaokul seviyesindeki gönüllü öğrenciler katılmıştır. Neden? Niçin? Nasıl? etkinliği, yarışma olarak düzenlenmiştir. Sınıf panosuna her hafta fen bilimleri dersi ile ilgili bir soru asılmıştır. Verilen bir hafta süre içinde öğrenciler soruların cevaplarını ve isimlerini yazmış oldukları bir kağıdı, panoya asılan kutunun içine atmışlardır. Geliştirilen bir değerlendirme ölçeği ile yapılan değerlendirme sonucunda sorulara en fazla doğru cevap veren öğrenci yarışmayı kazanmıştır. Etkinliğe ağırlıklı olarak kız öğrencilerin katıldığı, katılımcıların araştırma aracı olarak interneti tercih ettikleri görülmüştür.

Anahtar kelimeler: fen eğitimi, soru sorma, araştırma-sorgulama becerileri, fen etkinliği.

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INTRODUCTION

The Programme for International Student Assessment [PISA] is one of the most comprehensive educational studies aiming to measure the knowledge and skills students have acquired at school as they employ them in daily life. Scientific literacy is one of the three main areas assessed in PISA examinations. Science competencies, which are assessed within the scope of scientific literacy and which are expected of students are considered under the following three categories: 1) explain phenomena scientifically, 2) evaluate and design scientific enquiry, 3) interpret data and evidence scientifically (Ministry of National Education [MoNE], 2015; Organisation for Economic Co-operation and Development [OECD], 2016). Students can acquire these competencies through research-inquiry based learning.

Inquiry is a versatile activity involving making observations; creating questions; reviewing books and other sources of knowledge to see what is previously known; checking what is known in the light of experimental evidence; reaching the instruments necessary to collect, analyse, and interpret data; suggesting answers, explanations and predictions, and describing the findings. Assumptions should be made, critical and logical thinking skills should be used and alternative explanations should be taken into consideration in research (Koyunlu Ünlü, 2015; National Research council [NRC], 2000). As is clear from the definition, inquiry does not only mean doing experiments and interpreting the results. It also involves “reviewing books and other sources of knowledge to see what is already known” (NRC, 2000, p. 23). The dimensions of inquiry, research, and learning are mentioned in the definition of inquiry based learning in 2013 and 2017 science curriculum (MoNE, 2013, 2017).

Questions and answers which can be used on all dimensions are the indispensable elements of inquiry based learning. The questions of what and where are at low cognitive level whereas the questions of why and how are at high cognitive level (Bass, 1972). True/False questions, Yes/No questions, questions which students are not expected to answer, and questions which teachers answer are also

questions at low cognitive level (Martin, Sexton, Franklin, Grlovich, & McElray, 2005).

Question-answer method of teaching improves students’ ability to think, provides feedback in the learning and teaching process, helps students to make connections between different ideas, and increases students’ curiosity (Büyükalın Filiz, 2002). Question-answer is a technique that enables students to think, reason, and speak. Several issues should be taken into consideration when using this technique. The appropriate wait time should be allowed to answer a question once the question is asked, and volunteering students should be given priority. Students giving incorrect answers should not be judged, clues should be used to help find the correct answers, and correct answers should immediately be reinforced. Questions should be asked at random rather than in a certain order if they are asked for the whole classroom (Demirel, 2009).

Teachers generally expect students to answer questions within certain limits and to think in desired contexts. They usually do not look for flexibility, originality, or creativity in the answers (Akpınar, 1999). In research-inquiry based learning, however, it is very important that teachers have effective questioning skills (Jarret, 1997).

There are different classifications of question types in the literature. Some classifications are related to cognitive levels. The most commonly used classification was made by Bloom (1956). Bloom (1956) classified the types of questions as knowledge, comprehension, application, analysis, synthesis, and evaluation. Knowledge questions require remembering what has been previously learnt. A behaviour measured at this level involves such verbs as define, name, describe, list, choose, order, and match. Comprehension questions assess the level of students’ understanding. Skills considered in this group contain such student behaviours as distinguishing concepts, principles, and generalisations for a new situation; explaining them in their own words; giving new and original examples, and changing them into different forms. Application questions are associated with using what has been learnt previously in new situations. They are the

concretisation of abstract situations. Such behaviours as determining the most essential parts of a situation and determining the connections between them can be measured at this level. Synthesis questions assess behaviours related to choosing suitable elements and creating a product by combining these elements to serve a certain purpose. Students are asked to make statements about the value of a product or method serving to a certain purpose at the level of evaluation (Çelik, 2000).

