The Turkish Primary Students’ Understanding Of Scientific Events and Questions

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ABSTRACT
The students’ scientific conceptualizations of the things are important as they are responsible for their attitudes and behaviours. Therefore, it is believed that knowing about the students’ understanding of scientific questions and events are important as they are the indicators of their science self-concept. The purpose of this study was to explore the Turkish primary students’ understanding of scientific issues on the basis of scientific events and questions including their conceptions on being scientific. In order to achieve this, 30 students from six different schools located in the different parts of one of the western cities in Turkey were interviewed by using semi structured interview form. At the end, generally it was seen that students are not able to express their own understanding of scientific events and questions. Moreover, explaining the meaning of being scientific was quite challenging. Interestingly, the majority of students ignored the methodological issues of science besides having difficulty in easily relating the science to daily live.

Keywords: Scientific Understanding; Scientific Questions; Scientific Events; Science Education.

INTRODUCTION
One of the purposes of science education is to educate individuals who investigate and make connections between daily life and science subjects and understand the nature of science with its concepts, principals and theories. The current science and technology curriculum in Turkey that is based on constructivist approach also emphasizes this aim (MEB, 2005). In constructivist thinking, there are two key points to be redefined for leaving the traditional view of science education: learning and scientific knowledge. In constructivism, while learning is one’s building of self knowledge on his/her prior knowledge, scientific knowledge is building of knowledge on which the scientists agree on. When viewed from this point of view, the mentioned aim of science education can be reached by redefining the learning from
having knowledge to producing knowledge. Science education can only achieve this goal by encouraging students think about science, scientific issues, its applications and methods (Driver, in Steffe & Gale, 1995).

In their Assessment of Performance Unit (APU), Gott and Murphy (1987, as cited in Millar, 1991:44) put forward that understanding science is two-sided with conceptual and procedural patterns. While conceptual side addresses the core subjects of science such as natural events and facts; procedural side involves the fundamental skills to do science. At the same time, this view brings that science education includes the instruction of the science as a means of skills and methods building science itself (Tan & Temiz, 2003; Kaptan & Korkmaz, 2001).

Harlen (1999) emphasized that the development of scientific process skills has to be major goal of science education besides being general descriptions of logical and rational thinking:

*Learning with understanding in science involves testing usefulness of possible explanatory ideas by using them to make predictions or to pose questions, collecting evidence to test the prediction or answer the question and interpreting the results; in other words, using the science process skills* (p.130).

Harlen (1999) also adds that if these skills are not well developed then the emerging concepts will not help students understand the world around. The science and technology curriculum of Turkey being used since 2005 also emphasizes this subject by pointing out about growing students as skilled in using scientific method while solving the problems they encounter in their lives. Furthermore, it is also declared that guiding the students to have the view points of scientists in comprehending the world is essential (MEB, 2005).

In this point, extending the meaning of the view point of the scientist is important. In order for a student to have the view point of the scientist means being curious and asking questions about everything, having positive attitudes towards science, investigate the events they encounter in a multidimensional and critical way and try to find solutions to the problems they face in the scientific way (NRC, 1996 as cited in Ergin, Pekmez & Öngel, 2005).

The students have a wide range of exposure to science including school science, science documentaries on several media (TV, newspapers, magazines), scientific issues reported in the news, interactions with science teachers (Ryder, Leach & Driver, 1999). However, Ruffman, Perner, Olson and Doherty (1993) stated that a full understanding of science requires children recognize that the hypotheses they encounter in texts are formed on the basis of available evidence which are plausible though not necessarily correct ways of explaining the data. In addition, Brem (2000) claims that popular sources of scientific information often fail to provide the details needed to conduct critical analysis. She adds that reporting may only include the scientists’ conclusions without explaining the data and processes. As she points out, if students are expected to critically evaluate and use scientific information they may have to fill the gaps for themselves. What Brem (2000) argued above may be true for Turkish students according to the PISA 2003 results. PISA 2003 aims at measuring how well students perform in knowledge and skills beyond the school curriculum (Cinoğlu, 2009). In addition, it displays relationship between student and school characteristics (PISA, 2004). Turkey has the second lowest performance in all tests among OECD countries at PISA 2003 (PISA, 2004).

