

# Elementary Science Textbook Analysis of Korea and the United States

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## 한국과 미국의 초등학교 과학 교과서 분석

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### 국문 요약

과학교과서는 한국과 미국에서 가장 많이 쓰이는 교수 학습 자료이다. 과학교육목표와 과학교과내용의 특징을 분석하기 위하여 한국과 미국의 초등학교 과학 교과서를 분석하였다. 한국과 미국의 1학년과 4학년 과학 교과서 각각 100 쪽을 무작위로 선택하여 과학교육목표를 분석하였다. 1학년에서 6학년까지의 생명 영역의 과학 내용이 분석되었다. 한국의 1학년 과학내용은 슬기로운 생활 교과서를 분석하였는데, 슬기로운 생활 교과는 과학교과와 사회교과의 통합교과이다. 미국에서 많이 쓰이고 있는 초등학교 교과서 중 하나인 Harcourt Science의 1학년과 4학년 교과서를 분석하였다. 과학교육목표분석체계는 과학 지식, 과학적 탐구, 과학적 태도, STS, 그리고 과학 철학과 역사로 구성되어 있다. 한국과 미국의 초등학교 과학 교과서의 내용을 분석한 결과는 다음과 같다. 미국의 초등학교 과학 교과서는 과학적 탐구 보다 과학 지식을 더 많이 포함하고 있었다. 한국의 과학 교과서는 과학 지식 보다는 과학적 탐구를 더 많이 포함하고 있었다. 미국의 초등학교 과학 교과서는 생명 영역의 일부 주제에 대하여 한국 보다 더 어려운 내용을 다루었고, 세포나 생태계의 종류에 대해서는 여러 학년에 걸쳐 반복적으로 다루고 있는 것으로 분석되었다.

주요어: 과학 교과서 비교 분석, 국제 비교, 과학교육목표, 생명 영역 주제

## I. Introduction

Recently science and mathematics achievement of students are frequently compared internationally. Students in East Asia are doing very well in the international tests in mathematics and science (National Center for Education Statistics, 2006a; 2006b; 2007a; 2007b). Generally mathematics and science achievement of some Asian students are higher than students of the United States in TIMSS and PISA. But elementary students of the United States showed good scores, especially in science, TIMSS 2003.

Last 10 to 15 years, the United States has tried to higher the students' science achievement eagerly after shocked by the international science achievement comparisons such as TIMSS and

PISA, which is similar to the science curriculum development and nationwide dissemination movement after Sputnik shock in 1957. Now many states and school districts encourage schools and teachers to teach science. Some school districts invest a lot of money to adapt new science programs. Some school districts run curriculum material centers, where science specialists prepare the hands on activity materials and deliver to elementary schools. And also the United States has organized some curriculum centers nationally and disseminated science inquiry oriented programs(NSTA, 2002).

In the United States there are two distinguishable kinds of elementary science programs. One is the activity oriented program such as FOSS, STC, or DASH, and the other is

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the textbook used program. Textbook is still one of the frequently used teaching materials at elementary schools.

Elementary science textbooks of the United States have been changed during last forty years. Science textbooks have received and implemented the influence from the educational research results and trends such as emphasizing career, STS, nature of science, scientific inquiry, integrating with other subjects or technology. Recently published elementary science textbooks include a lot of hands on activities and educational technology such as introducing some web sites.

Korean elementary science textbooks usually have been developed by a lot of science educators selected from many teachers colleges in Korea. Recently many elementary teachers are involved in developing elementary science textbooks. The development of Korean elementary science textbooks has been led by the Ministry of education. Mostly Institute for Korean Curriculum and Evaluation, which was separated from Korean Educational Development Institute, had organized the textbook development team and running the team. Korean elementary science textbooks are developed by following the National science curriculum. Korean science curriculum have been developed eight times since 1946(Ham, 2004). Every 5 to 10 years Korea developed new science curriculum. Now 'Wise life' for first and second grades and 'Science' for third and fourth grades textbooks of elementary school was developed by following the '2007 revised science curriculum' (Ministry of Education, Science and Technology, 2007). Korea Foundation for the Advancement of Science & Creativity is developing the '2009 revised science curriculum.'

