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Content Analysis of Science Textbooks' Evaluation Questions Based on Physics, Chemistry, Biology, Environment and Astronomy Subject Area by Bloom's Taxonomy

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Abstract: The aim of this study is to determine the distribution of the units in the 6th, 7th and 8th grade science textbooks according to the contents of Biology, Physics, Chemistry, Environment and Astronomy learning domains and analyze the evaluation questions in these units according to Bloom's Taxonomy. The 6th, 7th and 8th grade science textbooks prepared in the framework of 1926, 1948, 1974, 1992, 2000, 2004 and 2013 science programs constitute the sample of this work. Questions to be considered in the study were evaluated independently by two field experts and the results were compared. As a result of the analyzes, it was determined that physics, biology, chemistry, environmental units were mainly included in every program but the number of astronomy units was less and only included in 6th and 7th grades' science textbooks. According to the Bloom's Taxonomy, when the questions are evaluated, it is determined that the questions in the Synthesis and Evaluation levels are insufficient and the questions in the Knowledge and Understanding levels are excessive. Based on the subject area, biology units' evaluation questions in 1948 program , the physics units' evaluation questions in 2013 program, the Astronomy units' evaluation questions in 1926 program and chemistry units' evatluation questions in 2000 program are prepared at the upper level based on Bloom's taxsonomy.

Keywords: Bloom's taxonomy, Content analysis, Textbook, Science education

Introduction

The aim of this study is to determine the distribution of the units in the 6th, 7th and 8th grade science textbooks according to the contents of Biology, Physics, Chemistry, Environment and Astronomy learning domains and analyze the evaluation questions in these units according to Bloom's Taxonomy.

In Turkey, Science education program had many revisions and had different names (1926, 1948, 1974, 1992, 2000, 2004 and 2013). In order to adapt to changing world conditions. In this process, new science textbooks have been written so that the new understandings in the programs can be used in learning environments. Textbooks are one of the complementary elements of the curriculum. They are the basic materials for studying and explaining the information of the subjects in the curriculum in a planned and regular way and as a source of information, to guide and educate the student towards the goals of the course (Ünal and Güneş, 2002). In particular, the quality of the questions in the textbooks has a great influence on the success of the students (Riazi and Mosalanejad 2010). This is because the textbooks have the highest contribution to the development of cognitive, emotional and psychomotor skills of students (Demirel, 2011).

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History of Primary Science Curriculum in Turkey

Throughout the history of Republic of Turkey, Science Education program had several changes and revisions based on new development in Educational Research area. Mainly, there are seven different science education program in History including 1926, 1948, 1974, 1992, 2000, 2004 and 2013 programs.

1926 program is the public education program, which was designed according to the child-specific and focus on close environmental principles. 1936 program is organized to get rid of the deficiencies of 1926 program. Characteristics of the program includes (1) Giving information according to student's level, (2) Teaching in the environment and in the natural environment, (3) Consideration of individual differences, (4) Collective education and (5) Focus on distant environment (Arslan, 2000; Çepni and Çil, 2011).

Prior to 1948 program, the 1936 program was implemented in urban villages (Tekışık, 1992). This program, which was enacted between 1948 and 1949, is known as the longest curriculum in Republic of Turkey's history (Gözütok, 2003). In this program, Mathematics, Family Science and Agriculture-Business lessons are given in the first semester classes in the Life Science units. In the second semester classes, the students will be given importance to gain information by direct observation and experimentation (Power and Captain , 1992).

In 1974 Program, the name of the course was changed to "Science Information" (Fen Bilgisi) and some changes were made in the scope of the unit (Gücün and Kaptan, 1992). In this program, the emphasis was to provide scientific information through scientific processes. It was emphasize on importance of social benefit philosophy and technology (Gücün and Kaptan, 1992).