Moreover, the results of the international exams such as PISA 2003 declares that it is highly important to know about the students’ characteristics and profiles (Savran, 2004). Because, the factors mentioned above which affect the students’ understanding and perception of the scientific issues result in students’ daily behaviours. For example, Jane, Fleer and Gipps (2007) stated that although the middle school students had negative views about and
show little interest in science, they are very keen on the latest products of science (such as mobile phones, computers, iPods and digital cameras).

There are also a number of studies conducted in Turkey in order to find out the students’ perception and understanding of science and scientists (Şahin, 2009; Kaya, Doğan & Öcal; 2008; Ekici, Doğan & Kaya, 2006). Besides, there are also some studies considering the students’ perception of science courses, scientific attitudes. Yaman and Öner (2006) found that Turkish primary students’ perception of science courses is nearly at the average level. The girls and the students living at the city center had more positive perception about science than the boys and the students living outside the city center. They explain these differences on the axis of students’ motivation and the realization level of their expectations including their parents’ socio-economic level. Demirbaş and Yağbasan (2005) put forward that students’ scientific attitudes are generally positive in the secondary schools except for the 6th grades concerning the structure of both scientific laws and theories and science. They also explored that the students generally have high scores about the importance of the science in the society and the willingness in scientific studies. Furthermore, questioning is very important for students to explore both their ideas and things surrounding them (Harlen, 1999) and to do science for thinking like scientists (Hurd, 1994). In order for children to learn science, they must learn to see the phenomena in the same way as scientists do (Shepardson, 1997).

Our understanding and perceiving of the things and events result in our behaviours and attitudes which is affected by how we conceptualize these rather than what they really are. Therefore, it is believed that knowing about the students’ understanding of scientific questions and events as the indicators of their science self-concept is important for arranging the science classes accordingly. The students’ understanding of scientific issues as a way of seeing or perceiving the scientific events and question compose the aim of this study.

METHODOLOGY

a- The research design

The study is in survey model. On the contrary of the most of the survey studies, qualitative techniques were used in the study. The data were collected through interviews which are conducted with thirty primary students in total.

b- Participants

Participants are thirty students’ from 6th, 7th and 8th grades from 5 differently located primary schools of a district in one of the cities located on the west of Turkey. Schools were selected by dividing the district in three levels (as high, average and low) regarding the socio-economic status of people living in. Two schools with 10 students from each level of district participated in the study. The science teachers of those schools helped for composing the sample of the study. The researcher told the aim of the study and took feedback about the science achievement of the students. Students were chosen by considering firstly being voluntary and then their science grades (equally distributed as high, average and low) in all grade levels.

c- Data collection tools

The aim of the interview is to identify one’s understanding, thoughts, feelings and intentions about the subject those cannot be observed directly (Patton, 1990). Since the students’ understanding of scientific issues cannot be measured directly, it is thought that their point of view can be best identified by interviewing. The students were interviewed by using a
semi-structured interview form. The interview form has three main parts which aim to investigate the meaning of being scientific on the basis of events and questions. The first part is about determining the meaning of being scientific. In both second and third parts, initially the meaning of being scientific and unscientific events and questions were asked respectively. They followed by presentations of some events and questions to be defined if they were scientific or not. The items related to events and questions were derived from Leach (1996). The students were asked about the grounds of their answers for capturing the way they reason as scientific or unscientific. The content and face validities of interview questions were supplied by having the views of one professor, two lecturers and two teachers of science education and then revised accordingly. The interview questions were also checked by conducting interviews with another 6 students of upper primary.

d- Data analysis

Data was analyzed by using qualitative data analysis techniques. The interview data was recorded and then transcribed. After being written down, it was checked for any missing items by reading the written text and listening to the interview records at the same time. Afterwards, the written text was analyzed by following Miles and Huberman’s (1994) method of data reduction, data display and data verification. For this, written text was coded according to the meanings of the answers two times in a two week interval. The level of agreement between two coding was found as 0.97. After that, the codes addressing the same group of data were categorized depending on the interview questions. The codes and categories were analyzed through descriptive statistics where the number of the students and percentages were calculated.