In the United States, Benchmarks for Science Literacy(AAA, 1993) and National Science Education Standards(NRC, 1996) were proposed as kind of national benchmarks of science education which suggested science educational objectives and science contents. By testing science in state level state departments of education encouraged teaching science at elementary schools.

Elementary teachers try teaching science thirty minutes a day, 150 minutes a week. It will make a big difference in future elementary school science achievement of the United States.

Textbooks are one of the most frequently used teaching materials. In this study by comparing the textbooks of two nations, we can have some ideas about what elementary students learn at schools in terms of science educational objectives and life science topics.

This study has three research questions, which are, firstly, to figure out similarities or differences in appearance and structure of elementary science textbooks of the United States and Korea, secondly, to analyze educational objectives in elementary science textbooks of the United States and Korea, thirdly, to find out differences in life science topics shown in elementary science textbooks of the United States and Korea.

## II. Literature Reviews

### 1. Textbook Analysis

Textbooks are the most frequently used basic teaching material, which suggest the teaching contents and teaching methods. Educational objectives can be found by analyzing textbooks. Textbooks showed what should be learned by students and what kinds of methods could be used in science instruction.

Textbook content analysis has been done focussing on specific content areas such as history of science(Choi *et al.*, 2005; Jeon *et al.*, 2004), earth science(Hu *et al.*, 2004), STS(Lee *et al.*, 2002), stimulus and response(Park *et al.*, 2006), evolution(Kim and Chang, 2003) and electrolysis(Hwang and Eom, 2006). Some science textbooks are analyzed in terms of scientific inquiry processes(Park *et al.*, 2006; Kim *et al.*, 2005; Hu *et al.*, 2004; Park, 1998; Kim *et al.*, 1997). Some researches compare science textbooks of North Korea and South Korea(Kim and Cho, 2002; Park *et al.*, 2004). Some use frequency counting method about their research themes such as specific science

concepts or scientific inquiry processes(Lee *et al.*, 2005; Kim and Chang, 2003; Jeon *et al.*, 2004). Some compare the number of textbook pages written about specific topics(Choi *et al.*, 1998; Lee *et al.*, 2002; Kim and Cho, 2002). Some show the interrater agreement ratio as an evidence of reliability(Kim and Chang, 2003; Lee *et al.*, 2005). Kim *et al.*(2005) shows the difference between suggested inquiry skills shown in textbook and performed inquiry skills done by students.

Elementary science textbooks of China, Japan, the United States, and Korea have been studied(Kim, 2002; Kim and Lee, 1995; Kim, 1993, Kim, 1992). Some research used concept map method(Kim, 1992). Some used frequency counting method of educational objectives. Chiappetta *et al.*(1991a; 1991b) suggested a textbook analysis method by quantifying scientific literacy themes. Chabalengula (2006) studied Zambian high school biology curriculum by using Chiappetta's method.

Grow Maienza *et al.*(2003) found Korean elementary math textbooks written with coherence, and clear in depth conceptualization and connections to the deep meaning within mathematics. And they claimed that American mathematics curriculum lost its coherence. Schmidt *et al.*(2005) also bring out the point of coherence in science curriculum. By comparing elementary science textbooks we can have better insight of elementary science teaching.

## 2. Science Educational Objectives

In order to have a criteria of comparison we reviewed science educational objectives frameworks. In general we have taxonomy of educational objectives of Bloom(1956) and Krathwohl *et al.*(1964). Klopfer(1971) showed a science educational framework, which include scientific knowledge, scientific inquiry, scientific attitude and career, and the historical and philosophical concerns. National Science Teachers Association(1982) proposed science educational objectives in terms of instructional time ratio by grade levels. The position paper showed four

quadratic graphs about scientific knowledge, scientific inquiry, application, and science technology society.

