EXPLORING REPRESENTATION OF NATURE OF SCIENCE ASPECTS IN SCIENCE TEXTBOOKS

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Approval of the Graduate School of Social Sciences

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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ABSTRACT

EXPLORING REPRESENTATION OF NATURE OF SCIENCE ASPECTS IN SCIENCE TEXTBOOKS

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The aim of this study was to examine middle school science textbooks according to some criteria in terms of nature of science (NOS). A total of three middle school science textbooks in 6th, 7th and 8th grade and two biology units were analyzed in each textbook. In the 6th grade science textbooks, "Reproduction, Development and Growth in Living Beings"and "Systems in Our Body" units, in the 7th grade science textbook, "Systems in Our Body" and "Human and Environment" units, in the 8th grade science textbook, "Cell Division and Heredity" and "Livings and Energy Relationships" units were analyzed by using "Nature of Science Criteria", adapted from Gunckel's (2004) study. The instrument consists of 3 categories, 9 criteria and 28 indicators. The categories are: "Science as Authoritative Knowledge", "Science as Understanding Phenomena" and "Science as the Social Construction of Knowledge".

A qualitative oriented approach was performed and content analysis method was used to assess the science textbooks. Data were analyzed by percentage and frequency analysis. Reliability was calculated by Cohen's Kappa and the value 0,71 which was found is reliable.

The results of this study revealed that the three science textbooks inadequately presented the nature of science categories. It was also found that the

percentages of almost all the indicators were under fifty. The textbooks presented the "science as authoritative knowledge" category relatively higher than the other two categories. The "science as the sociocultural construction of knowledge" category was portrayed less than the other two categories.

Key Words: Nature of Science, Elementary Science Textbooks, Textbook Analysis

ÖZ

BİLİMİN DOĞASI BOYUTLARININ FEN VE TEKNOLOJİ KİTAPLARINDA TEMSİLİNİN ARAŞTIRILMASI

Yamak, Yeliz
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Bu çalışmanın amacı ilköğretim fen ve teknoloji ders kitaplarını "bilimin doğası" açısından bazı kriterere göre incelemektir. Bu çalışmada toplam üç adet altıncı, yedinci ve sekizinci sınıf fen ve teknoloji dersi kitabı ve her kitapta iki biyoloji ünitesi analiz edilmiştir. 6. sınıf kitabında "Canlılarda Üreme, Büyüme ve Gelişme", ve "Vücudunuzda Sistemler" üniteleri, 7. sınıf fen ve teknoloji kitabında "Vücudumuzda Sistemler" ve "İnsan ve Çevre" üniteleri, 8. sınıf kitabında "Hücre Bölünmesi ve Katılım" ve "Canlılar ve Enerji İlişkileri" üniteleri Gunckel'in (2004) çalışmasında kullandığı kriterler adapte edilerek analiz edilmiştir. Ölçüm aracı 3 kategori, 9 kriter ve 28 göstergeden oluşmaktadır. Kategoriler "otoriter bilgi olarak bilim", "olguları anlamak için bilim" ve "bilginin sosyal inşaası olarak bilim"dir.

Ders kitaplarını değerlendirmek için nitel araştırma yöntemi ve döküman analizi kullanılmıştır. Elde edilen sonuçlar yüzde ve frekans analizi yapılarak değerlendirilmiştir. Güvenilirlik Kohen's Kappa istatistik yöntemi ile hesaplanmış ve bulunan değer 0,71 olarak güvenilir bulunmuştur.

Bu çalışmanın sonuçları üç ders kitabının bilimin doğası kategorilerini çok az gösterdiğini sunmuştur. Çalışmanın sonuçları hemen hemen tüm göstergelerin yüzdelerinin ellinin altında olduğunu göstermiştir. Her üç ders kitabı da diğer iki

kategoriye göre “otoriter bilgi olarak bilim” kategorisini göreceli olarak daha yüksek oranda göstermektedir.

Anahtar kelimeler: Bilimin doğası, İlköğretim Fen ve Teknoloji Ders Kitapları, Ders Kitabı Analizi.

To My Parents

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LIST OF ABBREVIATIONS

SPSS : Statistical Package for the Social Sciences Program

NOS : Nature of Science

STS : Science Technology and Society

CHAPTER I

INTRODUCTION

The primary purpose of science education is to bring up students as scientifically literate person (American Association for the Advancement of Science, 1993). There are different definitons among educators regarding scientific literacy. For example, Shiland (1998) defined scientific literacy as an ability to use commonly accepted theories in science to predict, to explain and to understand the natural world. However, this is a very limited explanation of scientific literacy. Although there is no consensus about scientific literacy among science educators, many of them accepted a general definition of it. According to most of the educators, scientific literacy refers to the understanding of concepts, theories, principles, processes of science, awareness of complex relationship, between science, technology and society (Abd-El-Khalick, Bell & Lederman, 1997). Many modern countries value scientific literacy in science education, including Turkey. In order to reflect changes in science, technology and society to the educational system, The Ministry of National Education in Turkey made some reform efforts in the elementary education curriculum and made some rooted changes in the science curriculum by putting the development of scientific literacy at the center. Thus, the program became effective in all elementary schools across the country during the academic year 2004/2005. One of the aims of the new curriculum was: "All students, regardless of individual differences, should have the opportunity to attain high leves of scientific literacy" (p. 5).

During the development of the new science curriculum, seven aspects of scientific literacy were used to develop the objectives and to select the activities. The seven aspects of scientific litracy were: nature of science, key science concepts, scientific process skills, interaction of science-technology-society-environment, scientific and technical psychomotor skills, essential values of science, attitudes and interests of science. One of the most important aspects of scientific literacy was

nature of science. Therefore a scientifically literate person should understand the nature of science (Fen ve Teknoloji Dersi Öğretim Programı, p.5). According to Lederman (2007) understanding NOS is necessary to use technological objects, understand science and to value science as a part of sociocultural issues. These are some of the important issues in science education and curriculum makers value them and this makes NOS an important subject in science education.

The need for development of scientific literacy has been regarded as vital goal in many countries (Abd-El-Khalick, Bell, & Lederman, 1998). Due to the fact that understanding NOS has been claimed to be indispensable part of scientific literacy, NOS has been gained attention by many researchers. Although NOS has been claimed as an important learning outcome for science education in many countries including Turkey, previous studies have consistently showed that both students and teachers do not understand the main aspects of NOS adequately (Lederman, 1992). One of the possible reason of this situation is that nature of science was not implemented enough in science textbooks.

Tetbooks are the essential materials that are used during lessons and they are primarily used by teachers to develop lessons (Güçlü, Topses, Yel, Korkmaz, Çakmak, Köksal, & Albayrak, 2001). It is a fact that textbooks are widely used by teachers and students. They are an important material to reach the goals of the science education program. According to Kuhn (1970) textbooks determine our vision about nature of science and the role of discovery and invention more than any other aspect of science. At this point, textbooks have an important role to achieve this aim as a teaching aid (Bakaç & Kesercioğlu, 2000). Therefore, to serve the purpose of the science and technology course program, the quality of the textbooks should be high (Başlantı, 2000).

Philips and Chiappetta (n.d.) stated that schools should modify the instructional materials to improve the students' scientific understanding and knowledge. One of the main instructional materials in science education are textbooks. Textbooks influence the understanding of students in lessons directly and this influence can be negative sometimes (Köseoğlu, Atasoy, Kavak, Akkuş, Budak, Tümay, Kadayıfçı, & Taşdelen, 2003). The researchers analyzed textbooks in Turkey according to their content and found that they were inadequate in providing the

purposes of science education and did not support to bring up scientifically literate individuals.

To sum up, textbooks are frequently used by teachers and students and convey a great deal of information to students in science lessons (Chieppetta, Fillman, & Sethna, 1991). Although there have been many researches in the literature about textbooks due to the importance as teaching aids in the classroom, (Chiappetta, & Fillman, 2007; Karamustafaoğlu, & Üstün, 2004; Dökme, 2004) only few studies focused on implementation of NOS in textbooks (Başlantı; 2000; Gunckel, 2004; Guisasola, Almudi, & Furio, 2005; Chiappetta and Fillman, 2007). Because the new science technology curriculum emphasizes the importance of nature of science, the purpose of the present study was to examine the aspects of nature of science in the biology units of 6^{th}, 7^{th} and 8^{th} grade science textbooks.

Problem

How are the aspects of nature of science presented in the biology units of 6^{th}, 7^{th} and 8^{th} grade science textbooks?

Significance of This Study

Science textbooks are one of the important sources of teachers in science education. They are not only the source of teachers, but also they are the source of students and parents. Kılıç, Atasoy, Tertemiz, Şeren and Ercan (2001) state that textbooks are the only source of teachers in crowded classes because there are insufficient educational materials of teachers as an alternative to textbooks. Therefore, evaluation and correction of textbooks are inevitable for helping teachers in their lessons. Textbooks have been evaluated in terms of assessment, content, pictures, races, ethnicity for years (Chiappetta & Fillman, 2007; Ünsal & Güneş, 2003; Karamustafaoğlu & Üstün, 2004). However, there are few studies about new developments of science education in textbooks such as implementation of scientific literacy or nature of science in textbooks.

NOS is one of the important issues in science education. Understanding of nature of science is a need for students to understand science as a discipline, and provides students a meaningful context for the topics in science eduction that we

expect students should learn (Lederman, 2007). Therefore, understanding NOS is important for students to gain main aims of science education. However, while different researchers mostly studied the understanding of NOS by teachers and students (Lederman, 1998; Abd-El-Khalick, 2005; Hanuscin, Akerson & Phillipson-Mover, 2006; Akerson, Morrison & McDuffie, 2006), how it is presented in science textbooks has not been studied adequately.

The results of the previous studies about presentation of NOS in science textbooks showed that new textbooks indicate some aspects of NOS but it is not sufficient enough (Guissasola, Almudi & Furio, 2005; Wilkinson, 1999; Gunckel, 2004; Chiappetta & Fillman, 2007). In Turkey, there are dramatically few studies about implementation of NOS in textbooks and the results of them also showed similarities with the researches which were done in foreign countries. Only two researches focusing on direct implementation of NOS in science textbooks are noticeable in Turkey. For example, Başlantı (2000) stressed that there is no balance on dimensions of NOS in science textbooks and the first dimension (knowledge of science) of NOS is still dominant in textbooks. The other researcher, Irez (n.d.) stated that some of the important themes of NOS are not presented in textbooks.

The researches about implementation of NOS in science textbooks are very limited in the world and especially in Turkey. One of the main goals of the new science and technology education program of MONE is to teach nature of science. Textbooks were written according to the aims of the new curriculum and they should meet all the goals of the program. Because of these reasons, there should be more research focusing on how nature of science is presented in science textbooks. Therefore, this study aims to examine the presentation of NOS in new middle school science textbooks. The textbooks which are going to be examined were not evaluated before by the criteria which are going to be used in this study.

CHAPTER II

REVIEW OF THE LITERATURE

The aim of this chapter is to give a brief summary of literature review about nature of science, and implementation of it in science textbooks.

2.1. The Nature of Science

The definition of nature of science (NOS) is not clear among historians, philosophers and science educators. Despite this disagreement, they all agree about the general characteristics of NOS. The nature of science is epistemology of science, science as a way of knowing, or the values and beliefs inherent to the development of scientific knowledge (Abd-El-Khalick, Bell, & Lederman, 1997).

Lederman (1998) claimed that "although there is no consensus among educators about all aspects of nature of science, the following aspects are acceptable for them: (a) Scientific knowledge is tentative (subject to change), (b) empirically based (based on and/or derived from observations of the natural world), (c) subjective (theory laden), (d) necessarily involves human inferences, imagination, and creativity (involves the invention of explanations), (e) necessarily involves a combination of observations and inferences, and (f) is socially and culturally embedded" (p. 917).

The previous studies about nature of science were mentioned in three categories in this study: Students' views of nature of science; teachers' views of nature of science; nature of science and classroom practice.

2.1.1. Students' Conceptions about Nature of Science

Recent studies in science education stressed the importance of nature of science and scientific inquiry (e.g. American Association for the Advancement of Science, 1993; National Research Council [NRC], 1996). However, some research studies showed that students do not have adequate understanding of nature of

science (Aikenhead, 1973; Bady, 1979; Broadhurst, 1970; Mackay, 1971; Abd-El-Khalick, & BouJaoude, 1995).

One of the earlier studies regarding the students' views about nature of science was conducted by Bady in 1979. This research was different than the earlier studies (Rubba, 1977; Rubba and Andersen, 1978 cited in Lederman, 2007) because the researcher focused on particular aspects of nature of science rather than examining all of it. The researcher examined the high school students' perception about nature of scientific hypothesis and theories. The sample of this study was twenty 9^{th} grade and twenty 11^{th} grade students from a large urban high school and thirty three 9^{th} grade and forty one 12^{th} grade students from a small private boy's school. A task developed by Watson and Johnson-Lairds was used as the instrument to evaluate the students' perception of hypothesis testing. In this task, subjects were given a hypothesis and asked to play a role of biologist to test it. The researcher concluded that few students' could show the logic of hypothesis testing. Students could not interpret the results in a correct manner. Additionally, students' view of nature of hypothesis testing is naive and absolutist.

Similar to Bady (1979), Griffiths and Barry (1993) also performed a study with high school students. They examined the high school students' understanding of nature of science. Thirty two senior high school students from Canada participated in the study. The researchers conducted interview with the students and found that students were confused about the relationship of laws, theories and facts. Most of them thought that laws were the higher level of theories.

Similar to Griffiths and Barry (1993), Sadler, Chambers and Zeidler (2004) also conducted a qualitative study about students' perception of NOS. Eighty-four high school students participated in this study. The participants read contradictory reports about global warming and answered some questions. Thirteen of eighty four students were interviewed as well. Data were analyzed qualitatively and the results of this study indicated that students had a range of different views about aspects of NOS. For instance, many students thought that science is tentative and science can change over time.

In the past two decades, the studies about the views of students on NOS done with high school students decreased (Lederman, 2007). However, a remarkable study was conducted in 2004. This study was a large scale survey and was

performed by Kang, Scharmann and Noh. The researchers examined students' views about NOS. A multiple-choice questionnaire was administered to 1702 6^{th} to 10^{th} grades students from Korea. The questionnaire consisted of 5 items which were; purpose of science, nature of models, origin of scientific theory, definition of scientific theory and tentativeness of scientific theory. Students also answered some open ended questions for these five items. Consistent with the earlier studies, the results of this study indicated that students have absolutist and empiricist views about NOS.

In another study, Aikenhead, Fleming, and Ryan (1987). The researchers conducted a large sample study to examine the high school graduates' beliefs about science, technology and society. In this study, 10,800 Canadian high school graduates responded the Views on Science-Technology-Society (VOSTS) questionnaire. Students explained their conceptions as "agree", "disagree", "can't tell" and also wrote argumentative paragraphs to show their views about STS. At the end of the study, researchers concluded that students' beliefs about STS were different. Forty five percent of the students were partially aware of the characteristics and limitations of scientific knowledge, such as the majority of them thought that scientific models and theories are tentative.

One of the researches about the factors which affect students' understanding of NOS was conducted by Vhurumuku, Holtman, Mikalsen and Kolsto (2006). However, the researchers focused on the factor affecting the students' perception about nature of science. They investigated the proximal and distal images of NOS that a-level students develop from their participation in chemistry laboratory work. Sample of this study was 12 high schools having upper sixth chemistry classes. Six students were chosen from each of the 12 schools. The total sample size of this study was 72 randomly selected students, 48 were males (67 %) and 27 were females (33 %). Average age of the students was 18. A total of 72 students answered an open–ended questionnaire about NOS and laboratory work. From the 72 students a total of 18 students were selected for an interview. Results showed that students build some understanding about NOS from their participation in laboratory learning experiences and various other sources (lectures, readings, etc) and the location of their exact origin cannot be found with utmost precision.

Most of the researchers worked on only students' or teachers' beliefs about nature of science. Different than the previous studies, Blanco and Niaz (1997) investigated both of them in the same study. They examined the epistemological belief of students and teachers about NOS. The participants of this study were 89 freshman students enrolled in General Chemistry I at the Instituto Universitario de Tecnologic in Venezuela and 7 chemistry teachers in the same institution. A 4-item questionnaire was used as a data source. Responds of students and teachers were classified as positivist, transitional or lakatasion. At the end of the study, results indicated that teachers' and students' responses were generally positivist. Both teachers' and students' ideas about law and theories are: Scientific law has not been proved while it is universal, and theory tells us complex and explicit phenomena. Different from earlier studies, researchers concluded that it could be an indicator of improvement of the understanding of nature of science by students and teachers.

While there were many studies in literature about the students' perception of nature of science, there were few studies about this subject in Turkey. For instance, Kılıç, Çakıroğlu and Tekkaya (2004) examined the Turkish students' views about NOS and also differences in students' understanding of NOS by the factors such as gender, grade levels and school types. Sample of this study was 989 9^{th} and 8^{th} grade students. In this study, Turkish version of Nature of Scientific Knowledge Scale (NSKS) was used for data collection. The results of this study showed that Turkish students' understanding of NOS changes by gender, grade levels and school types and they are negligently above the moderate understanding of NOS.

After a year, in 2005, Kılıç, Sungur, Çakıroğlu and Tekkaya examined 9^{th} grade students' understanding of the nature of scientific knowledge by gender and school type. The participants of this study were 575 9^{th} grade high school students. Data were collected through adapted version of Nature of Scientific Knowledge (NSKS) questionnaire and the results were statistically analyzed by MANOVA. The researchers found a similar result of the previous study (Kılıç, Çakıroğlu, & Tekkaya, 2004), that students' perception of nature of scientific knowledge is not sufficient. Another important result of this study was that students' understanding of knowledge changes by gender and school type. Students who attend Vocational High School have a more traditional view than the students who attend General

High School, Anatolian High School and Super Lycee. Concerning the gender, a significant difference was found between moral and unified students.

In another study, Çelikdemir (2006) studied the elementary level students' views on nature of science. A total of 1949 students from sixth and eight grades were participated this study. Data were collected through "Nature of Science Questionnaire for Elementary Level (E-NOS)" questionnaire and interviews Seven aspects of NOS: tentativeness, creativity and subjectivity of science, social and cultural embeddedness of science, relationship between theories and laws, uncertainty in developing science, inferences and imagination in science were examined to assess the students' views on nature of science. Twelve students were participated in the interviews. and they were asked some questions about definition of science, differences of science from the other disciplines and scientific methods. The results of this study indicated that most of the students have a traditional views about nature of science. Many of them do not aware of the differences between scientific theories and laws. Students believe that there is only one method to reach scientific knowledge. Another result of this study is that eight grade students have modern views about tentativeness and subjectivity and uncertainty of science while sitxth grade students have realistic views about the role of observation and inferences in science. The researcher also found that girls have more modern views about the nature of subjectivity and creativity of science than the boys.

2.1.2. Teachers' Conception about Nature of Science

The first study of the conception of teachers about nature of science was conducted by Anderson (1950). In this study, Anderson asked eight questions to teachers and investigated the perception of students about nature of science. Then some other researchers followed him and performed some similar studies (Behnke, 1961; Miler, 1963; Carey and Stauss, 1970 cited in Lederman, 2007) The results of earlier studies indicated that teachers have inadequate views about nature of science and they reflected their insufficiency about this subject to their students (Trent, 1965).

According to results of the earlier studies, Kimball (1967) investigated the source of this inadequate understanding of NOS among teachers. Therefore, the researcher conducted a study to examine if the science teacher preparation programs

were the cause of this inadequacy or not. The researcher compared science teachers' and scientists' views who have the same academic background about nature of science. In this study, a nature of science scale (NOSS), which was developed by the researcher, was used to compare the groups. At the end of the study the researcher concluded that science teachers' and scientists' views about nature of science were both insufficient. Researcher also concluded that teachers believed early criticism about the teacher education program was not justified because the early studies used biased samples and the references were not given from the non-teacher science majors. At the end of the study, the researcher stressed that of science preparation programs should be organized to improve the understanding of teachers about nature of science.

In 1970, another study was conducted at the Georgia University by Carey and Staus to investigate the understanding of NOS by teachers. The researchers worked with seventeen high school teachers and used Wilkinson Inventory of Science Process (WISP) questionnaire. The data were analyzed with pre-test and post-test. In the beginning of the school year a pre-test was administrated and at the end of the semester, a post-test was also administrated and the results of these tests were compared. The result of this study indicated that at the end of the year, teachers' perceptions about nature of science improved. The data were also analyzed according to the experience of teachers, academic success degree and the courses which they lecture. However, consistent with the result of Bady's (1979) study the researchers concluded that there were no significant differences in terms of these variables (Lederman, 1992).

In another study, Pomeroy (1993) used a comparison method and compared the differences between the teachers' and scientists' beliefs about nature of science, scientific method and science education according the factors; gender and relative responses of participants. A 5-1 likert type scale which consisted of fifty questions was used in this study. Seventy-one scientists and 109 elementary and secondary science teachers participated in this study. The results showed that elementary science teachers have less traditional views than the scientists and secondary school teachers. It was also found that men have more traditional views about nature of science than women and this study was consistent with the studies about explaining the gender differences in science.

Similarly, another comparison study was conducted by Tairab in 2001. In this study, the researcher examined the views of pre-service and in-service science teachers of nature of science and technology. The subtitles particularly examined in this study were; (a) the aim of science and scientific research, (b) the relationship between science and technology, (c) the characteristics of science and technology, and (d) the characteristics of scientific knowledge and scientific theories. Forty one pre-service and fifty four in-service teachers participated in this study. The participants were administrated the Nature of Science and Technology Questionnaire (NSTQ) which consisted of 26 items measuring variety of aspects of NOS and technology. However, only eight items related to the aims of this study were used. Students responses were classified as R (realistic), HM (has merit) and (naive). The data were analyzed by frequency distribution. The results of this study indicated that majority of the pre-service and in-service teachers had similar views about science and technology. Majority of the teachers thought science as a distinct field as biology, chemistry and physics and they also could not explain the terms science and technology correctly. They thought that technology applied as science.

The studies about the perception of teachers on nature of science were not only focused on the aspects of NOS but also some researchers studied the relation of NOS with other factors. For example, in 2007, Liu and Lederman conducted a study which was different from the earlier studies because the researchers not only examined the teachers' perception about nature of science but also the teachers' world views and relation between them. The participants of this study were 54 Taiwanese prospective science teachers. Authors collected data with two open-ended questionnaires and follow-up interviews. Data were analyzed by summarizing and coding the written responses to both questionnaires and interviews. Results indicated that there is an interplay between participants' socio cultural beliefs and understanding of nature of science. This study showed that different world views create different views of NOS.

Another interesting study was conducted by Zeidler and Lederman (1989) who examined the effect and methods of the language used by teachers in lessons to improve understanding and developing students' views of NOS. The participants of this study were 18 biology teachers and 409 students. The Nature of Scientific Knowledge Scale (NSKS) was used as an instrument and it was administrated at the

beginning and at the end of the semester. The researchers concluded that the language used by the teachers which is related to daily life and effective strategies which are used in lessons, improved the students' understanding of nature of science aspects. In general, to use correct language in lessons affected students' perception about nature of science.

In Turkey, there are few studies about the teachers' conception of NOS. For instance, Macaroğlu, Taşar and Çataloğlu (1998) examined NOS views of the Turkish pre-service elementary science teachers. The study was based on two parts. In the first part of the questionnaire there were five open-ended questions which assessed pre-service teachers' ability to incorporate the nature of science in their teaching. In the second part Taylor and Frarers' cross-sectional study was conducted. Science and School Science Questionnaire (BASSSQ) was used in this part to collect quantitative data about the pre-service teachers' beliefs about NOS. The research results showed that pre-service teachers believe in the objectivity of scientific knowledge and yet they believe that it is subject to change.

Yakmacı (1998) investigated the perception of pre-service and in-service teachers' NOS views. In this study, 115 pre-service and 101 in-service science teachers participated. They were administrated eighteen questions which were selected from VOST questionnaire. The researcher concluded that science teachers had a post-positivist view of NOS in terms of the aspects of; the nature of classification techniques, tentativeness of scientific knowledge, scientific approach in researches, scientific knowledge is not absolute, cause and effect relationships. However, they had positivist views of NOS in terms of the aspects of; definition of science, nature of observations, scientific models.

Similarly, Erdoğan, Çakıroğlu and Tekkaya (2006) examined the Turkish pre-service teachers' views of NOS by using a different questionnaire. Data were collected by using 21 selected items from VOSTS. 166 pre-service science teachers in different universities participated in the study. Additionally, 9 volunteers were interviewed. The results of the study indicated that pre-service teachers have traditional views on the definition of science, the nature of scientific models, indefiniteness in scientific knowledge, scientific method and the formation of scientific knowledge, the relationship and function of hypothesis, theories and laws, and epistemological status of scientific knowledge and connection between

disciplines. On the other hand, pre-service teachers have contemporary views on nature of scientific observations and classification of schemes, tentativeness of scientific knowledge and cause and effect relationship.

More recently, Küçük (2008) studied perception of pre-service elementary teachers of NOS. Participants were twelve pre-service elementary teachers who enrolled STS course. Views of the Nature of Science-form C (VNOS-C) survey was used as an instrument and it was followed by semi-structured interviews. Both survey and interviews were applied at the beginning and at the end of the STS course. The results of this study showed that pre-service teachers had insufficient understandings of NOS but after intervention the degree, understanding of NOS among them increased, except for relationship and distinction between theories and laws.

Bilican, Çakıroğlu, and Tekkaya (2008) examined the effect of explicit reflective NOS instruction by using 5-E learning cycle approach on the views of prospective science teachers. In this study six aspects of NOS were stressed. These are: tentative, empirical, imaginative, creative, inferencial and sociocultural embeddedness of NOS. A total of twenty four prospective teachers who enrolled in science method course were participated in this study. During intervention, concept maps, reflection papers and interviews were used to obtain data and participants joined some NOS activities followed up group discussion about function and description of science, function and relation between theory and law through the phases of 5-E learning cycle approach –engagement, exploration, explanation, elaboration and evaluation. The results of this study indicated that there is a remarkable improvement on the views of prospective science teachers after the treatment. This imporvements were seen especially on the subjective, tentative, emprical nature of science, what science deals with and various methods of science.

While most of the researches were conducted by pre-service teachers, in 2005, Bora investigated the views of physics, chemistry and biology teachers and tenth grade high school students on nature of science. A total of 1994 students and 362 teachers (115 physics, 124 chemistry and 123 biology) in seven geographical reagions of Turkey were participated in this study. The Views on Science-Technology-Society (VOSTS) questionnaire which was developed by Aikenhead, Ryan and Fleming (1989) was used to assess the views of students and teachers. The

questionnaire originally consists of nine categories and 114 multiple choice questions. A total of 25 questions were translated into Turkish and used in this study. The topic of the questions were: science (1 question), the effects of society in the science and technology (2 questions), the characteristics of scientific knowledge (14 questions), the characteristics of scientists (3 questions), social construction of scientific knowledge (2 questions), and the effects of scientific knowledge on society (3 questions). An interview followed the questionnaire to understand the views of participants in more detail was conducted. Nine teachers and ten students were participated in these interviews. The results of this study indicated a consistent result with the previous studies. For example, participants have many misconceptions about nature of science. Students and teachers have a realistic views about scientific observations, cause and effect relationship, the nature of classification schemes, tentativeness of scientific knowledge. However, the participants have naive views on the definition of science, the nature of scientific models, the relationship among hypothesis, theories and laws, scientific method, the basic assumptions of science, epistemologic situation of scientific knowledge, and the relationship among disciplines.

2.1.3. Nature of Science and Clasroom Practice

Researchers tended to investigate the relationship between nature of science and classroom practice in past two decades (Lederman, 2007). In this part, some earlier studies about teachers' perception of NOS and its relation with instructional planning, and the effects of some courses on teachers' understanding of NOS were presented.

Until fifteen years ago, many studies about nature of science were related only to teachers' or pre-service teachers' perception of NOS (Macaroğlu, Taşar & Çataloğlu, 1998; Liu & Lederman 2007). However, in 1990s and 2000s researchers began to investigate the relation of NOS with instructional planning. For example, Abd-El-Khalick, Bell and Lederman (1997) examined the translation of pre-service teachers' conception of nature of science into instructional planning and classroom practice. Fourteen pre-service secondary science teachers participated in this study. Participants were asked some open-ended questions to understand their conception of nature of science. The results of this study showed that pre-service teachers

understood several important aspects of nature of science including the empirical and tentative nature of science, the role of subjectivity and creativity in science, and distinction between observation and inference. The researcher concluded that understanding nature of science was required to teach science but it did not affect the classroom practice.

Although researches results showed that teachers understand several important aspects of NOS (Yakmacı, 1998), they could not implement it in their classroom practice. For example, Lederman (1998) conducted a very similar study with Abd-El-Khalick, Bell and Lederman (1997) and examined the perception of biology teachers about NOS and classroom practice. Five high school biology teachers participated in this study. The ranging of their experience was from 2 to 15 years. Multiple data sources (classroom observations, open-ended questionnaires, interviews, instructional plans and materials) were used. Additionally, students who were from each biology teachers' classrooms were interviewed to examine their understanding of NOS. All data sources were analyzed independently by using a model of analytical induction. Consistent with the previous study it was found that teachers' perception of NOS does not influence their classroom practice.

Another tendency of researches about teachers' perception of nature of science was examining the effects of courses. For example, Abd-El-Khalick (2005) conducted a study and investigated the effectiveness of a philosophy of science (POS) course on science teachers' views of nature of science (NOS), perception of teaching about NOS and instructional planning related to NOS. Fifty six undergraduate and graduate students who enrolled in a two science methods course in which participants received explicit and reflective nature of science instruction participated in this study. Participants' NOS views were assessed with *The View of Nature of Science Questionnaire-Form C at* the beginning and at the end of the study. Participants' lesson plans and NOS-specific reflection papers were also evaluated to assess the effectiveness of POS course on participants' perception about NOS and their instructional planning. Results showed that POS course participants developed deeper, more coherent understanding of NOS than method course participants. Additionally, POS course participants planned more explicit instructional plans than the other. It proves that the understanding of nature of science and instruction in class is directly related.

In another study, Abd-El-Khalick and Akerson (2004) investigated the effectiveness of an explicit reflective instructional approach for learning ecologies on pre-service elementary teachers' views of NOS. Participants were 28 undergraduate students who enrolled in an elementary science method course. Six of the participants, whose NOS views' growth different from others, were purposively selected and closely followed. Two data sources were used in this study. First data source was *The View of Nature of Science Questionnaire-Form B* (VNOS-B) which was used to evaluate the participants' views of NOS at the beginning and at the end of the study. The second data source included reflection papers, exit interviews, and an instructor's log. At the beginning of the study, most of the participants had a naive view of NOS but after the study, participants showed great favorable changes in their NOS views. Focus group participants' results showed that the effectiveness of intervention was mediated by motivational, cognitive and world view factors.

Different from the previous study, Tairab (2001b) examined the effects of a science teaching methods course on the views of pre-service science teachers about nature of science and technology. Forty one pre-service science teachers, who enrolled a secondary science teaching methods course, participated in this study. The Nature of Science and Technology Questionnaire (NSTQ) which consisted of 114 items, covering various aspects of nature of science and technology, was used in this study. The instrument was administrated as pre-test and post-test at the beginning and at the end of the course. The results of the study were analyzed by frequency distribution in order to characterize trend of participants' views of nature of science and technology. Sign tests were also administrated to investigate the significant changes between the pre and post-tests. The researcher concluded that pre-service teachers' perception of technology did not change after the intervention. On the other hand, their views of NOS changed after the course in a favorable way. For example, before the course, most of the participants thought that "science as a body of knowledge" but at the end of the course, the proportion of the participants who thought like that decreased.

A similar study was conducted by Akerson, Morrison and McDuffie in 2006 and they investigated the effects of science methods course on the pre-service elementary teachers' NOS views and retention of these views. A total of 19 (16 females and 3 males) pre-service elementary teachers, who enrolled in an

elementary science methods course, participated in the study. Data were collected through an open-ended questionnaire, *Views of Nature of Science* version B (VNOS-B) (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002) with a semi structured interview. Participants answered the questionnaire at the beginning and at the end of this study during 5 months. Volunteer participants were selected for interview. Pre-instruction interviews and VNOS-B questionnaires were analyzed independently. Study results indicated that pre-service teachers had inadequate ideas about NOS prior to instruction, but after the science methods course, an improvement was seen on their views. After 5 months of instruction, it was recognized that some of the students reverted back their earlier views.

In another study, Hanuscin, Akerson and Phillipson-Mover (2006) planned a NOS instruction in a physical science content course for pre-service elementary science teachers. Firstly, nine undergraduate teaching assistants' (UTAs) views of NOS and the impact of job-embedded professional development on their views were examined. To evaluate the change of participants' view of NOS over time, observation, interview, and document analysis techniques were used. At the end of the study, researchers concluded that while initially UTAs view of NOS was inconsistent, their views changed in a favorable way after interventions. This result was consistent with the previous studies.

2.2 Implementation of NOS in Science Textbooks

Recently, science education reformers have begun to focus attention on the role of curriculum materials used in science education. A proposal, submitted to the National Science Foundation in the US for the establishment of the Center for Curriculum Materials in Science states,

"There is a widespread belief in the education community that instructional materials are a powerful way to affect what science is taught and how it is taught. Instructional materials… are a primary source of science content and they promote specific views about the nature of science and about the nature of science teaching and learning." (American Association for the Advancement of Science, 2002 as cited in Gunckel, 2004, p.4).

Science textbooks include many aspects of NOS and goals of science education; illustrations of scientific relationships, science-technology and society relationship, engaging students with gathering information, telling the history of science and so on (Chiappeta & Fillman, 2007). However, implementation of NOS and scientific literacy in science textbooks were not studied so much until now.

The comprehensive study about textbooks was performed under the project 2061. This project was aimed to determine fundamental goals in achieving scientific literacy for the children in the USA. Many teachers, educators and experts worked on this project. One part of this project consisted of textbook analysis. In this study, widely used middle grades mathematics, science, algebra and high school biology textbooks were analyzed according to some criteria. The science textbooks were analyzed in terms of how well textbooks can help students learn key ideas in earth science, physical science, and life science. Each textbook was analyzed by two independent teams made up of middle school teachers, curriculum specialists, and professors of science education. This evaluation process continued three years with the participation of 100 scientists, mathematicians, educators and curriculum developers. At the end of the study, in 1999 Project 2061 released the results of an in-depth study of middle-grades science books and one of the important results was that none of the widely used science textbooks were rated as satisfactory. Some of the books were rated as satisfactory about nature of science dimensions, but some of them were rated as unsatisfactory according to these dimensions. Some other results showed that science textbooks cover too many topics and activities which are not relevant to learning key ideas. Dr. George Nelson, Director of Project 2061, stated that texts in the middle grade science textbooks neither educate nor motivate students.

Similarly, Wilkinson (1999) examined 20 physics textbooks. Eight of them were published before 1990 and 12 of them were published during or after 1990. Textbooks were analyzed according to the following aspects of scientific literacy: (a) science as a body of knowledge, (b) science as a way of investigating, (c) Science as a way of thinking, and (d) the interaction between science, technology and society. Textbooks were analyzed by a content analysis technique. Four major themes of scientific literacy were used in this content analysis. Each theme has some descriptors which are used by readers to analyze the textbooks. Then percentages of

the descriptors were calculated. Two teachers and the researcher scored the descriptors and average interrater agreement of 81 % and 83% were achieved, with corresponding mean kappa values of .74 and .76. At the end of the study, textbooks written after 1990 were found to place more emphasis on the theme science, technology and society than the texts written before 1990.

A very similar study of Wilkinson (1999) was conducted by Chiappetta and Fillman in 2007. In this study, researchers did not compare the results of two different studies but they compared the old and new biology textbooks in terms of NOS aspects. In this study five high school biology textbooks were analyzed according to inclusion of four aspects of NOS: (a) science as a body of knowledge, (b) science as a way of investigating, (c) science as a way of thinking, and (d) science and its interactions with technology and society. The same six chapters of these books were analyzed. A scoring procedure was used. Cohen's kappa values were ranging from 0.36-1.00 in most parts. These recent published biology textbooks were compared with the biology textbooks which were analyzed 15 years ago. Researchers obtained consistent results with Wilkinson's (1999) study and showed that the new biology textbooks are better than the old biology textbooks according to four NOS aspects.

Similar to the previous studies, Gunckel (2004) examined three science textbooks by using the similar criteria of the previous studies (Wilkinson, 1999; Chiappetta & Fillman, 2007) and compared the results with conclusion of the Project 2061. There are three main subtitles of criteria. Category I: Facts and Concepts; Category II: Application and Reasoning; and Category III: Sociocultural Construction of Knowledge. Textbooks were also analyzed by using the criteria of Project 2061. Results showed that two of the textbooks portrayed nature of science as a fact-based-on authority. However, one of the three textbook portrayed nature of science as sociocultural endeavor where knowledge is constructed from evidence by a community of validators. Results showed those textbooks which were rated highly in project 2061 did not engage students about nature of science in many aspects.

In another study, Guisasola, Almudi and Furio (2005) examined 30 physics textbooks for university first year courses published in 1972-1999. Nature of science criteria were used to analyze the textbooks. The criteria consist of three main topics: (a) the problem of the interpretation of magnetic interaction, (b) the construction of

the magnetic field theory, (c) the processes of unification, (d) criterical view of the theory. Some indicators were used to calculate the percentages of criteria for each book. The results showed that the large majority of books presented the introduction of the theory of magnetic field in a non-problematic, non-historical, "linear accumulation" manner. Additionally, many textbooks did not relate the theory of magnetic field to the other theories. Although Giusasola et al. (2005) focused on special topic to investigate the implementation of NOS in science textbook, the results were consistent with the previous studies..

Different from the previous studies, McComas (2003) examined two most important elements of nature of science. McComas investigated how concepts of "law" and "theory" were defined and applied in a range of the U.S. secondary school biology textbooks. The researcher also aimed to determine if the students and teachers using these books could get correct impression from both the terms. In this study, fifteen secondary school biology textbooks were analyzed by two coders. They took notes if the concepts of "law" and "theory" were presented in the texts as in the narrative or glossary. They worked independently and at the end of the study, they compared the results. The results of this study indicated that the concept "law" was slightly defined but variety of examples of this concept were given, especially in the genetics subject. On the other hand, the concept of "theory" was mainly defined but there were seldom examples of theories in the textbooks. This result partially explains why students did not have adequate knowledge about "law" and "theory" and their distinction (Griffiths & Barry, 1993)

A more recent study was conducted by Abd-El-Khalick, Waters and Le (2008). The researchers investigated the presentation of NOS in high school chemistry textbooks in the USA. In this study, some aspects of NOS were examined including emprical, tentative, theory-driven, creative, inferencial, and social nature of science. In addition, the myth of scientific method, the nature of scienctific laws and theories, and social cultural aspect of nature of science were examined. A structured, document analysis approach was used to evaluate the textbooks. Researchers developed a rubric to evaluate the textbooks. The rubric targeted ten aspects of nature of science. Therefore, researchers expected from -30 to + 30 scores for each textbook. The results of the study supported the earlier studies because it was found that majority of the textbooks falling in the range of -7 to +7. Four

textbooks had negative scores and ten of them had positive score from 3 to 12 points. This result demonstrated that the textbooks are inadequate to present nature of science aspects.