FINDINGS

a- The meaning of being scientific

The first interview question asked students about what they understand when they hear or see the word scientific. The codes from the students’ answers and their distribution are presented in Table 1.

<table>
<thead>
<tr>
<th>Codes</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>being about science</td>
<td>21</td>
<td>70</td>
</tr>
<tr>
<td>deeply researched out</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>being extraordinary</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>being about real things</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>being innovative</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Table1 shows that most of the students (%70) understand the word “scientific” as “being about science”. There are some examples of students’ answers given in this way:

Researcher: What do you understand when you hear the word “scientific”?

Student-1: “… the things put forward by scientists,… (What are they?), … experiments, observations,… all scientific”.  
Student-15: “… checked out by the scientists and therefore reliable, (For example?), … drug used in the treatment of cancer”.  
Student-26: “… it is something that does not change, (What like?), …. scientists find and everybody knows because it stays same…”.
The others seem to associate the meaning of word “scientific” with deep research (10%), being extraordinary (10%), being about real things (7%) and being innovative (3%). Some of the students’ thinking was presented below:

_Student 9:_ “… it is “scientific” when it is researched”.
_Student 18:_ “… if it is ordinary we do not use “scientific”, so, it is “extraordinary”.
_Student 22:_ “… science is based on real things; therefore it calls about real things.
_Student 25:_ “… it reminds innovations such us phone cells”

Students are unlikely to express the characteristics of science for understanding the word scientific even though they think of being about science in general.

After that, the second interview question asked students directly about the meaning of “being scientific”. The codes are presented in Table 2.

<table>
<thead>
<tr>
<th>Codes</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No answer</td>
<td>22</td>
<td>73</td>
</tr>
<tr>
<td>depending on evidence</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>being researched out</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>being innovative</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Though, the answers are similar to the answers for the previous question; interestingly Table 2 shows that most of the students (73%) didn’t answer this question. It seems they had difficulty in explaining about “being scientific” that aims to probe understanding of what is scientific or not. Among the other codes, five students (16%) think about the evidence, two students (6%) think about doing research and one student (3%) thinks about innovations as the indicators of being scientific. A few samples from students’ examples of evidence are like this:

_Researcher:_ What kind of evidence?
_Student-2:_ “… such us blood test report”.
_Student-3:_ “… roundness of the earth”.

b- The scientific events

In order to determine the students’ understanding of scientific events, the third question asked students to give their own examples of scientific events with a brief explanation for their reasons. Table 3 presents students’ answers and their reasons.

<table>
<thead>
<tr>
<th>Categories (%)</th>
<th>Examples</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>- No category (47%)</td>
<td>No example</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>“… doing/explaining it requires scientific studies” (32%)</td>
<td>“solar/lunar eclipse”</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>“day-night events”</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>“launching the rocket into the space”</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“occurrence of rainbow”</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“examining a tree while blossoming”</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>“… is proven by the scientist, there is a result (a formula)...” (17%)</td>
<td>“proving the Earth’s roundness”</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>“explaining the subject of simple machines by formulas”</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>“… it was new to that times society” (3%)</td>
<td>The invention of telephone</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
Approximately half of the students were not able to give any examples of scientific events. The answers of the other half of the students may be grouped into three according to the reasons given behind. Nearly 32% of the students see the scientific events as the events that could be explained by the scientific studies. In other words, for them what makes the events scientific is to do scientific studies on. However, students don’t seem to have clear ideas about what these scientific studies are:

Researcher: What do you mean by scientific studies?
Student-8: “… doing research…”

Researcher: What kind of research?
Student-8: “… the one the scientists do, (Can you describe it?) … they do experiments, observations sometimes…, (How is it conducted?) they work hard…”

17% of the students’ understanding of scientific events relies on the scientists’ proof of the events. Only 3% of the students think the scientific event as bringing newness to society.

The fourth question asked students whether the events given were scientific or not with reasons. The events sought to verify the base understanding for the third question. Table 4 highlighted the events that students’ thought to be scientific with the percentages rank.