NSES(National Research Council, 1996) categorized science teaching contents to inquiry, physical science, life science, earth and space science, science and technology, personal and social perspectives, history and nature of science, and unifying concepts and processes. Benchmarks for science literacy(AAAS, 1993) included mathematics and technology for science literacy. Categories in Benchmarks are nature of science, nature of mathematics, nature of technology, physical setting which is about physical science, living environment which is about biology, the human organism, human society, the designed world, the mathematical world, historical perspectives, common themes such as unit, and habit of mind. Bybee and Deboer(1994) suggested scientific knowledge, scientific methods, personal/ social development as science educational objectives.

Chiappetta *et al.*(1991b) used basic knowledge, investigative nature of science, a way of knowing, and science technology society as a textbook analysis framework. Chiappetta *et al.*(1991b) found that CHEM study included only 6.8 % inquiry, but ChemCom included 41.3 % of inquiry. Other textbooks included 8.7 to 30.5 % of inquiry. Staver and Bay(1987) used academic preparation, personal needs, career education/awareness and societal issues, Project synthesis goal cluster researched by Harms and Yager in 1981. Staver and Bay analyzed eleven elementary science textbooks and found elementary science textbooks included 10–30 % activities.

Science educational objective framework by Klopfer used for analyzing science instruction (Kim, 1984). When we consider textbook is one of the frequently used teaching materials, the amount of inquiry as a textbook content is very crucial in figuring out the actual instructional content and actual student learning.

By considering scientific inquiry, STS, and the nature of science, we developed a science educational objective framework, which is used for analyzing

elementary science textbooks of two nations.

### III. Research Methods

#### 1. Samples

The researched elementary science textbooks of the United States are 'Science' from Harcourt published in 2002, which are six science textbooks for grade 1-6. Korean elementary science textbooks researched are 'Wise life' for grade 1-2 published in 2000 and 'Science' for grade 3-6 published in 2001 and 2002. Each grade has two science textbooks, one for each semester in Korea. So the number of Korean science textbooks

researched are 12. Korean science textbooks were developed by following Science Curriculum which was the seventh national science curriculum presented in 1997 by Korean Ministry of Education (Ministry of Education, 1998).

For science educational objective analysis about 100 pages randomly selected from 1<sup>st</sup> and 4<sup>th</sup> grade textbooks by picking up pieces of paper written each chapter's number representing each chapter. For the United States 109 pages out of 385 pages are selected in the first grade textbook and 115 pages out of 636 pages in the fourth grade textbook. For Korea 102 pages out of 152 pages for the first grade textbooks and 92 pages out of 192 pages in the fourth grade textbooks (Table 1).

**Table 1** Pages of Textbooks Researched

Grade	The United States			Korea		
	Total	Researched	%	Total	Researched	%
First	385	109	28.3	192	92	47.9
Fourth	636	115	18.1	144	102	70.8

**Table 2** Topics of the United States and Korean First and Fourth Grade Science Textbooks

grade	The United State	Korea
First	A2 All about Plants D2 The Sky and the Seasons E1 Investigate Matter F2 Magnets	1.1.1 Joyful Playground
		1.1.2 Observing School Garden
		1.1.3 Picnic to Mountain and Field
		1.2.1 Shape of My Body
		1.2.2 Investigating by Various Senses
		1.2.3 Hospital Play
		1.3.1 Observing Changes in One Day
		2.1.2 I can also construct it.
		2.2.2 Meeting with Relatives
		2.2.3 My work to do
		2.3.2 Constructing Fall Garden
		2.3.3 Measuring Length
		2.4.1 Preparing Winter of our School
2.4.2 Preparing Winter of our Village		
2.4.3 Healthy Living in Winter		
Fourth	A4 Human body systems C2 Fossils E3 Sound F3 Simple Machines	2.5.1 Organizing
		1.2 Our Life and Liquid
		1.3 Lighting Bulbs
		1.4 Pinto Beans
		1.6 Plant Root
		1.8 Looking for Constellation
		2.2 Male and Female of Animals
		2.3 Looking for Strata
		2.6 Stretching Spring
		2.8 Transfer of heat and Our Life

The names of unit and chapters of science textbooks analyzed are in Table 2. Life science topics selected and compared from 1<sup>st</sup>–6<sup>th</sup> grade textbooks of two nations.