There have been few studies about implementation of NOS and scientific literacy in science textbooks in Turkey. For example, Başlantı (2000) investigated an elementary level science textbook in terms of scientific literacy themes. The book named 'Elementary Science 8' was analyzed by content analysis technique according to four dimensions of scientific literacy which are the knowledge of science, the investigative knowledge of science, science as a way of thinking, and interaction of science, technology and society. In this study, the researcher examined one topic from Chemistry, one topic from Physics and the other from Biology. An instrument developed by Chiappetta was used but the researcher changed some items before using it. Textbook was analyzed by the researcher and two science teachers. At the end of the analysis Cohen kappa value was calculated. Results of the study showed that the first dimension (the knowledge of science; 65 %) of NOS was dominant in the book. There was no balance among dimensions. Author concluded that dominating the first dimension effects students' perceptions of NOS because this aspect presented science as a body of knowledge and transmitted the scientific knowledge to students. Additionally, presenting only the first dimension of nature of science in science textbooks can affect the learning environment in a negative way, because teachers use the textbooks frequently in their lessons. According to researcher, textbooks should portray all the aspects of nature of science (Başlantı, 2000).

In a recent study, Irez (n.d.) investigated five secondary school biology textbooks in terms of NOS. Textbooks were analyzed by ethnographic content analysis technique. Analysis process began with coding of the data as numbers. The researcher coded chapters or sections where NOS was discussed. The second step of analysis was to group explanations from the textbooks which have some aspects of NOS. The third step of analysis was statement generation. At the end, cognitive maps were generated for each textbook. Data were analyzed by using these cognitive maps. Study results indicated that there were a number of serious problems about NOS in textbooks. Firstly, science was portrayed as a dynamic process of generating and testing alternative solutions or explanations about nature.

It was mostly portrayed as collection of facts. Irez also stated that authors of textbooks seemed not to understand the process well enough to explain them to students. So there were some deceptive and insufficient descriptions regarding scientific enterprise. The last important result of the study was that some of the important aspects of NOS (e.g. scientific method, tentativeness of science) were not presented in these textbooks.

2.3 Summary

Nature of science is a new and important issue in science education. Educators do not agree on the definition of nature of science but they agree on its importance (Lederman, 1998). However, there are some problems of implementing nature of science in classrooms and teachers' instruction (Abd-El-Khalick, Bell & Lederman, 1997; Lederman, 1998). Some interventions of NOS can generally cause improvement on understanding of it (Abd-El-Khalick, 2005; Hanuscin, Akerson & Phillipson-Mover, 2006; Akerson, Morrison & MucDuffie, 2006; Küçük, 2008). Another important component related to understanding of NOS by students and teachers are textbooks. One of the most important aspects regarding the content of a science textbook is the accurate description of nature of science (Chiappetta, Fillman, & Sethna,, 1993). However, research results indicated that not all the dimensions of nature of science were presented in the textbooks but some dimensions were presented partially (Wilkinson, 1999; Başlantı, 2000; Abd-El-Khalick, Waters, & Le, 2008). In addition, there have not been enough studies about the implementation of nature of science in science textbooks and there is a need for systematic researches about this.

CHAPTER III

METHOD

In this chapter, the design of the study, data source, instrument, procedure, reliability, analysis of data, assumptions and limitations are presented.

3.1 Design of the Study

The design of this study is content analysis. The aim of content analysis is enabling researchers to study human behavior in an indirect way, through an analysis of their written contents of communications (Fraenkel & Wallen, 2005). Written contents of communications are documents. The documents which can be the resource of data in educational studies are; curriculum directives, correspondence of school, student registrations, meeting records, student folders, student and teacher handbooks, homework and exams, unit plans, teacher folders, official documents and textbooks (Yıldırım & Şimşek, 2006).

The aim of content analysis is examining the documents which are mentioned above according to some concepts. There are two general types of content analysis: conceptual analysis and relational analysis. Beaney (2003) determined the conceptual analysis as breaking down the texts into units and analyzing the concepts, to better understand the special issue or gain knowledge about it. Conceptual analysis is to establish the existence and frequency of concepts while the purpose of relational analysis is to examine the relationships of concepts in the document.

This research is a type of conceptual analysis. Textbooks which are analyzed in this study are divided by chapters and two biology chapters are used in each textbook. Content of the textbooks are analyzed by using frequencies and percentages of indicators whether they meet criteria or not.

3.2 Data Source

The accessible sampling method was used to select the textbooks. Elementary level science textbooks can not be reached easily, especially the textbooks which were published by MONE. Both the textbooks published by MONE and private companies release, were delivered without any fee by the Ministry of National Education to all schools in Turkey. Because textbooks are not bought by students, book stores do not sell them. Another important point why textbooks are not easy to reach is that MONE delivered only a particular set of textbooks to a particular area. For example, the science textbooks which were used in Marmara region are not used in the Central Anatolian region and so on. The last important point that the researcher used accessible sampling because there are too few elementary level science textbooks were published according to new science curriculum. As the program is new, there is no accumulation of textbooks and also not enough research about them. Because of these reasons, the researcher could not reach all the elementary science textbooks which were written after the new program. Therefore, the researcher used the accessible science textbooks.

In this study, three 6^{th}, 7^{th} and 8^{th} grade science and technology textbooks (students' book) were analyzed. At the 6^{th}, 7^{th} and 8^{th} grade of the elementary level, there is one set of books for each grade. Each set includes a students' book, a teachers' book (teacher guide book) and a workbook. In the present study, the researcher analyzed only three students' science and technology textbooks for sixth, seventh and eighth graders. Table 3.2.1 presents the names, authors and publishign companies of the analyzed textbooks.

Table 3.2.1. Textbooks which are analyzed in this study are;

Grade Level	Name of The Book	Authors	Publishing Company
6th Grade	İlköğretim Fen ve Teknoloji Ders Kitabı	Yrd. Doç. Dr. Hünkar KORKMAZ, Dr. Nilgün TATAR, Arş. Gör. S. Ahmet KIRAY, Gözde KİBAR	Pasifik Yayınları
7th Grade	Fen ve Teknoloji Ders Kitabı	Dr. Tuncay TUNÇ, Necati BAĞCI, Nuray YÖRÜK, Nihal GÜRSOY KÖROĞLU, Ülya ÇELTİKLİ ALTUNOĞLU, Güzide BAŞDAĞ, Özgül KELEŞ, İnciser İPEK, Elif BAKAR	MONE
8th Grade	Fen ve Teknoloji Ders Kitabı	Dr. Tuncay TUNÇ, Elif BAKAR, Güzide BAŞDAĞ, İnciser İPEK, Necati BAĞCI, Nihal GÜRSOY KÖROĞLU, Nuray YÖRÜK, Özgül KELEŞ	MONE

In 2004, new science and technology course program was developed and authors immediately wrote 4th to 8th grade science textbooks. These textbooks were analyzed by Board of Education according to readability, content, objectives of science-technology-attitude-environment, objectives of attitude and values, scientific process skills, apperance, grammer, context, laboratory activities etc.The approved textbooks were published and the pilot study of these textbooks were carried out in elementary schools in particular cities. While pilot implementation of the new curriculum in pilot schools continued, feedbacks were given by the teachers, researchers and education specialists and some changes were done in the program and certainly in the textbooks. The pilot application of the science textbooks began in 2004 in some cities of Turkey and in 2006 the new 6 th grade science and technology textbooks were used in the elementary schools. One year later, the 7 th and 8 th grade science and technology textbooks were began to used in schools. In 2008, the pilot application of all the elementary science textbooks were completed and some corrections were done according to the feedbacks. While this study was

conducting, changes in program were also announced at the website of Board of Education. After all of these, the researcher decided to work on 6th, 7th and 8th grade elementary level science textbooks because feedbacks and corrections of the textbooks have been almost finished. Because the textbooks were very new, there was almost no research about them. This was another point why the researcher decided to examine these textbooks.

3.3. Instrument

The purpose of this study was to investigate how nature of science is presented in elementary science textbooks. Therefore, after the literature review, based on Gunckels' (2004) study some criteria regarding some aspects of the NOS were identified and translated into Turkish by the researcher. This instrument was found suitable for this research because the criteria were used to evaluate the textbooks in the aspect of how nature of science is presented in the texts, rather than rating the textbooks as good or bad. There are three categories in this instrument. These are; Category I- Facts and Concept, Category II- Application and Reasoning, and Category III- Sociocultural Construction of Knowledge and History of Science. The following is brief information about these three categories:

Category I – Facts and Concepts

Textbooks are evaluated in this category as presenting science as facts, terms and concept. There are two main criteria and five indicators of the criteria in this category.

Category II- Application and Reasoning

Textbooks are evaluated in this category as presenting science as the application of scientific theories and using model-based reasoning. There are four criteria and seven indicators under this category.

Category III- Sociocultural Construction of Knowledge

Textbooks are evaluated in this category as presenting science as social construction of scientific knowledge and understanding. There are three criteria and fifteen indicators which belong to these criteria.

The whole set of categories and criteria are presented in Appendix A.

3.4 Reliability

In content analysis methods, inter-rater reliability value should be calculated. Stempler (n. d.) determined the value of inter-rater reliability as the level of agreement a special set of judges on a special instrument at a special time. Textbooks were analyzed by the researcher and a science teacher. They compared the results for the reliability of the instrument. There are several methods to calculate the inter coder reliability but one of the most common methods is calculating Cohen's kappa value.

To calculate the Cohen's kappa in this study, the researcher used SPSS for Windows, Version 16.0. All the indicators of all criteria and categories were determined as sufficient (1) or insufficient (0). Then the data were analyzed by using SPSS.

According to Landis and Koch (1977) substential aggrement of Cohen's kappa reported of 0.61-0.80. In the current study the Cohen's kappa was found to be 0.71. This value was found acceptable for this study.

Table 3.4.1. Inter coder agreement value of Cohen's kappa

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of Agreement	Kappa	,710	,158	6,797	,000
N of Valid Cases		84			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

3.5 Procedure

This research began with searching textbooks analysis and nature of science concept. Textbooks, science textbooks, textbook analysis, nature of science, and some combination of these words were used for literature review. For some articles

which were not reached in internet researcher used some universities' libraries like METU library, İzzet Baysal University library, Bilkent University library. Most of the articles were searched in e-libraries and databases in these libraries. These databases were ERIC, Wiley Interscience, Dissertations and Theses, Taylor and Francis Online Journals, YOK. Additionally some national meetings' publications were benefited.

Based on the Gunckel's (2004) study, the instrument was developed to analyze the textbooks. After getting permission from the author, the researcher identified suitable criteria for textbook analysis and translated and adapted them into Turkish.

Researcher also prepared a criteria table to analyze the textbooks easily. This table is presented in Appendix B. This table has four columns. The title of columns are; Criteria, sufficient/insufficient, number of indicators and notes. The researcher and a science teacher used this table to analyze the textbooks. The researcher and the teacher noted the number of indicators and page number of indicators in textbooks. This table is presented in Appendix C. Then they decided if this criterion was sufficient or not. After this process, researcher and the teacher compared the results. They discussed the results and tried to get a consensus about the criteria which they did not agree.

At the end, the researcher analyzed the data by using SPSS to calculate the Cohen's kappa and reached some results.

3.6 Analyses of Data

Analyses were done by using SPSS for Windows, Version 13.0. Descriptive statistics; mean and frequency were presented by hand. For inter-rater reliability, Cohen's kappa value was calculated in SPSS.

3.7 Assumptions and Limitations

Assumptions and limitations, considered in this study, are expressed as below:

3.7.1 Assumptions

The criteria used in the content analysis are suitable for the standards. There are few textbooks written in the 6^{th}, 7^{th} and 8^{th} grade level. Therefore, textbooks were generalized easily. Additionally, since the textbooks were examined by the Board of Education, the textbooks were assumed to have the properties of new science education program. In addition, the raters were objective to evaluate the textbooks.

3.7.2. Limitations

There are some disadvantages of content analysis (Yıldırım, & Şimşek, 2006). Content analysis includes published materials. Another disadvantage of content analysis is that there is no standard format to analyze the document. In this study, the researcher developed/identified the criteria from the literature. There were no standard criteria to evaluate the textbook. Therefore, comparison of the textbooks analysis with the other studied textbooks is hard. In addition, only three elementary level science textbooks' biology units were analyzed in this research and the workbooks and teachers' guide books of the textbooks were not analyzed. The biology units were selected to study because many studies in the literature were about biology units and this can give an opportunity to compare the results. One of the limitations of this study is that textbooks were analyzed by using some aspects of nature of science, not all of the aspects of it.

CHAPTER IV

RESULTS

In this chapter, a descriptive statistic of the data and summary of the findings are presented.

4.1 Descriptive Statistics

Findings are presented as tables and figures from 6th grade to 8th grade. Two biology units were analyzed in each textbook. In the 6th grade science textbooks, "Reproduction, Development and Growth in Living Beings"and "Systems in Our Body" units were analyzed. In the 7th grade science textbook, "Systems in Our Body" and "Human and Environment" units were analyzed. In the 8th grade science textbook, "Cell Division and Heredity" and "Livings and Energy Relationships" units were analyzed. Each textbook was analyzed by two raters and common indicators were used to calculate the frequencies and percentages. Criteria used by the raters are presented in Appendix B.

In this part, percentage and frequencies of criteria and their indicators were reported. Textbooks were analyzed by three main categories which consist of criteria and indicators. These categories were; "Science as Authoritative Knowledge", "Science for Understanding Phenomena", and "Science as the Social Construction of Knowledge". The first category "Science as Authoritative Knowledge" consisted of two criteria and five indicators, the second category "Science for Understanding Phenomena" consisted of four criteria and eight indicators, and the third category "Science as the Social Construction of Knowledge" consisted of three criteria and fifteen indicators. Each indicator, criterion and category was summarized for 6th 7th and 8th grades in tables 4.1.1.1-4.1.3.32. Each table indicated that frequencies of indicators which showed that the total number of pages met the indicators, percentages of indicators which were calculated by dividing frequencies of indicators to total number of pages analyzed and multiplied by a hundred, total number of pages indicated that all pages in analyzed units..

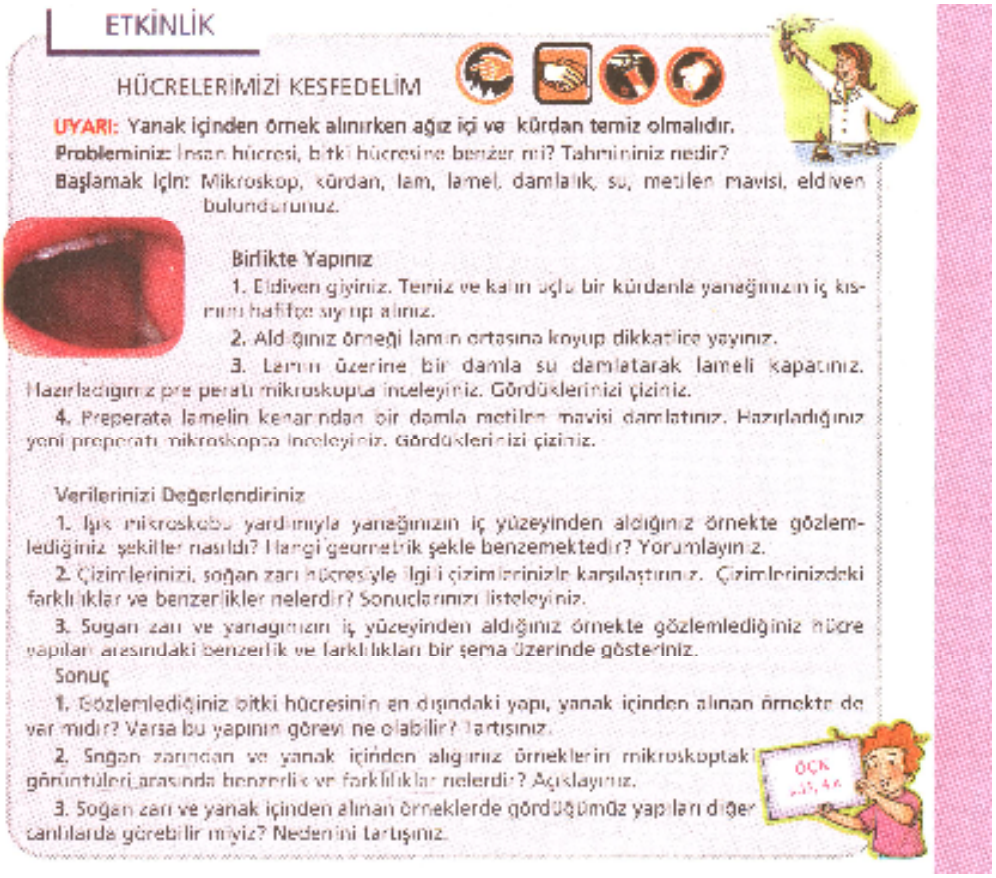
4.1.1 Analysis of Sixth Grade Science Textbook

In this part, analysis of representations of NOS in the 6th grade science textbook was presented.

The analysis of the 6th grade science textbook for category I (Science as Authoritative Knowledge), Criterion IA (Deductive Experiences) and indicator 1 (the material includes demonstrations or laboratory exercises that confirm concepts presented) showed that it met about 32.8 % of the indicator 1 (Table 4.1.1.1) and it sufficiently included demonstrations or laboratory activities. Figure 1 shows a laboratory activity which confirm the concepts of the differences between the plant cell and animal cell.

Table 4.1.1.1. Frequencies and percentages of the indicator 1 of criterion IA in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	22	32.8 %	67



ETKİNLİK

HÜCRELERİMİZİ KEŞFEDELİM

UYARI: Yanak içinden örnek alınırken ağız içi ve kürdan temiz olmalıdır.

Probleminiz: İnsan hücresi, bitki hücresine benzer mi? Tahmininiz nedir?

Başlamak İçin: Mikroskop, kürdan, lam, lamel, damlalık, su, metilen mavisi, eldiven bulundurunuz.

Birlikte Yapınız

1. Eldiven giyiniz. Temiz ve kalın uçlu bir kürdanla yanağınızın iç kısmını hafifçe sıyırıp alınız.
2. Aldığınız örneği lamın ortasına koyup dikkatlice yayınız.
3. Lamın üzerine bir damla su damlatarak lameli kapatınız. Hazırladığınız preparatı mikroskopta inceleyiniz. Gördüklerinizi çiziniz.
4. Preparata lamelin kenarından bir damla metilen mavisi damlatınız. Hazırladığınız yeni preparatı mikroskopta inceleyiniz. Gördüklerinizi çiziniz.

Verilerinizi Değerlendiriniz

1. Işık mikroskobu yardımıyla yanağınızın iç yüzeyinden aldığınız örnekte gözlemlediğiniz şekiller nasıldı? Hangi geometrik şekle benzemektedir? Yorumlayınız.
2. Çizimlerinizi, soğan zarı hücresiyle ilgili çizimlerinizle karşılaştırınız. Çizimlerinizdeki farklılıklar ve benzerlikler nelerdir? Sonuçlarınızı listeleyiniz.
3. Soğan zarı ve yanağınızın iç yüzeyinden aldığınız örnekte gözlemlediğiniz hücre yapıları arasındaki benzerlik ve farklılıkları bir şema üzerinde gösteriniz.

Sonuç

1. Gözlemlediğiniz bitki hücresinin en dışındaki yapı, yanak içinden alınan örnekte de var mıdır? Varsa bu yapının görevi ne olabilir? Tartışınız.
2. Soğan zarından ve yanak içinden alığınız örneklerin mikroskoptaki görüntüleri arasında benzerlik ve farklılıklar nelerdir? Açıklayınız.
3. Soğan zarı ve yanak içinden alınan örneklerde gördüğümüz yapıları diğer canlılarda görebilir miyiz? Nedenini tartışınız.

Figure 1. An example in the science textbook that includes a laboratory activity (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

When the 6th grade science textbook was analyzed for category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 1 (the material presents conclusions of scientific studies rather than details of supporting data and arguments), the result indicated that textbook met about 65.7 % of the indicator 1 (table 4.1.1.2). As shown in figure 2 it also presented the scientific knowledge including the conclusion of scientific studies without details. In this example, there is no supporting data and arguments.

Table 4.1.1.2 Frequencies and percentages of the indicator 1 of criterion IB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments	44	65.7%	67

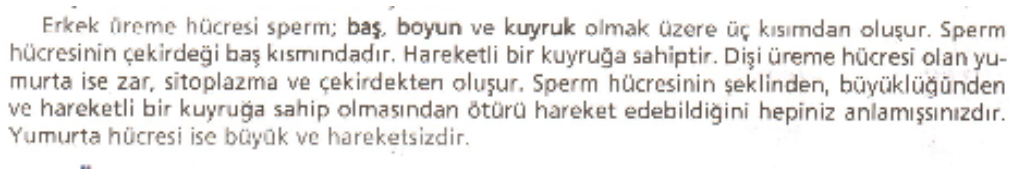

Erkek üreme hücresi sperm; **baş**, **boyun** ve **kuyruk** olmak üzere üç kısımdan oluşur. Sperm hücresinin çekirdeği baş kısmındadır. Hareketli bir kuyruğa sahiptir. Dişi üreme hücresi olan yumurta ise zar, sitoplazma ve çekirdekten oluşur. Sperm hücresinin şeklinden, büyüklüğünden ve hareketli bir kuyruğa sahip olmasından ötürü hareket edebildiğini hepiniz anlamışsınızdır. Yumurta hücresi ise büyük ve hareketsizdir.

Figure 2. An example in the science textbook that presents the conclusion of scientific studies without details (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The analysis of the 6th grade science textbook for category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 2 (the material focuses on the most important theories and models in the field) showed that it met only 2.9% of indicator 2 (table 4.1.1.3). The frequency of indicator 2 was low and there were two important models in this book but raters decided that this indicator is sufficient. Although it is almost impossible to include different theories and models in different pages, figure 3 shows that it focused on the most important of them in the field. In this examle, the most important and wellknown cell models are given.

Table 4.1.1.3 Frequencies and percentages of the indicator 2 of criterion IB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	2. The material focuses on the most important theories and models in the field	2	2.9 %	67

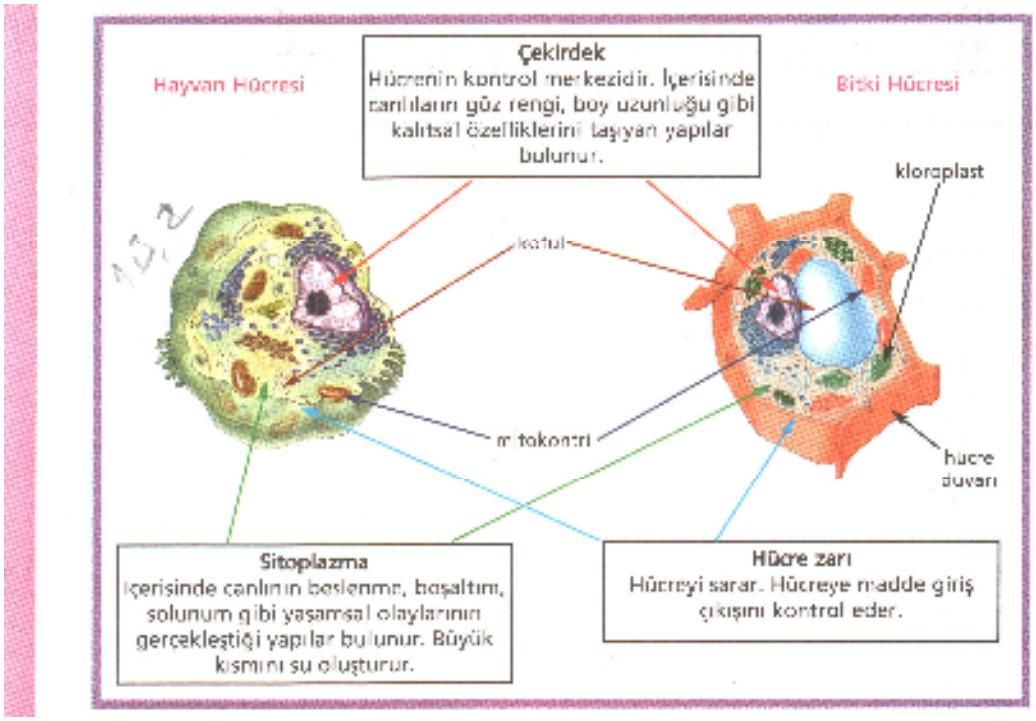


Figure 3. An example in the science textbook that focus on cell model (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The analysis done according to Category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 3 (the material includes graphs, charts, maps, pictures etc. that display relationships rather than original data) showed that the indicator was met by a percentage of 50,7 (table 4.1.1.4) and figure 4 shows one example of the pictures which were frequently included to display the relationship. In this examle, pictures were given to explain the relationship the phases of metamorphosis of two animals.

Table 4.1.1.4 Frequencies and percentages of the indicator 3 of criterion IB in 6th grade science textbook

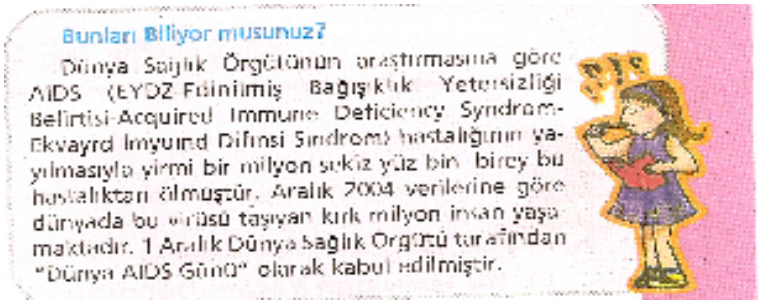
Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	Page number of the analyzed units
I	IB (Rhetoric Based on Authority)	3. The material includes graphs, charts, maps, pictures etc. that display relationships rather than original data	34	50.7 %	67

Figure 4. An example in the science textbook that includes a picture which displays a relationship (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The 6th grade science textbook was analyzed according to category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 4 (rhetoric relies on appeals to authority for persuasion). The results showed that the textbook met this indicator by a percentage of 2,9 (table 4.1.1.5) and the rhetoric only slightly relied on appeals to authority for persuasion (figure 5). In this examle, data of World Health Organisation were applied to persuasion.

Table 4.1.1.5 Frequencies and percentages of the indicator 4 of criterion IB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	4. Rhetoric relies on appeals to authority for persuasion	2	2.9 %	67


Bunları Biliyor musunuz?

Dünya Sağlık Örgütünün araştırmasına göre AIDS (EYDZ Edinilmiş Bağışıklık Yetersizliği Belirtisi-Acquired Immune Deficiency Syndrom-Ekvayrd İmyuned Difinsi Sindrom) hastalığının yayılmasıyla yirmi bir milyon sekiz yüz bin birey bu hastalıktan ölmüştür. Aralık 2004 verilerine göre dünyada bu virüsü taşıyan kırk milyon insan yaşamaktadır. 1 Aralık Dünya Sağlık Örgütü tarafından "Dünya AIDS Günü" olarak kabul edilmiştir.

Figure 5. An example in the science textbook that appeals to authority for persuasion (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The criteria and indicators of category I were used to answer the question: Does the material present science as confirmation of facts and concepts? According to table 4.1.1.6, the textbook met 40% of the criterion IA and an average of 30,55% of criterion IB. The textbook mostly included activities to confirm facts and concepts (Criterion IA). It included demonstrations or laboratory exercises that confirm concepts presented. Additionally, the textbook relied on conclusions and status of scientists to teach terms, concepts, and facts (Criterion IB); generally presented conclusions of scientific studies rather than details of supporting data and arguments (67.7 %), and focused on the most important theories and models in the field (2.9 %) – the percent of this indicator seems very low because not the page numbers but the number of theories were calculated. However, two theories in two units were found to be sufficient- the material frequently included graphs, charts, maps, etc. that display relationships rather than original data (50.7 %), but rhetoric slightly relied on appeals to authority for persuasion (2.9 %)

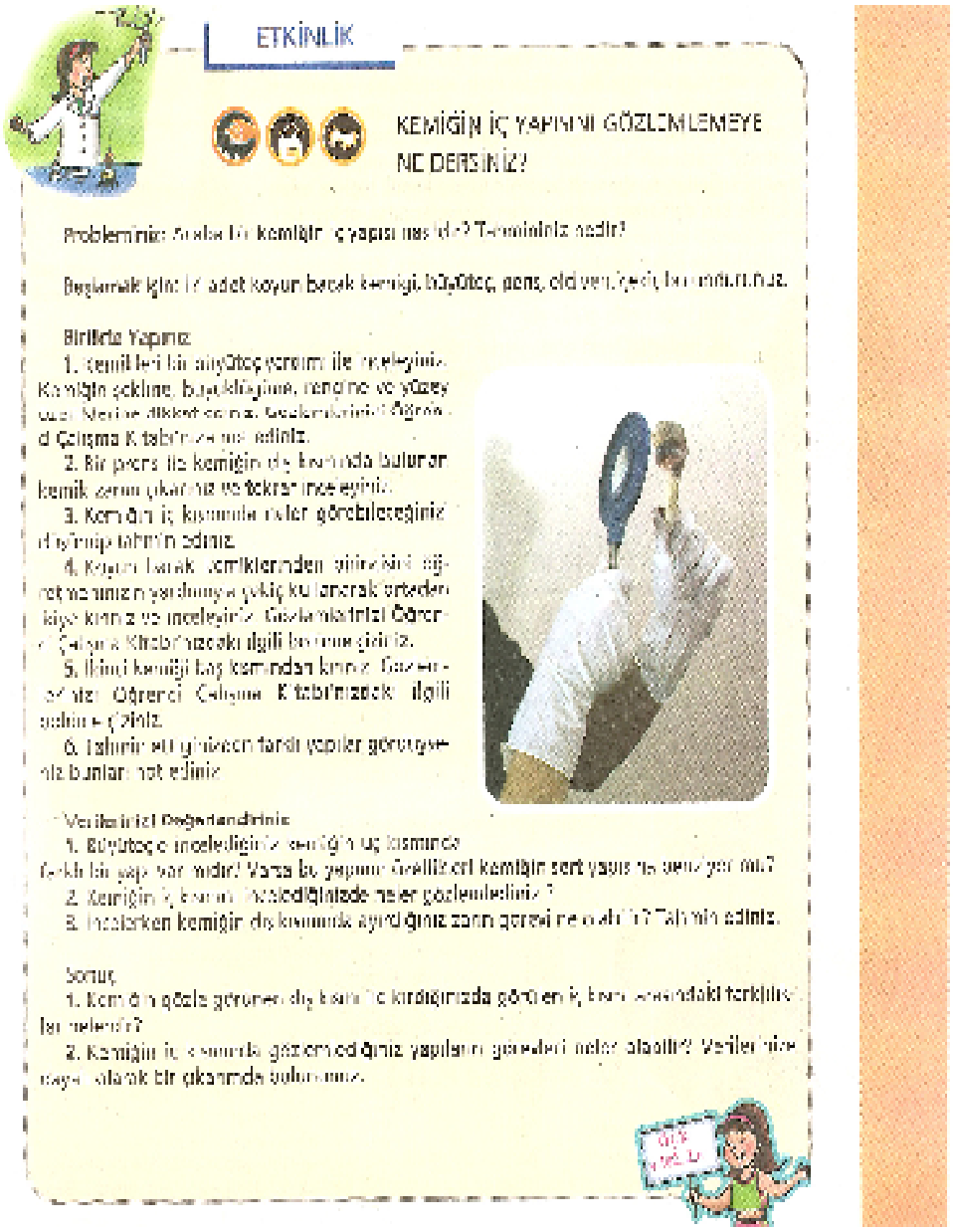
Table 4.1.1.6 Frequencies and percentages of the category I criteria and indicators in 6th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	27	40 %	67
	Mean		27	40	67
	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments	44	65.7 %	67
		2. The material focuses on the most important theories and models in the field	2	2.9 %	67
		3. The material includes graphs, charts, maps, etc. that display relationships rather than original data	34	50.7 %	67
		4. Rhetoric relies on appeals to authority for persuasion	2	2.9 %	67
	Mean		20.5	30.55 %	67

The analysis of the 6th grade science textbook for category II (Science for Understanding Phenomena) Criterion IIA (Engagement with Phenomena) and indicator 1 (The material engages students with relevant phenomena through first-hand or vicarious experiences) showed that it met 43% of the Criterion IIA - indicator 1 (table 4.1.1.7) and figure 6 is an example that the textbook generally engaged students with relevant phenomena through first-hand vicarious experiences. In this example, the textbook engages students with a laboratory activity to understand the internal structure of bones.

Table 4.1.1.7 Frequencies and percentages of the indicator 1 of criterion IIA in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	29	43 %	67



ETKİNLİK

KEMİĞİN İÇ YAPISINI GÖZLEMLEMEYE NE DERSİNİZ?

Figure 6. An example in the science textbook that engages students with first hand experience (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The 6th grade science textbook was analyzed according to category II (Science for Understanding Phenomena), Criterion IIA (Engagement with Phenomena) and indicator 2 (The primary purpose of the activities is to understand the scientific theory that explains the phenomena). Table 4.1.1.8 shows that the textbook met this indicator by a percentage of 5,9 and figure 7 is one of the few activities focused on understanding of the scientific theories. In this examle, the

primary purpose of the activity is to understand the structure of hearth to explain its action.

Table 4.1.1.8 Frequencies and percentages of the indicator 2 of criterion IIA in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIA (Engagement with Phenomena)	2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	4	5.9 %	67


ETKİNLİK

YAŞAM POMPANIZ NASIL ÇALIŞIYOR?

Probleminiz: Yaşamınız için gerekli en önemli organlarınızdan biri olan kalbin yapısı nasıldır? Tahmininiz nedir?

Başlamak için: Meme kalbi (inek veya koyun kalbi), makas, plastik eldiven, pens, bistüri, büyüteç, disekstyon küveti bulundurunuz.

Birlikte Yapınız

1. Elinize eldiven giyiniz ve memeli kalbini elinize alınız. Kalbin yapısının yumuşak mı sert mi olduğunu hissetmeye çalışınız.
2. Kalbin ne kadar büyüklükte olduğunu ölçünüz.
3. Kalbi disekstyon küvetine koyarak dış yapısını inceleyiniz. Damarların bağlantılarına dikkat ediniz. Gözlemlerinizi Öğrenci Çalışma Kitabı'nıza çiziniz.
4. Öğretmeninizin yardımıyla bir makasla kalbi en büyük damardan ve sonrasından başlayarak ikiye ayırınız. Büyüteci kullanarak kalbin iç yapısını gözlemlemeye çalışınız. Gözlemlerinizi Öğrenci Çalışma Kitabı'nıza çiziniz.
5. İç yapı ile dış yapı arasındaki farklılıkları Öğrenci Çalışma Kitabı'nıza not ediniz.

Verilerinizi Değerlendiriniz

1. Kalbe dokunduğunuzda nasıl bir yapıyla karşılaştınız?
2. Kalbi ikiye böldüğünüzde gözlemlediğiniz iç kısım kaç bölümden oluşmuştur?

Sonuç

Kalbin iç kısmının farklı bölümlerden oluşmasının nedenini gözlemlerinize dayalı olarak bir cümleyle anlatınız.

Figure 7. An example in the science textbook including an activity that aims to understand phenomena (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

When the 6th grade science textbook was analyzed for category II (Science for Understanding Phenomena) Criterion IIB (Identify and Address Student Ideas) and indicator 1 (The material includes questions or tasks that identify students naive conceptions) the result shows that it met the indicator 1 by 14,9% (table 4.1.1.9).

Figure 8 shows one of the few questions that were included to identify the naive conceptions of students about cell.

Table 4.1.1.9 Frequencies and percentages of the indicator 1 of criterion IIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	10	14.9 %	67

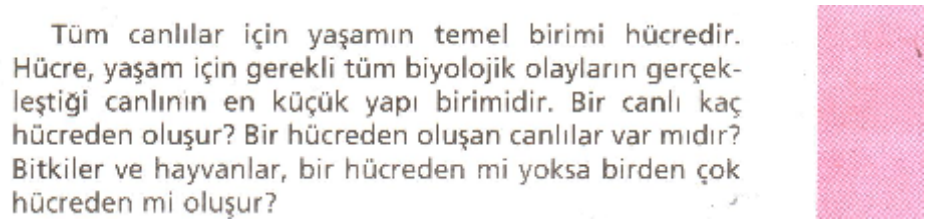

Tüm canlılar için yaşamın temel birimi hücredir. Hücre, yaşam için gerekli tüm biyolojik olayların gerçekleştiği canlının en küçük yapı birimidir. Bir canlı kaç hücreden oluşur? Bir hücreden oluşan canlılar var mıdır? Bitkiler ve hayvanlar, bir hücreden mi yoksa birden çok hücreden mi oluşur?

Figure 8. An example in the science textbook including questions or tasks that identify the students' naive ideas (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The analysis of the 6th grade science textbook for category II (Science for Understanding Phenomena) Criterion IIB (Identify and Address Student Ideas) and indicator 2 (The material includes questions and tasks that build on students naive ideas rather than simply contradicting ideas with presented facts) showed that the textbook did not meet this indicator (table 4.1.1.10).

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Table 4.1.1.10. Frequencies and percentages of the indicator 2 of criterion IIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIB (Identify and Address Student Ideas)	2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	-	0 %	67

The 6th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IIC (Developing and Using Scientific Ideas) and indicator 1 (The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to students naive ideas). Table 4.1.1.11 shows that the textbook did not meet this criterion.

Table 4.1.1.11. Frequencies and percentages of the indicator 1 of criterion IIC in 6th grade science textbook

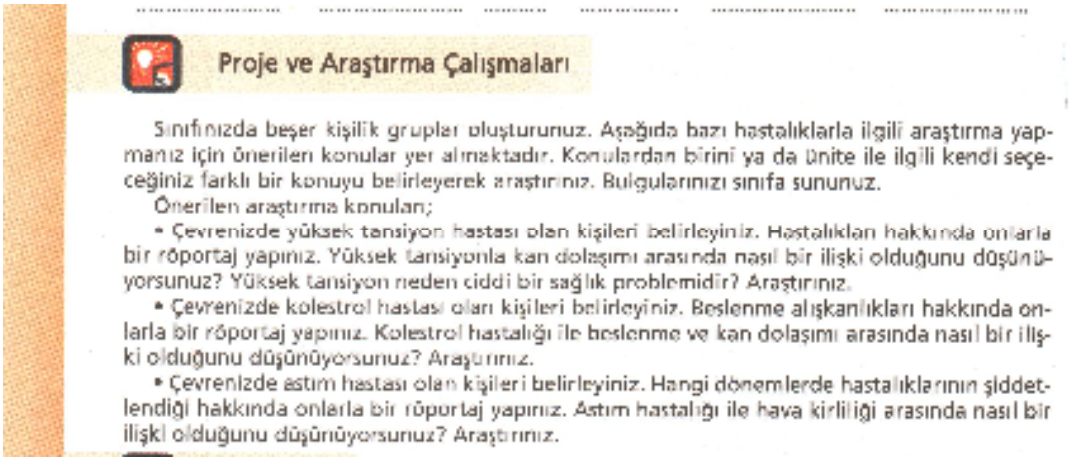
Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	67

The analysis of the 6th grade science textbook which was done regarding category I (Science for Understanding Phenomena), Criterion IIC (Developing and Using Scientific Ideas) and indicator 2 (The material provides opportunities to apply scientific concepts in new contexts) showed that the textbook only met the indicator by a percentage of 8,9 (table 4.1.1.12). Figure 9 is one of the few opportunities provided to apply scientific concepts in new contexts. In this example, project and inquiry works are an opportunity for students to apply scientific concepts about

illnesses. In this example students are expected to investigate the illnesses and find relationships between scientific knowledge about our body and causes of illnesses.