Table 4. The students’ categorization of events to be scientific

<table>
<thead>
<tr>
<th>Events</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Observing and drawing the moon’s phases at every night.</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>2-Observing the behaviors of the worms in rainy days.</td>
<td>27</td>
<td>90</td>
</tr>
<tr>
<td>3-Investigating the relationship between smoking cigarettes and risk of having heart attack.</td>
<td>23</td>
<td>76</td>
</tr>
<tr>
<td>4-Measuring the temperature of the water with thermometer.</td>
<td>21</td>
<td>70</td>
</tr>
<tr>
<td>5-Studying lesson by listening to music.</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>6-Buying the greenish apple from bazaar.</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Including the 47% of the students, who did not give any example about scientific events (Table 3), all of the students agreed on the first event to be scientific. When Table 4 is completely examined, it is seen that they likely think the events including “observing”, “investigating” and “measuring” to be scientific.

In the fifth order, the meaning of listening to music for the majority of 20% is for thinking the effects of the event as being scientific. The event “Buying the greenish apple from bazaar” is the one on which all students agreed on to be unscientific. Table 5 sums up the distributions of students reasons for indicating the events scientific or unscientific.

Table 5. The students’ reasons for the events

<table>
<thead>
<tr>
<th>Scientific</th>
<th>n</th>
<th>%</th>
<th>Unscientific</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>observing</td>
<td>21</td>
<td>70</td>
<td>Not related to scientific works</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td>using technological tools</td>
<td>11</td>
<td>37</td>
<td>personal choices</td>
<td>8</td>
<td>27</td>
</tr>
<tr>
<td>investigating</td>
<td>8</td>
<td>27</td>
<td>no need to research</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>establishing relationship</td>
<td>4</td>
<td>13</td>
<td>everyone can do</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>being real</td>
<td>2</td>
<td>7</td>
<td>cannot be found</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

The most of the students (70%) claim that “observing” makes the event scientific. 37% of the students associated the “using technological tools” with scientific event. 27% of the
students believed in “investigating” making the events scientific. Equally, 13% of the students argued for each “proving” and “establishing the cause effect relationship” should be in a scientific event. 7% of the students claimed that for an event to be scientific is “being real”.

The students’ reasons for finding the events unscientific are due to “not being related to scientific works” by 30%. 27% of the students find the events unscientific based on “personal choices”. In equal ratios of 10%, students think of events that there is “no need to research” and “everyone can do” unscientific. According to the 7% of the students events that “cannot be found” are also unscientific.

c- The scientific questions

The fifth question asked students to give their own examples of scientific questions in order to capture their understanding of scientific questions. Table 6 presents the students’ answers in four categories.

Table 6. Students’ answers to scientific question examples

<table>
<thead>
<tr>
<th>Categories (%</th>
<th>Example examples</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific question is not necessary (40%)</td>
<td>No example</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>Methodological questions (33%)</td>
<td>“who did it”, “why it happened so”, “how happened to be”, “when did it happen”, “where did it take place”</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Metacognitive questions (6%)</td>
<td>“why do I conduct this experiment?”</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Explanation questions (2%)</td>
<td>“what causes getting cold?”</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

40% of the students did not give any example of scientific questions thinking that science did not need asking questions. 33% of students attributing the methodological questions to be scientific followed this group. 20% of students thought the scientific questions in a metacognitive manner, generally, asking about the way the scientist do. Only 7% of students gave example of explanatory questions to be scientific.

In order to corroborate the students’ understanding of the scientific questions, the sixth question asked students whether the questions given were scientific or not with the reasons (Table 7).

Table 7. The students’ categorization of questions to be scientific

<table>
<thead>
<tr>
<th>Questions</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-How did the Earth occur?</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>8-Is the Earth’s atmosphere getting warm?</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>10-What kind of bacterium are there in the water?</td>
<td>27</td>
<td>90</td>
</tr>
<tr>
<td>4-How do migratory birds find their ways for flying to long distances?</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>1-What kind of fabric is waterproof?</td>
<td>24</td>
<td>80</td>
</tr>
<tr>
<td>5-What kind of diet should be given to babies for keeping their health?</td>
<td>20</td>
<td>67</td>
</tr>
<tr>
<td>3-Is it wrong to fish the dolphins just for having fun?</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>2-Which is the best program on TV?</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>9-Do the ghosts appear in old houses at nights?</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>6-Which one is more profitable for buying washing powder in small or big packages?</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

As seen from Table 7, all of the students agreed on the first two questions to be scientific. The following upper three order shows that students generally tend to classify the questions scientific including the words “Earth”, “atmosphere” and “bacterium”. Besides, they also seemed to understand the questions including investigations related to nature and living things. Students’ also seemed to understand the questions including “having fun”, “TV”, 
“buying” related to social issues to be unscientific. Table 8 presents, the students’ reasons for attributing the questions scientific or unscientific.

