ANALYSIS OF QUESTIONS IN THE SCIENCE TEXTBOOK OF THE FIRST SEMESTER OF THE THIRD GRADE (3-1) IN ELEMENTARY SCHOOL

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ABSTRACT

The purpose of this study is to investigate the characteristics of the questions presented in the elementary school 'Science 3-1' textbook in Korea. The research tool used the Text Questioning Strategies Assessment Instrument (TQSAI), developed by the University of California. The percentage of questions asked about the total number of sentences averaged 22.7% for five chapters. Many questions were placed at 61.7% in the initial stage at the location of the question. The mid-stage was 23.3% and the end-stage was 15.0%. The locations of the question were significant differences between units ($p < 0.05$). Then the output in the location of the questions in the science textbook did not assumed equal variances. The empirical questions were 59.6% for the text and 56.2% for the non-text, respectively. In the analysis of questions about the cognitive ability, 'Application' was the highest, followed by 'Knowledge'. In the compositional analysis of the questions, the text had the highest 'Focus Question', followed by 'Open Question'. In the analysis of questions about problem solving, 'Scientific Questions' was the highest. On the other hand, the question of solving the social problem was the lowest. In the analysis of the composition of the questions, 'Explorative Questions' was the highest, followed by 'Knowledge Questions'. Questioning Strategies should not simply ask questions to induce students' thinking, nor should they be too large a proportion.

Keywords: Composition of the questions, Question, Questioning Strategies Assessment Instrument, Science 3-1 textbook.

INTRODUCTION

Questions are an activity that inquires questions or reasons, and are an essential tool of teaching and sometimes used as a tool for evaluation. Questions require a thoughtful answer and can play diverse educational roles, such as stimulating the learning of new knowledge, as is the case in Problem-Based Learning (PBL) contexts (Leite, 2012).

Using questions to teach is an age-old practice and has been a cornerstone of education for centuries. The teacher invites responses from students but discounts their ideas, as she focuses solely on the scientific idea. Questioning plays a critical role in the way instructors structure the class environment, organize the content of the course and has deep implications in the way that students assimilate the information that is presented and discussed in class.

Questions can also be classified into knowledge dimensions. Multiple approaches to classifying questions exist in the education literature. There has been a growing interest in the role of students' questions in learning science as questions are an essential component of discursive activity and dialectical thinking (Chin & Osborne, 2008). A key, if not central, feature of

scientific discourse is the role of questioning in eliciting explanations, postulating theories, evaluating evidence, justifying reasoning, and clarifying doubts.

The science textbooks were designed to support the effective implementation of an inquiry-based approach to science teaching (Carulla, 2012). It is a children science book that provides science learning information to the elementary school students during the course of science class with the elementary school science. The entries in the curriculum section are grouped by scientific area such as Life Science, Earth Science, Physical Science, and Multidisciplinary and Applied Science and by types such as core materials, supplementary materials, and science activity books. High-quality science instruction moves students from curiosity to interest to reasoning (Moulding et al., 2015).

Questioning can engage learners by stimulating active participation in the learning process, guide them toward the understanding of deeper concepts, promote peer–peer collaboration, and build their confidence.

Armbruster and Ostertag (1993) investigates the characteristics of the questions asked in content area materials/addresses the issues of how many and what kind of questions-both instructional and assessment-appear in recent fourth- and fifth-grade science and social studies textbooks and teachers' manuals/examines the pattern of questioning with respect to research recommendations on questioning and the implicit educational philosophy.

The purpose of this study is to provide an overview of how the 'Science 3-1 Textbook' presents the questions and find out the location, composition, and roles of questions in the national elementary school textbook.

LITERATURE REVIEW

Research on classroom discourse, including asking questions, has been an important area of study beginning in science classrooms (Chin, 2007; Chin & Osborne, 2008; Herranen & Aksela, 2019; Mihladiz & Duran, 2014), and several others (Ernst-Slavit & Pratt, 2017). An international community of science education leaders and researchers from the United States, Canada, Britain, Australia, New Zealand and other countries actively shares ideas about what science to teach children, how to teach children and any number of other current science issues and trends (Nixon & Lizaire, 2007).

Cervetti et al. (2012) investigated the efficacy of an integrated science and literacy approach at the upper-elementary level. The similar study in Korea was the teaching and learning activities by comparing questions presented in the 2009 curriculum elementary science textbooks and questions presented in the elementary science textbooks of the 2015 revised curriculum (Kim & Kim, 2018). Lee (2013) analyze the characteristics of good science teachings with question-answer and request-accept regarded by preservice elementary school teachers.

METHODOLOGY

This study were the national elementary school 'Science 3-1' textbook developed and used in accordance with the current curriculum, and were asked questions in five chapters (Table 1). First chapter is How do scientists explore? (Table 2). Second is the properties of matter, 3rd, the life cycle of an animal, 4th, the use of magnets, and 5th, the appearance of the earth. Statements or statements do not have a questionable form or sentences with other functions other than the question were not considered questions in this study.