Table 4.1.1.12. Frequencies and percentages of the indicator 2 of criterion IIC in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIC	2. The material provides opportunities to apply scientific concepts in new contexts	6	8.9 %	67



Proje ve Araştırma Çalışmaları

Sınıfınızda beşer kişilik gruplar oluşturunuz. Aşağıda bazı hastalıklarla ilgili araştırma yapmanız için önerileri konular yer almaktadır. Konulardan birini ya da ünite ile ilgili kendi seçeceğiniz farklı bir konuyu belirleyerek araştırınız. Bulgularınızı sınıfa sununuz.

Önerilen araştırma konuları;

- Çevrenizde yüksek tansiyon hastası olan kişileri belirleyiniz. Hastalıkları hakkında onlarla bir röportaj yapınız. Yüksek tansiyonla kan dolaşımı arasında nasıl bir ilişki olduğunu düşünüyorsunuz? Yüksek tansiyon neden ciddi bir sağlık problemidir? Araştırınız.
- Çevrenizde kolestrol hastası olan kişileri belirleyiniz. Beslenme alışkanlıkları hakkında onlarla bir röportaj yapınız. Kolestrol hastalığı ile beslenme ve kan dolaşımı arasında nasıl bir ilişki olduğunu düşünüyorsunuz? Araştırınız.
- Çevrenizde astım hastası olan kişileri belirleyiniz. Hangi dönemlerde hastalıklarının şiddetlendiği hakkında onlarla bir röportaj yapınız. Astım hastalığı ile hava kirliliği arasında nasıl bir ilişki olduğunu düşünüyorsunuz? Araştırınız.

Figure 9. An example in the science textbook that provides opportunities to apply scientific concepts to new context (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

When the 6th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IID (Promotes Student Thinking About Experiences and Knowledge) and indicator 1 (The material engages students in using scientific ideas to reason about phenomena), result showed that the indicator was only met by 13,4% (table 4.1.1.13). The textbook seldom engaged students to use scientific ideas to reason about phenomena. Figure 10 shows that the textbook engages students in using scientific ideas about reproductive cells to find out the reasons regarding differences of these cells.

Table 4.1.1.13. Frequencies and percentages of the indicator 1 of criterion IID in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IID	1. The material engages students in using scientific ideas to reason about phenomena	9	13.4 %	67

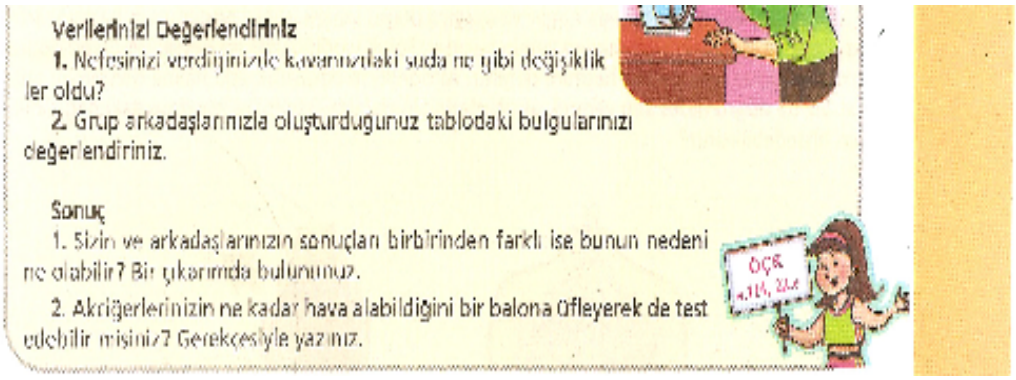
Figure 10. An example in the science textbook that engages students in using scientific ideas (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The analysis of the 6th grade science textbook which was done in accordance to category II (Science for Understanding Phenomena), Criterion IID (Promotes Student Thinking About Experiences and Knowledge) and indicator 2 (The material provides students the opportunities to compare/contrast scientific ideas to their experiences) showed that the indicator was met by 16,4% (table 4.1.1.14). Textbook

rarely provided opportunities to students to compare or contrast their experiences to scientific ideas. Figure 11 indicates a part of an activity which is an opportunity for students to compare their experiences and scientific ideas about the capacities of lungs.

Table 4.1.1.14. Frequencies and percentages of the indicator 2 of criterion IID in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IID (Promotes Student Thinking About Experiences and Knowledge)	2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	11	16.4 %	67


Verilerinizi Değerlendiriniz

1. Nefesinizi verdiğinizde kavanozdaki suda ne gibi değişiklik ler oldu?

2. Grup arkadaşlarınızla oluşturduğunuz tablodaki bulgularınızı değerlendiriniz.

Sonuç

1. Sizin ve arkadaşlarınızın sonuçları birbirinden farklı ise bunun nedeni ne olabilir? Bir çıkarımda bulunuyuz.

2. Akciğerlerinizin ne kadar hava alabildiğini bir balona üfleyerek de test edebilir misiniz? Gerekçesiyle yazınız.

Figure 11. An example in the textbook provides opportunities to students to compare their ideas with the scientific experiences (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

When considered if the material presents science as the application of scientific theories and use of reasoning to understanding phenomena, results were reported in accordance to frequencies and percentages of the indicators for category II (Science for Understanding Phenomena). As shown in table 4.1.1.15, 6th grade science textbook met an average 24.5 % of Criterion IIA indicators, only 9.7 % of Criterion IIB indicators, 4.5 % of the Criterion IIC indicators and 14.9 % of the

Criterion IID indicators. The textbook met relatively higher proportion of indicators of criterion IIA than the other criterion of category II.

The textbook slightly engaged students in real or vicarious phenomena (Criterion IIA). The material generally engaged students with relevant phenomena through first-hand or vicarious experiences (43 %), but the primary purpose of the activities was poor to understand the scientific theory that explains the phenomena (5.9 %). Additionally, the textbook was insufficient to identify common naive conceptions and address student ideas in order to build a more scientifically acceptable understanding of phenomena (Criterion IIB). The textbook included few questions or tasks that identify student naive conceptions (14.9 %), and very few questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts (4.5 %). The textbook rarely provided opportunities to develop reasoning and to practice applying new knowledge (Criterion IIC). It also did not include questions or tasks that offer intelligent, plausible, and fruitful alternatives to students' naive ideas (0 %), and slightly provided opportunities to apply scientific concepts in new contexts (8.9 %). In addition, it rarely promotes student thinking (Criterion IID). The textbook seldom engaged students to use scientific ideas to reason about phenomena (13.4 %), and slightly provided students opportunities to compare/contrast scientific ideas to their experience (16.4 %).

Table 4.1.1.15. Frequencies and percentages of the category II criteria and indicators in 6th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	29	43 %	67
		2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	4	5.9 %	67
	Mean		16.5	24.5 %	67
	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	10	14.9 %	67
		2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	-	0 %	67
	Mean		5	7.45 %	67
	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	67
		2. The material provides opportunities to apply scientific concepts in new contexts	6	8.9 %	67
	Mean		3	4.5 %	67
	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena	9	13.4 %	67
		2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	11	16.4 %	67
	Mean		10	14.9 %	67

When the 6th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural

and Technological World) and indicator 1 (The material fosters a sense of curiosity and questioning about the natural and technological world), result indicated that the textbook met the indicator by a percentage of 19,4 (table 4.1.1.16). Textbook fostered students' curiosity and questioning about nature and technology in a low proportion. Figure 12 shows a picture and some questions about flowers to foster the sense of curiosity and questioning about the nature among students..

Table 4.1.1.16. Frequencies and percentages of the indicator 1 of criterion IIIA in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA	1. The material fosters a sense of curiosity and questioning about the natural and technological world (NRC, 2000).	13	19.4 %	67

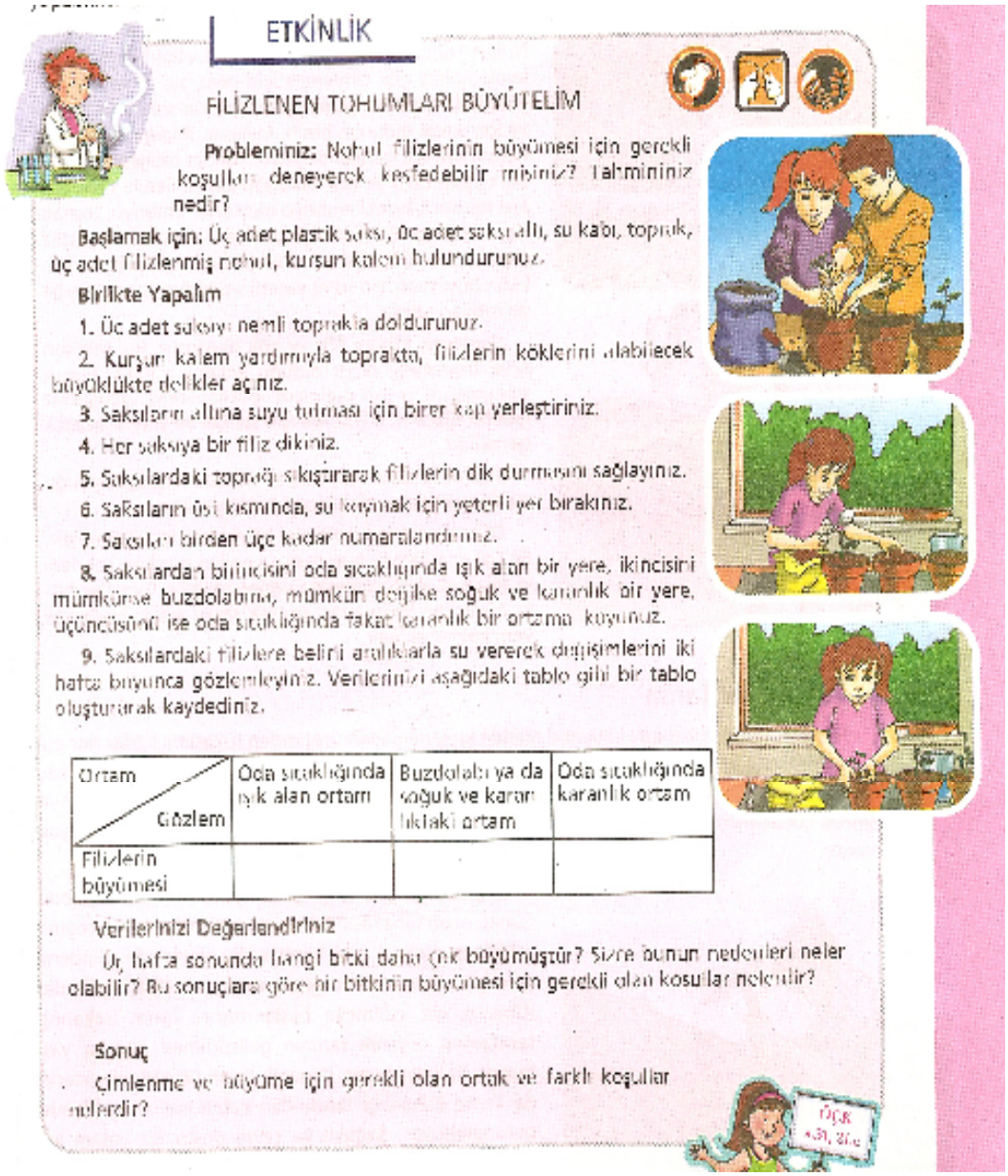
Figure 12. An example in the science textbook including some questions at the beginning of the unit to foster the curiosity about the natural world (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The analysis of the 6th grade science textbook was done according to category III (Science as the Social Construction of Knowledge), Criterion IIA (Engagement

with the Natural and Technological World) and indicator 2 (The material includes activities that engage students to find out what happens with the natural and technological world (experimental science)). The result, as shown in table 4.1.1.17, indicates that the textbook met this indicator by 19,4%. Figure 13 shows one of the seedling activities regarding the natural world which was slightly included in the textbook.

Table 4.1.1.17. Frequencies and percentages of the indicator 2 of criterion IIIA in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA	2. The material includes activities that engage students with the natural and technological world to find out what happens (experimental science)	13	19.4 %	67



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FİLİZLENEN TOHUMLARI BÜYÜTELİM

Probleminiz: Nohut filizlerinin büyümesi için gerekli koşulları deneyerek keşfedebilir misiniz? Tahmininiz nedir?

Başlamak için: Üç adet plastik saksı, üç adet saksı altı, su kabı, toprak, üç adet filizlenmiş nohut, kurşun kalem bulundurunuz.

Birlikte Yapalım

1. Üç adet saksıyı nemli toprakla doldurunuz.
2. Kurşun kalem yardımıyla toprakta, filizlerin köklerini alabilecek büyüklükte delikler açınız.
3. Saksıların altına suyu tutması için birer kap yerleştiriniz.
4. Her saksıya bir filiz dikiniz.
5. Saksılardaki toprağı sıkıştırarak filizlerin dik durmasını sağlayınız.
6. Saksıların üst kısmında, su koymak için yeterli yer bırakınız.
7. Saksıları birden üçe kadar numaralandırınız.
8. Saksılardan birincisini oda sıcaklığında ışık alan bir yere, ikincisini mümkünse buzdolabına, mümkün değilse soğuk ve karanlık bir yere, üçüncüsünü ise oda sıcaklığında fakat karanlık bir ortama koyunuz.
9. Saksılardaki filizlere belirli aralıklarla su vererek değişimlerini iki hafta boyunca gözlemleyiniz. Verilerinizi aşağıdaki tablo gibi bir tablo oluşturarak kaydediniz.

Ortam / Gözlem	Oda sıcaklığında ışık alan ortam	Buzdolabı ya da soğuk ve karanlıktaki ortam	Oda sıcaklığında karanlık ortam
Filizlerin büyümesi			

Verilerinizi Değerlendiriniz

Üç hafta sonunda hangi bitki daha çok büyümüştür? Sizce bunun nedenleri neler olabilir? Bu sonuçlara göre bir bitkinin büyümesi için gerekli olan koşullar nelerdir?

Sonuç

Çimlenme ve büyüme için gerekli olan ortak ve farklı koşullar nelerdir?

Figure 13. An example in the science textbook including an activity that students engage the natural world (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The 6th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 3 (The material includes activities that engage students to carefully and systematically record what they see). The result showed that the textbook met only 5.9 % of the Criterion IIIA, indicator 3 (table 4.1.1.18). It provided students very few activities to record what they see. Figure 14

shows an activity that engages students with systematic recording while observing the ingredients of blood.

Table 4.1.1.18. Frequencies and percentages of the indicator 3 of criterion IIIA in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA	3. The material includes activities that engage students in carefully and systematically recording what they see. (field sciences)	4	5.9 %	67

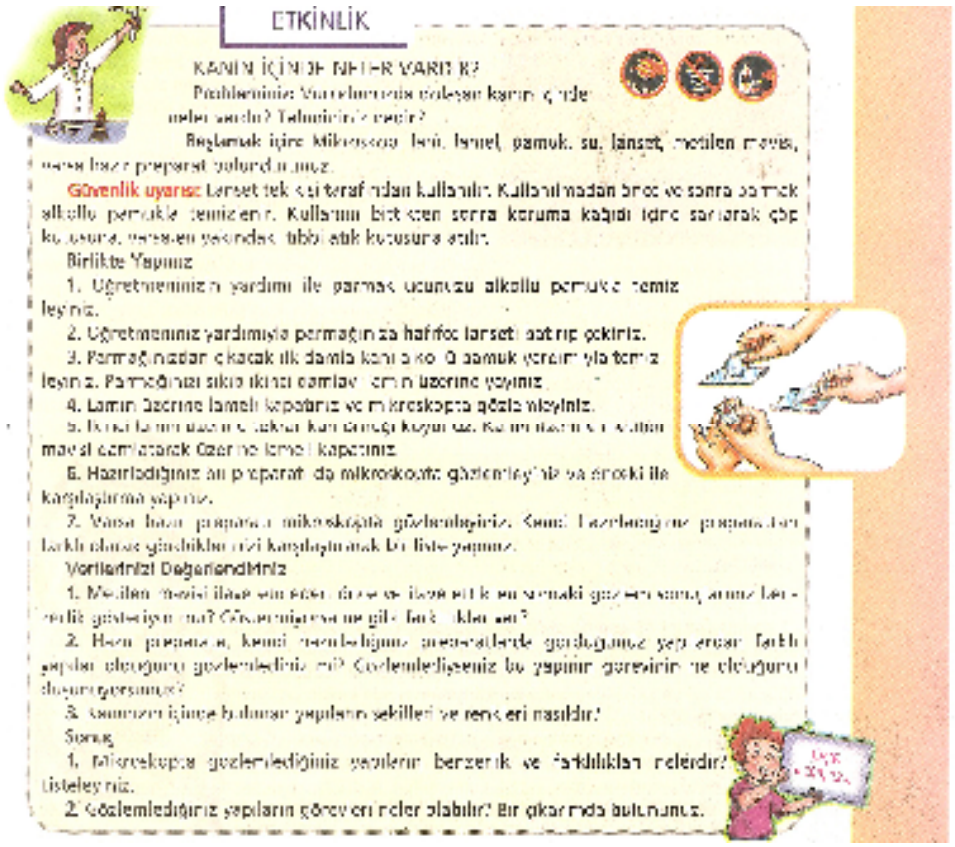
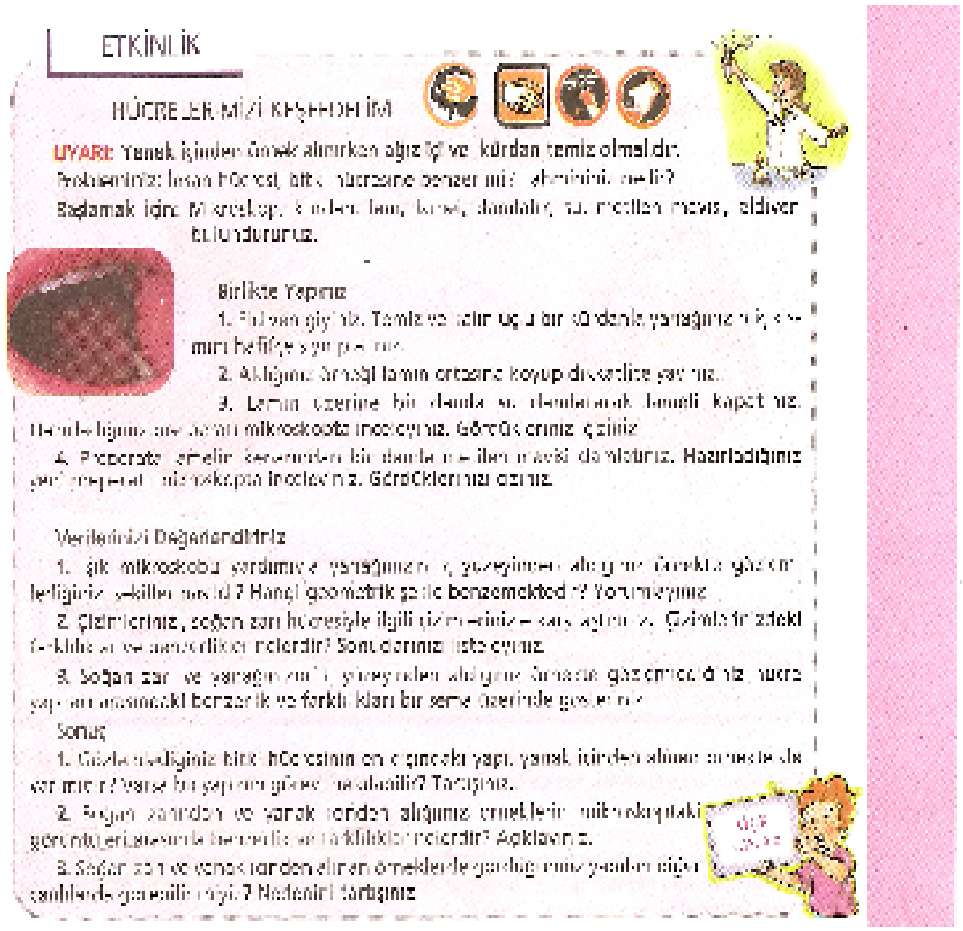


Figure 14. An example in the textbook including an activity that students record what they see carefully and systematically (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The analysis of the 6th grade science textbook which was done according to category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 4 (Activities using instruments and equipment to enhance and extend the senses) indicated that the textbook met the indicator by a percentage of 14,9% (table 4.1.1.19) and figure 15 shows one of the rare activities where instruments and equipments were used to extend and enhance the sense of students.

Table 4.1.1.19. Frequencies and percentages of the indicator 4 of criterion IIIA in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA	4. Activities use instruments and equipment to enhance and extend the senses	10	14.9 %	67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HÜCRELERİMİZİ KEŞFEDELİM

UYARI: Yanak içinden örnek alırken ağzınız ve kürdan temiz olmalıdır.

Birlikte Yapınız

Verileriniz Değerlendiriniz

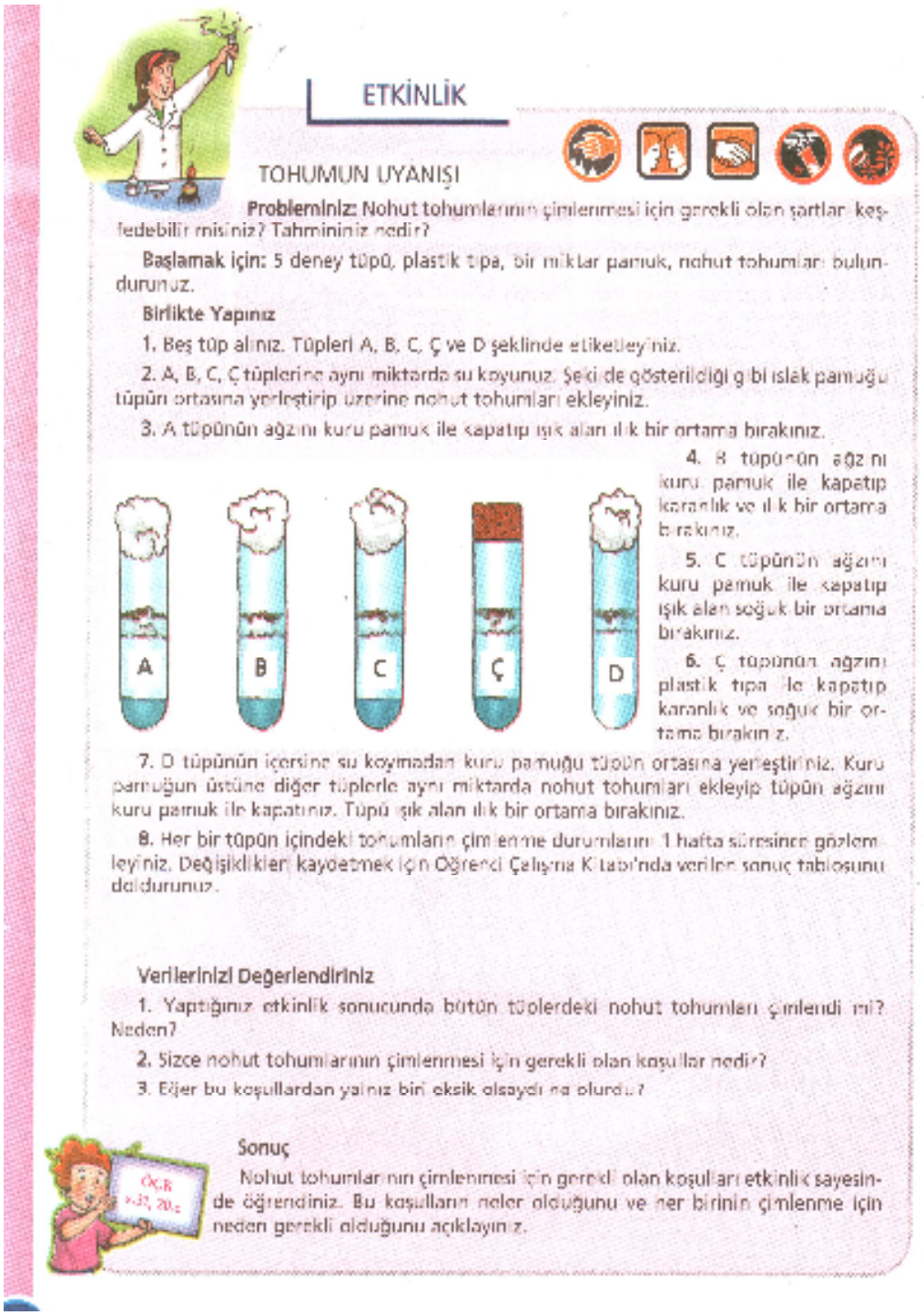
Sonuç

Figure 15. An example in the textbook that includes an activity in which instruments enhance and extend the senses (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

When the 6th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 1 (During data collection, technique and methods are stressed) result showed that the textbook met the indicator only by 7,5% (table 4.1.1.20). Techniques and methods of data collection in the activities were rarely stressed. Figure 16 indicates an activity which the methods are stressed to collect data about germination of seeds.

Table 4.1.1.20. Frequencies and percentages of the indicator 1 of criterion IIIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB	1. When students engage in data collection, technique and methods are stressed	5	7.5 %	67



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TOHUMUN UYANIŞI

Problem: Nohut tohumlarının çimlenmesi için gerekli olan şartlar keşfedebilir misiniz? Tahmininiz nedir?

Başlamak için: 5 deney tüpü, plastik tıpa, bir miktar pamuk, nohut tohumları bulundurunuz.

Birlikte Yapınız

1. Beş tüp alınız. Tüpleri A, B, C, Ç ve D şeklinde etiketleyiniz.
2. A, B, C, Ç tüplerine aynı miktarda su koyunuz. Şekilde gösterildiği gibi ıslak pamuğu tüpün ortasına yerleştirip üzerine nohut tohumları ekleyiniz.
3. A tüpünün ağzını kuru pamuk ile kapatıp ışık alan ılık bir ortama bırakınız.
4. B tüpünün ağzını kuru pamuk ile kapatıp karanlık ve ılık bir ortama bırakınız.
5. C tüpünün ağzını kuru pamuk ile kapatıp ışık alan soğuk bir ortama bırakınız.
6. Ç tüpünün ağzını plastik tıpa ile kapatıp karanlık ve soğuk bir ortama bırakınız.
7. D tüpünün içerisine su koymadan kuru pamuğu tüpün ortasına yerleştiriniz. Kuru pamuğun üstüne diğer tüplerle aynı miktarda nohut tohumları ekleyip tüpün ağzını kuru pamuk ile kapatınız. Tüpü ışık alan ılık bir ortama bırakınız.
8. Her bir tüpün içindeki tohumların çimlenme durumlarını 1 hafta süresince gözleyiniz. Değişiklikleri kaydetmek için Öğrenci Çalışma Kitabı'nda verilen sonuç tablosunu doldurunuz.

A B C Ç D

Verilerinizi Değerlendiriniz

1. Yaptığınız etkinlik sonucunda bütün tüplerdeki nohut tohumları çimlendi mi? Neden?
2. Sizce nohut tohumlarının çimlenmesi için gerekli olan koşullar nedir?
3. Eğer bu koşullardan yalnız biri eksik olsaydı ne olurdu?

Sonuç

Nohut tohumlarının çimlenmesi için gerekli olan koşulları etkinlik sayesinde öğrendiniz. Bu koşulların neler olduğunu ve her birinin çimlenme için neden gerekli olduğunu açıklayınız.

Figure 16. An example in the science textbook including an activity that stresses the data collection method (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The analysis of the 6th grade science textbook which was done in accordance to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 2 (When presenting concepts, the material

presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions) showed that the textbook only met the indicator by 8,9% (table 4.1.1.21). Techniques and methods of scientists were not presented enough in the textbook. Figure 17 shows an activity that presents a method of scientists to understand the structure of hearth.

Table 4.1.1.21. Frequencies and percentages of the indicator 2 of criterion IIIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB	2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	6	8.9 %	67

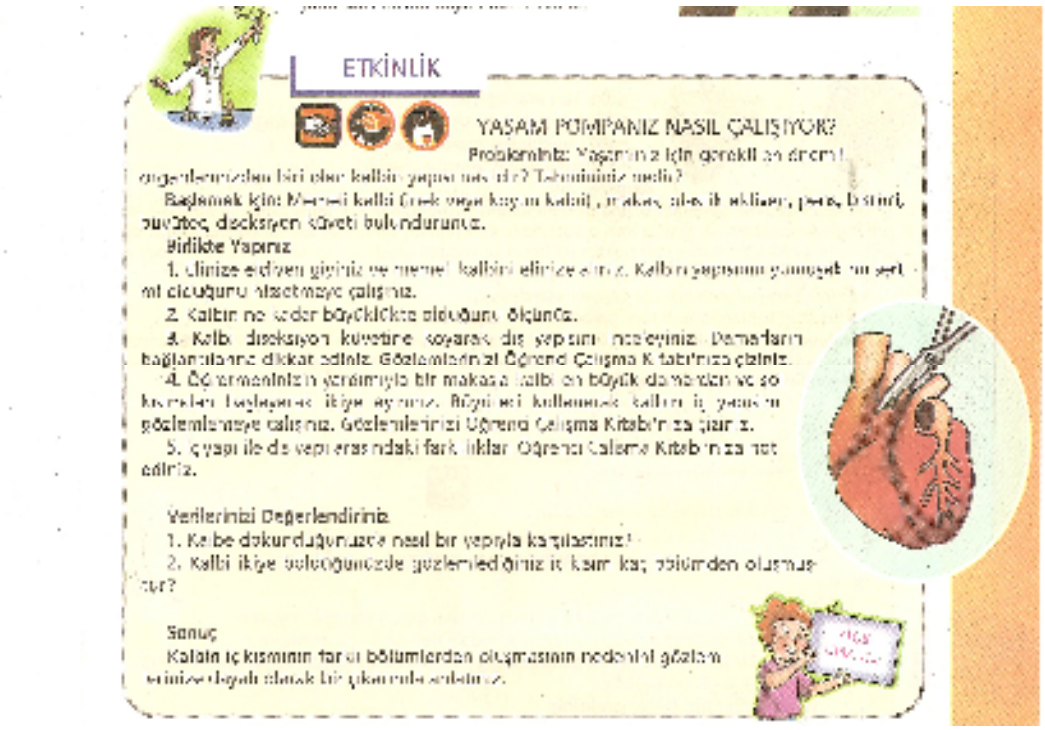


Figure 17. An example in the science textbook that presents a pattern-finding activity method of scientists that led to important conclusion (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The 6th grade science textbook was analyzed according to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 3 (Students develop techniques or methods to address their questions and hypotheses). Table 4.1.1.22 shows that the textbook did not meet this indicator.

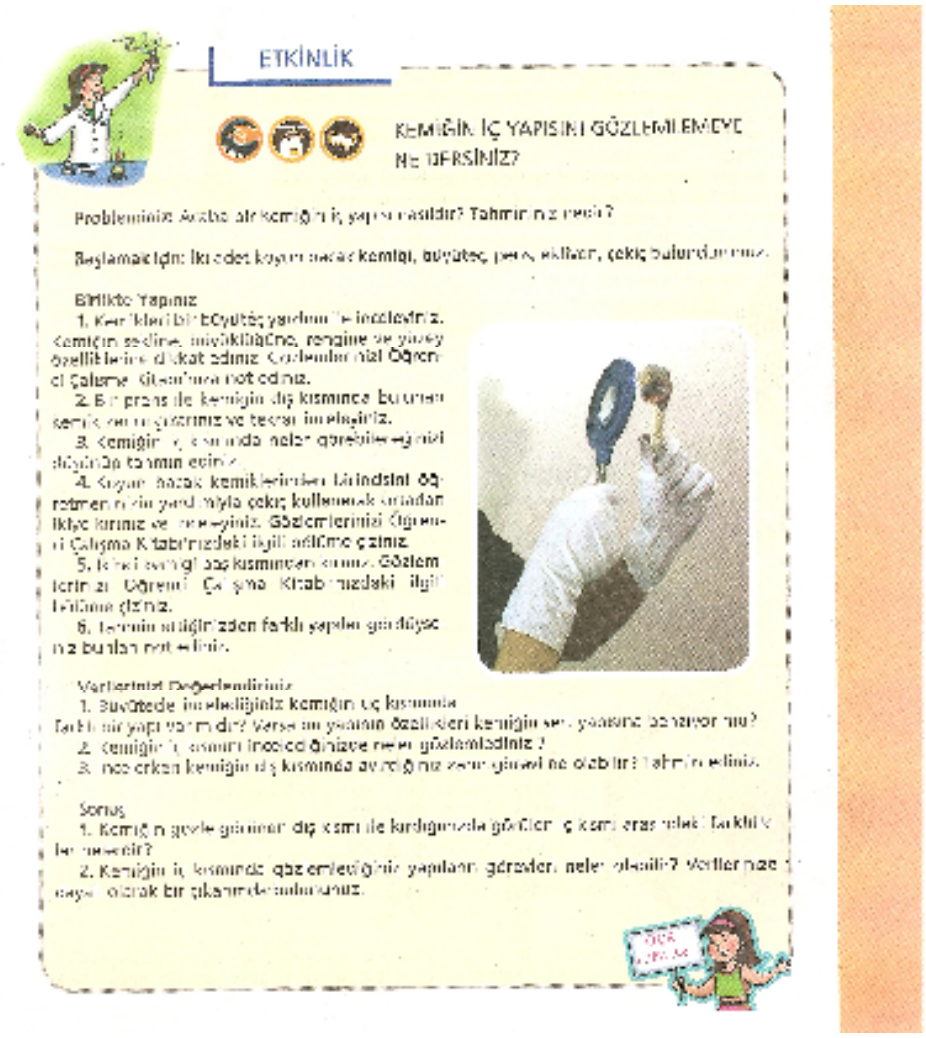
Table 4.1.1.22. Frequencies and percentages of the indicator 3 of criterion IIIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB	3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	67

The analysis of the 6th grade science textbook regarding category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 4 (Students use their own experiences/data to identify patterns and relationships) showed that the indicator was met by a percentage of 10,4 (table 4.1.1.23). Not enough opportunities were provided to the students to use their data to identify patterns or relationships in the textbook and figure 18 shows one of the few example present in the textbook. In this example, students use their own observations with bones to understand the pattern of them.

Table 4.1.1.23. Frequencies and percentages of the indicator 4 of criterion IIIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB	4. Students use their own experiences/data to identify patterns and relationships	7	10.4 %	67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KEMİĞİN İÇ YAPISINI GÖZLEMLEMEYE NE DERSİNİZ?

Figure 18. An example in the science textbook that provides opportunities to students to use their own experiences to identify patterns (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

As the result of the analysis of the 6th grade science textbook for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 5 (The material includes data that supports relationships shown in graphs, charts, pictures, and maps, etc.) indicated that the textbook only met the indicator by 1,5% (4.1.1.24) and it included just one case that supports a relationship shown in a table which is also demonstrated in figure 19. The graphs of this data are also drawn by the students in workbook.

Table 4.1.1.24. Frequencies and percentages of the indicator 5 of criterion IIIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB	5. The material includes data that support relationships shown in graphs, charts, maps, etc	1	1,5 %	67

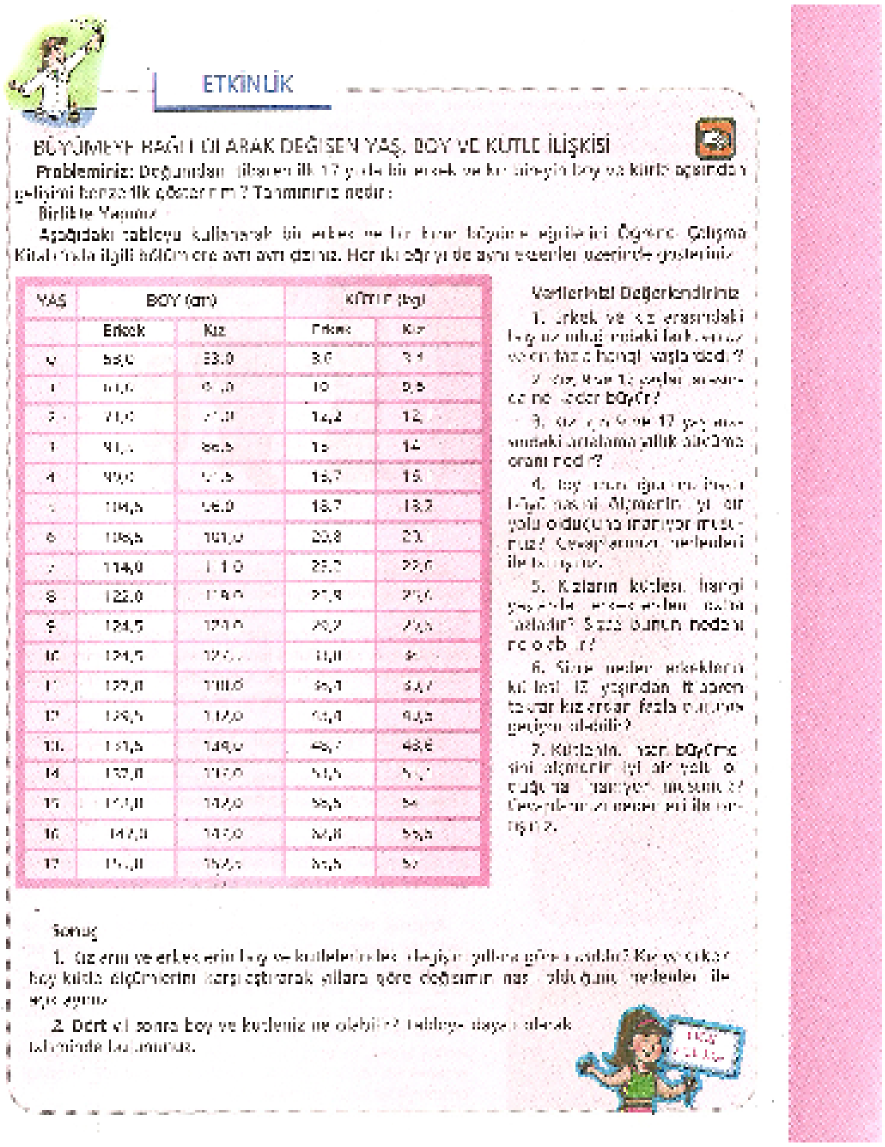


Figure 19. An example in the science textbook including data that support relationship shown in graphs. In this example the graphs will be drawn by the students (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

When the 6th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 6 (Students are encouraged to use their own experiences/data to develop and support arguments), result indicated that the textbook met indicator 6 by a percentage of 29,9 (table 4.1.1.25). As shown in figure 20, students were seldom encouraged to use their data to develop arguments. In this example, students are engaged with a first hand experience and then asked some questions to develop and support their arguments about plant cell.