<table>
<thead>
<tr>
<th>Table 8. The students’ reasons for the questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific</td>
</tr>
<tr>
<td>Requires investigation</td>
</tr>
<tr>
<td>Related to health</td>
</tr>
<tr>
<td>Requires observation</td>
</tr>
<tr>
<td>Related to livings</td>
</tr>
<tr>
<td>Requires trying</td>
</tr>
<tr>
<td>Arousing curiosity</td>
</tr>
</tbody>
</table>

%90 of the students’ sees the question scientific if there is “investigation” in the meaning. Some of the students’ answers are given below when they are asked about what they mean from “investigation”.

**Student-13:** “… investigating means observing, researching… (What do you mean by researching?), … working hard, reading very much.

**Student-19:** “… working in the laboratory, observing… (What is done in the laboratory?) they try new things.

The students have a very limited understanding of scientific investigation as shown. There is also a gap between students’ attribution of “investigation” (90%) and “related to health” (15%), “requires observation” (10%), “related to living things” (10%), “requires trying” (10%) and “arousing curiosity” (5%). They mostly find questions unscientific that are “personal” (70%) and include “wrong behaviour” (67%). Furthermore, the unscientific question also means them “do not require investigation” (33%) and “related to magazine”. The “economical” (15%) and “calculation” required issues do not sound them to be scientific.

**DISCUSSION**

**a- Being scientific**

This study tried to figure out students’ understanding of scientific issues starting from the meaning of scientific. As Table 1 shows, most of the students associated the word “scientific” with “being about science”. However, it was seen that they had difficulty in expanding their answers through the characteristics of the science. Their answers are based on the classical frameworks of science such as doing experiments, making observations similar with the findings of Ünal Çoban (2009). It is seen that they do not likely to think doing science means testing for ideas or hypothesis. Carey and Smith (1993) declare that there are three stages of understanding of science among the students. In the first stage students possess the understanding of science as true beliefs (i.e. doing something in a true way) or simple facts (i.e. knowing what happens). In the second stage, they start to assume that science is the collection of the tested ideas and distinguish the endeavours’, experiments and thoughts. In the third stage, they easily distinguish the experiments and thoughts and understand that science predicts the reason and results of the events. The developments in understanding of science from first to third stages are provided by the essential transformations in both conceptual understandings and scientific processes of the students. When viewed from this point of view, it is challenging to talk about the success of the primary science curriculum’s success on gain regarding the characteristics of science, which is being used in Turkey since 2005. However, Carey and Smith (1993) also found out that despite the constructivist
curriculum, the students may have traditional view of science. In the traditional view of science, science always gives rise the true, unchanging, and absolute knowledge (Aikenhead, 1997). The students’ understanding of something to be scientific when it does not change also corroborates this situation. This may indicate that the science courses are not given according to the characteristics of science and scientific studies despite the constructivist structure claim of the curriculum.

Moreover, minority of the students think of “scientific” as being researched out, extraordinary and real (Table 1). In addition, a small minority of students think of being scientific as being innovative. The students seem not to have the idea of what and how science does or proceeds. The answers, when directly asked about the meaning of “being scientific”, also corroborates this finding. The majority of the students are unable to answer “being scientific” with their own words (Table 2). A few students claim that being scientific means has similar meaning with depending on evidence. Besides, as in the meaning of “scientific”, “being researched out” and “innovative” are seen as the meaning of “being scientific” by only few students. On the contrary to this finding, Duran and Özdemir (2009) claimed that generally primary school students are interested in science as they like researching and find science to be productive regarding innovations. Although Flavell (1999) states that the students start to recognize that the word “science” leads to a more precise and true meaning than guessing or thinking by the end of the preschool period, this study shows that it is not easy to express it even at the secondary school level.