1992 program, even is not explicitly name it, it was focused on hand-on, minds-on learning and teaching (Demirbaş and Yağbasan, 2005). However in the program teacher-centered approach was over-emphasized (Turgut, 1990). During 2000 program, the science curriculum prepared according to scientific processes (Göktürk, 2003). The characteristics of the science curriculum were focus on active learning and teaching methodologies. The program was flexible enough to allow students to use their creativity without restricting teachers and textbooks

In 2004 program, the name of the course changed as "Science and Technology" (Çepni and Çil, 2011). The program prepared based on constructivist philosophy of teaching and learning. In the program, science content was mostly emphasis on everyday life and technology. The general objectives of the Science and Technology course curriculum aimed to have scientifically literate citizens (Ministry of National Education [MoNE], 2005). In 2013 program, name of the course changed again as a "Science". Program prepared based on constructivist philosophy of teaching and learning. Inquiry-based teaching methodologies was mainly emphasis on the program (MoNE, 2013).

Bloom's Taxonomy

In 1956, Bloom and his colleagues developed a classification system which we called today Bloom's Taxonomy. This classification method examines questions at different levels at the end of learning process.
Each level is measured by different types of questions (Table 1). This ranking is a classification of different thinking skills in a hierarchical order (Bloom, 1956). Bloom's Taxonomy of Cognitive Domain has lower-order thinking skills including knowledge, comprehension and application and higher-order thinking skills including analysis, synthesis, and evaluation (Cansüngü Koray and Yaman, 2002).

Table 1. Bloom's taxonomy of cognitive domain

	Cognitive Level
Lower-order thinking skills	Knowledge Comprehension Application
Higher-order thinking skills	Analysis Synthesis Evaluation

Bloom Taxonomy is used by teachers and researchers to determine the levels of questions (Dindar and Demir, 2006). In Turkey researchers usually use Bloom Taxonomy to analyze schools' exam questions level and

placement test questions' level for primary schools (Ayvacı and Türkdoğan, 2010; Baysen, 2006; Dindar and Demir, 2006; Eş, 2005; Gündüz, 2009; Cansüngü Koray and Yaman, 2002; Özcan and Oluk, 2007).

Method

Qualitative research method was used in this study and document review method was used as information gathering method. A document review involves analysis of written materials that contain information about the events for investigation. In qualitative research, document review can be used as a stand-alone data collection method. Which documents are important and can be used as a data source is closely related to the research problem (Yıldırım and Şimşek, 2011).

In this study, Foster's document review steps were used. These steps are sequentially (1) Accessing documents, (2) Checking authenticity, (3) Understanding the documents, (4) Analyzing data, and (5) Using the data (Yıldırım and Şimşek, 2008).

Sample

3809 questions from 21 science textbooks (including 6th, 7th and 8th grade) from seven different science program were evaluated (Table 2). List of the science textbooks were given in Table 3.

Table 2. Years of books used in the research

	Curriculum						
Grade	**1926**	**1948**	**1974**	**1992**	**2000**	**2004**	**2013**
6th	1933	1955	1976	2000	2002	2012	2015
7th	1932	1959	1979	2000	2002	2012	2015
8th	1933	1954	1980	1998	2002	2012	2016