Table 4.1.1.25. Frequencies and percentages of the indicator 6 of criterion IIIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB	6. Students are encouraged to use their own experiences/data to develop and support arguments	20	29,9 %	67

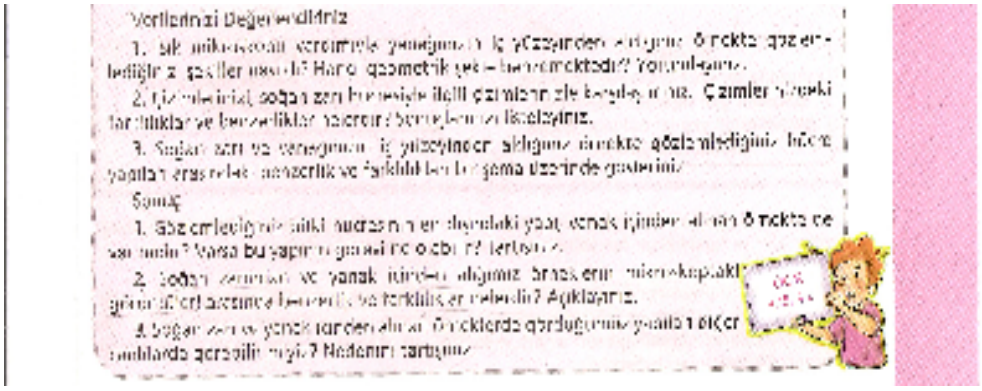


Figure 20. An example in the science textbook that encourages the students to use their own experiences to support arguments (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The 6th grade science textbook was analyzed according to category II (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from

Evidence) and indicator 7 (Text relies on empirical data rather than appeals to authority to support arguments). As demonstrated in table 4.1.1.26 the indicator was met by 16,4%. Text rarely relied on empirical data. Figure 21 shows that text rely on empirical data by engaging students with using magnifying glass and microscope to support arguments about size (smallness) of cells.

Table 4.1.1.26. Frequencies and percentages of the indicator 7 of criterion IIIB in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB	7. Text relies on empirical data rather than appeals to authority to support arguments	11	16.4 %	67

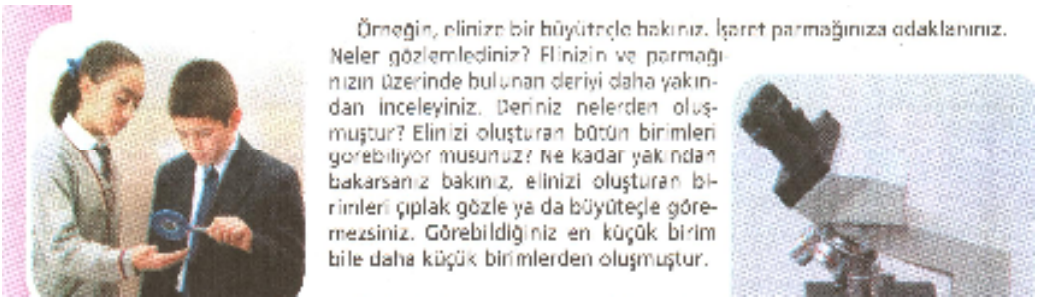


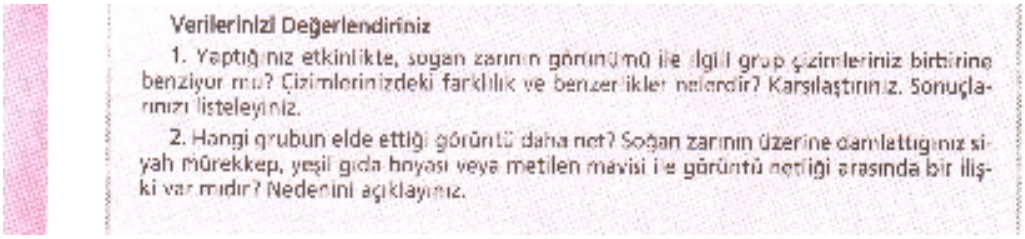
Figure 21. An example in the science textbook including texts that rely on empirical data (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The result of the analysis done with the 6th grade science textbook for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 1 (The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data) indicated that the textbook only met the indicator by a percentage of 10,4 (table 4.1.1.27). However, it slightly allowed multiple student interpretation of data. Figure 22 indicates an example of this indicator. It is

the last part of an activity. In this part, students are encouraged to compare the results of their experiences and present multiple interpretations of data.

Table 4.1.1.27. Frequencies and percentages of the indicator 1 of criterion IIIC in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	7	10,4 %	67


Verilerinizi Değerlendiriniz

1. Yaptığınız etkinlikte, soğan zarının görüntüsü ile ilgili grup çizimleriniz birbirine benziyor mu? Çizimlerinizdeki farklılık ve benzerlikler nelerdir? Karşılaştırınız. Sonuçlarınızı listeleyiniz.

2. Hangi grubun elde ettiği görüntü daha net? Soğan zarının üzerine damlattığınız siyah mürekkep, yeşil gıda boyası veya metilen mavisi ile görüntü netliği arasında bir ilişki var mıdır? Nedenini açıklayınız.

Figure 22. An example in the science textbook allows for multiple student interpretations of data (Korkmaz, H., Tatar, N., Kıray, A., Kibar, G., 2007).

The 6th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 2 (The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies of the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community). As shown in table 4.1.1.28, the textbook did not meet this indicator.

Table 4.1.1.28. Frequencies and percentages of the indicator 2 of criterion IIIC in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC	2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community	-	0 %	67

When the 6th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 3 (The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence) result showed that the textbook did not meet this indicator (table 4.1.1.29). However, it provided some opportunities for students to present their arguments in some written format in workbook, but there was no opportunity to reach a community consensus.

Table 4.1.1.29. Frequencies and percentages of the indicator 3 of criterion IIIC in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC	3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence (Vellom and Anderson, 1999; Bazerman, 1988; Latour and Woolgar, 1986).	-	0 %	67

The 6th grade science textbook was analyzed in accordance to category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 3 (The material emphasizes the special status of scientific understanding reached through community consensus). The result indicated that the textbook did not meet this indicator (table 4.1.1.30).

Table 4.1.1.30. Frequencies and percentages of the indicator 4 of criterion IIIC in 6th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC	4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	67

Frequencies and percentages of the indicators in 6th grade science textbook for category III-Science as the social Construction of Knowledge: Does the Material present Science as the Social Construction of Facts and Scientific Understanding?

The result demonstrated in table 4.1.1.31, 6th grade science textbook met 14,9 % of Criterion IIIA indicators, 8.6 % of Criterion IIIB indicators and 2.6 % of Criterion IIIC indicators. It was obviously seen that the textbook did not meet indicators of the criterion of category III well enough.

The textbook slightly supported intense engagement with the natural and technological world (Criterion IIIA). It rarely fostered a sense of curiosity and questioning about the natural and technological world (19.4 %), slightly included activities that engage students to find out what happens with the natural and technological world to find out what happens (19.4 %), also included very few activities that engage students in carefully and systematically recording what they see (5.9 %), and similarly instruments and equipment in the activities seldom enhanced and extended the senses (14.9 %).

The study results showed that the textbook also did not make arguments based on evidence as opposed to presenting only conclusions (Criterion IIIB). Data collection techniques and methods were not stressed enough (7.5 %), the textbook slightly presented the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions (8.9 %), but it did not provide students the opportunities to develop techniques or methods to address their questions and hypotheses (0 %). Students have been used their own experiences/data to identify patterns and relationships (10.4 %). In addition, the textbook included very few data that support relationships shown in graphs, charts, maps, etc (1.5 %), but students have been encouraged to use their own experiences/data to develop and support arguments on a relatively high proportion than other indicators. Lastly, text seldom relied on empirical data rather than appeals to authority to support arguments (16.4 %).

Additionally, the textbook did not emphasize the collective efforts o a community of scientists in developing and accepting scientific facts and concepts (Criterion IIIC). It did not present alternative interpretations of data but very rarely allowed for multiple student interpretations of data as long as arguments are supported by data (10.4 %). However, it did not meet other three indicators of criterion IIIC.

Table 4.1.1.31. Frequencies and percentages of the category III criteria and indicators in 6th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	1. The material fosters a sense of curiosity and questioning about the natural and technological world.	13	19.4 %	67
		2. The materials include activities that engage students with the natural and technological world to find out what happens. (experimental science)	13	19.4 %	67
		3. The material includes activities that engage students in carefully and systematically recording what they see. (field sciences)	4	5.9 %	67
		4. Activities use instruments and equipment to enhance and extend the senses	10	14.9 %	67
	Mean		10	14.9 %	67
	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed	5	7.5 %	67
		2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	6	8.9 %	67
		3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	67
		4. Students use their own experiences/data to identify patterns and relationships	7	10.4 %	67
		5. The material includes data that support relationships shown in graphs, charts, maps, etc.	1	1,5 %	67

(Table 4.1.1.31. Continued**)**

		6. Students are encouraged to use their own experiences/data to develop and support arguments	20	29,9 %	67
		7. Text relies on empirical data rather than appeals to authority to support arguments	11	16.4 %	67
	Total		8.6	10.6 %	67
	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	7	10.4 %	67
		2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community	-	0 %	67
		3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	67
		4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	67
	Mean		0	2.6 %	67

4.1.2. Analysis of Seventh Grade Science Textbook

In this part, analysis of representation of NOS in the 7th grade science textbooks was presented.

The analysis of the 7th grade science textbook for category I (Science as Authoritative Knowledge), Criterion IA (Deductive Experiences) and indicator 1 (The material includes demonstrations or laboratory exercises that confirm concepts presented) showed that it met 27% of the indicator (table 4.1.2.1) and it slightly included demonstrations or laboratory activities. Figure 23 shows a demonstration that confirm the concepts of nervous system.

Table 4.1.2.1. Frequencies and percentages of the indicator 1 of criterion IA in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	20	27 %	74

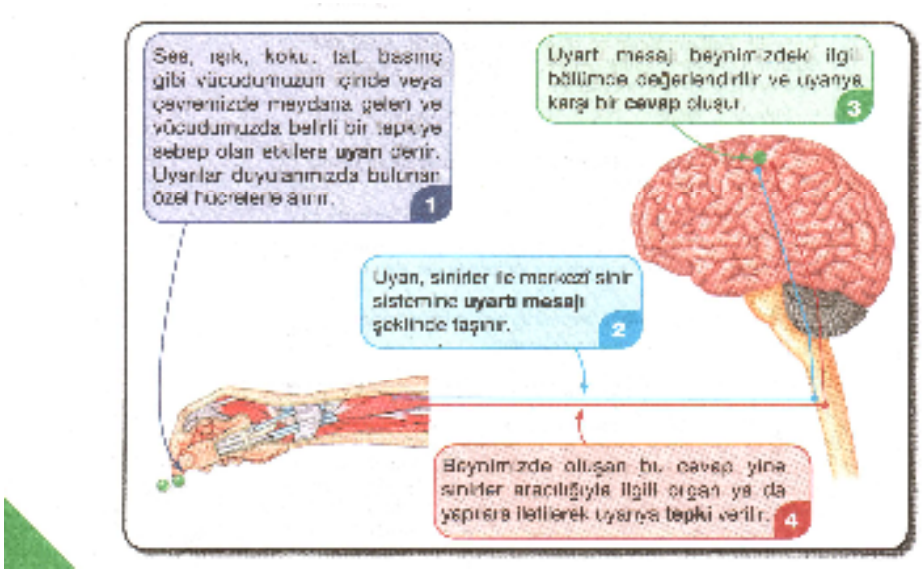


Figure 23. An example in the science textbook including demonstrations that confirm the concepts (Tunç, T., Bağcı, N., Yörük, N., Köroğlu, N. G., Altunoğlu, Ü. Ç., Başdağ, G., Keleş, Ö., İpek, İ., Elif, B., 2007).

When the 7th grade science textbook was analyzed for category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 1 (Textbook presents conclusions of scientific studies rather than details of supporting data and arguments) the result indicated that the textbook met 51,4% of the indicator (table 4.1.2.2). As shown in figure 24, the textbook in relatively high proportion presented conclusions of scientific studies, but did not show any details of supporting data and arguments.

Table 4.1.2.2. Frequencies and percentages of the indicator 1 of criterion IB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	1. Textbook presents conclusions of scientific studies rather than details of supporting data and arguments	38	51.4 %	74

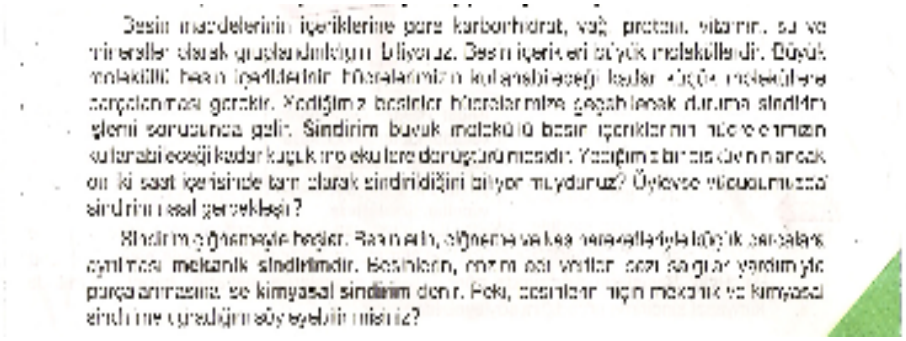


Figure 24. An example in the science textbook that presents the conclusion of scientific studies (Tunç, T., et. al., 2007).

The analysis of the 7th grade science textbook for category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 2 (The material focuses on the most important theories and models in the field) showed that it met only 13,5% of the indicator (table 4.1.2.3). The reason why the frequencies of this indicator were low is that it did not show the total number of

pages which meet this indicator but it indicated the total number of analyzed models and theories in the analyzed units. However, it was thought that percentage of presence of theories and models in two units were not so low. Figure 25 indicates an ear model.

Table 4.1.2.3. Frequencies and percentages of the indicator 2 of criterion IB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	2. The material focuses on the most important theories and models in the field	10	13.5 %	74

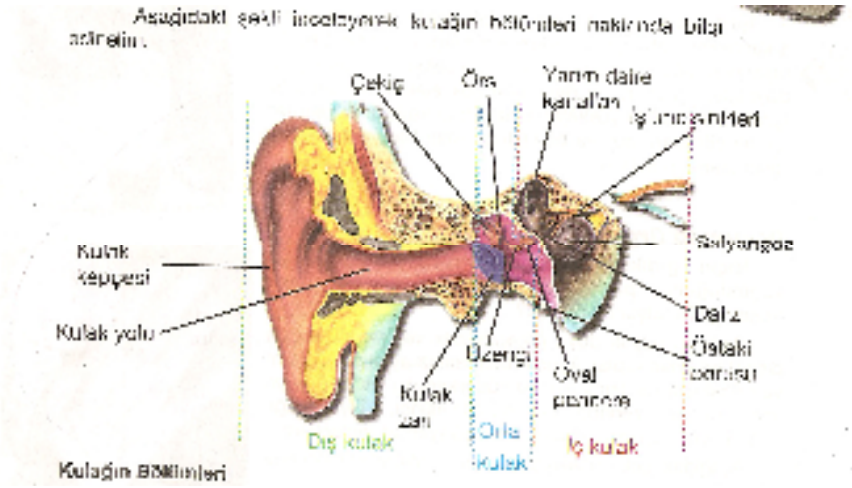


Figure 25. An example in the science textbook that includes an ear model (Tunç, T., et. al., 2007).

The result of the analysis of the 7th grade science textbook done in accordance to category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 3 (Textbook includes graphs, charts, maps, pictures etc. that display relationships rather than original data) indicated that the textbook met this indicator by 33,8% (table 4.1.2.4). It included some pictures to display relationships

(figure 26). In this example, the picture displays the relationship between nutritions and the organs where they are digested.

Table 4.1.2.4. Frequencies and percentages of the indicator 3 of criterion IB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	3. Textbook includes graphs, charts, maps, pictures etc. that display relationships rather than original data	25	33.8 %	74

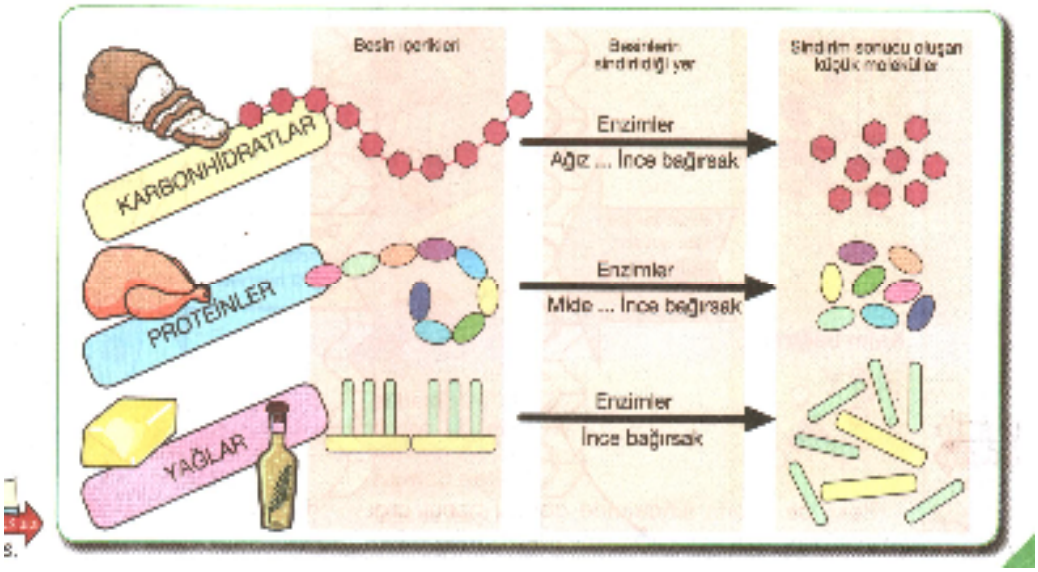


Figure 26. An example in the science textbook that includes a picture which displays a relationship (Tunç, T., et. al., 2007).

The 7th grade science textbook was analyzed according to category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 4 (Rhetoric relies on appeals to authority for persuasion). The result showed that the textbook met the indicator only by 2,7% (table 4.1.2.5) and rhetoric did not mainly rely on appeals to authority for persuasion (figure 27). In this example, rhetoric relies on appeals to scientists for persuation of increasing temperature of earth.

Table 4.1.2.5. Frequencies and percentages of the indicator 4 of criterion IB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	4. Rhetoric relies on appeals to authority for persuasion	2	2.7 %	74

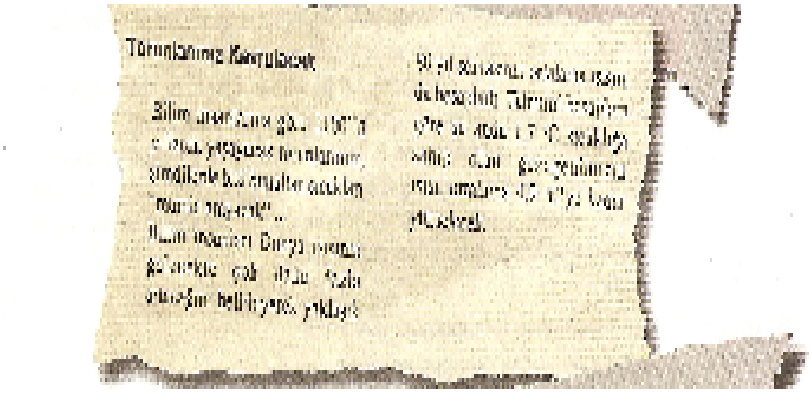


Figure 27. An example in the science textbook that relies appeal to authority for persuasion (Tunç, T., et. al., 2007).

The criteria and indicators of category I were used to answer the following question: Does the Material present science as confirm facts and concepts? According to table 4.1.2.6 the result of the study showed that the 7th grade science textbook met 13.5 % of Criterion IA and 17.6 % of Criterion IB. The textbook included few activities to confirm facts and concepts (Criterion IA). It included demonstrations or laboratory exercises that confirm concepts presented (13.5 %). Additionally, the textbook slightly relied on conclusions and status of scientists to teach terms, concepts, and facts (Criterion IB). It generally presented conclusions of scientific studies rather than details of supporting data and arguments (51.4 %), and focused on the most important theories and models in the field (13.5 %). This indicator was sufficient because the percentage of this indicator was not presenting the total page numbers which meet the indicator, but the number of theories and models in the field. Also the textbook very rarely included graphs, charts, maps, etc.

that display relationships rather than original data (2.7 %) and lastly, rhetoric seldom relied on appeals to authority for persuasion (2.7 %).

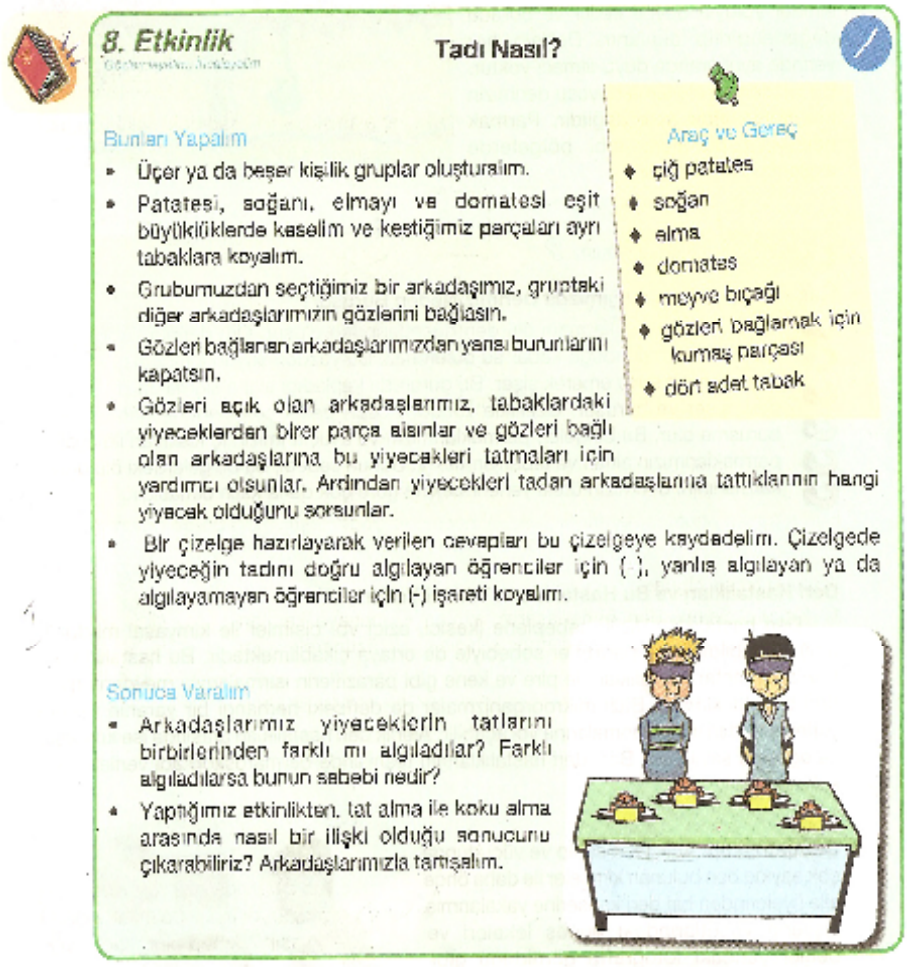
Table 4.1.2.6. Frequencies and Percentages of the category I criteria and indicators in 7th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	20	27 %	74
	Mean		10	13.5 %	74
	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments	38	51.4 %	74
		2. The material focuses on the most important theories and models in the field	10	13.5 %	74
		3. The material includes graphs, charts, maps, etc. that display relationships rather than original data	25	33.8%	74
		4. Rhetoric relies on appeals to authority for persuasion	2	2.7 %	74
	Mean		13	17.6 %	74

The analysis of the 7th grade science textbook for category II (Science for Understanding Phenomena), Criterion IIA (Engagement with Phenomena) and indicator 1 (The material engages students with relevant phenomena through first-hand or vicarious experiences) showed that it met 22,9% of the criterion IIA, indicator 1 (table 4.1.2.7) and only few opportunities were provided for students to engage with relevant phenomena through first-hand or vicarious experiences. Figure 28 shows a first hand experience which is about the relationship between testing and smelling.

Table 4.1.2.7. Frequencies and percentages of the indicator 1 of criterion IIA in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	17	22.9 %	74



8. Etkinlik

Tadı Nasıl?

Araç ve Gereç

- çiğ patates
- soğan
- elma
- domates
- meyve bıçağı
- gözleri bağlamak için kumaş parçası
- dört adet tabak

Bunları Yapalım

- Üçer ya da beşer kişilik gruplar oluşturalım.
- Patatesi, soğanı, elmayı ve domatesi eşit büyüklüklerde keselim ve kestiğimiz parçaları ayrı tabaklara koyalım.
- Grubumuzdan seçtiğimiz bir arkadaşımız, gruptaki diğer arkadaşlarımızın gözlerini bağlasın.
- Gözleri bağlanan arkadaşlarımızdan yarısı burunlarını kapatsın.
- Gözleri açık olan arkadaşlarımız, tabaklardaki yiyeceklerden birer parça alsınlar ve gözleri bağlı olan arkadaşlarına bu yiyecekleri tatmaları için yardımcı olsunlar. Ardından yiyecekleri tadan arkadaşlarına tattıklarının hangi yiyecek olduğunu sorsunlar.
- Bir çizelge hazırlayarak verilen cevapları bu çizelgeye kaydedelim. Çizelgede yiyeceğin tadını doğru algılayan öğrenciler için ( ), yanlış algılayan ya da algılayamayan öğrenciler için (-) işareti koyalım.

Sonuca Varalım

- Arkadaşlarımız yiyeceklerin tatlarını birbirlerinden farklı mı algıladılar? Farklı algıladılarsa bunun sebebi nedir?
- Yaptığımız etkinlikten, tat alma ile koku alma arasında nasıl bir ilişki olduğu sonucunu çıkarabiliriz? Arkadaşlarımızla tartışalım.

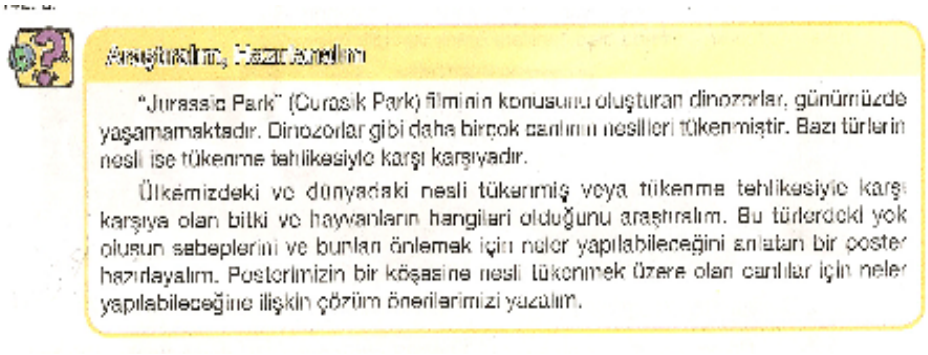
Figure 28. An example in the science textbook that engages students with relevant phenomena through a first-hand experience (Tunç, T., et. al., 2007).

The 7th grade science textbook was analyzed according to category II (Science for Understanding Phenomena), Criterion IIA (Engagement with Phenomena) and indicator 2 (The primary purpose of the activities is to understand

the scientific theory that explains the phenomena). Table 4.1.2.8 shows that the textbook met this indicator by a percentage of 4,0 and figure 29 is showing one of the few activities whose primary purpose is to understand the scientific theories. In this example, the purpose of the activity is to understand the theory about extinction of dinosaurs and other animals.

Table 4.1.2.8. Frequencies and percentages of the indicator 2 of criterion IIA in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIA (Engagement with Phenomena)	2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	3	4.0 %	74


"Jurassic Park" (Curasik Park) filminin konusunu oluşturan dinozorlar, günümüzde yaşamamaktadır. Dinozorlar gibi daha birçok canlının nesilleri tükenmiştir. Bazı türlerin nesli ise tükenme tehlikesiyle karşı karşıyadır.

Ülkemizdeki ve dünyadaki nesli tükenmiş veya tükenme tehlikesiyle karşı karşıya olan bitki ve hayvanların hangileri olduğunu araştıralım. Bu türlerdeki yok olusun sebeplerini ve bunları önlemek için neler yapılabileceğini anlatan bir poster hazırlayalım. Posterlimizin bir köşesine nesli tükenmek üzere olan canlılar için neler yapılabileceğine ilişkin çözüm önerilerimizi yazalım.

Figure 29. An example in the science textbook including an activity whose primary purpose is to understand some theories of why some specials extinct (Tunç, T., et. al., 2007).

When the 7th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IIB (Identify and Address Student Ideas) and indicator 1 (The material includes questions or tasks that identify students naive conceptions), the result showed that the textbook met the indicator by 18,9% (table 4.1.2.9). As shown in figure 30, the textbook included few questions that identify students' naive ideas about the concepts of species, populations and ecosystems.

Table 4.1.2.9. Frequencies and percentages of the indicator 1 of criterion IIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	14	18.9 %	74

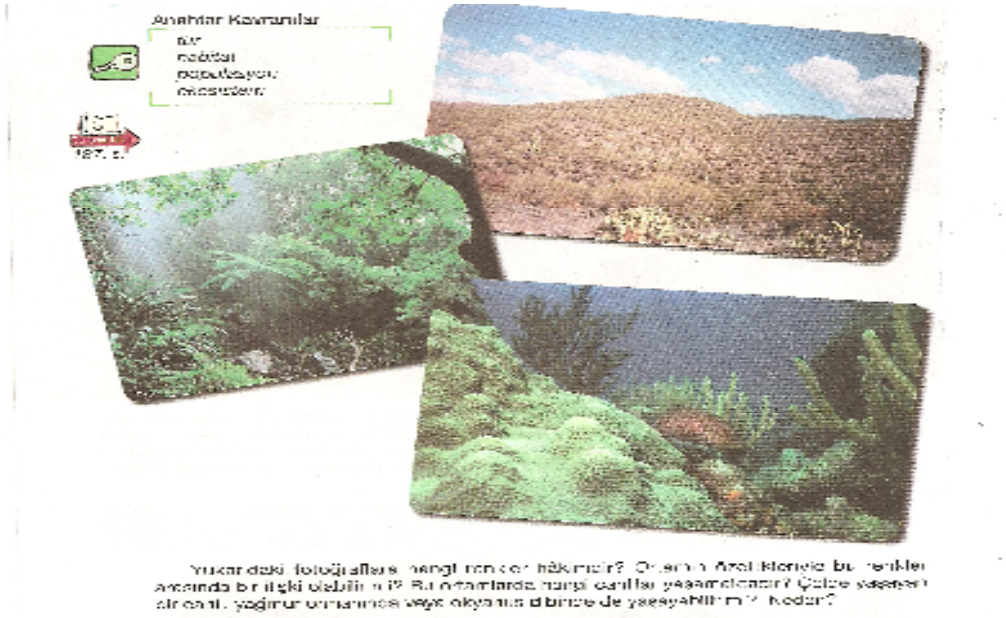


Figure 30. An example in the science textbook that includes some questions to identify the students' naive ideas (Tunç, T., et. al., 2007).

The analysis of the 7th grade science textbook for category II (Science for Understanding Phenomena), Criterion IIB (Identify and Address Student Ideas) and indicator 2 (The material includes questions and tasks that build on students naive ideas rather than simply contradicting ideas with presented facts) showed that the textbook did not meet this indicator (table 4.1.2.10).

Table 4.1.2.10. Frequencies and percentages of the indicator 2 of criterion IIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIB	2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	-	0 %	74

When the 7th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IIC (Developing and Using Scientific Ideas) and indicator 1 (The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas) the result showed that it did not meet this indicator (table 4.1.2.11).

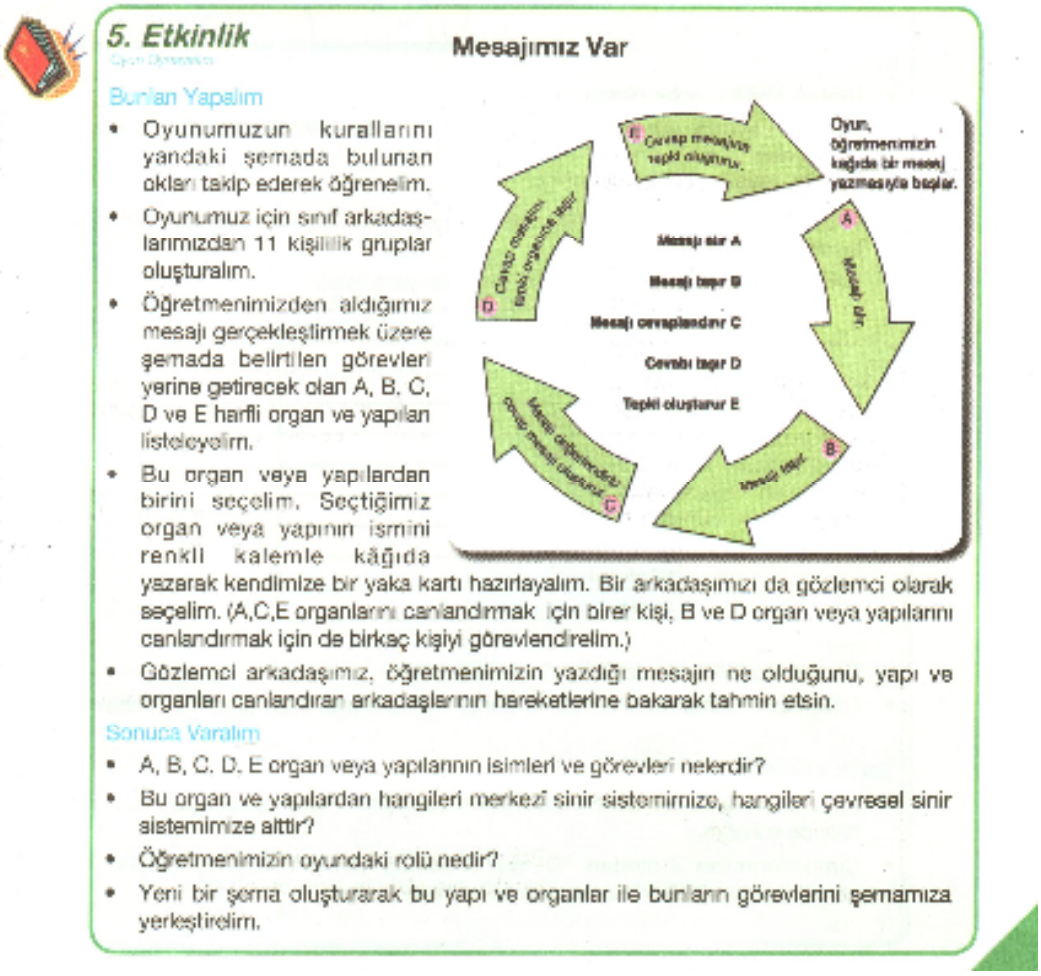
Table 4.1.2.11. Frequencies and percentages of the indicator 1 of criterion IIC in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	74

The analysis of the 7th grade science textbook which was done regarding category II (Science for Understanding Phenomena), Criterion IIC (Developing and Using Scientific Ideas) and indicator 2 (The material provides opportunities to apply scientific concepts in new contexts) showed that the textbook met this indicator by a percentage of 13,5 (table 4.1.2.12) and figure 31 is an example to one of the few provided opportunities to apply scientific concepts in new contexts. In this example, students were given an opportunity to apply the knowledge about nervous system in a drama activity.

Table 4.1.2.12. Frequencies and percentages of the indicator 2 of criterion IIC in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIC (Developing and Using Scientific Ideas)	2. The material provides opportunities to apply scientific concepts in new contexts	10	13.5 %	74



5. Etkinlik

Mesajımız Var

Bunları Yapalım

- Oyunumuzun kurallarını yandaki şemada bulunan okları takip ederek öğrenelim.
- Oyunumuz için sınıf arkadaşlarımızdan 11 kişilik gruplar oluşturalım.
- Öğretmenimizden aldığımız mesajı gerçekleştirmek üzere şemada belirtilen görevleri yerine getirecek olan A, B, C, D ve E harfli organ ve yapıları listeleyelim.
- Bu organ veya yapılardan birini seçelim. Seçtiğimiz organ veya yapının ismini renkli kalemle kâğıda yazarak kendimize bir yaka kartı hazırlayalım. Bir arkadaşımızı da gözlemci olarak seçelim. (A,C,E organlarını canlandırmak için birer kişi, B ve D organ veya yapılarını canlandırmak için de birkaç kişiyi görevlendirelim.)
- Gözlemci arkadaşımız, öğretmenimizin yazdığı mesajın ne olduğunu, yapı ve organları canlandıran arkadaşlarının hareketlerine bakarak tahmin etsin.

Oyun, öğretmenimizin kâğıda bir mesaj yazmasıyla başlar.