## 2. Science Educational Objective Framework

In order to analyze educational objectives shown in elementary science textbooks, science educational objectives are developed by literature review and checking content validity. For content validity of the framework four science educators discussed and agreed about the categories and sub-categories. The framework includes science knowledge, scientific inquiry, scientific attitude and science related career, science, technology and society, and philosophical, historical concerns in science. The framework used here is influenced by Klopfer's science educational objective framework, Bybee's

concern, Benchmarks and National Science

Education Standards. The science educational objective framework is in Table 3.

## 3. Textbook Analysis Methods

Textbook analysis methods mainly followed Chiappetta's method (Chiappetta *et al.*, 1991). Textbook analysis manual used is followed. Units of analysis are a paragraph, a question, a figure with caption, a table with caption and a complete step in laboratory or hands on activity. Experiment materials, vocabulary words, internet link and review questions are not included for the analysis.

Safety description is considered as a scientific procedure or scientific method(A,3). In Korean textbook analysis, 'Introduction' is about beginning of every chapters, which is analyzed. 'Further experiment,' 'Other activity,' 'Further activity,' 'Further steps,' and 'Reading material' are analyzed.

**Table 3** Science Educational Objectives Framework

- 
- 
- A. Scientific Knowledge
    - A.1 Recognition or Understanding
    - A.2 Application, Analysis, Synthesis or Evaluation
    - A.3 Scientific procedure or Scientific method
  - B. Scientific Inquiry
    - B.1 Recognizing Problems
    - B.2 Predicting, Controlling variables, Hypothesizing or Defining operationally
    - B.3 Gathering and recording data: Observing, Measuring, Recording, constructing
    - B.4 Inferring, Transforming data or Interpreting data
    - B.5 Concluding or Communicating
  - C. Scientific Attitudes
    - C.1 Perseverance, Willingness
    - C.2 Making a decision based on evidence
    - C.3 Open mind, Cooperativeness
    - C.4 Creativity
  - D. Science, Technology, and Society
    - D.1 Science and Technology
    - D.2 Societal issues related to Science
    - D.3 Career Awareness related to Science
  - E. Philosophy of Science, Nature of Science or History of Science
    - E.1 Inductive/Deductive Reasoning
    - E.2 Tentativeness/Objectivity/Subjectivity
    - E.3 History of Science
-

The followings are the typical examples of each educational objective aimed in textbooks. Korean textbook, pages 48–49, showing picture of life cycle of pinto bean and bong-sung-a, that is counted as the framework A.2, which is application, synthesizing and evaluation of science knowledge. A description of a safety issue is counted as the framework A.3, which is scientific method. Korean fourth grade science textbook, page 53, showing equipment setting for the separation of mixture is counted as a scientific method, which is the framework A.3. Korean fourth grade textbook, page 54, which is a reading material about getting salt from sea water, is counted as the framework A.1, which is recognizing knowledge, and the framework D.1, which is science and technology. Another reading material in Korean fourth grade science textbook, page 57 about getting rid of oil from sea is counted as four of the framework D.2, which is about societal issues. Korean 4th grade textbook pages 58–59, which is counted three B.3.

When the authors are analyzing elementary science textbooks of the United States, one main concept, which is usually a paragraph explained by more than two sentences is counted as one of the framework A.1, understanding scientific knowledge. For example, building blocks in page A 6 and a drawing of cell structure in page A 7 of the fourth grade textbook, Harcourt Science are counted as A.1. The drawing of cell structure includes mitochondria, cytoplasm, vacuole, cell membrane, and nucleus, which are explained by 1–2 sentences. Cone bearing plants, in page A 20 of 4<sup>th</sup> grade textbook is counted as one A.1 even though it is explained by several sentences.

## IV. Results

The analysis and comparison of textbook appearance, educational objectives shown in textbooks and characteristics of content of elementary science textbooks of the United States and Korea are followed.