Asking questions about daily life in classes adds authenticity to learning environments. The concept of authenticity may be defined as transferring the complexity of situations and problems in real life into classroom environment and related learning (Bektaş & Horzum, 2010). Science lessons in particular are associated with daily life. Raising students' awareness of science related issues they encounter in daily life enables students to approach issues in an inquiring manner.

This activity aims to increase students' research-inquiry skills (reviewing books and other sources of knowledge to see what has previously been known) through high level cognitive questions related to science and to promote that they ask questions about science. The activity lasted for 15 weeks and was implemented as a competition.

ACTIVITY IMPLEMENTATION

Volunteer secondary school students attending a Science and Art Centre in Turkey participated in the activity. Science and Art centres offer education to students in their free time outside school. Students who have passed oral and written examinations in the fields of intelligence and ability are entitled to attend these centres. Students engage in applied activities by taking various courses. The participants have obtained the right to be educated in a Science and Art centre in the field of intelligence.

This activity was performed in 2016-2017 academic year. There were six groups and 24 students (4th - 7th graders) who were taking the science course in the academic year when the activity was performed. The number of students in the groups ranged between 3 and 5.

In the first semester 14 students (12 girls and 2 boys) participated in the activity while 11 students (8 girls and 3 boys) participated in the activity in the second semester.

The *Why? What for? How?* activity lasted for ten weeks in the first semester and for five weeks in the second semester, and was organised as a competition. The rules for the competition were announced on the pin board in the science classroom a week before the competition. The rules were as follows:

- 1) Students taking science classes in Science and Art Centre X can take part in this competition.
- 2) The competition will be held in the period October 24, 2016 and January 23, 2017, and the results will be announced on January 24, 2017.
- 3) Competitors should write their answers to the questions announced on the science pin board on a piece of paper and put the paper into the envelope attached to the pin board.
- 4) The student receiving the highest score for his/her answers will be the winner. The winner(s) will be given a small gift.

In accordance with the rules of the competition, a science question was put on the pin board each week. The competitors wrote their answers to the questions on a piece of paper and put the paper into the envelope on the pin board. Table 1 shows the questions asked to the students during the *Why? What for? How?* competition which continued for ten weeks in the first semester and five weeks in the second semester.

Science books written for children were used in selecting the questions shown in Table 1 (Ergin Çetin, 2014a, 2014b, 2014c). Some of the questions are related to the standards in 2013 science curriculum. The question "How do we keep our balance?" for instance, is related to the standard "classifying nervous system as central and peripheral nervous system and showing it on a model and explaining its duties" within the "Systems in Our Body" unit in the 7th grade. The question "why do comets have a tail?" on the other hand, is associated with the standard "comparing stars with planets" in the unit "Solar System and Beyond" (MoNE, 2013).

Table 1. Questions Asked in the Why? What for? How? Competition

Semester I	Questions
Week 1	How do we keep our balance?
Week 2	Why does our hair go gray?
Week 3	Why do we have hiccups?
Week 4	How do birds find worms?
Week 5	Why does cheese mould?
Week 6	Why do we shiver when we feel cold?
Week 7	How does soap clean our hands?
Week 8	Why do comets have a tail?
Week 9	How does a remote control work?
Week 10	Why do we yawn?
Semester II	Questions
Week 1	Why can mice not vomit?
Week 2	Why is pepper bitter?
Week 3	Why do birds on electric wires not have electric shock?
Week 4	Why do ants wander as a line?
Week 5	Why do clouds look white?

**Photograph 1.** Science Pin board

Photograph 1 shows the pin board for science. Students' answers were evaluated according to the criteria of "explain phenomena scientifically" and "interpret data and evidence scientifically" which are among PISA science competencies (MoNE, 2015). The students also received points for submitting their answers on time. The assessment scale prepared for this purpose is shown in Table 2.

Table 2. The Assessment Scale Used in the Activity

Criteria	Score
1) Reaching the source/sources where the answer to the question can be found	1
2) Understanding the question under research	2
3) Analysing the data obtained from the source reached	3
4) Answering the question by interpreting the data scientifically	3
5) Answering the question on time (in a week)	1
Total	10

As Table 2 shows, reaching the source(s) where the answer is to be found receives 1 point, understanding the question researched receives 2 points, analysing the data obtained from the source reached receives 3 points (low level= 1 point, medium level= 2 points, high level= 3 points), answering the question by interpreting the data in accordance with the question receives 3 points (low level= 1 point, medium level= 2 points, high level= 3 points), and answering the question on time receives 1 point. An answer can be assigned 10 points at the maximum. Besides, 1-4 points are considered as low level, 5-7 points as medium level, and 8-10 points as high level. Figure 1 shows the answer given by a student who has scored full points in the activity of the first semester.