Mesajı alır A

Mesajı taşır B

Mesajı cevaplandırır C

Cevabı taşır D

Tepki oluşturur E

Sonuca Varalım

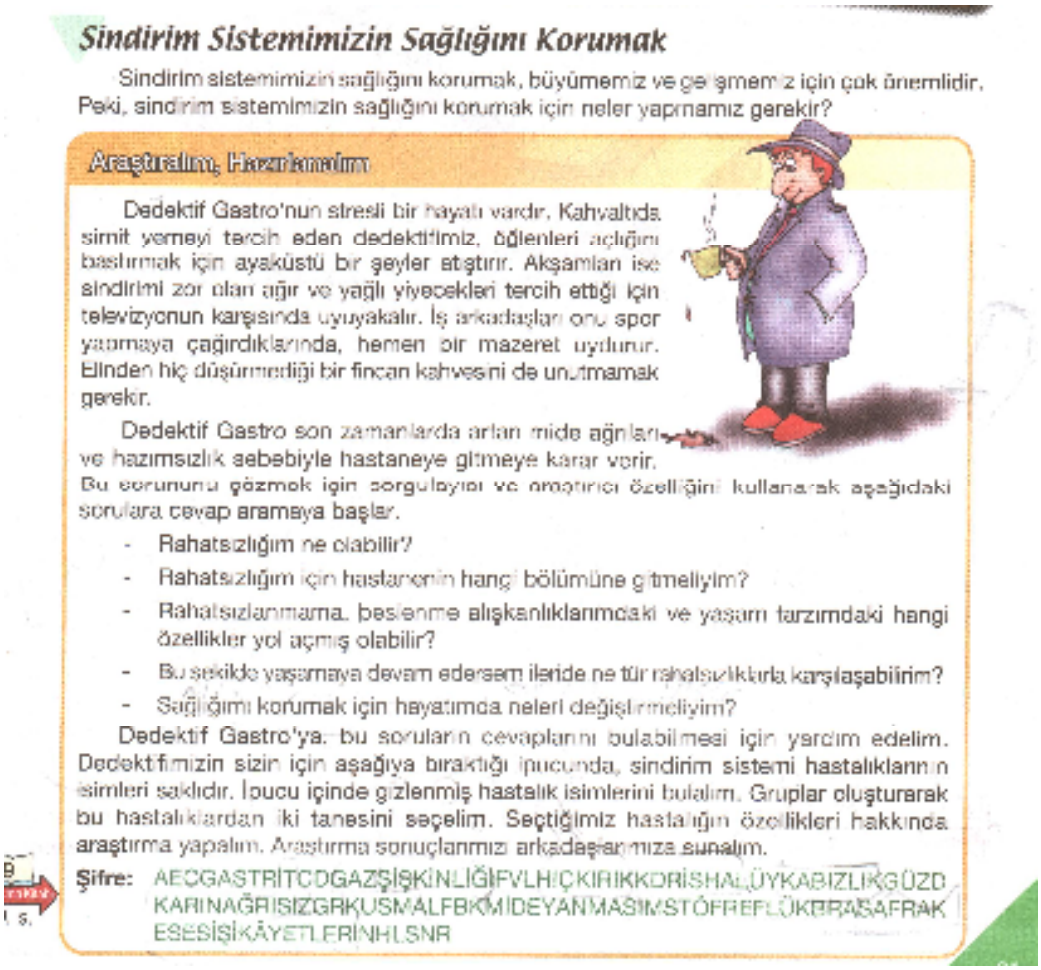
- A, B, C, D, E organ veya yapılarının isimleri ve görevleri nelerdir?
- Bu organ ve yapılardan hangileri merkezî sinir sistemimize, hangileri çevresel sinir sistemimize aittir?
- Öğretmenimizin oyundaki rolü nedir?
- Yeni bir şema oluşturarak bu yapı ve organlar ile bunların görevlerini şemamıza yerleştirelim.

Figure 31. An example in the science textbook provides opportunity students to use scientific knowledge in new context (Tunç, T., et. al., 2007).

When the 7th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IID (Promotes Student Thinking About Experiences and Knowledge) and indicator 1 (The material engages students to use scientific ideas to reason about phenomena) the result showed that the textbook only met the indicator by 4,0% (table 4.1.2.13). The textbook seldom engaged students to use scientific ideas to reason about phenomena. Figure 32 show a rare activity which engage students in using scientific ideas to find the reasons of stomach illness.

Table 4.1.2.13. Frequencies and percentages of the indicator 1 of criterion IID in the 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena	3	4.0 %	74



Sindirim Sistemimizin Sağlığını Korumak

Sindirim sistemimizin sağlığını korumak, büyümemiz ve gelişmemiz için çok önemlidir. Peki, sindirim sistemimizin sağlığını korumak için neler yapmamız gerekir?

Araştıralım, Hazırlanalım

Dedektif Gastro'nun stresli bir hayatı vardır. Kahvaltıda simit yemeyi tercih eden dedektifimiz, öğlenleri açlığını bastırmak için ayaküstü bir şeyler atıştırır. Akşamları ise sindirimi zor olan ağır ve yağlı yiyecekleri tercih ettiği için televizyonun karşısında uyuyakalır. İş arkadaşları onu spor yapmaya çağırdıklarında, hemen bir mazeret uydurur. Elinden hiç düşürmediği bir fincan kahvesini de unutmamak gerekir.

Dedektif Gastro son zamanlarda artan mide ağrıları ve hazımsızlık sebebiyle hastaneye gitmeye karar verir. Bu sorununu çözmek için sorgulayıcı ve araştırıcı özelliğini kullanarak aşağıdaki sorulara cevap aramaya başlar.

- Rahatsızlığım ne olabilir?
- Rahatsızlığım için hastanenin hangi bölümüne gitmeliyim?
- Rahatsızlanmama, beslenme alışkanlıklarımdaki ve yaşam tarzımdaki hangi özellikler yol açmış olabilir?
- Bu şekilde yaşamaya devam edersem ileride ne tür rahatsızlıklarla karşılaşabilirim?
- Sağlığımı korumak için hayatımda neleri değiştirmeliyim?

Dedektif Gastro'ya bu soruların cevaplarını bulabilmesi için yardım edelim. Dedektifimizin sizin için aşağıya bıraktığı ipucunda, sindirim sistemi hastalıklarının isimleri saklıdır. İpucu içinde gizlenmiş hastalık isimlerini bulalım. Gruplar oluşturarak bu hastalıklardan iki tanesini seçelim. Seçtiğimiz hastalığın özellikleri hakkında araştırma yapalım. Araştırma sonuçlarımızı arkadaşlarımıza sunalım.

Şifre: AECGASTRİTCDGAZŞİŞKİNLİĞİFVLHİÇKIRIKKDRİSHALÜYKABIZLIKGÜZD KARINAĞRISIZGRKUSMALFBKMİDEYANMASIMSTÖFREFLÜKBRAŞAFRAK ESESİŞİKÂYETLERİNHLSNR

Figure 32. An example in the science textbook that engages students in using scientific ideas to reason about phenomena (Tunç, T., et. al., 2007).

The analysis of the 7th grade science textbook which was done in accordance to category II (Science for Understanding Phenomena), Criterion IID (Promotes Student Thinking About Experiences and Knowledge) and indicator 2 (The material provides students opportunities to compare/contrast scientific ideas to their experiences) showed that the textbook met this indicator by a percentage of 4,0 (table 4.1.2.14). The textbook rarely provided opportunities students to compare/contrast their experiences to scientific ideas. Figure 33 indicates an activity which is an opportunity for students to compare their ideas with scientific ideas about nutrition net.

Table 4.1.2.14. Frequencies and percentages of the indicator 2 of criterion IID in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IID (Promotes Student Thinking About Experiences and Knowledge)	2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	3	4.0 %	74

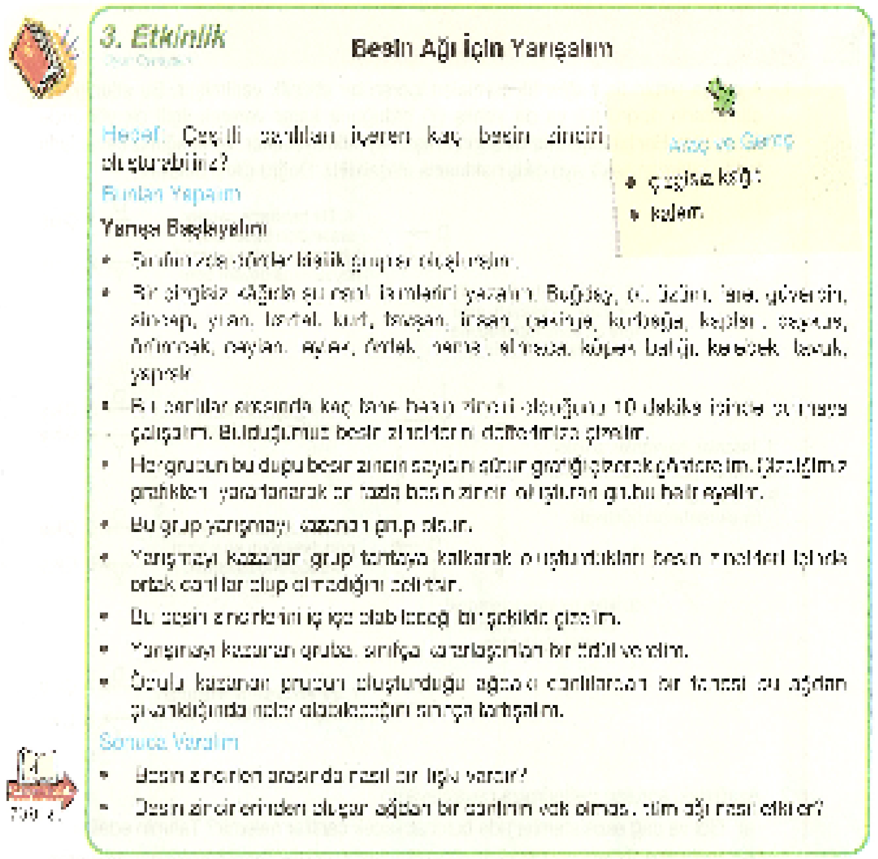


Figure 33. An example in the science textbook that provides students an opportunity to compare or contrast their ideas with the scientific ideas (Tunç, T., et. al., 2007).

When considered if the material present science as the application of scientific theories and use of reasoning to understand phenomena, results were presented in accordance to frequencies and percentages of the indicators for category II (Science for Understanding Phenomena). As shown in table 4.1.2.15, 7th grade

science textbook met 13.5 % of Criterion IIA, 14.8 % of Criterion IIB, 6.5 % of the Criterion IIC and 4 % of the Criterion IIC. According to this result, science textbook relatively presented the criterion IIB (Identify and address students ideas) than the other criteria.

The textbook rarely engaged students in real or vicarious phenomena (Criterion IIA). It seldom engaged students with relevant phenomena through first-hand or vicarious experiences (22.9 %), and the primary purpose of the activities was to slightly understand the scientific theory that explains the phenomena.

In addition, the textbook slightly identified common naive conceptions and addressed student ideas in order to build a more scientifically acceptable understanding of phenomena (Criterion IIB). It included few questions or tasks that identify students' naive conceptions (18.9 %), and did not include any questions and tasks that build on students' naive ideas rather than simply contradicting ideas with presented facts (0 %).

Moreover, the textbook provided very few opportunities to develop reasoning and to practice applying new knowledge (Criterion IIC). It did not include any questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas (0 %), and slightly provided opportunities to apply scientific concepts in new contexts (13.5 %). Lastly, the textbook rarely promoted student thinking (Criterion IID). It slightly engaged students to use scientific ideas to reason about phenomena (4 %), and provided students with very little opportunities to compare/contrast scientific ideas to their experiences (4 %).

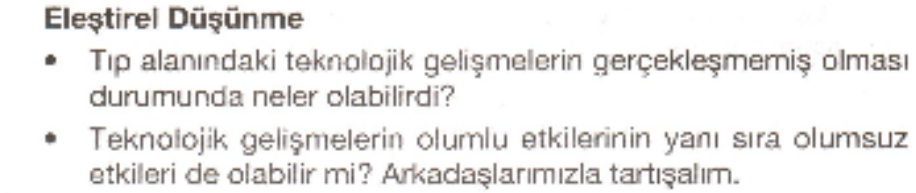
Table 4.1.2.15. Frequencies and Percentages of the category II criteria and indicators in the 7th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	17	22.9 %	74
		2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	3	4.0 %	74
	Mean		10	13.5 %	74
	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	14	18.9 %	74
		2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	-	0 %	74
	Mean		7	7.4 %	74
	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	74
		2. The material provides opportunities to apply scientific concepts in new contexts	10	13.5 %	74
	Mean		5	6.5 %	74
	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena	3	4.0 %	74
		2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	3	4.0 %	74
	Mean		3	4 %	74

When the 7th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 1 (The material fosters a sense of curiosity and questioning about the natural and technological world), the result showed that the textbook met the indicator by a percentage of 21,6 (table 4.1.2.16). The textbook slightly fostered students' curiosity and questioning about natural and technological world. Figure 34 shows some questions which foster the sense of curiosity about technological world.

Table 4.1.2.16. Frequencies and percentages of the indicator 1 of criterion IIIA in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	1. The material fosters a sense of curiosity and questioning about the natural and technological world	16	21.6 %	74


Eleştirel Düşünme

- Tıp alanındaki teknolojik gelişmelerin gerçekleşmemiş olması durumunda neler olabilirdi?
- Teknolojik gelişmelerin olumlu etkilerinin yanı sıra olumsuz etkileri de olabilir mi? Arkadaşlarımızla tartışalım.

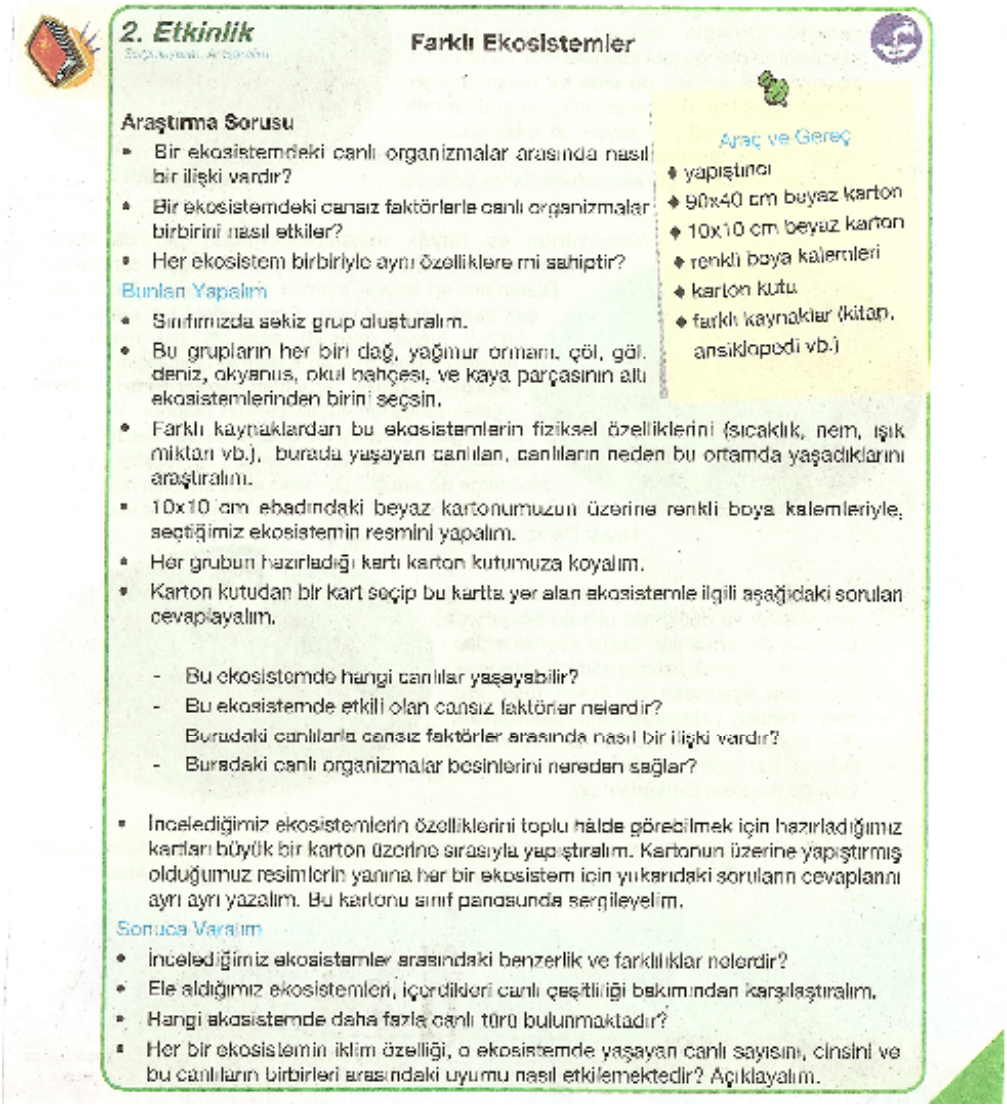
Figure 34. An example in the science textbook including the questions that foster a sense of curiosity about the technological world (Tunç, T., et. al., 2007).

The analysis of the 7th grade science textbook was done according to category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 2 (The materials include activities that engage students to find out what happens with the natural and technological world). The result, as shown in table 4.1.2.17, indicates that the

textbook met this indicator by 17,6%. Figure 35 shows one of the rare examples which engaged students to find out what happens with the natural world.

Table 4.1.2.17. Frequencies and percentages of the indicator 2 of criterion IIIA in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	2. The materials include activities that engage students with the natural and technological world to find out what happens (experimental science)	13	17.6 %	74



2. Etkinlik

Farklı Ekosistemler

Araştırma Sorusu

- Bir ekosistemdeki canlı organizmalar arasında nasıl bir ilişki vardır?
- Bir ekosistemdeki cansız faktörlerle canlı organizmalar birbirini nasıl etkiler?
- Her ekosistem birbiriyle aynı özelliklere mi sahiptir?

Araç ve Gereç

- yapıştırıcı
- 90x40 cm beyaz karton
- 10x10 cm beyaz karton
- renkli boya kalemleri
- karton kutu
- farklı kaynaklar (kitap, ansiklopedi vb.)

Bunları Yapalım

- Sınıfımızda sekiz grup oluşturalım.
- Bu grupların her biri dağ, yağmur ormanı, çöl, göl, deniz, okyanus, okul bahçesi, ve kaya parçasının altı ekosistemlerinden birini seçsin.
- Farklı kaynaklardan bu ekosistemlerin fiziksel özelliklerini (sıcaklık, nem, ışık miktarı vb.), burada yaşayan canlıları, canlıların neden bu ortamda yaşadıklarını araştıralım.
- 10x10 cm ebadındaki beyaz kartonumuzun üzerine renkli boya kalemleriyle, seçtiğimiz ekosistemin resmini yapalım.
- Her grubun hazırladığı kartı karton kutumuza koyalım.
- Karton kutudan bir kart seçip bu kartta yer alan ekosistemle ilgili aşağıdaki soruları cevaplayalım.
  - Bu ekosistemde hangi canlılar yaşayabilir?
  - Bu ekosistemde etkili olan cansız faktörler nelerdir?
    Buradaki canlılarla cansız faktörler arasında nasıl bir ilişki vardır?
  - Bursdaki canlı organizmalar besinlerini nereden sağlar?
- İncelediğimiz ekosistemlerin özelliklerini toplu hâlde görebilmek için hazırladığımız kartları büyük bir karton üzerine sırasıyla yapıştıralım. Kartonun üzerine yapıştırmış olduğumuz resimlerin yanına her bir ekosistem için yukarıdaki soruların cevaplarını ayrı ayrı yazalım. Bu kartonu sınıf panosunda sergileyelim.

Sonuca Varalım

- İncelediğimiz ekosistemler arasındaki benzerlik ve farklılıklar nelerdir?
- Ele aldığımız ekosistemleri, içerdikleri canlı çeşitliliği bakımından karşılaştıralım.
- Hangi ekosistemde daha fazla canlı türü bulunmaktadır?
- Her bir ekosistemin iklim özelliği, o ekosistemde yaşayan canlı sayısını, cinsini ve bu canlıların birbirleri arasındaki uyumu nasıl etkilemektedir? Açıklayalım.

Figure 35. An example in the science textbook including an activity that engages students with the natural world to understand what happens (Tunç, T., et. al., 2007).

The 7th grade science textbook was analyzed according to category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 3 (The material includes activities that engage students to carefully and systematically recording what they see). As shown in table 4.1.2.18, the textbook did not meet this indicator.

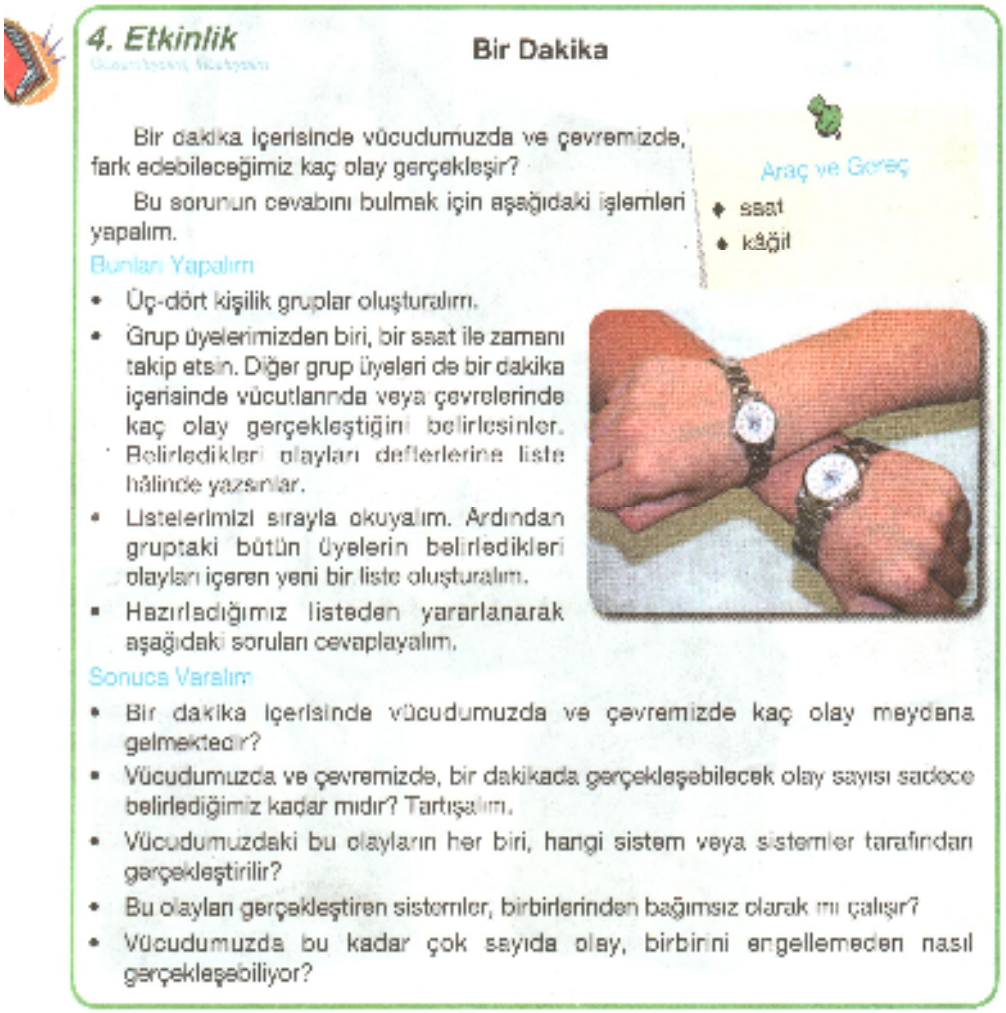
Table 4.1.2.18. Frequencies and percentages of the indicator 3 of criterion IIIA in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	3. The material includes activities that engage students in carefully and systematically recording what they see (field sciences)	-	0 %	74

The analysis of the 7th grade science textbook which was done according to category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 4 (Activities use instruments and equipment to enhance and extend the senses) indicated that the textbook met this indicator by 5,4% (table 4.1.2.19). In the activities, instruments and equipments were rarely used to extend the sense of students. Figure 36 shows an activity which uses a watch and a paper to enhance and extend our all senses while doing this activity.

Table 4.1.2.19. Frequencies and percentages of the indicator 4 of criterion IIIA in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	4. Activities use instruments and equipment to enhance and extend the senses	4	5.4 %	74



4. Etkinlik

Bir Dakika

Bir dakika içerisinde vücudumuzda ve çevremizde, fark edebileceğimiz kaç olay gerçekleşir?

Bu sorunun cevabını bulmak için aşağıdaki işlemleri yapalım.

Araç ve Gereç

- saat
- kâğıt

Bunları Yapalım

- Üç-dört kişilik gruplar oluşturalım.
- Grup üyelerimizden biri, bir saat ile zamanı takip etsin. Diğer grup üyeleri de bir dakika içerisinde vücutlarında veya çevrelerinde kaç olay gerçekleştiğini belirlesinler. Belirledikleri olayları defterlerine liste hâlinde yazsınlar.
- Listelerimizi sırayla okuyalım. Ardından gruptaki bütün üyelerin belirledikleri olayları içeren yeni bir liste oluşturalım.
- Hazırladığımız listeden yararlanarak aşağıdaki soruları cevaplayalım.

Sonuca Varalım

- Bir dakika içerisinde vücudumuzda ve çevremizde kaç olay meydana gelmektedir?
- Vücudumuzda ve çevremizde, bir dakikada gerçekleşebilecek olay sayısı sadece belirlediğimiz kadar mıdır? Tartışalım.
- Vücudumuzdaki bu olayların her biri, hangi sistem veya sistemler tarafından gerçekleştirilir?
- Bu olayları gerçekleştiren sistemler, birbirlerinden bağımsız olarak mı çalışır?
- Vücudumuzda bu kadar çok sayıda olay, birbirini engellemeden nasıl gerçekleşebiliyor?

Figure 36. An example in the science textbook's activity that uses instruments to extend or enhance the senses (Tunç, T., et. al., 2007).

When the 7th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 1 (When students engage in data collection, technique and methods are stressed), the result showed that the textbook met the indicator by only 1,4% (table 4.1.2.20). Figure 37 is an example of the rare activities where techniques and methods of data collection were stressed.

Table 4.1.2.20. Frequencies and percentages of the indicator 1 of criterion IIIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed	1	1.4 %	74

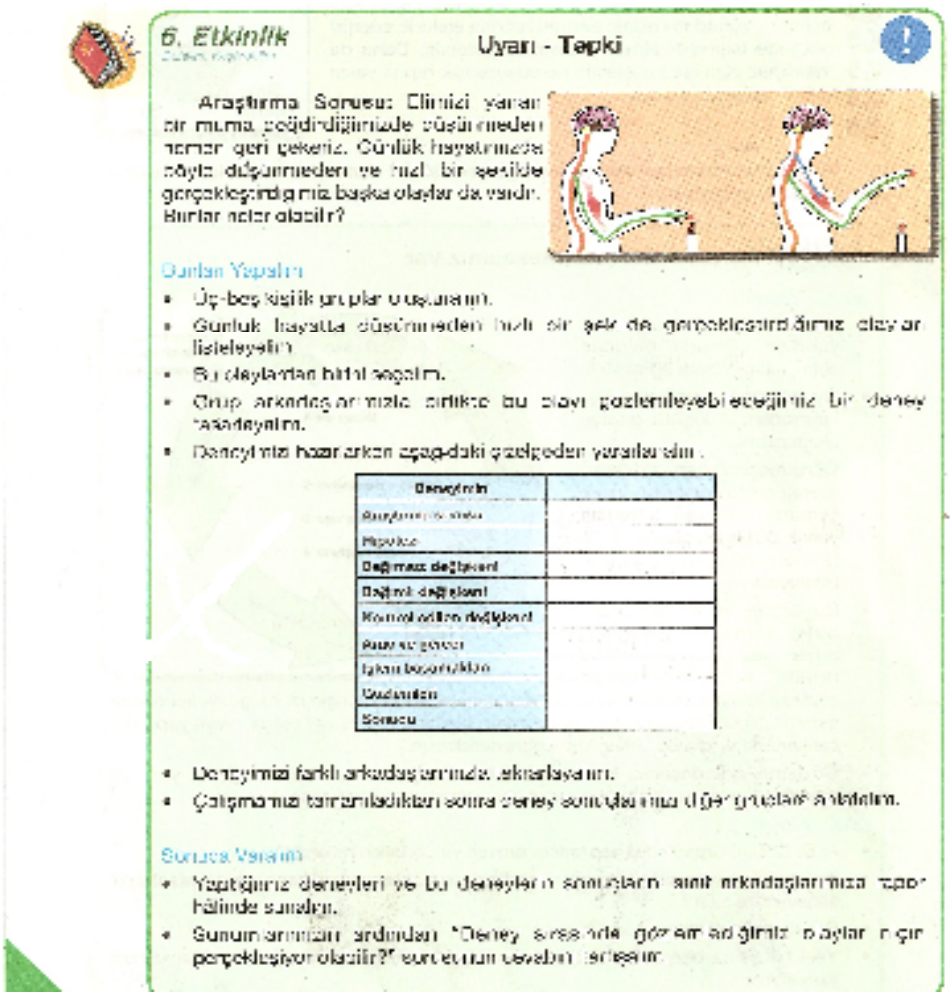


Figure 37. An example in the science textbook's activity that stresses the methods or techniques during data collection (Tunç, T., et. al., 2007).

The analysis of the 7th grade science textbook which was done in accordance to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 2 (When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions) showed that the textbook did not meet this indicator (table 4.1.2.21).

Table 4.1.2.21. Frequencies and percentages of the indicator 2 of criterion IIIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	-	0 %	74

The 7th grade science textbook was analyzed according to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 3 (Students develop techniques or methods to address their questions and hypotheses). Table 4.1.2.22 shows that the textbook did not meet this indicator.

Table 4.1.2.22. Frequencies and percentages of the indicator 3 of criterion IIIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	74

The analysis of the 7th grade science textbook regarding category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 4 (Students use their own experiences/data to identify patterns and relationships) showed that the textbook did not meet this indicator (table 4.1.2.23).

Ta**ble 4.1.2.23.** Frequencies and percentages of the indicator 4 of criterion IIIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	4. Students use their own experiences/data to identify patterns and relationships	-	0 %	74

As the result of the analysis of the 7th grade science textbook for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 5 (The material includes data that support relationships shown in graphs, charts, maps, etc.) showed, the textbook did not meet this indicator.

Table 4.1.2.24. Frequencies and percentages of the indicator 5 of criterion IIIB in 7th grade science textbook

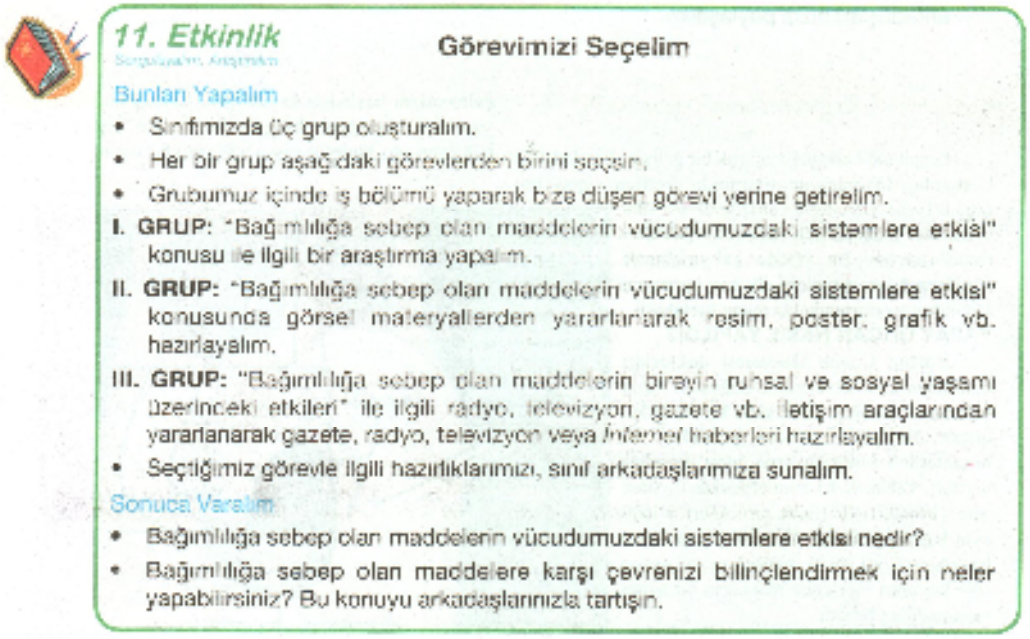
Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	5. The material includes data that support relationships shown in graphs, charts, maps, etc.	-	0 %	74

When the 7th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 6 (Students are encouraged to use their own experiences/data to develop and support arguments) the result showed that the textbook met this

indicator by a percentage of 25,7 (table 4.1.2.25). Students were seldom encouraged to use their data to develop arguments. Figure 38 is an example which encourages students to investigate the reasons of addiction and use their data to support the arguments about it.

Table 4.1.2.25. Frequencies and percentages of the indicator 6 of criterion IIIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	6. Students are encouraged to use their own experiences/data to develop and support arguments	19	25.7 %	74



11. Etkinlik

Görevimizi Seçelim

Bunları Yapalım

- Sınıfımızda üç grup oluşturalım.
- Her bir grup aşağıdaki görevlerden birini seçsin.
- Grubumuz içinde iş bölümü yaparak bize düşen görevi yerine getirelim.

I. GRUP: "Bağımlılığa sebep olan maddelerin vücudumuzdaki sistemlere etkisi" konusu ile ilgili bir araştırma yapalım.

II. GRUP: "Bağımlılığa sebep olan maddelerin vücudumuzdaki sistemlere etkisi" konusunda görsel materyallerden yararlanarak resim, poster, grafik vb. hazırlayalım.

III. GRUP: "Bağımlılığa sebep olan maddelerin bireyin ruhsal ve sosyal yaşamı üzerindeki etkileri" ile ilgili radyo, televizyon, gazete vb. iletişim araçlarından yararlanarak gazete, radyo, televizyon veya *İnternet* haberleri hazırlayalım.

- Seçtiğimiz görevle ilgili hazırlıklarımızı, sınıf arkadaşlarımıza sunalım.

Sonuca Varalım

- Bağımlılığa sebep olan maddelerin vücudumuzdaki sistemlere etkisi nedir?
- Bağımlılığa sebep olan maddelere karşı çevrenizi bilinçlendirmek için neler yapabilirsiniz? Bu konuyu arkadaşlarınızla tartışın.

Figure 38. An example in the science textbook that encourages students to use their experiences to support arguments (Tunç, T., et. al., 2007).

The 7th grade science textbook was analyzed according to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 7 (Text relies on empirical data rather than appeals to

authority to support arguments). As demonstrated in table 4.1.2.26, the indicator was not met.

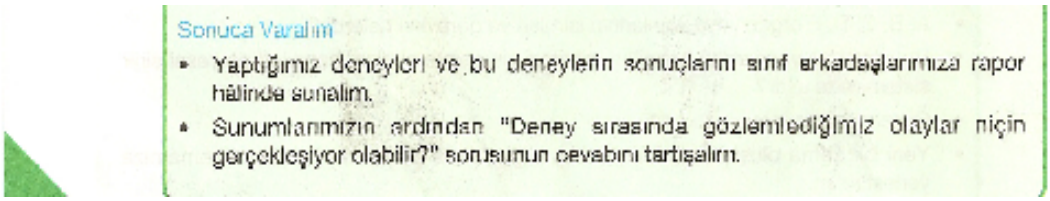
Table 4.1.2.26. Frequencies and percentages of the indicator 7 of criterion IIIB in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	7. Text relies on empirical data rather than appeals to authority to support arguments	-	0 %	74

The result of the analysis done with the 7th grade science textbook for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 1 (The material presents alternative interpretations or allows for multiple student interpretations of data as long as arguments are supported by it) indicated that the textbook met this indicator by only 2,7% (table 4.1.2.27). It slightly allowed for multiple student interpretations of data. Figure 39 is an example which encourage students for multiple interpretations of their data.

Table 4.1.2.27 Frequencies and percentages of the indicator 1 of criterion IIIC in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	2	2.7 %	74


Sonuca Varalim

- Yaptığımız deneyleri ve bu deneylerin sonuçlarını sınıf arkadaşlarımıza rapor hâlinde sunalım.
- Sunumlarımızın ardından "Deney sırasında gözlemlediğimiz olaylar niçin gerçekleşiyor olabilir?" sorusunun cevabını tartışalım.

Figure 39. An example in the science textbook that allows for multiple student interpretations (Tunç, T., et. al., 2007).

The 7th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 2 (The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community). As shown in table 4.1.2.28, the textbook did not meet this indicator.

Table 4.1.2.28. Frequencies and percentages of the indicator 2 of criterion IIIC in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC (Collective Validation)	2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific	-	0 %	74

When the 7th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 3 (The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach

a community consensus about data and scientific claims, based on empirical evidence), the result showed that it did not meet the indicator (table 4.1.2.29).

Table 4.1.2.29. Frequencies and percentages of the indicator 3 of criterion IIIC in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC (Collective Validation)	3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	74

The 7th grade science textbook was analyzed in accordance to category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 4 (The material emphasizes the special status of scientific understanding reached through community consensus). As shown in table 4.1.2.30, the textbook did not meet this indicator.

Table 4.1.2.30. Frequencies and percentages of the indicator 4 of criterion IIIC in 7th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC (Collective Validation)	4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	67

To examine if the material present science as the social construction of facts and scientific understanding, frequencies and percentages of the indicators in 7th grade science textbook for Category III-Science as the social Construction of Knowledge was reported. As the result demonstrated in table 4.1.2.31, 7th grade science textbook met an average 11.2% of category III criterion IIIA indicators, 3.4 % of criterion IIIB indicators and 0.7 % of criterion IIIC indicators. The textbook met all the indicators of all categories. It relatively met higher indicators of criterion IIIA than the other two criteria.

The textbook rarely supported intense engagement with the natural and technological world (Criterion IIIA). The material slightly fostered a sense of curiosity and questioning about the natural and technological world (21.6 %), included few activities that engage students to find out what happens with the natural and technological world (17.6 %), did not include activities that engage students to carefully and systematically record what they see (0 %).Lastly, activities rarely used instruments and equipment to enhance and extend the senses (4 %). In addition, the textbook very rarely made arguments based on evidence as opposed to presenting only conclusions (Criterion IIIB). During data collection, technique and methods were rarely stressed (1.4 %). Students were rarely encouraged to use their own experiences/data to develop and support arguments (25.7 %). Text relied on empirical data rather than appeals to authority to support arguments (4 %). While presenting the concepts, the textbook did not present the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions, did not provide opportunities for students to develop techniques or methods to address their questions and hypothesis, did not provide opportunities for students use their own experiences/data to identify patterns and relationships, and did not include any data that support relationships shown in graphs, charts, maps, etc.

Textbook also very slightly emphasized the collective efforts of a community of scientists in developing and accepting scientific facts and concepts (Criterion IIIC). It slightly presented alternative interpretations or allows for multiple student interpretations of data as long as arguments are supported by data (2.7 %) and did not present the other indicators of criterion IIIC.