### 1. Elementary Science Textbook Appearance

Elementary science textbooks of the United States have 3392 pages of 1<sup>st</sup> to 6<sup>th</sup> grade textbooks, for first grade, 385 pages; for second grade, 401 pages; for third grade 556 pages; for fourth grade, 636 pages; for fifth grade 680 pages; for sixth grade 734 pages. Korean elementary science textbooks have 1055 pages, for first grade 152 pages; for second grade 159 pages; for third grade 200 pages; for fourth grade, 192 pages; for fifth grade, 176 pages; for sixth grade, 176 pages. Elementary science textbooks of the United States have about three times more pages than Korean elementary science textbooks.

The height of 1<sup>st</sup> to 6<sup>th</sup> grade elementary science textbooks of the United States is 16.6 cm and Korean is 6.1 cm. The width of the United States textbook is 21.5 cm and Korean is 18.8 cm. The length of the United States is 27.5 cm and Korean is 25.5 cm. The volume of the United States science textbooks is 9814.7 cm<sup>3</sup>, and Korean is 2924.3 cm<sup>3</sup>. American elementary science textbooks have three times more volume than Korean elementary science textbooks.

### 2. Educational Objectives shown in Elementary Science Textbooks

Science educational objectives are analyzed from the textbooks and compared between two nations. Interrater agreement is 90.6 % for the United States and 83.9 % for Korea.

Educational objectives in science textbooks of the United States and Korea are significantly different at  $p < .05$  in Chi Square Test and Cramer's phi is .415 for the first grade science textbook. For the fourth grade educational objectives shown in two nations' elementary science textbooks are significantly different at  $p < .05$  and Cramer's phi is .379.

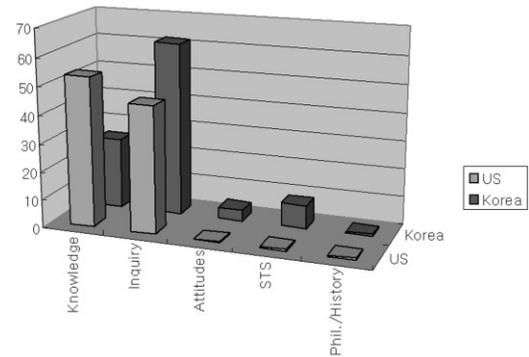
Science educational objectives shown in the first grade science textbooks are in Table 4. The first grade science textbook of the United States includes more scientific knowledge than scientific

inquiry, that is, 1,2 times more knowledge than inquiry. Korean first grade science textbooks include more scientific inquiry than scientific knowledge, that is, 2.4 times more inquiry than knowledge. Basically Korean elementary science textbooks are for guiding students to do some scientific inquiry activities. American science textbooks are for presenting scientific knowledge to students and guiding students to do some hands on activities.

Korean first science textbooks include more 'recognizing problems' (B.1), which is written such as 'Let observe our body,' 'interpreting data' (B.4), which is written such as 'What is the difference between day and night ?' after observing scenes of day and night, and 'conclusion' or 'communication' (B.5), which is written such as 'Let talk about scenes of day.' The first grade science textbook of the United States includes more 'collecting data' (B.3), than

Korean.

The elementary first grade science textbook of the United States emphasizes scientific knowledge more than Korean. Korean textbooks aimed scientific inquiry more than scientific knowledge as shown in Table 4 and Figure 1. Scientific inquiry /scientific



**Fig. 1** Educational Objectives in the United States and Korean First Grade Elementary Science Textbooks (%)

**Table 4** Educational Objectives by subcategories shown in the First grade Elementary Science Textbooks

Educational Objectives	The United States		Korea	
	f	%	f	%
A,1 recognition or understanding	98	33,2	40	13,3
A,2 application, analysis, synthesis or evaluation	54	18,3	22	7,3
A,3 scientific procedures or scientific method	5	1,7	14	4,7
B,1 recognizing problems	21	7,1	41	13,6
B,2 predicting, controlling variables, hypothesizing or defining operationally	19	6,4	22	7,3
B,3 gathering or recording data	64	21,7	48	15,9
B,4 inferring, transforming data or interpreting data	14	4,7	34	11,3
B,5 concluding or communicating	15	5,1	41	13,6
C,1 perseverance, willingness	0	0	1	0,3
C,2 making a decision based on evidence	0	0	2	,7
C,3 open minded, cooperativeness	1	0,3	6	2
C,4 creativity	0	0	3	1
D,1 science and technology	0	0	11	3,7
D,2 societal issues related to science	1	0,3	8	2,7
D,3 career awareness related to science	1	0,3	6	2
E,1 inductive/deductive reasoning	1	0,3	0	0
E,2 tentativeness/objectivity/subjectivity	1	0,3	2	0,7
E,3 history of science	0	0	0	0
Total	295	99,7	301	100,1