Table 3. List of the textbooks used in the study

Program	**Reference**
1926	Maarif Vekaleti (1933). *Fen bilgisi I. kitap.* İstanbul: Devlet Matbaası Maarif Vekaleti (1932). *Fen bilgisi II. kitap.* İstanbul: Devlet Matbaası Maarif Vekaleti (1933). *Fen bilgisi III. kitap.* İstanbul: Devlet Matbaası
1948	Tardu, B., Çağlayan M., ve Çağlayan, H. (1955). *Tabiat ve fen bilgisi I,* Ankara: Maarif Basımevi. Tardu, B., Çağlayan M., ve Çağlayan, H. (1959). *Tabiat ve fen bilgisi II*. Ankara: Maarif Basımevi. Tardu, B., Çağlayan M., ve Çağlayan, H. (1954). *Tabiat ve fen bilgisi III,* Ankara: Maarif Basımevi.
1974	Bayın, Ö., Güney, Ş. ve Özgen, R .(1976). *Fen bilgisi 1.sınıf.* İstanbul: Milli Eğitim Basımevi. Bayın, Ö., Güney, Ş. ve Özgen, R .(1979). *Fen bilgisi 2.sınıf.* İstanbul: Milli Eğitim Basımevi. Bayın, Ö., Güney, Ş. ve Özgen, R. .(1980). *Fen bilgisi 3.sınıf.* İstanbul: Milli Eğitim Basımevi.
1992	Çığırgan, H., Altıntaş, H., Özkan, H. ve Ay, M. (2000). *İlköğretim fen bilgisi ders kitabı 6*. İstanbul: Milli Eğitim Basımevi. Çığırgan, H., Altıntaş, H., Özkan, H. ve Ay, M. (2000). *İlköğretim fen bilgisi ders kitabı 7*. Eskişehir: Anadolu Üniversitesi Basımevi. Çığırgan, H., Altıntaş, H., Özkan, H. ve Ay, M. (1998). *İlköğretim fen bilgisi ders kitabı 8*. Eskişehir: Anadolu Üniversitesi Basımevi.
2000	Güngör, B., Yıldıran, N., Dökme, İ. ve Aydınlar, R. (2002). *İlköğretim fen bilgisi ders kitabı 6*. İstanbul: Milli Eğitim Basımevi. Büyük, Ş., Baş, B., Salmaner, V. ve Görür, N. (2002). *İlköğretim fen bilgisi ders kitabı 7.* Ankara: Basım Matbaacılık. Koyuncu, Ç., Kavas, B., Tiryaki, N. ve Salmaner, V. (2002). *İlköğretim fen bilgisi ders kitabı 8.* İstanbul: Milli Eğitim Basımevi.

2004	Taşar, M. F. (Ed.). (2012). *İlköğretim fen ve teknoloji ders kitabı 6.* İstanbul: Milli Eğitim Basımevi. Leblebicioğlu, G. (Ed.). (2012). *İlköğretim fen ve teknoloji ders kitabı 7.* İstanbul: Milli Eğitim Basımevi. Güneş, B. (Ed.). (2012). *İlköğretim fen ve teknoloji ders kitabı 8.* İstanbul: Milli Eğitim Basımevi. Ünsal, Y. (2015). *Ortaokul fen bilimleri 6. sınıf.* İstanbul: Milli Eğitim Basımevi. Özoğlu, H. H. & Mısırlıoğlu, Z. (2015). *Ortaokul fen bilimleri 7. sınıf*. Ankara: ADA
2013	Yayıncılık. Urhan, A. (2015). *Ortaokul fen bilimleri 8. sınıf.* Ankara: Tutku Yayıncılık.

Data Collection

In order to ensure the understanding of the documents, the units in the textbooks obtained are analyzed according to the Cognitive Process Dimension of the Bloom Taxonomy, which are arranged according to years. Below 1926 science textbooks units arranged based on the subject area (Table 4). This arrangement was done for all the grade levels and the programs.

Table 4. Distribution of science textbooks' units based on content are in 1926 science program

Grade	**Unit number**	**Content area**	**Title of the Unit**
	1	Astronomy	Üzerinde Yaşadığımız Arz
	2	Physics	Hava ve İklim
	3	Biology	İyi Yiyecek Elde Etmek
	4	Enviroment	İyi Bir Akarsu Temin Etmek
	5	Biology	Vücudun Zindeliğini ve Sıhhatini Muhafaza Etmek
6	6	Chemistry	Giyeceklerimizin İntihabı ve Muhafazası
	7	Biology	Kendimizi Hastalıklardan Korumak
	8	Chemistry	Ateşin Mahiyeti ve Kontrolü
	9	Physics	Binalarımıza Sıcak ve Taze Hava Temin Etmek
	10	Chemistry	Yapı Malzemesi
7	11	Physics	İş Yapıcı Makineler
	12	Physics	Havanın ve Suyun Kuvvetlerinden İstifade Etmek
	13	Physics	Kuvvei Muharrike için Buhar ve İnfilak Edici Gazdan İstifade
	14	Physics	Elektrik Elde Etmek ve Kullanmak
	15	Physics	Evlerimizi ve Sokaklarımızı Aydınlatmak
8	16	Physics	Konuşma, Dinleme Yolları ve Aletleri
	17	Physics	Kara, Su ve Hava Yolu ile Nakil İşleri

Data Analysis

Descriptive and content analysis processes were utilized during data analyzing. In this research, the cognitive process dimension of the Bloom's Taxonomy were determined by using the studies in the literature primarily according to the descriptive analysis approach. The questions obtained from the science textbooks were examined by the researcher and a specialist researcher taking into account the criteria table. In order to better understand which issue belongs to which step, a table containing the characteristics of each step was prepared.