Table 4.1.2.31. Frequencies and Percentages of the category III criteria and indicators in 7th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	1. The material fosters a sense of curiosity and questioning about the natural and technological world.	16	21.6 %	74
		2. The materials include activities that engage students with the natural and technological world to find out what happens. (experimental science)	13	17.6 %	74
		3. The material includes activities that engage students in carefully and systematically recording what they see. (field sciences)	-	0 %	74
		4. Activities use instruments and equipment to enhance and extend the senses	4	5.4 %	74
	Mean		8.3	11.2 %	74
	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed	1	1.4 %	74
		2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	-	0 %	74
		3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	74
		4. Students use their own experiences/data to identify patterns and relationships	-	0 %	74
		5. The material includes data that support relationships shown in graphs, charts, maps, etc.	-	0 %	74
		6. Students are encouraged to use their own experiences/data to develop and support arguments	19	25.7 %	74

(Table 4.1.2.31. Continued**)**

		7. Text relies on empirical data rather than appeals to authority to support arguments	-	0 %	74
	Mean		2.8	3.4 %	74
	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	2	2,7 %	74
		2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community	-	0 %	74
		3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	74
		4 . The material the special status of scientific understanding reached through community consensus	-	0 %	74
	Mean		-	0.7 %	74

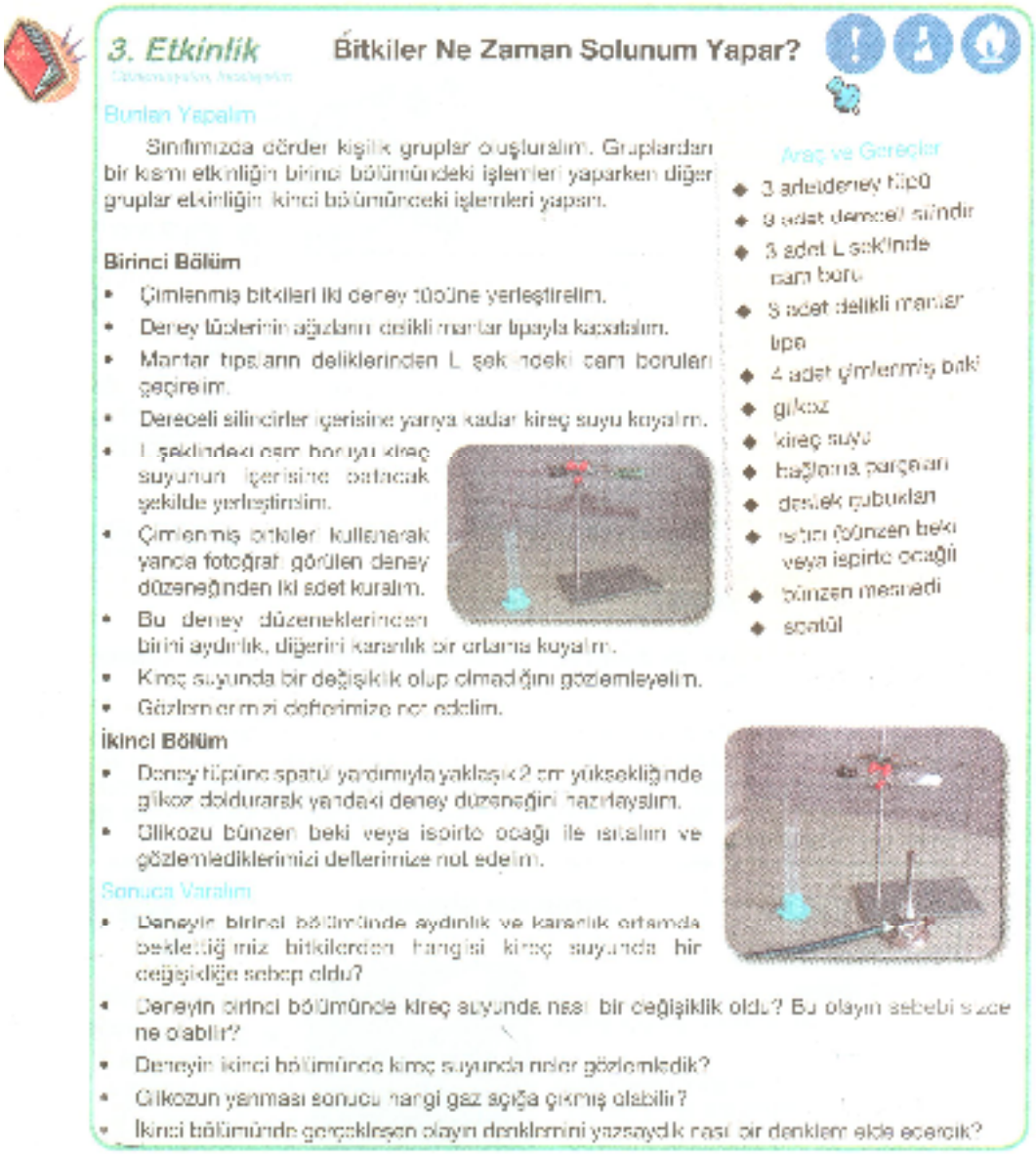
4.1.3 Analysis of Eighth Grade Science Textbook

In this part, analysis of the representations of NOS in the 8th grade science textbooks was presented.

The analysis of the 8th grade science textbook for category I (Science as Authoritative Knowledge), Criterion IA (Deductive Experiences) and indicator 1 (textbook includes demonstrations or laboratory exercises that confirm concepts presented) showed that the textbook met only 32.8 % of the indicator 1 (table 4.1.3.1). It slightly included some demonstrations or laboratory activities. Figure 40 shows a laboratory activity to confirm the concepts of plant respiration.

Table 4.1.3.1. Frequencies and percentages of the indicator1 of criterion IA in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. Textbook includes demonstrations or laboratory exercises that confirm concepts presented	21	32.8 %	64



3. Etkinlik

Bitkiler Ne Zaman Solunum Yapar?

Bunları Yapalım

Sınıfımızda dörder kişilik gruplar oluşturalım. Gruplardan bir kısmı etkinliğin birinci bölümündeki işlemleri yaparken diğer gruplar etkinliğin ikinci bölümündeki işlemleri yapsın.

Araç ve Gereçler

- 3 adet deney tüpü
- 3 adet dereceli silindir
- 3 adet L şeklinde cam boru
- 3 adet delikli mantar tıpa
- 4 adet çimlenmiş bakla
- glikoz
- kireç suyu
- bağlama parçaları
- destek çubukları
- ısıtıcı (bünzen beki veya isıtıcı ocağı)
- bünzen maşası
- spatül

Birinci Bölüm

- Çimlenmiş bitkileri iki deney tüpüne yerleştirelim.
- Deney tüplerinin ağızların delikli mantar tıpayla kapatalım.
- Mantar tıpaların deliklerinden L şekilleri cam boruları geçirelim.
- Dereceli silindirler içerisine yarıya kadar kireç suyu koyalım.
- L şeklindeki cam boruyu kireç suyunun içerisine batacak şekilde yerleştirelim.
- Çimlenmiş bitkiler kullanarak yanda fotoğrafı görülen deney düzeneğinden iki adet kuralım.
- Bu deney düzeneklerinden birini aydınlık, diğerini karanlık bir ortama koyalım.
- Kireç suyunda bir değişiklik olup olmadığını gözlemleyelim.
- Gözlemlerimizi defterimize not edelim.

İkinci Bölüm

- Deney tüpüne spatül yardımıyla yaklaşık 2 cm yüksekliğinde glikoz doldurarak yandaki deney düzeneğini hazırlayalım.
- Glikozu bünzen beki veya ısıtıcı ocağı ile ısıtalım ve gözlemlediklerimizi defterimize not edelim.

Sonuca Varalım

- Deneyin birinci bölümünde aydınlık ve karanlık ortamda beklettiğimiz bitkilerden hangisi kireç suyunda bir değişikliğe sebep oldu?
- Deneyin birinci bölümünde kireç suyunda nasıl bir değişiklik oldu? Bu olayın sebebi sizce ne olabilir?
- Deneyin ikinci bölümünde kireç suyunda neler gözlemledik?
- Glikozun yanması sonucu hangi gaz açığa çıkmış olabilir?
- İkinci bölümünde gerçekleşen olayın denklemini yazsaydık nasıl bir denklem elde edecek?

Figure 40. An example in the science textbook including a laboratory exercises that confirms concepts presented (Tunç, T., Bakar, E., Başdağ, G., İpek, İ., Bağcı, N., Köroğlu, N. G., Yörük, N., Keleş, Ö., 2008).

When the 8th grade science textbook was analyzed for category I (Science as Authoritative Knowledge), Criterion IB(Rhetoric Based on Authority) and indicator 1 (textbook presents conclusions of scientific studies rather than details of supporting data and arguments), the result indicated that the textbook met 50 % of the Criterion IB, indicator 1 (table 4.1.3.2). It presented conclusions of scientific studies directly, but did not show the details of supporting data and arguments. Figure 41 indicates

conclusion of a scientific study which belongs to Lamarck. There is no details of supporting data and arguments about Lamarck's theory.

Table 4.1.3.2. Frequencies and percentages of the indicator 1 of criterion IB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	1. Textbook presents conclusions of scientific studies rather than details of supporting data and arguments	32	50 %	64

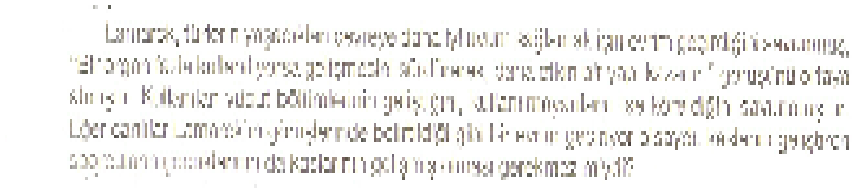


Figure 41. An example in the science textbook that presents conclusion of a scientific study rather than details of supporting data and arguments (Tunç, T., et. al., 2008).

The analysis of the 8th grade science textbook for category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority), and indicator 2 (the material focuses on the most important theories and models in the field) showed that it met only 4.7 % of the Criterion IB, indicator 2 (table 4.1.3.3). It focused on the most important theories and models in the field (figure 42). There were two important theories and a model (Mendel's inheritance theory, Lamark's theory and Watson and Cricks' DNA model) in unit 1. Percentages of the theories were low in the textbook.

Table 4.1.3.3. Frequencies and percentages of the indicator 2 of criterion IB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	2. The material focuses on the most important theories and models in the field	3 (2 theories and a model)	4.7 %	64

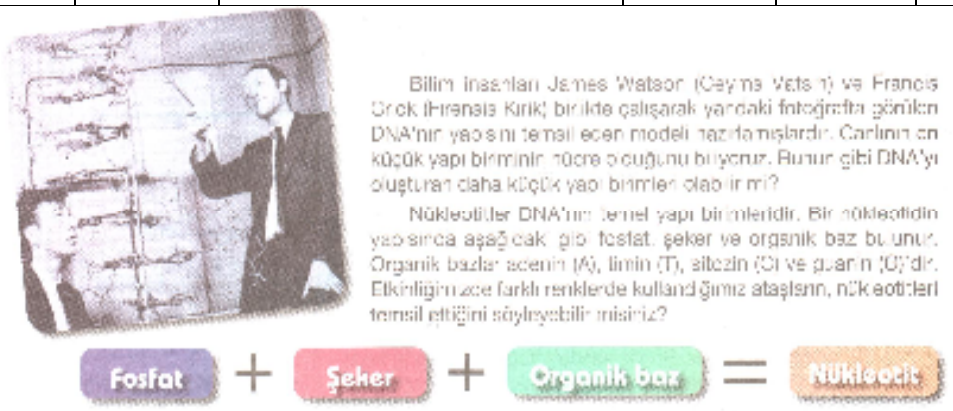


Figure 42. An example in the science textbook that focuses on an important model in the field (Tunç, T., et. al., 2008).

The analysis done according to Category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 3 (textbook includes graphs, charts, maps, pictures etc. that display relationships rather than original data) showed that the indicator was met by a percentage of 48.4 % (table 4.1.3.4) and figure 43 shows one example of the graphs displaying the relationship between the amount of carbon dioxide and the energy sources.

Table 4.1.3.4. Frequencies and percentages of the indicator 3 of criterion IB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	3. Textbook includes graphs, charts, maps, pictures etc. that display relationships rather than original data	31	48.4 %	64

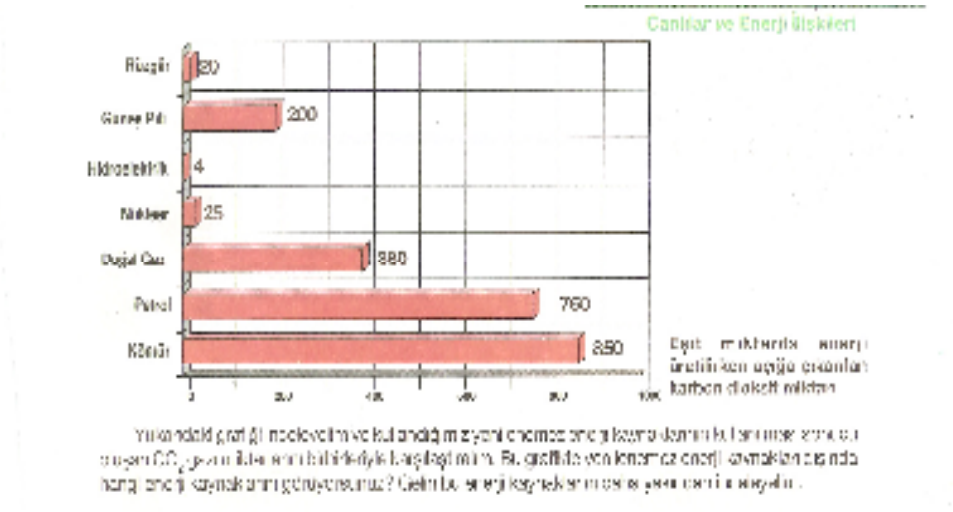


Figure 43. An example in the science textbook including a graph that displays relationships rather than original data (Tunç, T., et. al., 2008).

The 8th grade science textbook was analyzed according to category I (Science as Authoritative Knowledge), Criterion IB (Rhetoric Based on Authority) and indicator 4 (rhetoric relies on appeals to authority for persuasion). The results showed that the textbook met only 6.3% of the Criterion IB, indicator 4. Rhetoric very rarely relied on appeals to authority for persuasion. Figure 44 indicates that rhetoric relies on appeals to data of World Energy Agency for persuasion of the amount of energy sources which are used frequently.

Table 4.1.3.5. Frequencies and percentages of the indicator 4 of criterion IB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IB (Rhetoric Based on Authority)	4. Rhetoric relies on appeals to authority for persuasion	4	6.3 %	64

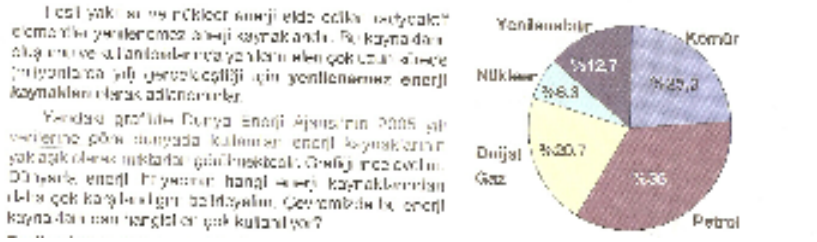


Figure 44. An example in the science textbook that relies on appeals to authority for persuasion (Tunç, T., et. al., 2008).

The criteria and indicators of category I were used to answer the following question: Does the Material present science as confirm facts and concepts? According to the table 4.1.3.6, the textbook met on an average of 32.8 % of criterion IA and 27.4 % of the criterion IB. The textbook met relatively higher indicators of criterion IA than criterion IB. It slightly included activities to confirm facts and concepts (Criterion IA). It seldom included demonstrations or laboratory exercises that confirm concepts presented (32.8 %). Additionally, the textbook rarely relied on conclusions and status of scientists to teach terms, concepts, and facts (Criterion IB). It presented conclusions of scientific studies rather than details of supporting data and arguments (50 %), focused on the most important theories and models in the field (4.7 %) – the percent of this indicator was not presented the total page number met the indicator, but the number of the theories and models including graphs, charts, maps, etc. that display relationships rather than original data (48.4 %), and lastly, rhetoric slightly relied on appeals to authority for persuasion (6.3 %).

Table 4.1.3.6. Frequencies and percentages of the category I criteria and indicators in 8th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	22	32.8 %	64
	Mean		22	32.8 %	64
	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments	32	50 %	64
		2. The material focuses on the most important theories and models in the field	3	4.7 %	64
		3. The material includes graphs, charts, maps, etc. that display relationships rather than original data	31	48.4 %	64
		4. Rhetoric relies on appeals to authority for persuasion	4	6.3 %	64
	Mean		17.5	27.4 %	64

The analysis of the 8th grade science textbook for category II (Science for Understanding Phenomena), Criterion IIA (Engagement with Phenomena) and indicator 1 (the material engages students with relevant phenomena through first-hand or vicarious experiences) showed that it met only 35.4 % of the Criterion IIA, indicator 1 (table 4.1.3.7) and figure 45 is an example that the textbook slightly engaged students with relevant phenomena through first-hand or vicarious experiences. In this example, the first hand activity engages students with Mendel's genetics.

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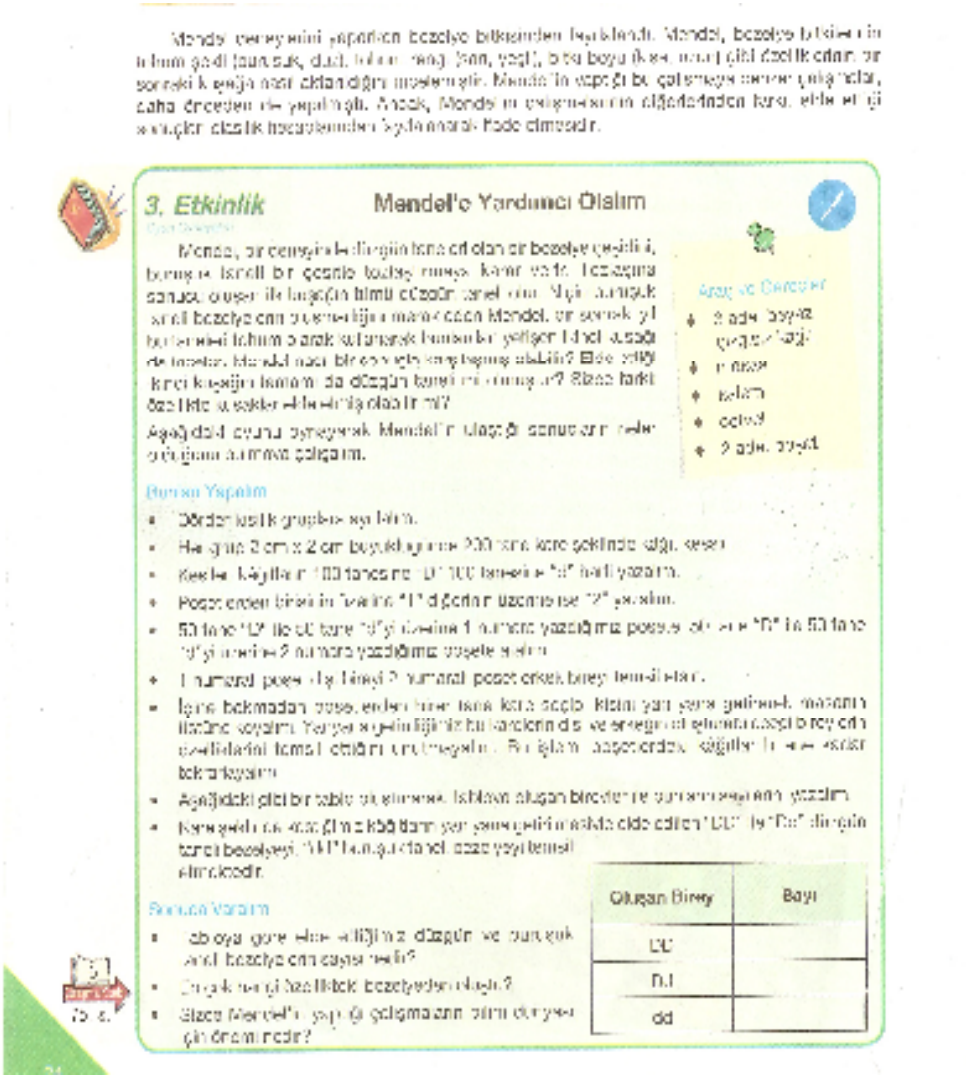
Table 4.1.3.7. Frequencies and percentages of the indicator 1 of criterion IIA in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	23	35.4 %	64



3. Etkinlik

Mendel'e Yardımcı Olalım

Araç ve Gereçler

Deney Yapalım

Sonuç Yapalım

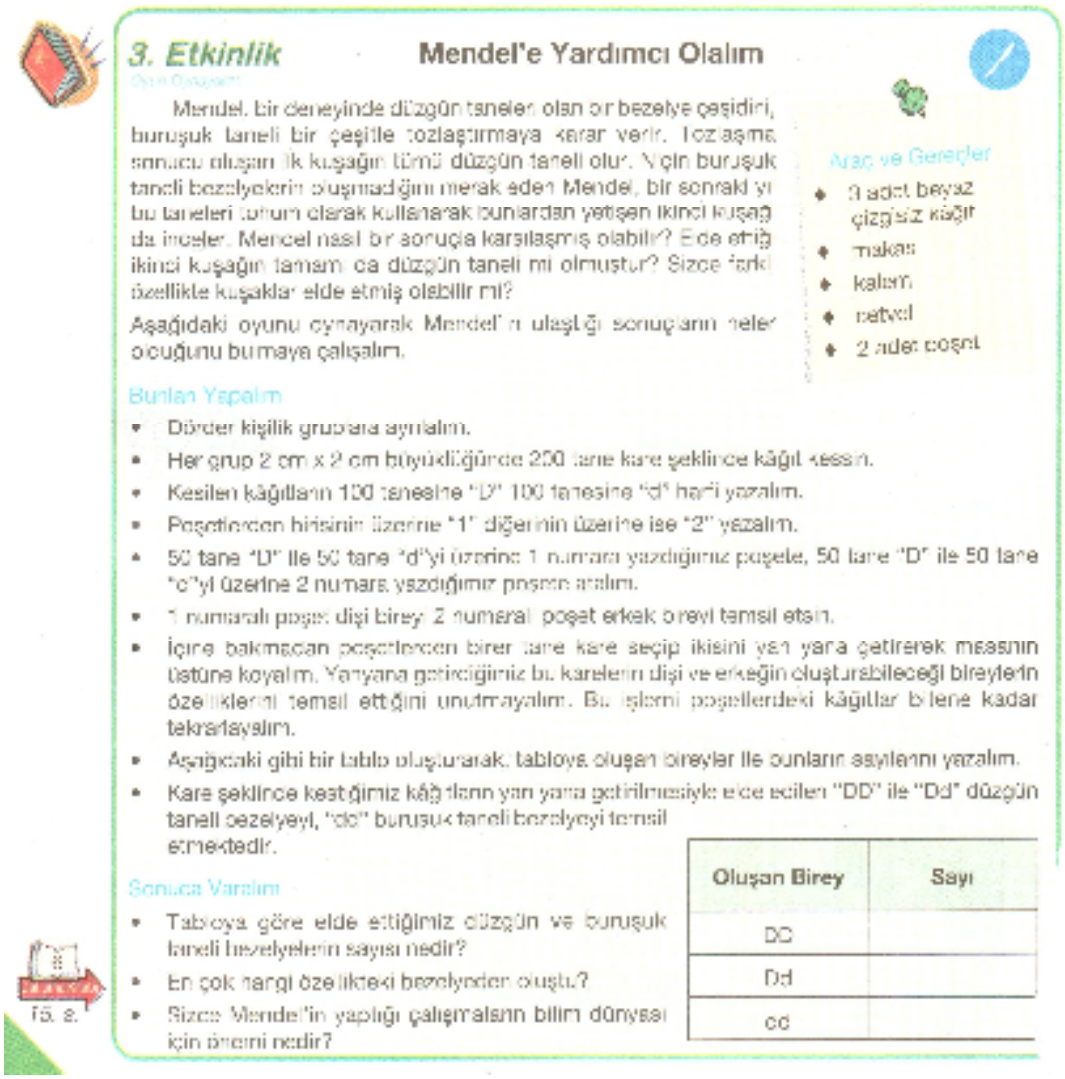
Oluşan Birey	Boyu
DD	
Dd	
dd	

Figure 45. An example in the science textbook that engages students with relevant phenomena through a first-hand experience (Tunç, T., et. al., 2008).

The 8th grade science textbook was analyzed according to category II (Science for Understanding Phenomena), Criterion IIA (Engagement with Phenomena) and indicator 2 (the primary purpose of the activities is to understand the scientific theory that explains the phenomena). Table 4.1.3.8 shows that the textbook met this indicator by a percentage of only 9.4 % and figure 46 is one of the few activities whose primary purpose is to understand the scientific theories. In this example, the activity aims students to understand the theory of Mendel's heredity theory.

Table 4.1.3.8. Frequencies and percentages of the indicator 2 of criterion IIA in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIA	2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	6	9.4 %	64



3. Etkinlik — **Mendel'e Yardımcı Olalım**

Mendel, bir deneyinde düzgün taneler olan bir bezelye çeşidini, buruşuk taneli bir çeşitle tozlaştırmaya karar verir. Tozlaşma sonucu oluşan ilk kuşağın tümü düzgün taneli olur. Için buruşuk taneli bezelyelerin oluşmadığını merak eden Mendel, bir sonraki yı bu taneleri tohum olarak kullanarak bunlardan yetişen ikinci kuşağ da inceler. Mendel nasıl bir soruçla karşılaşmış olabilir? Ede etliğ ikinci kuşağın tamamı da düzgün taneli mi olmuştur? Sizce farkl özellikte kuşaklar elde etmiş olabilir mi?

Aşağıdaki oyunu oynayarak Mendel'in ulaştığı sonuçların neler olduğunu bulmaya çalışalım.

Araç ve Gereçler

- 3 adet beyaz çizgisiz kâğıt
- makas
- kalem
- cetvel
- 2 adet poşet

Bunları Yapalım

- Dörder kişilik gruplara ayrılalım.
- Her grup 2 cm x 2 cm büyüklüğünde 200 tane kare şeklinde kâğıt kesin.
- Kesilen kâğıtların 100 tanesine "D" 100 tanesine "d" harfi yazalım.
- Poşetlerden birisinin üzerine "1" diğerinin üzerine ise "2" yazalım.
- 50 tane "D" ile 50 tane "d"yi üzerine 1 numara yazdığınız poşete, 50 tane "D" ile 50 tane "d"yi üzerine 2 numara yazdığınız poşete koyalım.
- 1 numaralı poşet dişi birey, 2 numaralı poşet erkek bireyi temsil etsin.
- İçine bakmadan poşetlerden birer tane kare seçip ikisini yan yana getirerek masanın üstüne koyalım. Yanyana getirdiğimiz bu karelerin dişi ve erkeğin oluşturabileceği bireylerin özelliklerini temsil ettiğini unutmayalım. Bu işlemi poşetlerdeki kâğıtlar bitene kadar tekrarlayalım.
- Aşağıdaki gibi bir tablo oluşturarak, tabloya oluşan bireyler ile bunların sayılarını yazalım.
- Kare şeklinde kesti̇ğimiz kâğıtların yan yana getirilmesiyle elde edilen "DD" ile "Dd" düzgün taneli bezelyeyi, "dd" buruşuk taneli bezelyeyi temsil etmektedir.

Oluşan Birey	Sayı
DD	
Dd	
dd	

Sonuca Varalım

- Tabloya göre elde ettiğimiz düzgün ve buruşuk taneli bezelyelerin sayısı nedir?
- En çok hangi özellikteki bezelyeden oluştu?
- Sizce Mendel'in yaptığı çalışmaların bilim dünyası için önemi nedir?

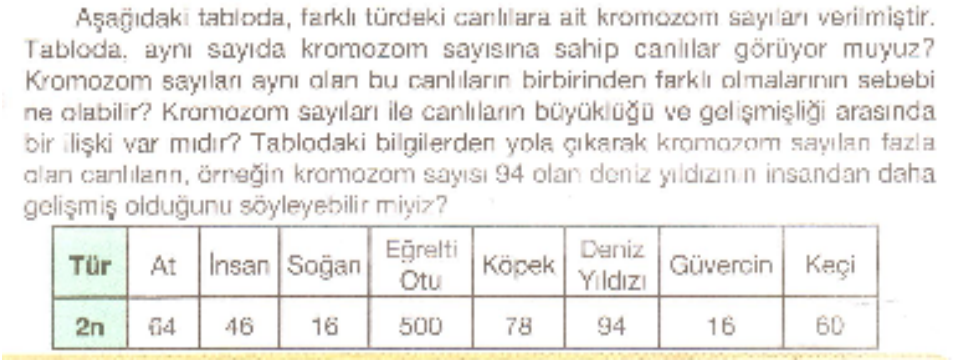
15. s.

Figure 46. An example in the science textbook in which the primary purpose of the activity is to understand the scientific theory that explains the phenomena (Tunç, T., et. al., 2008).

When the 8th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IIB (Identify and Address Student Ideas) and indicator 1 (the material includes questions or tasks that identify student naive conceptions) the result showed that it met the indicator 1 by 7.8 % (table 4.1.3.9). Figure 47 shows one of the few questions or tasks that identify the naive ideas of students. In this example, there are some questions which try to identify students' naive ideas about the number of chromosomes and the level of development.

Table 4.1.3.9. Frequencies and percentages of the indicator 1 of criterion IIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	5	7.8 %	64



Aşağıdaki tabloda, farklı türdeki canlılara ait kromozom sayıları verilmiştir. Tabloda, aynı sayıda kromozom sayısına sahip canlılar görüyor muyuz? Kromozom sayıları aynı olan bu canlıların birbirinden farklı olmalarının sebebi ne olabilir? Kromozom sayıları ile canlıların büyüklüğü ve gelişmişliği arasında bir ilişki var mıdır? Tablodaki bilgilerden yola çıkarak kromozom sayıları fazla olan canlıların, örneğin kromozom sayısı 94 olan deniz yıldızının insandan daha gelişmiş olduğunu söyleyebilir miyiz?

Tür	At	İnsan	Soğan	Eğrelti Otu	Köpek	Deniz Yıldızı	Güvercin	Keçi
2n	64	46	16	500	78	94	16	60

Figure 47. An example in the science textbook includes questions that identify students naive conceptions (Tunç, T., et. al., 2008).

The analysis of the 8th grade science textbook for category II (Science for Understanding Phenomena), Criterion IIB (Identify and Address Student Ideas) and indicator 2 (the material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts) showed that the textbook met only 7.8 % of the Criterion IIB, indicator 2 (table 4.1.3.10). Textbook included few questions or tasks that build on students' naive ideas (figure 48). In this example, there are some questions about the cell and differences among living beings which build on student naive ideas about this subject. However, some questions or tasks were followed by an explanation. Therefore, students did not have any opportunity to construct their own idea.

Table 4.1.3.10. Frequencies and percentages of the indicator 2 of criterion IIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIB (Identify and Address Student Ideas)	2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	5	7.8 %	64

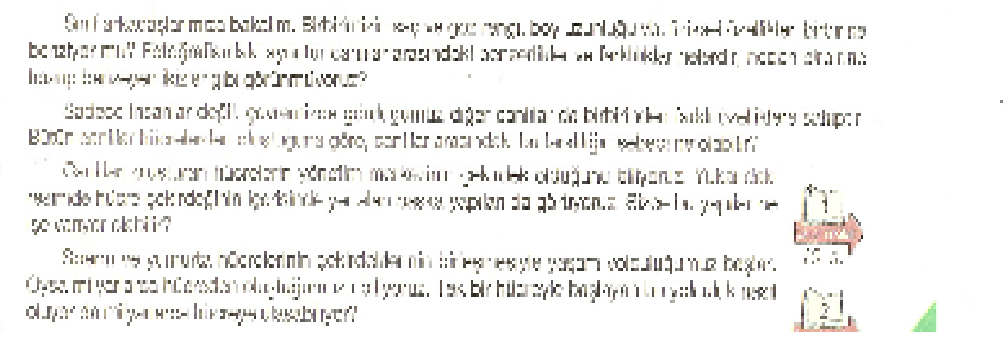


Figure 48. An example in the science textbook includes some questions that build on students' naive ideas about cell (Tunç, T., et. al., 2008).

The 8th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IIC (Developing and Using Scientific Ideas) and indicator 1 (the material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas). Table 4.1.3.11 shows that textbook did not meet this indicator for this criterion.

Table 4.1.3.11. Frequencies and percentages of the indicator 1 of criterion IIC in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	64

The analysis of the 8th grade science textbook which was done regarding category II (Science for Understanding Phenomena), Criterion IIC (Developing and Using Scientific Ideas) and indicator 2 (the material provides opportunities to apply scientific concepts in new contexts) showed that the textbook only met the indicator by a percentage of 25.0 (table 4.1.3.12). Figure 49 is one of the few opportunities to the students to apply scientific concepts in new contexts. This example helps students apply their scientific knowledge in an activity to understand the mechanism of heredity crossing.

Table 4.1.3.12. Frequencies and percentages of the indicator 2 of criterion IIC in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IIC (Developing and Using Scientific Ideas)	2. The material provides opportunities to apply scientific concepts in new contexts	16	25.0 %	64

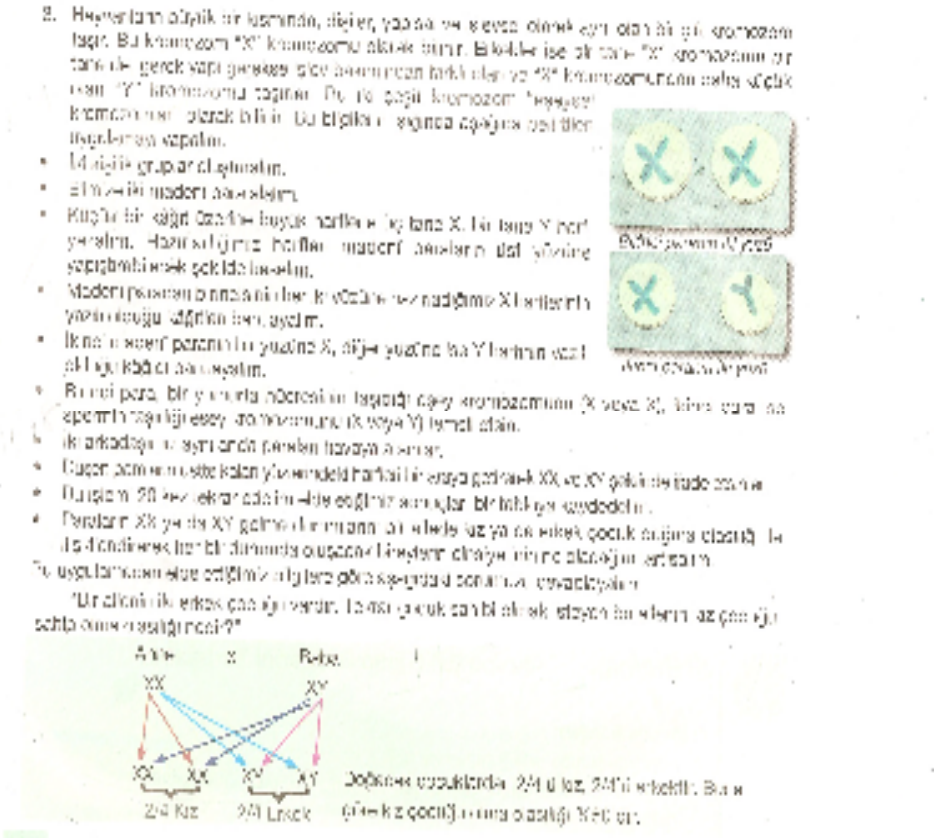


Figure 49. An example in the science textbook that provides opportunities to apply scientific concepts in new context (Tunç, T., et. al., 2008).

When the 8th grade science textbook was analyzed for category II (Science for Understanding Phenomena), Criterion IID (Promotes Student Thinking About Experiences and Knowledge), and indicator 1 (the material engages students in using scientific ideas to reason about phenomena), result showed that the indicator was met about 10.9 % (table 4.1.3.13). Textbook seldom engaged students to use scientific ideas to reason about phenomena. Figure 50 is an example of an activity which engages students by investigating the reproduction cells and forming a model to find the reasons about the differences between mitosis and meiosis cell division.

Table 4.1.3.13. Frequencies and percentages of the indicator 1 of criterion IID in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena	7	10.9 %	64

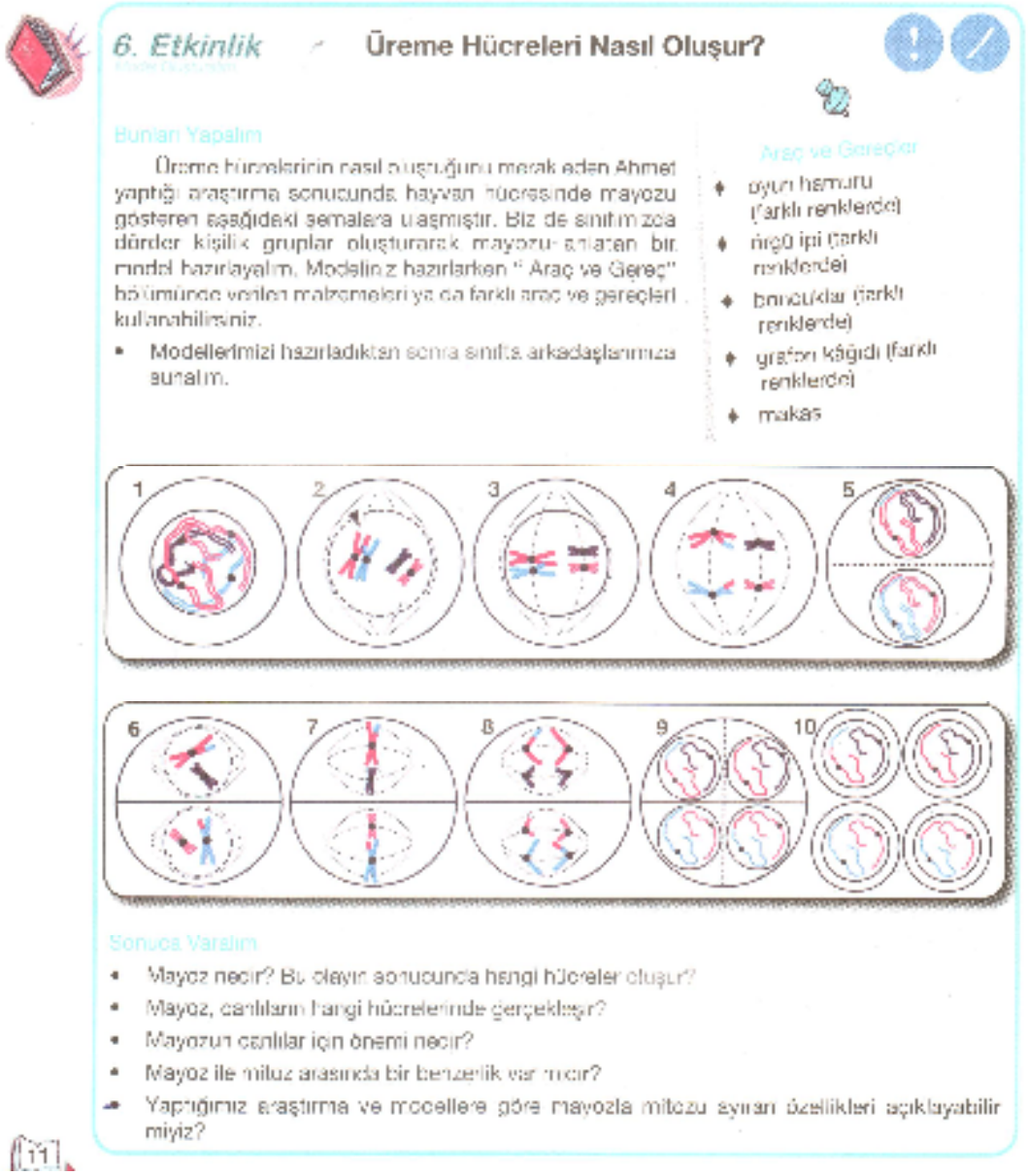
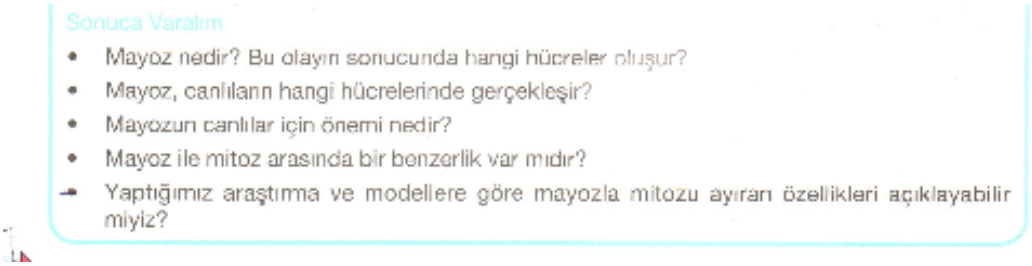


Figure 50. An example in the science textbook that engages students in using scientific ideas to reason about phenomena (Tunç, T., et. al., 2008).