The research tool used the Text Questioning Strategies Assessment Instrument (TQSAI) (Lowery & Leonard, 1975), developed by the University of California as part of a collaborative teacher preparation project in 1975. It is a tool to analyze the frequency, form, and location of questions presented in textbooks and examine the exploration process in which questions are asked to examine whether there are meaningful differences in questions for each textbook chapter or unit. The form of the tool divides the questions into two top categories of empirical (experience) and non-experiential questions, each consisting of several subcategories, but here we treat them as separate items due to the large number of questions.

The location of the question was divided into the title or introduction step, intermediate step, and finishing or organizing step in any section. The analysis of questions about the exploration process was divided into knowledge, understanding, application, analysis synthesis, and evaluation. The composition of the questions was divided into investigation, information, focus, openness, and value. The analysis of questions about problem solving was divided scientifically, technically, socially, and routinely. Exploration composition methods for questions were divided into knowledge, exploration, and attitudes.

The chi-square of frequences or mean values to infer whether differences exist among the questions was tested. Except where stated otherwise, statistical analyses were performed using the SPSS software (Release 21.0).

Table 1. The elementary school science 3-1 textbook used in this study

Code	Copyright holder	Compilation	Publishing company	Date of publication
3-1	Ministry of Education and Human Resources Development	Korea Foundation for the Advancement of Science & Creativity	Chenjae Textbook	2021, 3

Table 2. Composition of the elementary school science 3-1 textbook

Chapter	Title	Page volume
1	How do scientists explore?	14 (8-21)
2	The properties of matter	22 (22-43)
3	The life cycle of an animal	24 (44-67)
4	The use of magnets	26 (68-93)
5	The appearance of the earth	24 (94-117)

RESULTS

The percentage of questions asked about the total number of sentences averaged 22.7% for five chapters (Table 3). The chapter with the highest ratio was 27.9% in Chapter 3, while the chapter with the lowest ratio was 17.9% in Chapter 1. Many questions were placed at 61.7% in the initial stage at the location of the question. The mid-stage was 23.3% and the end-stage was 15.0%. Since the x^2-values for the text and the non-text were 342.06 ($p < 0.001$) and 8.88 ($p < 0.05$), respectively. There were significant differences between units. Then the output in the location of the questions in the science textbook did not assumed equal variances.

The empirical questions were 59.6% for the text and 56.2% for the non-text, respectively (Table 4). Non-experiential questions were 40.4% in the text and 47.4% in the non-text. There were significant differences between units ($x^2 = 11.78^*$ for text, $x^2 = 45.98^*$ for non-text).

In the analysis of questions about the cognitive ability, 'Application' was the highest followed by 'Knowledge' (Table 5). Questions about the exploration process differed a lot among the units. So, there were significant differences between units ($x^2 = 44.50^{***}$ for text, $x^2 = 216.62^{***}$ for non-text).

In the compositional analysis of the questions, the text had the highest 'Focus Question', followed by 'Open Question' (Table 6). On the other hand, 'Open Question' was the highest in non-text questions, followed by 'Focus Question'. There were no information questions among all chapters. There were significant differences in the composition of the questions among the chapters ($x^2 = 11.06^{*}$ for text, $x^2 = 23.37^{**}$ for non-text).

In the analysis of questions about problem solving, 'Scientific Questions' was the highest (Table 7). On the other hand, the question of solving the social problem was the lowest. There were significant differences between units ($x^2 = 43.16^{**}$ for text, $x^2 = 10.57^{*}$ for non-text).

In the compositional analysis of the questions, 'Explorative Questions' was the highest (Table 8). Next was 'Intellectual Question'. There were significant differences between units ($x^2 = 110.01^{***}$ for text, $x^2 = 43.53^{**}$ for non-text).

Table 3. The location of the questions in the science textbook for the first semester of the third grade of elementary school

Step	Chapter					Total
	1	2	3	4	5	
Introduction	7(4)	6(7)	7(7)	8(7)	9(8)	37(33)
Intermediate	0(2)	5(0)	1(2)	6(7)	2(6)	14(17)
Finish	0(7)	4(6)	2(13)	2(13)	1(8)	9(47)
Total	7(13)	15(13)	10(22)	16(27)	12(22)	60(97)

$x^2 = 342.06^{***}$ for text, $x^2 = 8.88^{*}$ for non-text, $^{*}: p < 0.05$, $^{***}: p < 0.001$.

Table 4. Experience and non-experience of the questions in the science textbook

Step	Chapter					Total
	1	2	3	4	5	
Experience	3(6)	11(4)	5(14)	13(22)	7(5)	39(51)
Non-experience	4(7)	4(9)	5(8)	3(5)	5(17)	21(46)

$x^2 = 11.78^{*}$ for text, $x^2 = 45.98^{*}$ for non-text, $^{*}: p < 0.05$, $^{**}: p < 0.01$.