Reliability and Validity

In order to measure the External Reliability of the study, 20% of the questions (762 questions) to be investigated were examined by the researcher at various time intervals according to Bloom's Cognitive Domain Steps. The result of the Cohen Kappa Coefficient was obtained as K = 0.82. To increase internal validity in qualitative studies, data are collected by more than one researcher (Büyüköztürk et al., 2010). For this purpose, 200 randomly selected questions were examined by a different researcher to determine the consistency between the evaluators. Kendall's coefficient was calculated as r = 0,78.

Results and Discussion

All science textbooks' units were checked and analyze to decide which units prepared for which subjects area including physics, chemistry, biology, environment and astronomy. According to Table 5, astronomy subjects only taught on 8th grades in 1948 program; environment subjects only taught in 8th grades in 1948, 1992, 2004 and 2013 programs. In all programs, 7th grade program has more content than other grades.

Table 5. Analysis of science programs textbooks' unit based on subjects

Grade level	Physics	Chemistry	Biology	Environment	Astronomy
6	1 (1926 prog)	1 (1926 prog)	2 (1926 prog)	1 (1926 prog)	1 (1926 prog)
	-	-	5 (1948 prog)	1(1948 prog)	-
	-	2 (1974 prog)	4 (1974 prog)	1 (1974 prog)	-
	3 (1992 prog)	-	2 (1992 prog)	1 (1992 prog)	-
	1 (2000 prog)	-	2 (2000 prog)	-	1 (2000 prog)
	4 (2004 prog)	1 (2004 prog)	2 (2004 prog)	1 (2004 prog)	-
	4 (2013 prog)	1 (2013 prog)	2 (2013 prog)	-	1 (2013 prog)
7	4 (1926 prog)	2 (1926 prog)	1 (1926 prog)	-	-
	4 (1948 prog)	1 (1948 prog)	4 (1948 prog)	1 (1948 prog)	-
	3 (1974 prog)	1 (1974 prog)	3 (1974 prog)	-	-
	3 (1992 prog)	-	2 (1992 prog)	1 (1992 prog)	1 (1992 prog)
	2 (2000 prog)	1 (2000 prog)	-	1 (2000 prog)	-
	3 (2004 prog)	1 (2004 prog)	1 (2004 prog)	1 (2004 prog)	1 (2004 prog)
	3 (2013 prog)	1 (2013 prog)	1 (2013 prog)	1 (2013 prog)	1 (2013 prog)
8	4 (1926 prog)	-	-	-	-
	2 (1948 prog)	2 (1948 prog)	-	2 (1948 prog)	1 (1948 prog)
	2 (1974 prog)	1 (1974 prog)	1 (1974 prog)	-	-
	2 (1992 prog)	1 (1992 prog)	1 (1992 prog)	2 (1992 prog)	-
	1 (2000 prog)	1 (2000 prog)	3 (2000 prog)	-	-
	3 (2004 prog)	2 (2004 prog)	2 (2004 prog)	1 (2004 prog)	-
	3 (2013 prog)	2 (2013 prog)	2 (2013 prog)	1 (2013 prog)	-

Cognitive Domain of Biology Subjects

When 6th grade biology units' evaluation questions analyzed, results showed that in all programs, knowledge level is the highest. In 1948 program, analysis level is better than other programs. 1948 and 2013 programs has good number of evaluation levels. Analysis of 7th grade biology units' evaluation questions showed that analysis, synthesis and evaluation level is only found in 1926 and 1948 programs. Unfortunately 2013 program is not have enough higher level of cognitive domain based on Bloom's taxonomy. Analysis of 8th grade biology units' evaluation questions showed that 1926 and 1948 programs didn't had biology subjects in 8th grades. Among all 2000 program had better questions based on Bloom's taxonomy. 2013 program has mainly lower level of questions based on Bloom's taxonomy.