knowledge ratio is .85 for the first grade textbook of the United States. Korean first grade textbooks have 2.45 inquiry/knowledge ratio. Educational objective A.1 is 'recognition and understanding' which is shown in Korean first grade science textbook such as showing the name of a plant with the photograph.

Table 5 shows that fourth grade science textbook of the United States includes more than 50 % of the contents for scientific knowledge but Korean textbooks, 30 % for scientific knowledge. Korean fourth grade science textbooks are used more than 60 % of their space for scientific inquiry. General patterns of Korean elementary science textbooks are 'recognizing problem,' 'planning for experimenting,' 'procedures of experimenting,' 'interpreting data,' and 'concluding.'

Table 5 shows that the fourth grade textbook of the United States presents science career-related

contents and history of science. The science textbooks of the United States introduce many kinds of scientists by showing their specific works and biographical facts, which can invoke students' interests in science.

The fourth grade textbook of the United States showed 1.6 times more scientific knowledge than scientific inquiry. Korean fourth grade science textbook showed 2 times more scientific inquiry than scientific knowledge.

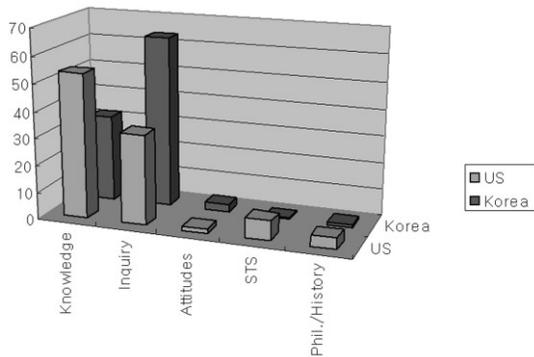
As shown in Table 5 and Figure 2, the elementary 4th grade science textbook of the United States emphasize scientific knowledge more than scientific inquiry which is similar to the first grade textbook. And also Korean fourth grade science textbooks aim scientific inquiry more than scientific knowledge which is similar to the first grade. The fourth grade textbook of the United States presents considerable amounts of STS and career, and history of science, Schmidt *et*

**Table 5** Educational Objectives by subcategories shown in the Fourth grade Elementary Science Textbooks

Educational Objectives	The United States		Korea	
	f	%	f	%
A.1 recognition or understanding	254	42.3	112	21.6
A.2 application, analysis, synthesis or evaluation	64	10.7	32	6.2
A.3 scientific procedures or scientific method	4	0.7	22	4.2
B.1 recognizing problems	21	3.5	62	12
B.2 predicting, controlling variables, hypothesizing or defining operationally	18	3	39	7.5
B.3 gathering or recording data	102	17	121	23.3
B.4 inferring, transforming data or interpreting data	46	7.7	76	14.7
B.5 concluding or communicating	13	2.2	32	6.2
C.1 perseverance, willingness	1	0.2	0	0
C.2 making a decision based on evidence	1	0.2	2	0.4
C.3 open minded, cooperativeness	7	1.2	8	1.5
C.4 creativity	0	0	4	0.8
D.1 science and technology	17	2.8	3	0.6
D.2 societal issues related to science	8	1.3	0	0
D.3 career awareness related to science	19	3.2	0	0
E.1 inductive/deductive reasoning	3	0.5	2	0.4
E.2 tentativeness/objectivity/subjectivity	1	0.2	0	0
E.3 history of science	21	3.5	3	0.6
Total	600	100.2	518	100

al.(2005) also found that more science topics in each grade of the science curriculum in the United States and each topic stays in curriculum for more grades than the six high achieving countries such as Japan, Taiwan or Korea. Their finding suggests that elementary science curricula and textbooks in the United States should include less topics.