b- Scientific events

When it comes to the students’ understanding of scientific events, it is surprising that almost half of the students could not give any example of scientific events (Table 3). However, they have the science and technology course starting from the 4th grade in Turkish primary science curriculum. Therefore, the students at least may be expected to give example of scientific events from textbooks they had in the courses. Nonetheless, although they understand the courses and they are at least at the average level they failed to give examples. This situation may be explained by the children’s ability to explain a phenomenon often lags behind their understanding of the phenomena itself (Flavel, 1985). In other words, although they understand if the events are addressing a scientific issues or not they had difficulty in explaining the reason behind those events. Edmondson and Novak (1993), claimed that students having science courses under traditional framework evaluate their surrounding on the basis of recall of knowledge instead of explaining based on reasoning.

The majority of the other half of the students sees the events scientific related to scientific studies by directly giving example of events (Table 3). However, their explanations reveal that (as in the case of the Student- 8), they have the surface understanding of scientific studies such as doing research, experiments and observations. The students did not mention about the core subjects of the scientific studies such as hypothesis testing, fair test, controlling the variables. This finding is also similar with the findings of Chin and Brewer (1993), Sandoval (2005). This result may lead to think that the students’ science process skills are not developed sufficiently.

Small amount of students see the events proven by evidence as scientific. Lederman & O’Malley (1990) found that students’ believe that their daily lives would be unchanged by science unless they were provided with proof. Depending on this, it may be claimed that the students participated in this research give less importance to proof or evidence as the indicator of science in their daily lives. This may due to the fact that hypothesis (or idea)-evidence
relationship or the ways of theory-knowledge coordination are not given to students in science classes.

The students’ selection of the given events showed that (Table 4) they all agreed on the events including keyword “observing” to be scientific although they could not give their own examples. Claiming the events including “observing” to be scientific by all of the students may indicate that they all have internalized the “observation” as science process skills. Again, this result support the idea that the students’ science process skills are not developed sufficiently.

In addition, the majority of the students claim the events including “investigating” (76%) and “measuring” (70%) to be scientific (Table 4). This finding shows that the majority of students associate observation, investigation and measurement with scientific events without considering the methodological issues what makes an event scientific. Smith, Maclin, Houghton and Hennesey (2000) explain that students had these kinds of understandings due to the formal science courses they had at school, daily epistemological conceptual difficulties and general challenges based on their biological developments. Especially, the formal science courses including recipe type experiments and activities conducted by students without understanding their purposes and examinations those do not force students thinking may prepare the base understanding for a science of memorizing and stereotype. Therefore, they seem to have a low level of science process skills. This result is consistent with the results of other studies put in forward that students have a low level of science process skills by Çakar (2008), Aydınlı (2007) and Temiz (2001). Beside, this may also indicate that students do not have methodological (or procedural) concerns as stated by Gott and Murphy (1987, as cited in Millar, 1991:44).

They also seem unlikely to load the meaning of scientific to the events including “studying” and “buying”. This finding is parallel with Edmondson’s (1989) in that students believe in that the knowledge in natural sciences and other branch of the sciences are different and the latter can not be counted as science. This finding also makes contribution to the conclusion that students of this age are not able to see the science in a methodological manner. Further, their understanding of science is only limited to nature, they could not develop the idea of science involving with daily life experiences. Moreover, this result also shows that they do not have a scientific view point for daily events. This finding is also parallel with the findings of studies which are conducted by Yüzbaşoğlu and Esin (2004) dealing with the students’ learning level of daily biology subjects; Tomal (2009) determining the usage level of geographical knowledge in daily life; Ayvacı and Devecioğlu (2008) investigating the relating level of physics subjects in daily life. All these result indicate that although students perceive the events related to nature to be scientific, they had difficulty in realizing daily life issues as scientific. This may address that students have not an adequate involvement in science subjects regarding daily lives. This finding also displays that students do not view science as a social issue and part of everyday life outside of the courses and laboratories. This understanding indicates that traditional understanding of science is dominant in science classes.