Table 5. Analysis of questions about the cognitive ability in the science textbook

Chapter	Knowledge	Understanding	Application	Analysis	Synthesis	Evaluation	Total
1	-	-	5(7)	2(2)	0(3)	-	7(13)
2	2	-	7(11)	3(1)	3(0)	0(1)	15(13)
3	5(9)	1	3(7)	1(3)	0(2)	0(1)	10(22)
4	0(6)	1(6)	13(13)	2(2)	-	-	16(27)
5	11(10)	0(9)	1(2)	0(1)	-	-	12(22)
Total	18(25)	2(15)	29(40)	8(9)	3(5)	0(2)	60(97)

$x^2 = 44.50^{***}$ for text, $x^2 = 216.62^{***}$ for non-text, $^{***}: p < 0.001$.

Table 6. The composition of the questions in the science textbook

Chapter	Investigation	Information	Focus	Openness	Value	Total
1	1(2)	-	6(0)	0(8)	0(3)	7(13)
2	2(1)	-	7(3)	5(8)	1(1)	15(13)
3	-	-	5(10)	5(12)	-	10(22)
4	-	-	10(6)	6(19)	0(2)	16(27)
5	1(0)	-	7(8)	4(13)	0(1)	12(22)
Total	4(3)	-	35(27)	20(60)	1(7)	60(97)

$x^2 = 11.06^{*}$ for text, $x^2 = 23.37^{**}$ for non-text, $^{*}: p < 0.05$, $^{**}: p < 0.01$.

Table 7. The analysis of questions about problem solving in the science textbook

Problem solving	Chapter					Total
	1	2	3	4	5	
Scientific	5(6)	4(4)	9(9)	8(16)	0(7)	31(43)
Technical	1(6)	3(2)	0(8)	0(4)	9(7)	13(27)
Social	1(0)	0(1)	1(0)	-	-	2(1)
Routine	0(1)	2(5)	0(5)	8(7)	3(8)	14(26)

$x^2 = 43.16^{**}$ for text, $x^2 = 10.57^{*}$ for non-text, $^{*}: p < 0.05$, $^{**}: p < 0.01$.

Table 8. Exploration composition methods for questions in the science textbook

Composition method	Chapter					Total
	1	2	3	4	5	
Knowledge	0(1)	5(2)	3(3)	5(15)	10(13)	23(34)
Exploration	-	10(9)	7(17)	11(12)	0(9)	34(56)
Attitude	1(3)	0(2)	0(2)	-	2(0)	3(7)

$x^2 = 110.01^{***}$ for text, $x^2 = 43.53^{**}$ for non-text, $^{**}: p < 0.05$, $^{***}: p < 0.001$.

DISCUSSION

Questions can stimulate student thinking and provide feedback for the teacher about students' understanding. Much of the early studies on teacher questioning (Dantonio & Paradise, 1988; Mill et ., 1980; Redfield & Rousseau, A. 1981) were conducted using a process-product paradigm to study the relationship between teacher questioning and student achievement (Chin, 2007). Much of the elementary science education reform of the last decade has focused on engaging students in scientific inquiry though the use of hands-on curriculum in school (Foley & McPhee, 2008). It is a major focus of the (National Science Education Standards, 2000) and has been advocated in numerous documents (American Association for the Advancement of Science, 1990; National Research Council, 1996). An important goal of science education is to create a classroom environment where students make sense of novel phenomena that engage them in science performances at the intersection of three dimensional learning (Moulding et al., 2015). A highly effective way to think about how three dimensional learning is implemented in a classroom is with a performance sequence of: gathering, reasoning, and communicating. High-quality elementary science education is essential for establishing a sound foundation of learning in later grades, instilling a wonder of and enthusiasm for science

that lasts a lifetime, and in addressing the critical need for a well-informed citizenry and society (National Science Teachers Association, 2014).

Questions must be specifically designed for various students ability. Questioning techniques that should be used are the techniques that will stimulate widest students' attendance (Apriani & Marchelina, 2018). Not only questions, statements should also encourage students. One questioning strategy may also apply to science textbook in elementary school. In the science textbook in elementary school, many exploration activities are set up in each chapter. Textbooks for the first semester of the third grade are no exception. Many questions are set in the exploration activity. For example, what do you need? What should we do? are very simple questions. These can be replaced simply by 'preparations' and 'methods'. It's a meaningless question, but students may not think so. Therefore, it should be expressed in a statement, not in a question.

Too many questions can reduce students' interest or lead to indifference. Questions should be timely where necessary. Science education reform makes use of research within the cognitive sciences, which seek to uncover the mental processes of learning. The role of questions in textbooks are to guide students in building knowledge and help students learn about scientific practice, explain phenomena, and develop explanations of the phenomenon. This information provides a description of effective investigation questions in science learning practice. On the other hand, constructive questions are terms used to describe a method that asks open-ended questions and engages students in conversation about a subject area. If the right questions are asked, students will be thoroughly engaged in the discussion, where they will share prepared and researched ideas, explore thoughts and reflections.

In conclusion, effective questioning in science instruction moves students from curiosity to interest to reasoning. However, many simple questions can reduce students' interest or lead to indifference. In the science textbook in Korean 3-1 textbook of elementary school, many exploration activities are set up in each chapter. There were consisted of many simple and formal questions.

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