The analysis of the 8th grade science textbook which was done in accordance to category II (Science for Understanding Phenomena), Criterion IID (Promotes Student Thinking About Experiences and Knowledge) and indicator 2 (the material provides students with opportunities to compare/contrast scientific ideas to their experiences) showed that the indicator was met by only 9.4 % (table 4.1.3.14). The textbook rarely provided opportunities to students to compare/contrast their experiences to scientific ideas. Figure 51 shows a part of activity which includes questions to students to compare their experiences gained in the activity with the scientific ideas about cell division.

Table 4.1.3.14. Frequencies and percentages of the indicator 2 of criterion IID in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
II	IID (Promotes Student Thinking About Experiences and Knowledge)	2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	6	9.4 %	64


Sonuca Varalım

- Mayoz nedir? Bu olayın sonucunda hangi hücreler oluşur?
- Mayoz, canlıların hangi hücrelerinde gerçekleşir?
- Mayozun canlılar için önemi nedir?
- Mayoz ile mitoz arasında bir benzerlik var mıdır?
- Yaptığımız araştırma ve modellere göre mayozla mitozu ayıran özellikleri açıklayabilir miyiz?

Figure 51. An example in the science textbook provides students with opportunity to compare scientific ideas to their experiences (Tunç, T., et. al., 2008).

The question stating "Does the material present science as the application of scientific theories and use of reasoning to understanding phenomena?" was answered in accordance to frequencies and percentages of the indicators for category II (Science for Understanding Phenomena). As the table 4.1.3.15 shows, 8th grade

science textbook met on an average of 22.4 % of Criterion IIA indicators, 7.8 % of Criterion IIB indicators, 12.5 % of Criterion IIC indicators and 10.1 % of Criterion IID indicators. The results showed that the textbook met relatively higher indicators of Criterion IIA.

The textbook slightly engaged students in real or vicarious phenomena (Criterion IIA). It rarely engaged students with relevant phenomena through first-hand or vicarious experiences (35.4 %). In addition, the primary purpose of the activities was rarely to understand the scientific theory that explains the phenomena.

Results also indicated that the textbook seldom identified common naive conceptions and addressed students' ideas in order to build a more scientifically acceptable understanding phenomena (Criterion IIB). It rarely included questions or tasks that identify students' naive conceptions (7.8 %), and slightly included questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts (7.8 %).

The textbook provided opportunities to develop reasoning and to practice applying new knowledge (Criterion IIC). It did not include any questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas (0 %), and rarely provided opportunities to apply scientific concepts in new contexts (25 %).

The textbook seldom promoted student thinking (Criterion IID). It slightly engaged students in using scientific ideas to reason about phenomena (10.9 %), and slightly provided students with opportunities to compare/contrast scientific ideas to their experiences (9.4 %).

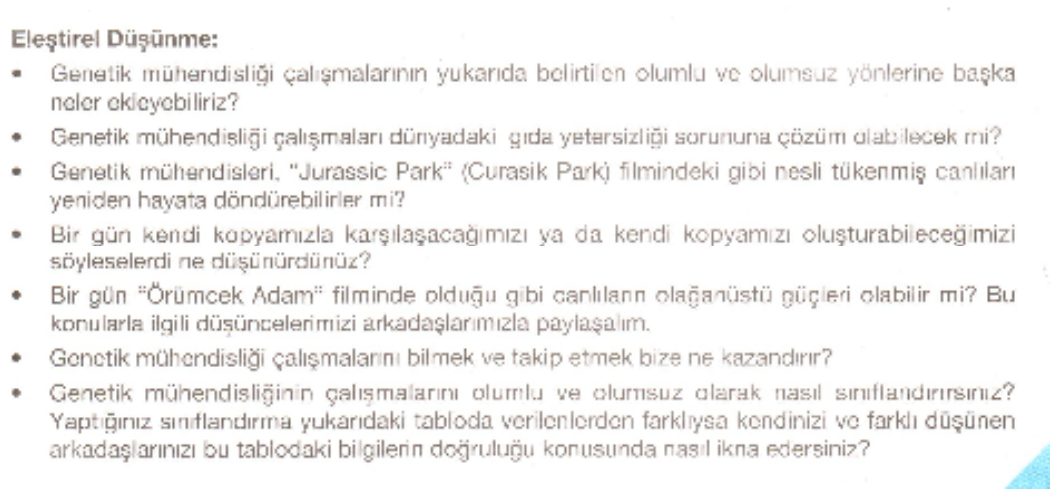
Table 4.1.3.15. Frequencies and Percentages of the category II criteria and indicators in 8th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of indicators	The total number of pages analyzed
II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	23	35.4 %	64
		2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	6	9.4 %	64
	Mean		14.5	22.4 %	64
	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	5	7.8 %	64
		2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	5	7.8 %	64
	Mean		5	7.8	64
	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	64
		2. The material provides opportunities to apply scientific concepts in new contexts	16	25.0 %	64
			8	12.5 %	64
	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena	7	10.9 %	64
		2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	6	9.4 %	64
			6.5	10.1 %	64

When the 8th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 1 (the material fosters a sense of curiosity and questioning about the natural and technological world), result showed that the textbook met only 21.8 % of the Criterion IIIA, indicator 1 (table 4.1.3.16). Textbook rarely fostered students' curiosity and questioning about nature and technology. Figure 52 shows some questions which foster a sense of curiosity about the technological world.

Table 4.1.3.16. Frequencies and percentages of the indicator 1 of criterion IIIA in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Science as the Social Construction of Knowledge)	1. The material fosters a sense of curiosity and questioning about the natural and technological world.	14	21.8 %	64



Eleştirel Düşünme:

- Genetik mühendisliği çalışmalarının yukarıda belirtilen olumlu ve olumsuz yönlerine başka neler ekleyebiliriz?
- Genetik mühendisliği çalışmaları dünyadaki gıda yetersizliği sorununa çözüm olabilecek mi?
- Genetik mühendisleri, "Jurassic Park" (Curasik Park) filmindeki gibi nesli tükenmiş canlıları yeniden hayata döndürebilirler mi?
- Bir gün kendi kopyamızla karşılaşacağımızı ya da kendi kopyamızı oluşturabileceğimizi söyleseler di ne düşünürdünüz?
- Bir gün "Örümcek Adam" filminde olduğu gibi canlıların olağanüstü güçleri olabilir mi? Bu konularla ilgili düşüncelerimizi arkadaşlarımızla paylaşalım.
- Genetik mühendisliği çalışmalarını bilmek ve takip etmek bize ne kazandırır?
- Genetik mühendisliğinin çalışmalarını olumlu ve olumsuz olarak nasıl sınıflandırırsınız? Yaptığınız sınıflandırma yukarıdaki tabloda verilenlerden farklıysa kendinizi ve farklı düşünen arkadaşlarınızı bu tablodaki bilgilerin doğruluğu konusunda nasıl ikna edersiniz?

Figure 52. An example in the science textbook that fosters the curiosity and questioning about the technological world (Tunç, T., et. al., 2008).

The analysis of the 8th grade science textbook was done according to category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement

with the Natural and Technological World) and indicator 2 (the materials include activities that engage students to find out what happens with the natural and technological world). The result, as shown in table 4.1.3.17, indicated that the textbook met this indicator only 14.0 %. Figure 53 shows one of the activities regarding the technological world which were rarely included in the textbook.

Table 4.1.3.17. Frequencies and percentages of the indicator 2 of criterion IIIA in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA	2. The materials include activities that engage students with the natural and technological world to find out what happens.	9	14 %	64

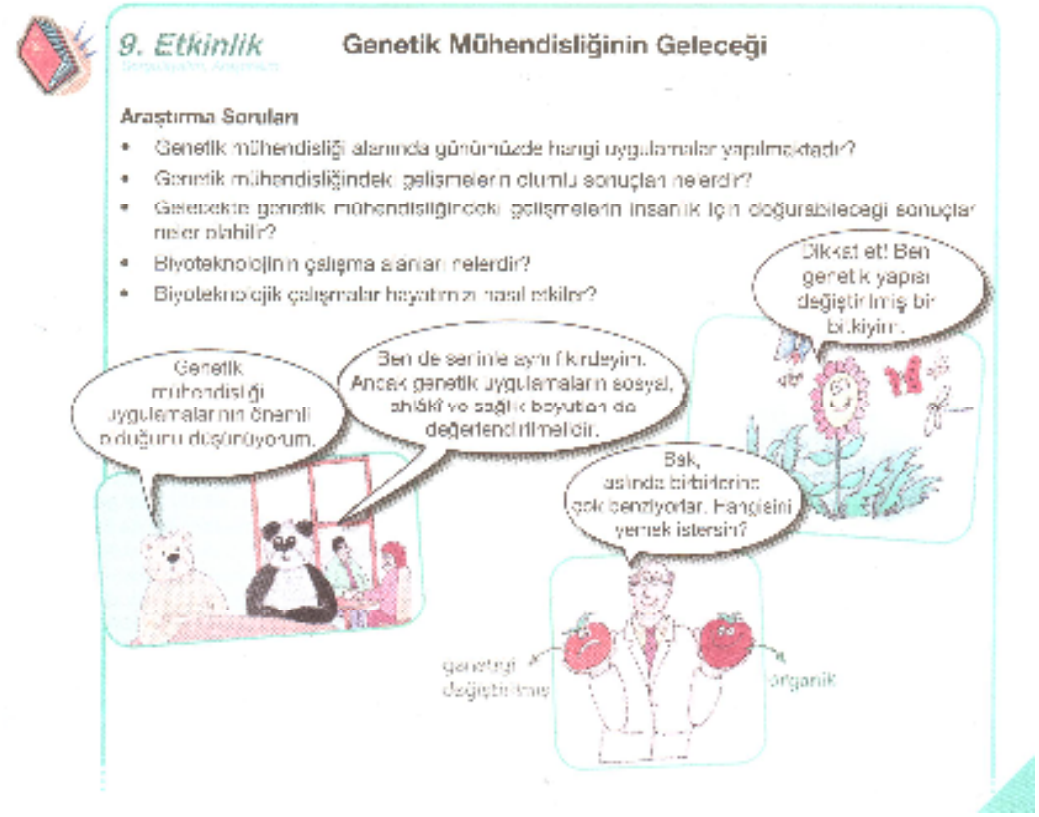
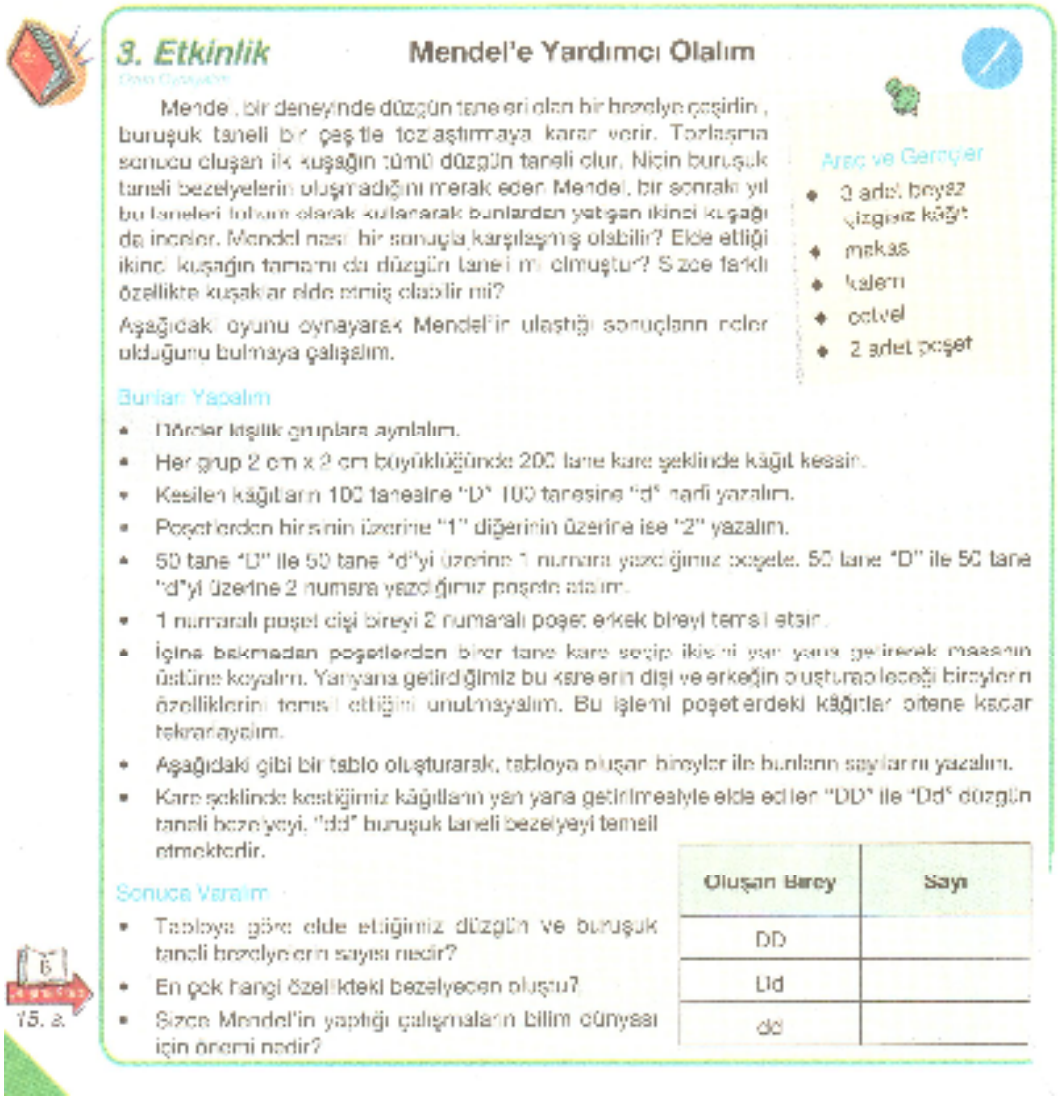


Figure 53. An example in the science textbook including an activity that engages students with technological and natural world (Tunç, T., et. al., 2008).

The 8th grade science textbook for category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World) and indicator 3 (the material includes activities that engage students in carefully and systematically recording what they see). The result showed that the textbook met only 3.1 % of the Criterion IIIA, indicator 3 (table 4.1.3.18). It provided students very few activities to record what they see. Figure 54 shows an activity in which systematical recording is stressed.

Table 4.1.3.18. Frequencies and percentages of the indicator 3 of criterion IIIA in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	3. The material includes activities that engage students in carefully and systematically recording what they see.	2	3.1 %	64



3. Etkinlik

Mendel'e Yardımcı Olalım

Mendel, bir deneyinde düzgün taneli olan bir bezelye çeşidini, buruşuk taneli bir çeşitle tozlaştırmaya karar verir. Tozlaşma sonucu oluşan ilk kuşağın tümü düzgün taneli olur. Niçin buruşuk taneli bezelyelerin oluşmadığını merak eden Mendel, bir sonraki yıl bu taneleri tohum olarak kullanarak bunlardan yetişen ikinci kuşağı da inceler. Mendel nasıl bir sonuçla karşılaşmış olabilir? Elde ettiği ikinci kuşağın tamamı da düzgün taneli mi olmuştur? Sizce farklı özellikte kuşaklar elde etmiş olabilir mi?

Aşağıdaki oyunu oynayarak Mendel'in ulaştığı sonuçların neler olduğunu bulmaya çalışalım.

Araç ve Gereçler

- 3 adet beyaz çizgisiz kâğıt
- makas
- kalem
- cetvel
- 2 adet poşet

Bunları Yapalım

- Öğrenciler eşitlik gruplara ayrılsın.
- Her grup 2 cm x 2 cm büyüklüğünde 200 tane kare şeklinde kâğıt kessin.
- Kesilen kâğıtların 100 tanesine "D" 100 tanesine "d" harfi yazalım.
- Poşetlerden birisinin üzerine "1" diğerinin üzerine ise "2" yazalım.
- 50 tane "D" ile 50 tane "d"yi üzerine 1 numara yazdığımız poşete, 50 tane "D" ile 50 tane "d"yi üzerine 2 numara yazdığımız poşete atalım.
- 1 numaralı poşet dişi bireyi 2 numaralı poşet erkek bireyi temsil etsin.
- İçine bakmadan poşetlerden birer tane kare seçip ikisini yan yana getirerek masanın üstüne koyalım. Yanyana getirdiğimiz bu iki renk dişi ve erkeğin oluşturacağı bireylerin özelliklerini temsil ettiğini unutmayalım. Bu işlemi poşetlerdeki kâğıtlar bitene kadar tekrarlayalım.
- Aşağıdaki gibi bir tablo oluşturarak, tabloya oluşan bireyler ile bunların sayılarını yazalım.
- Kare şeklinde kestiğimiz kâğıtların yan yana getirilmesiyle elde edilen "DD" ile "Dd" düzgün taneli bezelyeyi, "dd" buruşuk taneli bezelyeyi temsil etmektedir.

Oluşan Birey	Sayı
DD	
Dd	
dd	

Sonuca Varalım

- Tabloya göre elde ettiğimiz düzgün ve buruşuk taneli bezelyelerin sayısı nedir?
- En çok hangi özellikteki bezelyeden oluştu?
- Sizce Mendel'in yaptığı çalışmaların bilim dünyası için önemi nedir?

15. s.

Figure 54. An example in the science textbook including an activity that engages students to record what they see systematically (Tunç, T., et. al., 2008).

The analysis of the 8th grade science textbook which was done according to category III (Science as the Social Construction of Knowledge), Criterion IIIA (Engagement with the Natural and Technological World and indicator 4 (activities use instruments and equipment to enhance and extend the senses) indicated that the textbook met the indicator by a percentage of 3.1 (table 4.1.3.19) and figure 55 shows one of the few activities where instruments and equipments were used to extend the sense of students to understand the mechnanism of respiration without oxygen.

Table 4.1.3.19. Frequencies and percentages of the indicator 4 of criterion IIIA in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIA (Engagement with the Natural and Technological World)	4. Activities use instruments and equipment to enhance and extend the senses	2	3.1 %	64

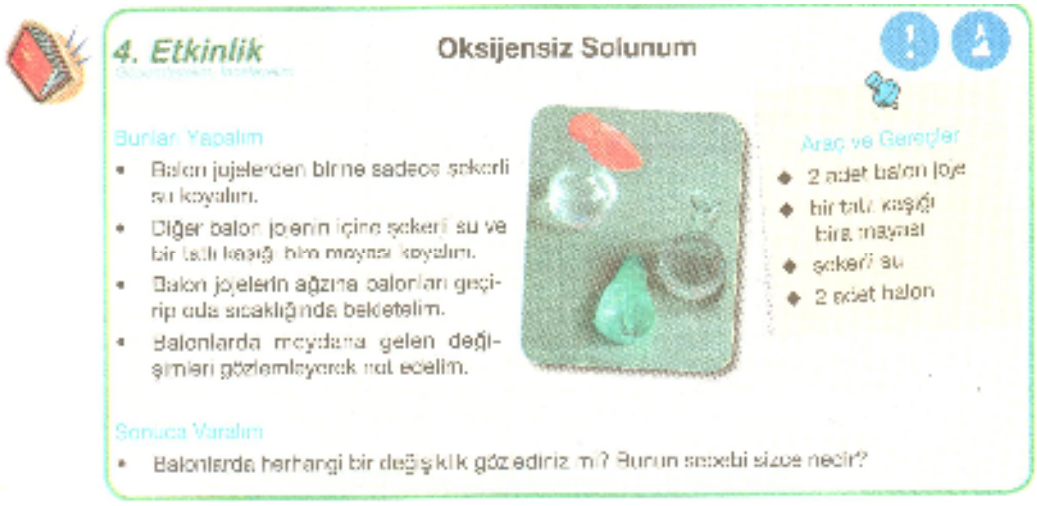
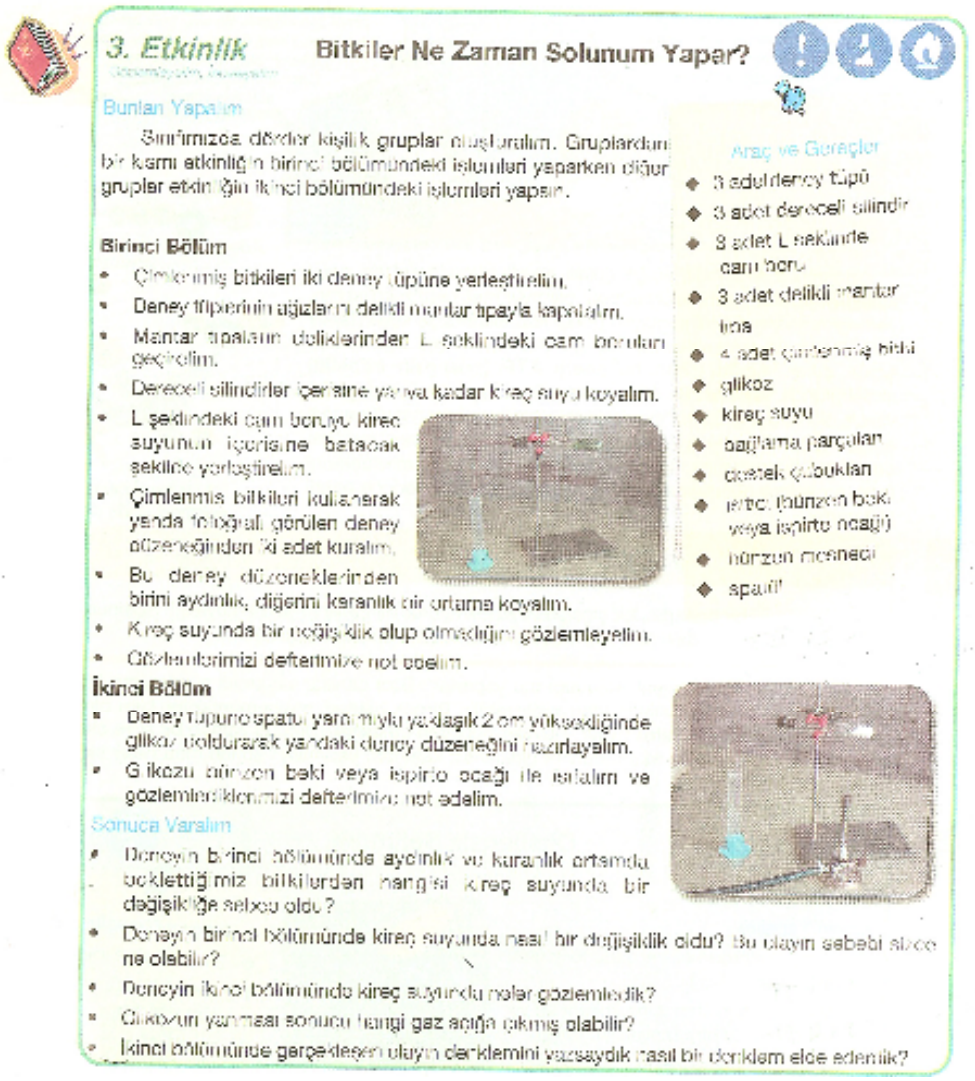


Figure 55. An example in the science textbook including an activity that uses instruments to extend or enhance the senses (Tunç, T., et. al., 2008).

When the 8th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Argument from Evidence) and indicator 1 (when students engage in data collection, technique and methods are stressed), result showed that the textbook met the indicator only by 4.7 % (table 4.1.3.20) Techniques and methods of data collection were rarely stressed. Figure 56 shows an activity in which data collection methods are stressed.

Table 4.1.3.20. Frequencies and percentages of the indicator 1 of criterion IIIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed	3	4.7 %	64



3. Etkinlik

Bitkiler Ne Zaman Solunum Yapar?

Bunları Yapalım

Sınıfımızda dörder kişilik gruplar oluşturalım. Gruplardan bir kısmı etkinliğin birinci bölümündeki işlemleri yaparken diğer gruplar etkinliğin ikinci bölümündeki işlemleri yapsın.

Araç ve Gereçler

- 3 adet deney tüpü
- 3 adet dereceli silindir
- 3 adet L şeklinde cam boru
- 3 adet delikli mantar tıpa
- 4 adet çimlenmiş bitki
- glikoz
- kireç suyu
- pamuk parçaları
- ahşap çubuklar
- ispirto (bünzen bek veya ispirto ocağı)
- bünzen musluğu
- spatül

Birinci Bölüm

- Çimlenmiş bitkileri iki deney tüpüne yerleştirelim.
- Deney tüplerinin ağızlarını delikli mantar tıpayla kapatalım.
- Mantar tıpaların deliklerinden L şeklindeki cam boruları geçirelim.
- Dereceli silindirler içerisine yarıya kadar kireç suyu koyalım.
- L şeklindeki cam boruyu kireç suyunun içerisine batacak şekilde yerleştirelim.
- Çimlenmiş bitkileri kullanarak yanda fotoğrafı görülen deney düzeneğinden iki adet kuralım.
- Bu deney düzeneklerinden birini aydınlık, diğerini karanlık bir ortama koyalım.
- Kireç suyunda bir değişiklik olup olmadığını gözlemleyelim.
- Gözlemlerimizi defterimize not edelim.

İkinci Bölüm

- Deney tüpüne spatül yardımıyla yaklaşık 2 cm yüksekliğinde glikoz doldurarak yandaki deney düzeneğini hazırlayalım.
- Glikozu bünzen beki veya ispirto ocağı ile ısıtalım ve gözlemlerimizi defterimize not edelim.

Sonuca Varalım

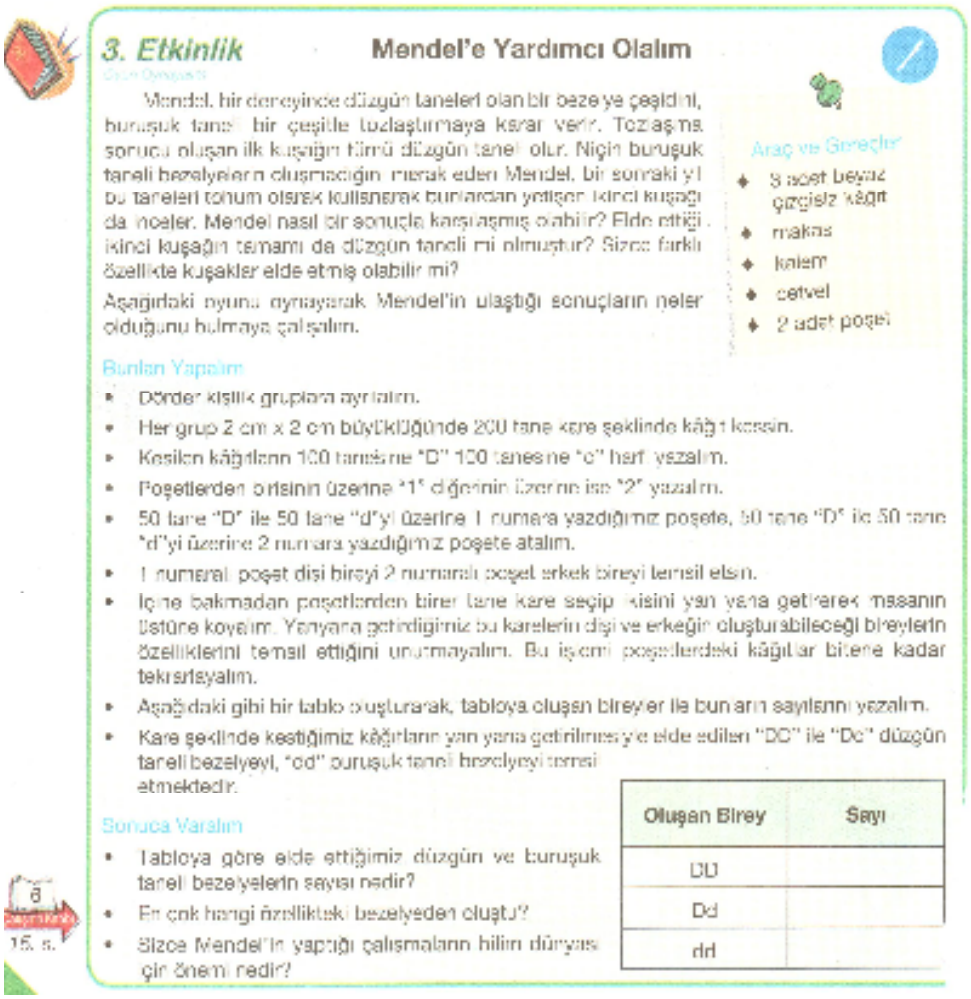
- Deneyin birinci bölümünde aydınlık ve karanlık ortamda büyüttüğümüz bitkilerden hangisi kireç suyunda bir değişikliğe sebep oldu?
- Deneyin birinci bölümünde kireç suyunda nasıl bir değişiklik oldu? Bu olayın sebebi sizce ne olabilir?
- Deneyin ikinci bölümünde kireç suyunda neler gözlemledik?
- Glikozun yanması sonucu hangi gaz açığa çıkmış olabilir?
- İkinci bölümünde gerçekleşen olayın denklemini yazsaydık nasıl bir denklem elde edebilirdik?

Figure 56. An example in the science textbook that includes an activity, techniques and methods of data collection (Tunç, T., et. al., 2008).

The analysis of the 8th grade science textbook which was done in accordance to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 2 (when presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions) showed that the textbook met the indicator only by 6.3 % (table 4.1.3.21). Techniques and methods of scientists were not presented well enough. Figure 57 presents the method of Mendel that led to him important conclusions about heredity.

Table 4.1.3.21. Frequencies and percentages of the indicator 2 of criterion IIIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	4	6.3 %	64



3. Etkinlik — **Mendel'e Yardımcı Olalım**

Mendel, bir deneyinde düzgün taneleri olan bir bezelye çeşidini, buruşuk taneli bir çeşitle tozlaştırmaya karar verir. Tozlaşma sonucu oluşan ilk kuşağın tümü düzgün taneli olur. Niçin buruşuk taneli bezelyelerin oluşmadığını merak eden Mendel, bir sonraki yıl bu taneleri tohum olarak kullanarak bunlardan yetişen ikinci kuşağı da incelер. Mendel nasıl bir sonuçla karşılaşmış olabilir? Elde ettiği ikinci kuşağın tamamı da düzgün taneli mi olmuştur? Sizce farklı özellikte kuşaklar elde etmiş olabilir mi?

Aşağıdaki oyunu oynayarak Mendel'in ulaştığı sonuçların neler olduğunu bulmaya çalışalım.

Araç ve Gereçler

- 8 adet beyaz çizgisiz kâğıt
- makas
- kalem
- cetvel
- 2 adet poşet

Bunları Yapalım

- Dörder kişilik gruplara ayrılalım.
- Her grup 2 cm x 2 cm büyüklüğünde 200 tane kare şeklinde kâğıt kessin.
- Kesilen kâğıtların 100 tanesine "D" 100 tanesine "d" harfi yazalım.
- Poşetlerden birinin üzerine "1" diğerinin üzerine ise "2" yazalım.
- 50 tane "D" ile 50 tane "d"yi üzerine 1 numara yazdığımız poşete, 50 tane "D" ile 50 tane "d"yi üzerine 2 numara yazdığımız poşete atalım.
- 1 numaralı poşet dişi bireyi 2 numaralı poşet erkek bireyi temsil etsin.
- İçine bakmadan poşetlerden birer tane kare seçip kâğıdını yan yana getirerek masanın üstüne koyalım. Yanyana getirdiğimiz bu karelerin dişi ve erkeğin oluşturabileceği bireylerin özelliklerini temsil ettiğini unutmayalım. Bu işlemi poşetlerdeki kâğıtlar bitene kadar tekrarlayalım.
- Aşağıdaki gibi bir tablo oluşturarak, tabloya oluşan bireyler ile bunların sayılarını yazalım.
- Kare şeklinde kestiğimiz kâğıtların yan yana getirilmesiyle elde edilen "DD" ile "Dd" düzgün taneli bezelyeyi, "dd" buruşuk taneli bezelyeyi temsil etmektedir.

Oluşan Birey	Sayı
DD	
Dd	
dd	

Sonuca Varalım

- Tabloya göre elde ettiğimiz düzgün ve buruşuk taneli bezelyelerin sayısı nedir?
- En çok hangi özellikteki bezelyeden oluştu?
- Sizce Mendel'in yaptığı çalışmaların bilim dünyası için önemi nedir?

15. s.

Figure 57. An example in the science textbook that presents the methods of a scientist that led to important conclusions (Tunç, T., et. al., 2008).

The 8th grade science textbook was analyzed according to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence), and indicator 3 (students develop techniques or methods to address their questions and hypotheses). Table 4.1.3.22 shows that the textbook did not meet this indicator.

Table 4.1.3.22. Frequencies and percentages of the indicator 3 of criterion IIIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	64

The analysis of the 8th grade science textbook regarding category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 4 (students use their own experiences/data to identify patterns and relationships) showed that the indicator was met by a percentage of 4.7 (table 4.1.3.23). Not enough opportunities were provided to the students to use their data to identify patterns or relationships in the textbook and figure 58 is one of the few example presented in the textbook. In this example, students are encouraged to use their own experiences about mitosis to identify the patterns of it.

Table 4.1.3.23. Frequencies and percentages of the indicator 4 of criterion IIIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	4. Students use their own experiences/data to identify patterns and relationships	3	4.7 %	64

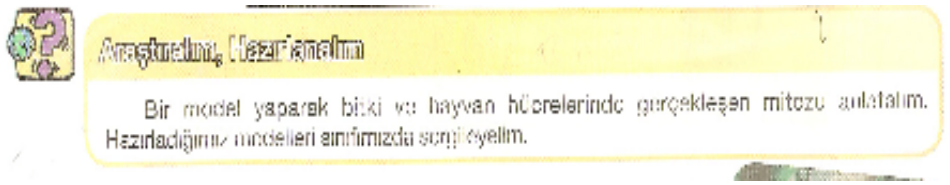


Figure 58. An example in the science textbook that provides students an opportunity to use their own experiences to identify patterns (Tunç, T., et. al., 2008).

The result of the analysis of 8th grade science textbook for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 5 (the material includes data that support relationships shown in graphs, charts, maps, pictures etc.) showed that the textbook only met the indicator by 3.1 % (table 4.1.3.24) and it included only two cases that support relationship shown in table which is demonstrated in figure 59. In this example, data were presented a relationship between amount of carbon dioxide and energy sources which shown in a graph.

Table 4.1.3.24. Frequencies and percentages of the indicator 5 of criterion IIIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	5. The material includes data that support relationships shown in graphs, charts, maps, pictures etc.	2	3.1 %	64

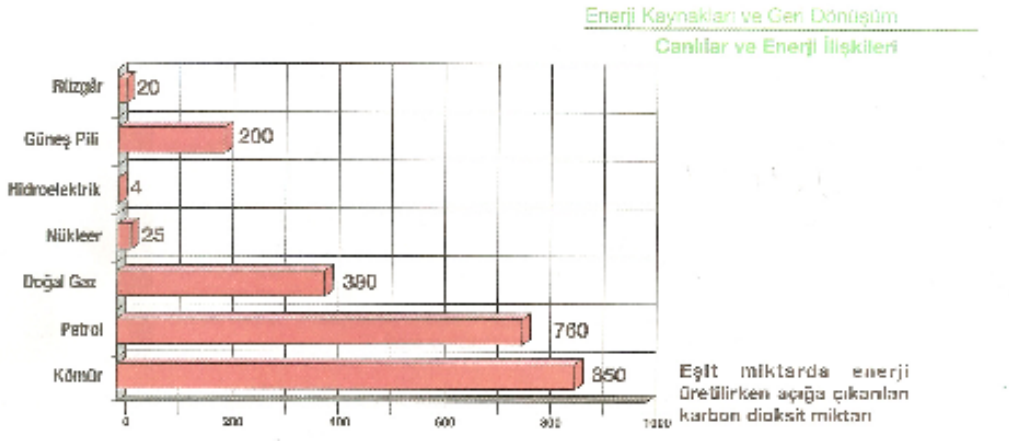


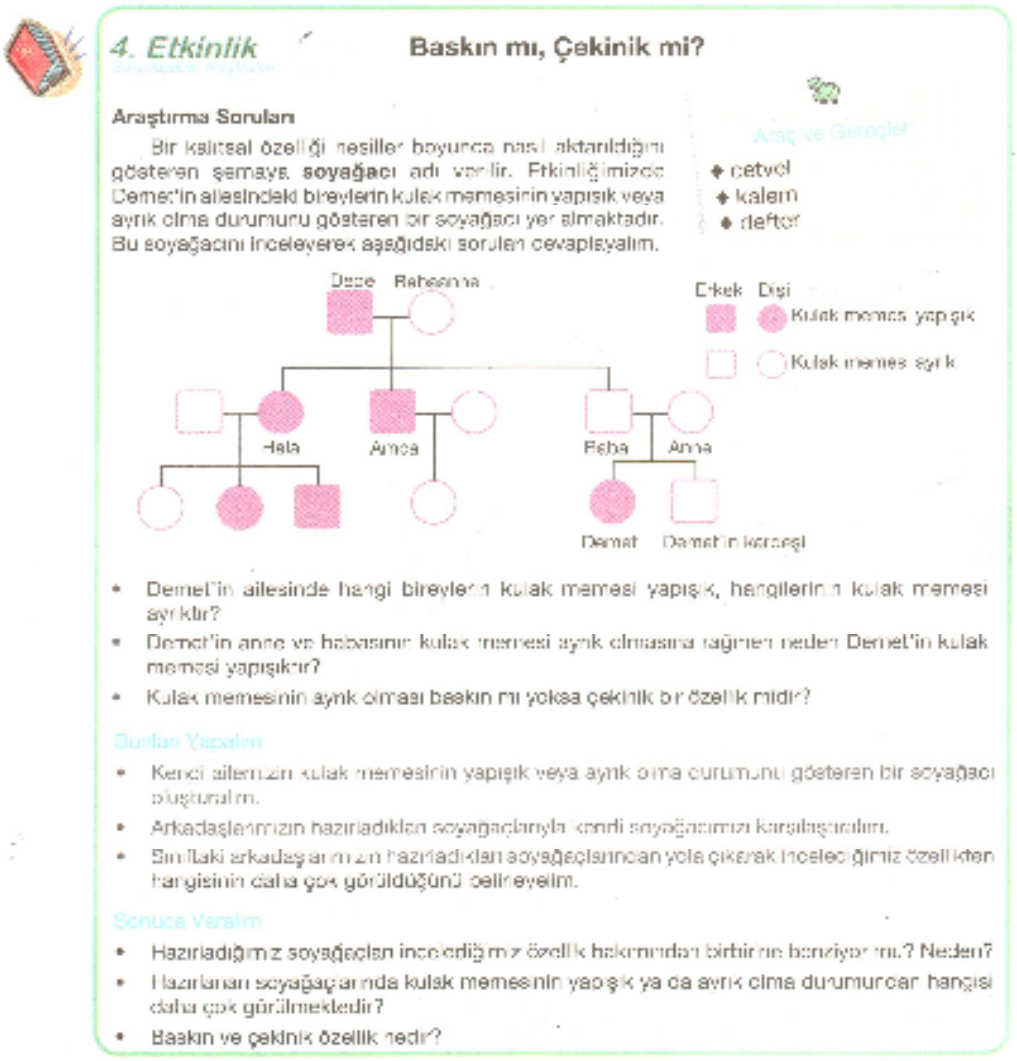
Figure 59. An example in the science textbook including data that support relationships shown in the graph (Tunç, T., et. al., 2008).