The students’ reasons about what makes the event scientific both supports and extends their categorization of events (Table, 5). The majority of students insist on claiming that observation makes event scientific. Moreover, “using technological tools”, “investigating” can be evaluated as the popular description of scientific events addressed by twenty five percent of the students. These may be classified under the sub-stages developed by Ünal Çoban (2009) from Carey and Smith’s (1993) three stages of understanding of science. These sub-stages allow evaluating ideas in science in more details. In the sub-stages of the first stage as true beliefs described as “doing or conducting things” based on concrete events, activities
(such as doing experiments, observations etc.) and scientific products (such as innovations, inventions and etc.) doing experiments, observations etc.) point that the participant students had first stage understanding of science one more time.

This group of reasons is followed by “proving” and “establishing cause-effect relationship” and “being real” by a small number of students addressing the fundamental concerns of science. Similar to this result, Khishfe and Abd-El-Khalick (2002) found out that 6th graders were not able to distinguish the scientific causes and evidence and consider that they assume to know only what they see.

The students claim the events to be unscientific which are not related to scientific works. It is also interesting that they declare about the personal choices to be unscientific. The subjects or things those do not need to be researched or can be done by everyone are also seen as unscientific reasons. This finding is interesting in showing that scientific events are not as easy as everyone can do or explain. The students giving this answer seem to underestimate the way of doing or reasoning in science regarding the methodological perspectives as in the case of their scientific events selection (Table, 5). Moreover, the things having the idea of “cannot be known (or found no solution)” behind are also unscientific. This idea may also show that students believe in that scientific things or science can find everything as showing parallelism with other studies finding out an absolute (certain) science understanding (Doğan-Bora, 2005; Doğan-Bora, Arslan & Çakıroğlu, 2006; Çelikdemir, 2006; Ünal Çoban, 2009; Aydoğdu, 2009).

**c. Scientific questions**

As in the case of being unable to give their own examples, a great number of students also could not give any example of scientific questions (Table 6). This finding may show that the students have difficulty in preparing their own answers (or questions), they can easily select (or choose) the options when they are given choices. This may due to the fact that they very much get used to test technique at assessments (i.e. lycee entrance exams and the course exams) by only choosing the right answer without considering the reason behind. This situation is also supported by the failure of Turkish students from PISA 2003. The reason for the students’ failure may be seen as the mismatch of this international exam and Turkish Lyceum and University Entrance Exams (Savran, 2004).

These two findings give important information about the way of students’ thinking. Moreover, the students seem to think in a weakly productive way regarding inquiry. Ryder, Leach and Driver (1999) state that students’ experiences of science -covering a wide range from school science to scientific issues the in everyday life via TV, newspapers, magazines or interaction with people- form an internal dialogue that includes students asking themselves the questions about science, also an external dialogue including discussions with people about science as well. From this perspective, this result shows that the students are weak in questioning and also are not aware of that science starts with question. Ünal Çoban (2009), in her study found similar results explaining that the students generally question about concrete events and simple observations. This may be seen as the effects of teacher centred classroom environments where the students’ questioning is weak.

The majority of the students give examples of the methodological questions asking about “wh” and “how” questions. It may be because they all need answers of less defined explanations due to students’ goal in seeking information. Brem (2000) mentions about two information goals; while story goals determine a “wh” link, existence goals seek for the reliably true. In the classroom settings where explanations mostly take place instead of scientific evidence, the students often raise questions in mechanistic manner. Therefore, this
result may indicate that students often encounter (teacher centered) explanations or lectures in the classroom.

One out of five students understands about investigating the scientific works in a metacognitive way considering the reasons and causes behind the scientists actions. On Kuhn’s (1989) claim that metacognitive abilities determine the students’ differentiation and understanding of scientific works, it may be said that the students are not so good at analyzing the scientific works. This situation needs to be searched for raising the students’ metacognitive awareness.

As in the “scientific event” part, despite not giving their own example of scientific questions, all of the students agreed on the question “How did the Earth occur?” and “Is the Earth’s atmosphere getting warm?” to be scientific (Table 7). They also mostly agree on the question asking about the bacterium in the water, migratory birds and fabric to be scientific. In addition, in majority they see these questions to be scientific as they require investigation to be answered. After then, in the second order, they see the reason of health. This reason is followed by requiring observation, related to living things and trying. In the last order, students attribute questions arousing curiosity to be scientific.