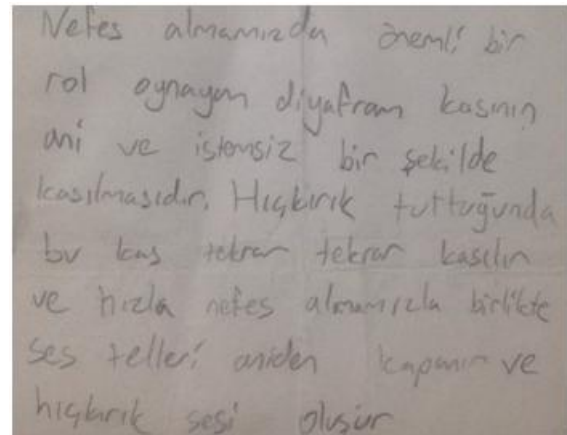
**Figure 1.** The Correct Answer Given by a Participant

Figure 1 shows the answer submitted by a student who received 10 points for the question “why do we have hiccups?” This student interpreted the scientific information in the text that she reached in her research, analyzed it, and provided an appropriate answer in the allowed time. Figure 2, on the other hand, shows the answer of a student for the question “how do birds find worms?”

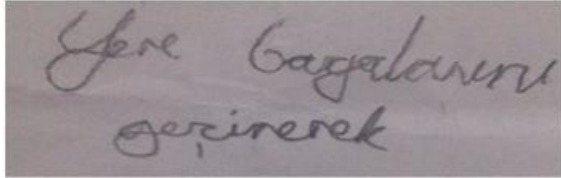


Figure 2. Incomplete Answer Given by a Participant

The student answer shown in Figure 2 is incomplete. The correct answer should have been as in the statement “birds usually choose morning time or the time just after it rains when worms come closer to the surface of the soil to have respiration. Birds, who have developed sense of sight and hearing, plunge their beak into different parts of the soil and thus find worms.” The student received only 2 points for the criteria “*analysing the data obtained from the source reached*” and “*answering the question by interpreting the data scientifically.*” In this case, the student answer shown in Figure 2 received 6 points (medium level).

In addition to that, a chart containing students’ names, question items and the points the students have scored was prepared. Accordingly, the student having the highest number of correct answers won the competition. The winner was given a small gift.

CONCLUSIONS and SUGGESTIONS

Students were asked questions about science topics related to daily life in the form of a competition in this study. This study aimed to help students inquire the causes of a situation or an event by reaching a source and be aware of the underlying reasons. Table 3 shows the number of students taking part in the activity and winning the competition.

Table 3. The Number of Participating and Winning Students

Semester	Number of Participants	Number of Winners
Semester I	14	3
Semester II	11	4

Table 3 shows that 14 students participated in the activity in the first semester and 3 of them won the competition while 11 students participated in the second semester and 4 of them won the competition. The same students were winners in the first and second semesters but one more female student was added to the list of winners in the second semester. Because competition rules included the rule of answering the questions on time, the students giving correct answers for the beginning questions participated more in the competition. Yarışmayı kazanan öğrencilerin puanları 1. dönem orta seviyede iken, 2. dönem yüksek seviyeye çıkmıştır.

It was found that girls had participated in the activities more and that the participants mostly chose the internet as the tool of research. The reason for the higher number girl participants in the activity might be the fact that most of the students taking the science course were girls. Thus, this situation influenced the results.

Since the activity was done in a Science and Art Centre, it may be said that all of the students had investigative personality. Students who could not come to the centre in some weeks phoned the centre and wanted to hear the question in this way. Moreover, it was observed that the students went and checked whether or not the question of the week had been put on the pin board. Therefore, it may be stated that the activity triggered students’ excitement and curiosity. Because answering the questions on time also meant additional points for students, the students who failed to give answers on time withdrew from the competition. The number of students participating in the activity dropped week by week, and certain students competed against each other. Evaluation can be made at the end of the activity so that students scoring lower points keep participating in the activity. Classroom discussion can be held to share the

answers to the questions after announcing the date of evaluation.

Programmes associated with daily life affect students' attitudes towards and views of science. It was found through research, for instance, that students taking part in a robotics competition had positive attitudes towards science and science-related subjects (Welch & Huffman, 2011). The current activity can also be done in regular schools. It should be announced beforehand. It is thought that it would be better to determine students wishing to participate in the activity voluntarily at the beginning.

As pointed out in the introduction part, inquiry does not only mean doing experiments and interpreting the results. The stage of "reviewing books and other sources of knowledge to see what is previously known" is given prominence here. Therefore, various measurement tools (science literacy skills, computer literacy skills, and writing skills) can also be employed with participants to assess the development of their ability to reach a source, to research and to distinguish necessary information from unnecessary information.

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