Cognitive Domain of Physics Subjects

When 6th grade physics units' evaluation questions analyzed, results showed that 2013 program is better than other programs based on Bloom's taxonomy. Analysis of 7th grade physics units' evaluation questions showed that science textbooks prepared according to 2004 program has less number of higher level questions based on Bloom's taxonomy. Textbooks from 1926 and 1974 programs had all level of cognitive domain. Analysis of 8th grade physics units' evaluation questions showed that 1926 program had all levels of cognitive domain. 1948, 1974 and 2000 programs didn't have synthesis and evaluation levels.

Cognitive Domain of Chemistry Subjects

When 6th grade chemistry units' evaluation questions analyzed, results showed that 1926, 1974, 2004 and 2013 programs had good number of questions in analysis level. Only 1926 and 2013 programs had questions in synthesis level. Analysis of 7th grade chemistry units' evaluation questions showed that 1926 program had questions from all levels. 2013 program didn't have questions from synthesis and evaluation level. Analysis of

8th grade chemistry units' evaluation questions showed that questions prepared to evaluate mostly low level of cognitive domain. 2000 and 1948 programs had more number of questions on analysis level. 2013 program didn't have questions in synthesis and evaluation level

Cognitive Domain of Environment Subjects

When 6th grade environment units' evaluation questions analyzed, results showed that question in 2004 program only prepared in knowledge level. Only questions in 1992 had analysis, synthesis and evaluation level. Number of questions were highest in 1926 program. Analysis of 7th grade environment units' evaluation questions showed that 2000 program didn't have any question in knowledge level. 2000 program had question in analysis, synthesis and evaluation level. 2013 program had more questions in knowledge level than others. Analysis of 8th grade environment units' evaluation questions showed that 1948 and 1992 programs had good number of questions in higher level of cognitive domain. 2004 and 2013 didn't have any question in evaluation level.

Cognitive Domain of Astronomy Subjects

When 6th grade astronomy units' evaluation questions analyzed, results showed that only 1926, 2000 and 2013 programs had astronomy subjects. Questions in 1926 had better cognitive domain level than others. 2013 program only gave knowledge and comprehension level of questions. Analysis of 7th grade astronomy units' evaluation questions showed that only 1992, 2004 and 2013 programs had astronomy subjects. 2004 program had analysis level of questions compared to other programs. 2013 program had questions in synthesis and evaluation level. Analysis of 8th grade astronomy units' evaluation questions showed that only 1948 program had astronomy subject in 8th grade. Questions in analysis level is more than questions in knowledge and comprehensive level

Conclusion

When 6th, 7th and 8th grade science textbooks from seven different program (1926, 1948, 1974, 1992, 2000, 2004 and 2013), results showed that in biology subject, evaluation questions in science textbooks prepared in 1948 program had better in 6th and 7th grades than others. 2000 program had better questions in 8th grade based on Bloom's cognitive domain. In Physics subject, evaluation questions in science textbooks prepared in 2013 program is better in 6th grade compared to other programs. 1926 program is better in 7th and 8th grades based on Bloom's cognitive domain. In chemistry subject, evaluation questions in science textbooks prepared in 2013 program is good for 6th grade, 1926 program is good for 7th grade and 2000 program is good for 8th grade based on Bloom's cognitive domain. In environment subject, evaluation questions in science textbooks prepared in 1992 program is good for 6th and 8th grade, 2000 program is good for 7th grade based on Bloom's cognitive domain. In astronomy subject, evaluation questions in science textbooks prepared in 1926 program is good for 6th grade, 2013 program is good for 7th grade and 1948 program is good for 8th grade based on Bloom's cognitive domain.

Since 2013 program is the newest program we expect that the evaluation questions prepared based on this program has higher level of cognitive domain than other programs. However only evaluation questions in 6th grade physics and chemistry subjects and 7th grade astronomy subject is good. Interestingly evaluation questions in science textbooks prepared based on 1926 and 2000 programs had better based on Bloom's cognitive domain.

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