When students’ reasons for unscientific questions are examined it is seen that “being personal” and “wrong behaviour” are on the top order. However, it may be expected that “do not require investigation” should be in the first order as they claimed requiring investigation to be the first in the scientific order. Only one in third of the students see that the unscientific questions do not require investigation and related to magazine.

CONCLUSIONS

In this research, the students’ understanding of scientific events and questions were tried to figure out. It was found that, it is not easy for students to explain the meaning of being scientific. Moreover, they had difficulty in expanding their answers through the characteristics of the science. This study also showed that they do not have clear ideas about either what science does or how it proceeds. In addition, their answers are based on the classical frameworks of science such as doing experiments, making observations. It is seen that they do not likely to think doing science means testing for ideas or hypothesis.

Generally, students are in difficulty to express their own understanding of scientific issues and to give their own example of scientific events and questions as well. However, when they are given the events or the questions they are able to classify them as scientific or not. Besides, all the students know that “observing” belongs to the scientific issues. Interestingly, the majority of students associate observation, investigation and measurement with scientific events without considering the methodological issues of science.

This study also revealed that students are not able to easily relate the science to daily live regarding the scientific events and questions. They also seem unlikely to load the meaning of scientific to the events including “studying” and “buying”. Their understanding of science is only limited to nature, they could not develop the idea of science involving with daily life experiences.

Furthermore, they believe in that scientific events are not as easy as everyone can do or explain. Moreover, the students seem to think in a weakly productive way regarding inquiry. The students are weak in creating question and also are not aware of that science starts with question. It is seen that the students generally produce questions about concrete events, simple observations.

These results support the results of the international studies (i.e. PISA 2003) which aim to assess to what extent the students use their knowledge and skills they learnt at schools in
real life situations as a measure of the validity of the curriculum. In addition, this study, by putting forward the students’ understanding and perceptions of scientific events and questions, reveals the legitimacy of the increasing critics about Turkish education system in recent years (Aydoğdu, Aydın & Sönmez, 2009; Cinoğlu, 2009; Savran, 2004). When the structure of PISA 2003 is compared to Turkish national exams (university entrance exams, secondary education settlement exams, level determining exams or exams for scholarships), it was seen that while the former tries to measure how well the students perform relating the school context to everyday life the latter is mostly based on traditional measuring based on memorizing facts (Savran, 2004). These effects of students’ assessment is hoped to change with new level determining assessments of Turkish Ministry of National Education (started in 2008) towards 6th, 7th and 8th grades that is based over the period focused on the principles of the curricula. However, when the “time” is considered to be the best variable for science achievement (Anıl, 2009), it may take some time to see the positive effect of this new assessment on students’ understanding of scientific issue.

To accelerate this process, the students should be encouraged to produce questions starting from simple daily life issues. Teachers should ask productive and open-ended questions to students in the classroom to be a model for their thinking. It is seen that, not only they do not have the idea of hypothesis testing but also they are not able to express the meaning of scientific with their own words. Therefore, science teachers and curriculum makers should emphasize the goal of science is to test idea for understanding the world. It is suggested that the science curriculum should be reviewed under the light of this kind of studies revealing to what extent the curriculum and its applicators are successful at transferring the principles and the philosophy of science presented within it to the students. The guidance books for teachers should be enriched with the appropriate guiding to give true understanding of the characteristics of science and scientific issues. Moreover, as the results of this study suggest, the science process skills of students should be investigated through both hands on (procedural) and minds on (conceptual) activities extending from course topics to daily life issues. Additionally, students’ use of evidence should be investigated in detail as a measure of their awareness of idea-evidence coordination, science processes and production of scientific knowledge. It will also be useful if science teachers are given in-service training on how to coordinate and use of the mentioned skills in classroom environments.

Furthermore, in order to get a more valid result, this research should be repeated with large number of students including comparisons with a series of data about their hands on performances, metacognitive questionings, self-regulation skills and etc.
REFERENCES