The United States fourth grade science textbook shows .62 inquiry/knowledge ratio. Korean fourth grade science textbooks show 1.99 inquiry/knowledge ratio. The first grade science textbooks showed bigger inquiry/knowledge ratio than the fourth grade textbooks.



**Fig. 2** Educational Objectives in the United States and Korean Fourth Grade Elementary Science Textbooks (%)

Korean elementary science textbooks showed bigger inquiry/knowledge ratio than that of the United States. The fourth grade science textbook of the United States includes contents of technology, career and history of science. Korean first grade science textbooks emphasized STS and career, which can be explained by that Korean first grade science subject is an integrated subject with social studies, named by 'Wise Life.

### 3. Characteristics of Elementary Science Textbooks in the United States and Korea

As shown in Table 6, life science topics in elementary science textbooks of the United States are more redundant than Korean. 'Heredity' is presented in the 5<sup>th</sup> and 6<sup>th</sup> grade textbooks of the United States. 'Cell' is showed in the 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>

and 6<sup>th</sup> grade science textbooks of the United States but Korean, only in the 5<sup>th</sup> grade textbooks. The contents of 'Kinds of ecosystem' are presented in the 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> grade textbooks of the United States but Korean, only in the 6<sup>th</sup> grade textbooks. Contents of 'Photosynthesis' appear in the 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> science textbooks of the United States but Korean, only in the 5<sup>th</sup> grade science textbooks. Mostly Korean science textbooks present only one time for a specific topic but three to five times in the United States. Through the elementary years, students learn about same topics twice will be reasonable. According to Bruner's representation theory, students could learn science concepts effectively with learning materials prepared by considering their representational stages. So during the first grade to the 6<sup>th</sup> grade two kinds of presentation of same topics by two different representational methods will be proper.

'Cell' and 'Kinds of ecosystem' are presented from the 3<sup>rd</sup> grade in elementary science textbooks of the United States but from the 5<sup>th</sup> or 6<sup>th</sup> grades in Korean. The Elementary science textbooks in the United States introduce some topics earlier than Korean.

Elementary science textbooks of the United States present science topics redundantly and earlier than Korean, which makes elementary science textbooks of the United States to be thick. Five kingdoms, cell reproduction, food chain, and kinds of ecosystem are shown in fifth and six grade science textbooks of the United States with considering almost same content. Classification is included in first, second, fourth, fifth, and sixth grade with considering classification of different living things. Korean science textbooks do not include similar contents in different grades. The thick elementary science textbooks of the United States have a lot of well described scientific information and a lot of vivid pictures, which will stimulate students's curiosity and interest to nature.

**Table 6** Specific topics in Life science shown in the elementary science textbooks of the United States and Korea

Topics	The United States	Korea
Heredity	5 <sup>th</sup> , 6 <sup>th</sup>	1 <sup>st</sup>
Cell	3 <sup>rd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup>	5 <sup>th</sup>
Kinds of ecosystem	3 <sup>rd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup>	6 <sup>th</sup>
Classification	1 <sup>st</sup> , 2 <sup>nd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup>	1 <sup>st</sup> , 4 <sup>th</sup> , 6 <sup>th</sup>
Photosynthesis	4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup>	5 <sup>th</sup>

#### 4. Some considerations about elementary science textbook

Textbooks are the most influential teaching material to elementary teachers in the United States and Korea. The contents of textbooks affect the way of teaching and teaching contents. Even though some elementary teachers in the United States do not cover all contents of the textbook, they try to cover most of the contents of the textbook they use. But Korean elementary teachers cover all contents of science textbooks.

Presenting science textbook contents with factual knowledge gives elementary teachers chances to be misdirected in terms of teaching methods and educational objectives. Elementary teachers try to cover the content of the textbook. So if the science textbook includes a lot of factual knowledge, then elementary teacher will teach the factual knowledge. Science teaching can not be activity-oriented or inquiry-oriented. If the science textbook is activity-oriented, elementary teachers will teach science with the activity-oriented method.