When the 8th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 6 (students are encouraged to use their own experiences/data to develop

and support arguments), result indicated that the textbook met indicator 6 by a percentage of 32.8 (table 4.1.3.25). As shown in figure 60, students were seldom encouraged to use their data to develop arguments. In this example, students are encourage to use their experiences about heredity problems to develop and support arguments.

Table 4.1.3.25. Frequencies and percentages of the indicator 6 of criterion IIIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	6. Students are encouraged to use their own experiences/data to develop and support arguments	21	32.8 %	64



4. Etkinlik

Baskın mı, Çekinik mi?

Araştırma Soruları

Bir kalıtsal özelliği nesiller boyunca nasıl aktarıldığını gösteren şemaya **soyağacı** adı verilir. Etkinliğimizde Demet'in ailesindeki bireylerin kulak memesinin yapışık veya ayrık olma durumunu gösteren bir soyağacı yer almaktadır. Bu soyağacını inceleyerek aşağıdaki soruları cevaplayalım.

Araç ve Gereçler

- cetvel
- kalem
- defter

- Demet'in ailesinde hangi bireylerin kulak memesi yapışık, hangilerinin kulak memesi ayrıktır?
- Demet'in anne ve babasının kulak memesi ayrık olmasına rağmen neden Demet'in kulak memesi yapışıktır?
- Kulak memesinin ayrık olması baskın mı yoksa çekinik bir özellik midir?

Bunları Yapalım

- Kendi ailemizin kulak memesinin yapışık veya ayrık olma durumunu gösteren bir soyağacı oluşturalım.
- Arkadaşlarımızın hazırladıkları soyağaçlarıyla kendi soyağacımızı karşılaştıralım.
- Sınıftaki arkadaşlarımızın hazırladıkları soyağaçlarından yola çıkarak incelediğimiz özellikten hangisinin daha çok görüldüğünü belirleyelim.

Sonuca Varalım

- Hazırladığımız soyağaçları incelediğimiz özellik bakımından birbirine benziyor mu? Neden?
- Hazırlanan soyağaçlarında kulak memesinin yapışık ya da ayrık olma durumlarından hangisi daha çok görülmektedir?
- Baskın ve çekinik özellik nedir?

Figure 60. An example in the science textbook including an activity which encourages students to use their own data or experiences (Tunç, T., et. al., 2008).

The 8th grade science textbook was analyzed according to category III (Science as the Social Construction of Knowledge), Criterion IIIB (Arguments from Evidence) and indicator 7 (text relies on empirical data rather than appeals to authority to support arguments). As demonstrated in the table 4.1.3.26 the indicator did not meet this indicator.

Table 4.1.3.26. Frequencies and percentages of the indicator 7 of criterion IIIB in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIB (Arguments from Evidence)	7. Text relies on empirical data rather than appeals to authority to support arguments	-	0 %	64

The result of the analysis done with the 8th grade science textbook for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation), and indicator 1 (the material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data) indicated that the textbook did not meet this indicator (table 4.1.3.27).

Table 4.1.3.27. Frequencies and percentages of the indicator 1 of criterion IIIC in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	-	0 %	64

The 8th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 2 (the material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes

made to claims as a result of the collective efforts of the scientific community). As shown in table 4.1.3.28, the textbook did not meet this indicator.

Table 4.1.3.28. Frequencies and percentages of the indicator 2 of criterion IIIC in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC	2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community	-	0 %	64

The 8th grade science textbook was analyzed for category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation) and indicator 3 (the material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence). The result showed that the textbook did not meet this indicator (table 4.1.3.29).

Table 4.1.3.29. Frequencies and percentages of the indicator 3 of criterion IIIC in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC	3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	64

The 8th grade science textbook was analyzed in accordance to category III (Science as the Social Construction of Knowledge), Criterion IIIC (Collective Validation), and indicator 4 (the material emphasizes the special status of scientific understanding reached through community consensus). The result indicated that the textbook did not meet this indicator (table 4.1.3.30).

Table 4.1.3.30. Frequencies and percentages of the indicator 4 of criterion IIIC in 8th grade science textbook

Category	Criterion	Indicator	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
III	IIIC	4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	64

When considering if material presents science as the social construction of facts and scientific understanding (Category III- Science as the Social Construction of Knowledge), it was found that 8th grade textbook met 10.5 % of Criterion IIIA

indicators, 7.4 % of Criterion IIIB indicators, and 2.4 % of Criterion IIIC indicators. The textbook met relatively higher indicators of Criterion IIIA than the other two criteria.

The textbook supported intense engagement with the natural and technological world (Criterion IIIA). It rarely fostered a sense of curiosity and questioning about the natural and technological world (21.8 %), included few activities that engage students to find out what happens with the natural and technological world (14. %) included very few activities that engage students in carefully and systematically recording what they see (3.1 %). Lastly, activities rarely used instruments and equipment to enhance and extend the senses (3.1 %).

The textbook slightly made arguments based on evidence as opposed to presenting only conclusions (Criterion IIIB). During data collection, technique and methods were slightly stressed (4.7 %). When presenting concepts, the textbook slightly presented the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions (6.3 %). Students did not develop techniques or methods to address their questions and hypotheses (0 %). Textbook seldom included data that support relationships shown in graphs, charts, maps, etc. (3.1 %). Students were slightly encouraged to use their own experiences/data to develop and support arguments (32.8 %). Lastly, text rarely relied on empirical data rather than appeals to authority to support arguments (6.3 %).

Additionally, the textbook did not meet the indicators of criterion IIIC.

Table 4.1.3.31. Frequencies and Percentages of the category III criteria and indicators in 8th grade science textbook

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed

(Table 4.1.3.31. Continued **)**

III	IIIA (Engagement with the Natural and Technological World)	1. The material fosters a sense of curiosity and questioning about the natural and technological world.	14	21.8 %	64
		2. The materials include activities that engage students with the natural and technological world to find out what happens. (experimental science)	9	14 %	64
		3. The material includes activities that engage students in carefully and systematically recording what they see. (field sciences)	2	3.1 %	64
		4. Activities use instruments and equipment to enhance and extend the senses	2	3.1 %	64
	Mean		6.8	10.5 %	64
	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed	3	4.7 %	64
		2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	4	6.3 %	64
		3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	64
		4. Students use their own experiences/data to identify patterns and relationships	3	4.7 %	64
		5. The material includes data that support relationships shown in graphs, charts, maps, etc.	2	3.1 %	64
		6. Students are encouraged to use their own experiences/data to develop and support arguments	21	32.8 %	64
		7. Text relies on empirical data rather than appeals to authority to support arguments	-	0 %	64

(Table 4.1.3.31. Continued**)**

	Mean		4.7	7.4 %	64
	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data		0 %	64
		2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community	-	0 %	64
		3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	64
		4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	64
	Mean		-	0 %	64

4.1.4. Summarıy of the Results

In this part, summary tables of 6th, 7th and 8th grade science textbooks were presented. The results of the three science textbooks were compared.

The study results in table 4.1.4.1 indicated that 6th grade science textbook met 31 % of the category I criteria and indicators, 12.8 % of the category II criteria and indicators and 9.8 % of the category III criteria and indicators. This means that it relatively presented science as an authoritative knowledge (Category I). Then the textbook slightly presented science as the application of scientific theories and use of reasoning to understanding phenomena (Category II) and very slightly presented science as the social construction of facts and scientific understanding (Category III).

Table 4.1.4.1. Frequencies and Percentages of the indicators in 6th Grade Science Textbook for Category I, II and III.

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	22	32.8%	67
	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments	44	65.7 %	67
		2. The material focuses on the most important theories and models in the field	2	2.9 %	67
		3. The material includes graphs, charts, maps, etc. that display relationships rather than original data	34	50.7 %	67
		4. Rhetoric relies on appeals to authority for persuasio	2	2.9 %	67
	Mean		20.8	31 %	67

(Table 4.1.4.1. Continued**)**

II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	29	43 %	67
		2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	4	5.9 %	67
	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	10	14.9 %	67
		2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	-	0 %	67
	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	67
		2. The material provides opportunities to apply scientific concepts in new contexts	6	8.9 %	67
	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena	9	13.4 %	67
		2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	11	16.4 %	67

(Table 4.1.4.1. Continued**)**

	Mean		8.6	12.8 %	67
III	IIIA (Engagement with the Natural and Technological World)	1. The material fosters a sense of curiosity and questioning about the natural and technological world.	13	19.4 %	67
		2. The materials include activities that engage students with the natural and technological world to find out what happens. (experimental science)	13	19.4 %	67
		3. The material includes activities that engage students in carefully and systematically recording what they see. (field sciences)	4	5.9 %	67
		4. Activities use instruments and equipment to enhance and extend the senses	10	14.9 %	67
	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed	5	7.5 %	67
		2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions (	6	8.9 %	67
		3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	67
		4. Students use their own experiences/data to identify patterns and relationships	7	10.4 %	67
		5. The material includes data that support relationships shown in graphs, charts, maps, etc.	1	1,5 %	67
		6. Students are encouraged to use their own experiences/data to develop and support arguments	20	29,9 %	67

(Table 4.1.4.1. Continued**)**

		7. Text relies on empirical data rather than appeals to authority to support arguments	11	16.4 %	67
	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	7	10.4 %	67
		2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community	-	0 %	67
		3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	67
		4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	67
	Mean		6.5	9.8 %	67

The study results in table 4.1.4.2 indicated that 7th grade science textbook met 13.24 % of category I criteria and indicators, 8.4 % of category II criteria and indicators, and 4.9 % of category III criteria and indicators. The textbook fit category II (science for understanding phenomena) comparatively higher than other categories. The textbook slightly met all the indicators and criteria of categories.

Table 4.1.4.2. Frequencies and Percentages of the indicators in 7th grade science textbook for Category I, II and III

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	20	27 %	74
	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments	2	2.7 %	74
		2. The material focuses on the most important theories and models in the field	-	0 %	74
		3. The material includes graphs, charts, maps, etc. that display relationships rather than original data	25	33.8 %	74
		4. Rhetoric relies on appeals to authority for persuasion	2	2.7 %	74
	Mean		9.8	13.24%	74
II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	17	22.9 %	74
		2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	3	4.0 %	74
	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	14	18.9 %	74
		2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	-	0 %	74

(Table 4.1.4.2. Continued**)**

	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas	-	0 %	74
		2. The material provides opportunities to apply scientific concepts in new contexts	10	13.5 %	74
	IID (Promotes Student Thinking About Experiences and Knowledge)	The material engages students in using scientific ideas to reason about phenomena	3	4.0 %	74
		2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	3	4.0 %	74
	Mean		6.3	8.4 %	74
III	IIIA (Engagement with the Natural and Technological World)	The material fosters a sense of curiosity and questioning about the natural and technological world.	16	21.6 %	74
		2. The materials include activities that engage students with the natural and technological world to find out what happens. (experimental science)	13	17.6 %	74
		3. The material includes activities that engage students in carefully and systematically recording what they see. (field sciences)	-	0 %	74
		4. Activities use instruments and equipment to enhance and extend the senses	4	5.4 %	74
	IIIB (Arguments from Evidence)	1.When students engage in data collection, technique and methods are stressed	1	1.4 %	74
		2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	-	0 %	74

(Table 4.1.4.2. Continued**)**

		3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	74
		4. Students use their own experiences/data to identify patterns and relationships	-	0 %	74
		5. The material includes data that support relationships shown in graphs, charts, maps, etc.	-	0 %	74
		6. Students are encouraged to use their own experiences/data to develop and support arguments	19	25.7 %	74
		7. Text relies on empirical data rather than appeals to authority to support arguments	-	0 %	74
	IIIC (Collective Validation)	The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	2	2,7 %	74
		2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific	-	0 %	74
		3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	74
		4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	74
	Mean		3.7	4.9 %	74

The study results in the table 4.1.4.3 indicated that 8th grade science textbook met 19.4 % of category I criteria and indicators, 13.2 % of category II criteria and indicators, and 6.25 % of category III criteria and indicators. The textbook rarely presented science as terms, facts and concepts. Additionally, it did not present science as the application of scientific theories and use of reasoning to understanding phenomena enough. Lastly, the textbook slightly presented science as the social construction of facts and scientific understanding.

Table 4.1.4.3. Frequencies and Percentages of the indicators in 8th grade science textbook for Category I, II and III .

Category	Criterion	Indicators	Frequencies of Indicators	Percentages of Indicators	The total number of pages analyzed
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented	21	32.8 %	64
	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments	3	4.7 %	64
		2. The material focuses on the most important theories and models in the field	3	4.7 %	64
		3. The material includes graphs, charts, maps, etc. that display relationships rather than original data	31	48.4 %	64
		4. Rhetoric relies on appeals to authority for persuasion	4	6.3 %	64
	Mean		12.4	19.4 %	64

(Table 4.1.4.3. Continued**)**

II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences	23	35.4 %	64
		2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena	6	9.4 %	64
	IIB (Identify and Address Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions	5	7.8 %	64
		2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts	5	7.8 %	64
	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naşve ideas	-	0 %	64
		2. The material provides opportunities to apply scientific concepts in new contexts	16	25.0 %	64
	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena	7	10.9 %	64
		2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences	6	9.4 %	64
	Mean		8.5	13.2 %	64

(Table 4.1.4.3. Continued**)**

III	IIIA (Engagement with the Natural and Technological World)	1. The material fosters a sense of curiosity and questioning about the natural and technological world.	14	21.8 %	64
		2. The materials include activities that engage students with the natural and technological world to find out what happens. (experimental science)	9	14 %	64
		3. The material includes activities that engage students in carefully and systematically recording what they see. (field sciences)	2	3.1 %	64
		4. Activities use instruments and equipment to enhance and extend the senses	2	3.1 %	64
	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed	3	4.7 %	64
		2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions	4	6.3 %	64
		3. Students develop techniques or methods to address their questions and hypotheses	-	0 %	64
		4. Students use their own experiences/data to identify patterns and relationships	3	4.7 %	64
		5. The material includes data that support relationships shown in graphs, charts, maps, etc.	2	3.1 %	64
		6. Students are encouraged to use their own experiences/data to develop and support arguments	21	32.8 %	64

(Table 4.1.4.3. Continued**)**

		7. Text relies on empirical data rather than appeals to authority to support arguments	-	0 %	64
	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data	-	0 %	64
		2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community	-	0 %	64
		3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence	-	0 %	64
		4 . The material emphasizes the special status of scientific understanding reached through community consensus	-	0 %	64
	Mean		4	6.25 %	64

The results of this study indicated that the three science textbooks in 6^{th}, 7^{th} and 8^{th} grades in Turkey portrayed the nature of science aspects inadequately. Except that the category-I in 6^{th} grade science textbook, all categories of nature of science spread under 15 percent. It was very small proportion. This finding is consistent with the previous studies in Turkey (Başlantı, 2000).

The three science textbook relatively higher presented science as authoritative knowledge category rather than presenting science as understanding phenomena and social construction of knowledge categories. The second category "science as

understanding phenomena" was presented less than the category I "science as authoritative knowledge". The third category was portrayed in these textbooks at least. This means that science was not presented as social construction of knowledge adequately. There is no significant differences among textbooks in terms of presenting nature of science aspects.

CHAPTER V

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

In this chapter, the findings of the present study, implications for practice and recommendations for future research were presented.

5.1. Discussion

The purpose of this study was to examine the representations of nature of science in 6th, 7th and 8th grade elementary science textbooks. The textbooks were analyzed by three main categories, "Science as Authoritative Knowledge", "Science for Understanding Phenomena" and "Science as the Social Construction of Knowledge".

Majority of the studies in the literature were performed to examine the representation of NOS in science textbooks by focusing on four aspects of nature of science (Wilkinson, 1999; Başlantı, 2000; Kanlı &Yağbasan, 2004; Gunckel, 2004; Guisasola, Almudi, & Furio, 2005; Phillips & Chiappetta, 2007; Chiappetta & Fillman, 2007; Abd-El-Khalick, Waters, & Le, 2008). These four aspects of NOS were; "The Knowledge of Science", "The Investigative Nature of Science", "Science as a Way of Thinking", and "Interaction of Science, Technology and Society". These aspects of NOS refer to the categories which were used in the present study. For example, Category I referred to "The Knowledge of Science", Category II referred to "The Investigative Nature of Science" and "Science as a Way of Thinking" and Category III referred to "Interaction of Science, Technology and Society" aspects of NOS.

In general, the results of the present study indicated that the textbooks portrayed all the categories of nature of science criteria used in the study inadequately. This finding is consistent with recent studies by İrez (n.d.) and Abd-El-Khalick, Waters, and Le (2008). For example, İrez (n.d.) analyzed some secondary school biology textbooks in Turkey and the results showed that there were serious

problems regarding representation of the aspects of nature of science in textbooks. Especially, in the textbooks science was portrayed as a collection of facts. Additionally, some important aspects of NOS were not presented in these textbooks. However, the results of this study should be evaluated according to the aims of new science and technology course program. Although the program did not refuse the other learning theories it gives importance to constructivist theory. Therefore, the program suggested use of teaching strategies which make students more active physically and intellectually. As the textbooks have been written according to this program, they should indicate the properties of constructivism. The science and technology course program defines constructivism as individuals do not have an empty vessel during construction of knowledge, set present mind construction into action related with concepts and subjects, have a tendency to select cases which can articulate with their knowledge, and construct new knowledge in their mind actively. This theory suggests that knowledge should not transmit from teacher to student but it should be constructed by the student actively and transformed into a new format. So, it was expected that the percentage of the "science as authoritative knowledge" category should be lower than the other categories in the textbooks.

In this part, the results of the present study were discussed in details by the three main categories of the criteria; Science as Authoritative Knowledge, Science for Understanding Phenomena, and Science as the Social Construction of Knowledge.

5.1.1 Discussion about the "Science as Authoritative Knowledge" category (I)

The analysis results of the three elementary science textbooks indicated that "Science as Authoritative Knowledge" category was presented in the textbooks inadequately. This category consisted of two criteria and five indicators. The textbooks did not met the indicators in high level. This conclusion generally showed that the textbooks did not present science as terms, facts and concepts. However, the results of the indicators demonstrated some interesting percentages. For example, in the 6th grade elementary science textbook, the percentage of "Rhetoric Based on Authority" criterion and the indicator "The material presents conclusions of scientific studies rather than details of supporting data and arguments" was 65.7. In addition,

the percentage of the same criterion and the indicator "The material includes graphs, chart, maps, pictures, etc. that display relationships rather than original data" was 50.7. These results indicated that the 6th grade textbook generally did not present science as authoritative knowledge, but in particularly it mainly presented the conclusion of scientific studies rather than supporting arguments and included generally pictures to display the relationships rather than original data. This result interestingly is not consistent with the previous studies. For example, "Knowledge of Science" aspect was presented in the textbooks in a higher proportion than the other aspects (Başlantı, 2000; Gunckel, 2004; Phillips & Chiappetta, 2007). Başlantı stated that the percentage of the "Knowledge of Science" aspect was 65 and it was portrayed higher than the other three aspects in the 8th grade science textbook. In another study, Gunckel (2004) examined three science textbooks and one of them was found portraying the "Knowledge of Science" aspect in a higher level than the other aspects. In this study, all the categories were found to be portrayed in a very low proportion but comparatively category I was portrayed higher than the other two categories. This result indicated that the textbooks presented science as facts, terms and concepts relatively higher than they presented science as understanding phenomena and science as the social construction of knowledge. One of the possible reasons of this is due to the aims of new science and technology course program. Textbooks did not show the indicators of "science as authoritative knowledge" category adequately. Because the textbooks have been written according to the aims of new science and technology course program. The program emhasizes the importance of constructivism and expected from students to construct their own science knowledge rather than transmitting knowledge to the students. This category aims to transmit concepts, terms and facts. Therefore, the percentages of the indicators of this category is low but still the percentage of "science as authoritative knowledge" category higher than the other two categories. It means that textbooks have been written according to the aims of constructivism, but science is still presented in textbooks as facts, concepts and terms.

5.1.2 Discussion about the "Science for Understanding Phenomena" category (II)

This study also displayed that the three elementary science textbooks were inadequate in presenting the science as understanding phenomena category. The average percentages of the textbooks which met the indicators of this category were under fifteen in the three science textbooks. The "Science for Understanding Phenomena" category consisted of these criteria; "engagement with phenomena", "identify and address student ideas", "developing and using scientific ideas", and "promotes student thinking about experiences and knowledge". All the three science textbooks portrayed the criterion "engagement with phenomena" relatively higher than the other criteria. The 6th grade science textbook presented this criterion higher than the 7th and 8th grade science textbooks. Similarly, the 6th grade science textbook portrayed "science as the application of scientific theories and use of reasoning to understanding phenomena" category higher than the other two textbooks. Additionally, a conspicuous result of this analysis for "Science for Understanding Phenomena" category was that the three textbooks did not meet the indicator "The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas" of criterion "Developing and Using Scientific Ideas". This result indicated that elementary level textbooks did not focus on the students' naive ideas. This results were consistent with the previous studies. For example, Kanlı and Yağbasan (2004) investigated some science textbooks by developing criteria based on project 2061. The results of this study indicated that elementary level science textbooks did not take the student ideas into account. It seems that they did not foster curiosity, nor did they enable students the use of scientific knowledge and the development of it. On the other hand, some studies indicated that recently published textbooks portrayed "the investigative nature of science" and "science as a way of thinking" aspects of NOS more than the older textbooks (Wilkinson 1999; Chiappetta & Fillman, 2007). In the present study, science for understanding phenomena category refers to these two aspects of NOS and it was expected that the analyzed textbooks should portray this category in high proportions since these textbooks were recently written according to the new science and technology course program. One of the aims of the new science and technology program is to teach nature of science. Therefore, the textbooks ought to have a high

proportion of all aspects of NOS. However, the results of this study indicated that the textbooks were not adequate to portray "Science for Understanding Phenomena" category.

5.1.3 Discussion about the "Science as the Social Construction of Knowledge" category (III)

Considering the last category "Science as the Social Construction of Knowledge", three textbooks presented science as social construction of facts and scientific understanding inadequately. The mean percentages of this category were below ten in the three science textbooks. This category was portrayed in the textbooks less than the other two categories; "science as authoritative knowledge", and "science for understanding phenomena". "Science as the social construction of knowledge" category consisted of three main criteria; "Engagement with the technological and natural world", "arguments from evidence", "and collective validation". These categories refer to the science, technology and society (STS) issue. Because of this, it may be said that textbooks did not present STS enough. Whereas, the new science curriculum stresses the importance of STS under eight main topics of science-technology-society and environment objectives. These are; science and nature of science, nature of technology, human, society and science, science and technology, science and environment, technology and environment, human, society, science and environment, human, society and technology.

The most remarkable result of the analysis was that none of the textbooks presented collective validation criteria and its indicators. This result is supported by some researches (Gunckel, 2004; Guisasola et al., 2005).

One of the results of this study was that textbooks were not adequate presenting science as the social construction of facts and scientific understanding. This finding was consistent with the previous studies in literature (Gardner, 1999; Guisasola et al., 2005; Phillips & Chiappetta, 2007). For example, Gardner (1999) found that the textbooks slightly portrayed history and philosophy of science. In another study, Phillips and Chiappetta (2007) also concluded that science textbooks are not enough to portray interaction of science, technology and society relationship. However, interestingly Chiappetta and Fillman (2007) reported that majority of the

textbooks which were analyzed portrayed science as social construction of knowledge.

In conclusion, 6th, 7th and 8th grade science textbooks did not adequately represent nature of science aspects. All three science textbooks did not portrayed science as authoritative knowledge. However, 6th grade science textbook portrayed some indicators of this category in high proportions when compared with the other two textbooks. The textbooks were also insufficient about presenting science as understanding phenomena. None of them adequately engaged students with scientific phenomena. Textbooks also did not value students' ideas. They are insufficient to identify students' naive ideas. The textbooks slightly gave students some opportunities to apply scientific concepts in new context. Additionally, the textbooks very rarely presented science as the social construction of knowledge. They never presented the collective efforts behind the scientific theories or laws. The history of science was almost not presented in the three science textbooks. Only in the "Cell Division and Heredity" unit in the 8th grade science textbook, the history of heredity was presented.

5.2. Implications for Practice

Nature of science is one of the important issues in science education. Many countries' priority in science education is to educate children as scientifically literate person. However, previous research showed that students and teachers have traditional views about some aspects of nature of science. There might be some factors about why students and teachers have traditional views about NOS. One of these factors can be the inadequacy of textbooks presenting nature of science. Because textbooks are still essential materials for teachers and students, they are still frequently used in classrooms. In the same line, the present study investigated the presentation of nature of science in textbooks. Based on the results of literature review and the present study, some suggestions can be made in order to improve presentation of NOS in science textbooks.

The results of this study and previous studies indicated that science textbooks generally portrayed "knowledge of science" aspect more than the other aspects of NOS. Presenting this aspect highly means transmitting only the facts, concepts and

theories without engaging students with scientific ideas and without displaying the endeavor behind the scientific knowledge. This situation can affect the students' perception of nature of science in an unfavorable way. It is clear that teachers use textbooks frequently in their lessons. Therefore, the textbooks which do not represent the aspects of NOS in balance, can affect the learning environment in a negative way. For these reasons, all aspects of nature of science should be presented in science textbooks in the same ratio.

Moreover, science textbook writers ought to stress the importance of nature of science in the textbooks. Because the science and technology course program emphasizes the importance of NOS, textbooks should be written according to this issue. Textbook writers should pay attention to present all the aspects of NOS in the same ratio. Additionally, textbook writers should give importance the nature of science aspects which are acceptable by many educators. These aspects are: scientific knowledge is tentative, subjective, theory laden, necessarily involves human inferences, combination of observations and nferences, and socially and culturally embedded. They also ought to portray collective validation criterion because the result showed that none of the textbooks present this aspect. Students' naive ideas should also be stressed in the textbooks.

5.3. Recommendations for Future Research

In this part, some suggestions were given for future research in this field.

The present study was conducted with three elementary level science textbooks for the 6^{th}, 7^{th} and 8^{th} grades. For this reason, a similar research can be conducted with more textbooks. Moreover, 4^{th} and 5^{th} grade textbooks can also be analyzed in terms of NOS. Only three aspects of NOS were examined in the present study, but in another study different aspects of NOS can be investigated in the textbooks.

This study was performed by qualitative method with the use of content analysis technique. A further study may be conducted by quantitative data analysis methods. Students' and teachers' views about the presentation of nature of science in textbooks may be asked by using a questionnaire.

In this study, elementary level science textbooks were analyzed in terms of NOS aspects. Another similar study may be conducted with secondary level science textbooks.

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APPENDIX A

Criteria for Determining the Portrait of Nature of Science Presented in Science Textbooks

Category I – Science as Authoritative Knowledge. Does the material present science as terms, facts and concepts?

Criterion IA – Deductive Experiences. Does the material include activities to confirm facts and concepts?

1. The material includes demonstrations or laboratory exercises that confirm concepts presented.

Criterion IB – Rhetoric Based on Authority. Does the material rely on conclusions and status of scientists to teach terms, concepts, and facts?

1. The material presents conclusions of scientific studies rather than details of supporting data and arguments.
2. The material focuses on the most important theories and models in the field.
3. The material includes graphs, charts, maps, pictures etc. That display relationships rather than original data.
4. Rhetoric relies on appeals to authority for persuasion.

Category II – Science for Understanding Phenomena. Does the material presents science as the application of scientific theories and use of reasoning to understanding phenomena? (These criteria are adapted from Project 2061 criteria).

Criterion IIA – Engagement with Phenomena. Does the material engage students in real or vicarious phenomena?

1. The material engages students with relevant phenomena through first-hand or vicarious experiences.
2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena.

Criterion IIB – Identify and Address Student Ideas. Does the material identify common naive conceptions and address student ideas in order to build a more scientifically acceptable understanding of phenomena?

1. The material includes questions or tasks that identify student naive conceptions.
2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts.

Criterion IIC – Developing and Using Scientific Ideas. Does the material provide opportunities to develop reasoning and to practice applying new knowledge?

1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naïve ideas.
2. The material provides opportunities to apply scientific concepts in new contexts.

Criterion IID – Promotes Student Thinking About Experiences and Knowledge. Does the material promote student thinking?

1. The material engages students in using scientific ideas to reason about phenomena.
2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences.

Category III – Science as the Social Construction of Knowledge: Does the material present science as the social construction of facts and scientific understanding?

Criterion IIIA – Engagement with the Natural and Technological World. Does the material support intense engagement with the natural and technological world?

1. The material fosters a sense of curiosity and questioning about the natural and technological world.

1. The materials include activities that engage students with the natural and technological world to find out what happens.
2. The material includes activities that engage students in carefully and systematically recording what they see.
3. Activities use instruments and equipment to enhance and extend the senses.

Criterion IIIB - Arguments from Evidence. Does the material make arguments based on evidence as opposed to presenting only conclusions?

1. When students engage in data collection, technique and methods are stressed.

2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions.
3. Students develop techniques or methods to address their questions and hypotheses.
4. Students use their own experiences/data to identify patterns and relationships.
5. The material includes data that support relationships shown in graphs, charts, maps, etc.
6. Students are encouraged to use their own experiences/data to develop and support arguments.
7. Text relies on empirical data rather than appeals to authority to support arguments.

Criterion IIIC - Collective Validation. Does the material emphasize the collective efforts of a community of scientists in developing and accepting scientific facts and concepts?

1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data.
2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community.
3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence.
4. The material emphasizes the special status of scientific understanding reached through community consensus.

APPENDIX B

Name of the Book:

Name of the rater:

Category	Criteria	Indicators	Page number of indicator	Sufficient or not.	Notes of the rater.
I	IA (Deductive Experiences)	1. The material includes demonstrations or laboratory exercises that confirm concepts presented			
	IB (Rhetoric Based on Authority)	1. The material presents conclusions of scientific studies rather than details of supporting data and arguments			
		2. The material focuses on the most important theories and models in the field			
		3. The material includes graphs, charts, maps, etc. that display relationships rather than original data			
		4. Rhetoric relies on appeals to authority for persuasion			
II	IIA (Engagement with Phenomena)	1. The material engages students with relevant phenomena through first-hand or vicarious experiences			
		2. The primary purpose of the activities is to understand the scientific theory that explains the phenomena			
	IIB (Identify and Adress Student Ideas)	1. The material includes questions or tasks that identify student naive conceptions			
		2. The material includes questions and tasks that build on student naive ideas rather than simply contradicting ideas with presented facts			
	IIC (Developing and Using Scientific Ideas)	1. The material includes questions or tasks that offer intelligent, plausible, and fruitful alternatives to student naive ideas			

APPENDIX B Continued

		2. The material provides opportunities to apply scientific concepts in new contexts			
	IID (Promotes Student Thinking About Experiences and Knowledge)	1. The material engages students in using scientific ideas to reason about phenomena			
		2. The material provides students with opportunities to compare/contrast scientific ideas to their experiences			
III	IIIA (Engagement with the Natural and Technological World)	1. The material fosters a sense of curiosity and questioning about the natural and technological world.			
		2. The materials include activities that engage students with the natural and technological world to find out what happens. (experimental science)			
		3. The material includes activities that engage students in carefully and systematically recording what they see.			
		4. Activities use instruments and equipment to enhance and extend the senses			
	IIIB (Arguments from Evidence)	1. When students engage in data collection, technique and methods are stressed			
		2. When presenting concepts, the material presents the methods (data collection activities and pattern-finding activities) of scientists that led to important conclusions			
		3. Students develop techniques or methods to address their questions and hypotheses			
		4. Students use their own experiences/data to identify patterns and relationships			

APPENDIX B Continued

		5. The material includes data that support relationships shown in graphs, charts, maps, etc.			
		6. Students are encouraged to use their own experiences/data to develop and support arguments			
		7. Text relies on empirical data rather than appeals to authority to support arguments			
	IIIC (Collective Validation)	1. The material presents alternative interpretations of data or allows for multiple student interpretations of data as long as arguments are supported by data			
		2. The material depicts the processes of collective inquiry by telling the whole story behind the development of science concepts, including the challenges to claims made by other scientists, the replies by the first scientists, and the changes made to claims as a result of the collective efforts of the scientific community			
		3. The material provides opportunities for students to present their arguments in some written format, challenge others' ideas, develop replies, and reach a community consensus about data and scientific claims, based on empirical evidence			
		4 . The material emphasizes) the special status of scientific understanding reached through community consensus			

APPENDIX C

Page numbers of indicators in 6th grade science textbook.

Category	Criteria	Indicators	Page numbers of the indicators
I	IA (Deductive Experiences)	1	18,19,20,21,28,29,36,38,40,41,42,43,148,152,154,156,158,160,161,167,168,170
	IB (Rhetoric Based on Authority)	1	16,17,20,21,22,23,24,25,26,27,28,29,32,33,34,35,37,38,40,41,42,43,46,148,150,151,152,153,154,156,157,158,159,160,161,162,163,164,165,166,167,168,170,171,
		2	20,40
		3	17,20,21,22,23,24,25,27,28,29,32,36,38,40,41,42,43,44,148,150,151,152,154,156,157,158,160,161,163,164,167,168,170,174,
		4	35,166
II	IIA (Engagement with Phenomena)	1	16,18,19,22,31,36,37,38,40,43,44,45,49,149,150,155,157,158,159,162,164,165,166,167,168,169,170,172,173
		2	18,19,157,169
	IIB (Identify and Adress Student Ideas)	1	36,37,40,42,153,154,160,163,164,165
		2	-
	IIC (Developing and Using Scientific Ideas)	1	-
		2	49,50,162,172,173,174

APPENDIX C Continued

	IID (Promotes Student Thinking About Experiences and Knowledge)	1	23,25,27,37,42,44,45,158,169
		2	18,19,31,44,45,150,157,158,159,168,169
III	IIIA (Engagement with the Natural and Technological World)	1	36,37,38,40,41,42,43,155,160,162,164,168,170
		2	18,19,27,31,44,45,149,150,157,158,159,168,169
		3	18,19,45,159
		4	18,19,44,45,149,150,157,159,168,169
	IIIB (Arguments from Evidence)	1	18,19,44,45,159
		2	18,19,44,45,157,159
		3	-
		4	18,19,44,45,149,157,159
		5	31
		6	18,19,35,36,37,38,40,45,149,150,153,155,157,158,159,165,166,168,169,170
		7	18,19,31,44,45,149,150,157,159,168,169
	IIIC (Collective Validation)	1	18,36,37,38,155,169,170
		2	-
		3	-
		4	-

APPENDIX C Continued

Page numbers of indicators in the 7th grade science textbook

Category	Criteria	Indicators	Page numbers of the indicators
I	IA (Deductive Experiences)	1	17,18,19,20,21,29,33,34,37,39,43,44,45,46,47,49,50,230,241,242
	IB (Rhetoric Based on Authority)	1	56,239
		2	-
		3	18,19,20,21,22,23,24,25,27,33,34,35,36,37,39,42,43,44,45,46,47,49,50, 230,234
		4	56,239
II	IIA (Engagement with Phenomena)	1	17,21,32,35,36,42,48,50,55,60,229,231,233,236,237,240,243
		2	35,36,48
	IIB (Identify and Adress Student Ideas)	1	16,17,22,24,26,27,32,37,49,50,53,228,230,240
		2	-
	IIC (Developing and Using Scientific Ideas)	1	-
		2	23,30,35,40,64,65,231,234,246,247
	IID (Promotes Student Thinking About Experiences and Knowledge)	1	21,35,48
		2	17,35,233

APPENDIX C Continued

III	IIIA (Engagement with the Natural and Technological World)	1	27,35,38,47,57,63,230,232,233,235,237,238,240,241,242,245
		2	17,32,35,36,42,48,50,229,231,233,236,237,240
		3	-
		4	17,42,48,54
	IIIB (Arguments from Evidence)	1	36
		2	-
		3	-
		4	-
		5	-
		6	17,21,25,28,32,35,36,42,48,50,54,55,60,229,231,233,236,237,238
		7	-
	IIIC (Collective Validation)	1	36,42
		2	-
		3	-
		4	-

APPENDIX C Continued

Page numbers of indicators in the 8th grade science textbook

Category	Criteria	Indicators	Page numbers of the indicators
I	IA (Deductive Experiences)	1	19,20,22,24,25,27,28,29,32,33,34,35,37,38,42,184,186,189,192,194,200
	IB (Rhetoric Based on Authority)	1	25,38,47
		2	22,24,25
		3	19,20,21,22,25,26,27,28,29,32,33,34,35,37,38,39,40,183,184,185,186,189,190,191,192,194,195,196,197,200,206
		4	46,47,200,202
II	IIA (Engagement with Phenomena)	1	19,20,23,24,26,29,30,31,33,37,39,41,43,45,46,185,186,187,191,192,195,199,203
		2	24,37,39,186,191,192
	IIB (Identify and Adress Student Ideas)	1	17,18,20,16,185
		2	17,18,20,26,185
	IIC (Developing and Using Scientific Ideas)	1	-

APPENDIX C Continued

		2	21,26,27,31,33,39,43,47,50,51,185,189,203,205,208,209
	IID (Promotes Student Thinking About Experiences and Knowledge)	1	24,26,37,39,186,191,192
		2	24,26,37,39,186,191
III	IIIA (Engagement with the Natural and Technological World)	1	18,25,30,31,41,46,49,184,185,193,195,201,202,204
		2	19,24,26,41,185,186,191,192,203
		3	24,186
		4	186,191
	IIIB (Arguments from Evidence)	1	24,186,191
		2	24,186,191,192
		3	-
		4	24,187,191
		5	20,201

APPENDIX C Continued

		6	20,22,24,25,26,29,30,31,33,37,39,41,43,46,185,186,187,191,192,195,199
		7	-
	IIIC (Collective Validation)	1	-
		2	-
		3	-
		4	-