Practically Elementary teachers in the United States can not cover all contents in the science textbooks. But the contents of the science textbooks affect science teaching at elementary schools. So if we think activity-oriented and inquiry-oriented elementary science teaching is effective, then inquiry-oriented and activity-oriented textbook is better than scientific factual knowledge-oriented and scientific term-oriented elementary science textbook.

Therefore elementary science textbook, from the first to the sixth grade in the United States,

needs to be more inquiry-oriented and activity-oriented. And elementary science textbooks in the United States need to omit the redundant topics and difficult contents to elementary students.

Korean elementary science textbooks need to include scientific concepts from the first grade systematically and to include more hands-on activities in the first grade and second grade textbooks. Korean first grade science textbooks show 61.8% of inquiry. But the inquiry is not about hands-on activities of basic science concepts mostly, but it is mostly about recognizing problems and communicating what students' think about safety, health or everyday life and some basic science concepts. Korean elementary science textbooks need to introduce basic science concepts earlier than the third grade systematically.

The 2007-revised science national curriculum is emphasized too much on concepts of physics. Concepts of biology, earth science and chemistry also can be introduced in the first and second grade science textbooks. Application of science concepts in everyday life and technology, or science-related societal issues can be introduced as a part of each chapter. But basic science concepts is better as the main structure of elementary science textbook than others.

## V. Conclusion

By analyzing elementary science textbooks in the United States and Korea, we find three things, which are about the appearance, educational objectives and characteristics of life science topics.

First, textbooks in the United States have three times more volume than Korean, and include

higher quality photographs and more explanatory science reading materials.

Second, The degree of emphasis in science educational objectives is different between two nations. Scientific knowledge and scientific inquiry are mostly emphasized in two nations' elementary science textbooks. The ratio of scientific inquiry/scientific knowledge in the United States is less than Korea. The ratio of inquiry/knowledge of the first grade textbook is bigger than the fourth grade's. The elementary science textbooks in the United States emphasized scientific knowledge more than scientific inquiry. Korean elementary science textbooks include more scientific inquiry than scientific knowledge. The United States elementary science textbooks presented less scientific inquiry than Korean elementary science textbooks. In the 4th grade textbook of the United States, science related careers and history of science is presented more than in Korean textbooks where it is negligible. Scientific knowledge is more emphasized in the fourth grade science textbook than in the first grade science textbook of the United States.

Third, elementary science textbooks in the United States showed life science contents more redundantly than Korean and presented more advanced contents in life science topics than Korean. The United States elementary science textbook present some concepts in the earlier grade than Korean in life science.

Elementary science textbooks in the United States need to present more simplified and concise science contents comparing to the present textbooks. Elementary science textbooks in the United States need to be considered profoundly the redundancy of life science topics whether which is a necessary textbook structure as a spiral curriculum or not. Korean elementary science textbooks need better photographs and diagrams which can give more meaningful information.

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## Abstract

Science textbook is the most frequently used teaching material in elementary schools of the United States and Korea. Elementary science textbooks of the United States and Korea are analyzed to find out the educational objectives and characteristics of contents shown in textbooks. About 100 pages each in the first grade and fourth grade science textbooks each nations are selected randomly for educational objective analysis. Life science contents of 1st to 6th grade are analyzed from elementary science textbooks of the United States and Korea. The analyzed textbooks in Korea are 'Wise life,' an integrated subject with social studies and science, and 'science.' The analyzed elementary science textbooks of the United States are Harcourt Science, which is one of the frequently used textbooks. The educational objective framework used includes science knowledge, scientific inquiry, scientific attitude, STS, and philosophy and history of science.

The results show science textbooks of the United States emphasize scientific knowledge more than scientific inquiry. Korean science textbooks emphasize scientific inquiry more than scientific knowledge. Elementary science textbooks of the United States present some life science topics redundantly and expose more difficult topics than Korean.

**Key words:** science textbook comparison, international comparison, science educational objectives, life science topics