Shared-Book Experience Using Science-Themed Books to Develop Scientific Literacy: An Interactive Approach with Struggling Readers

Mi-Hyun Chung & Barbara Keckler,
Mercy College

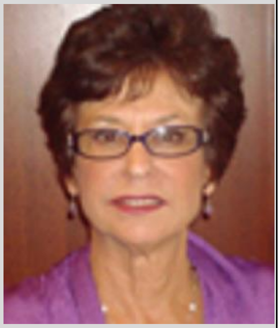
ABSTRACT

This paper will explain what a reading teacher learned from working with a group of first-grade struggling readers in a series of shared-book experience classes. The shared-book experience approach used a variety of science-themed books that were aligned with the first-grade curriculum and appropriate for beginning readers. Considering the readers' ages, the reading teacher used "big books," enlarged versions of the original books devised for early childhood reading classes.

Integrating reading with science may increase science instruction time in the overcrowded elementary curriculum, and more importantly, can develop both reading skills and scientific knowledge, satisfying the learning standards for both areas (Froschauer, 2011; Olson and Gee, 1991). Other studies (Padilla, Muth, and Padilla, 1991; Rutherford and Ahlgren, 1990) agree that reading and science thinking process skills interrelate; and both require social, interactive, and communication skills to develop. In this article, the model of the shared-book experience using science-themed books is described, and questions and comments made by the children during the experiences are analyzed and discussed. The findings from the shared-book experience classes suggest that the shared-book experience, using quality science-themed books, may help students to develop scientific literacy skills such as science concepts and enhance reading and science thinking process skills.

AUTHOR BIOGRAPHIES

Mi-Hyun Chung, PhD. is the Chair of Department of Literacy and Multilingual Studies and Associate professor at Mercy College School of Education, New York. She has served the field of Literacy as an elementary school teacher and professor in higher education. She is currently teaching a language and literacy development course. Her most recent research interests include, but not limited to, multicultural education, children's literature, and scientific literacy. Questions or comments may be directed at mchung@mercy.edu



Barbara Keckler , PhD. is an Associate Professor, at Mercy College, School of Education who has had a lengthy experience as a literacy specialist in the state of New York. She currently prepares literacy candidates for practical classroom experiences by providing an environment that encourages the use of effective literacy instructional practices and assessment techniques. Her areas of expertise include emergent literacy as well as diagnosis, prescription, and remediation of reading and study skills. Questions or comments may be directed at bkeckler@mercy.edu.

According to two recent Census Bureau reports (Census Bureau Reports, June 25 2015; Nov 03 2015), the United States has become a more diverse society in terms of ethnicity, gender, age, disability, and so forth, and in the New York metropolitan area, about 200 different languages are spoken at home by one third of the population. According to Westby and Torres-Valasquez (2000), there is some indication that children from culturally and linguistically diverse backgrounds may exhibit difficulty in learning reading, math, and science due to the lack of connection between what is taught at school and what they have experienced. Therefore, teachers must be equipped with pedagogies that can help different levels of readers who bring various types of background knowledge to the class. In addition to these demographic changes in the classroom, teachers are asked to meet the requirements set up by new standards such as Common Core Learning Standards (CCLS). In such standards, emphasis is given to teaching text structure and comprehension of informational texts as in history, social studies, science, and technology texts (Common Core Standards Initiatives, 2016; New York State Education Department, 2010).

The current emphasis on content-area literacy instruction is not new; it has always been an integral part of literacy education. For example, one proposed way of teaching science in the early years is to integrate the reading and science curriculum. This integration has been considered a means to increase science instruction time in the overcrowded elementary curriculum, which usually emphasizes reading and mathematics instruction (Plummer & Kuhlman, 2008). Combining reading and science makes sense because reading and science process skills interrelate (Padilla, Muth, & Padilla, 1991). Science is a social activity that incorporates human values and communication skills, including language or literacy skills (Rutherford & Ahlgren, 1991). Moreover, not only does integrating reading and science benefit students in gaining scientific knowledge and skills, but it also helps in learning how to read fact-based expository texts (Froschauer, 2011; Olson and Gee, 1991). According to Froschauer (2011), teachers can help children develop literacy skills by engaging them in reading, writing, and interactive discussion. In effect, using science-themed books during a reading class encourages talking about science, while enhancing both ability of reading expository texts and science process skills.

Scientific literacy refers to one's ability to understand scientific vocabulary, concepts, and processes. Incorporating scientific knowledge, skills, and habits of mind enables people to understand and reflect on many of the ideas, claims, and events they encounter in everyday life (American Association for the Advancement of Science, 1990/2009). Today, there are growing calls for recognizing the importance of elementary science instruction (See National Science Teachers Association, 2011; American Association for the Advancement of Science, 2011). Research (See Gelman & Brenneman, 2004) emphasizes the importance of science process skills, the connection to the experiences, and the roles of communication or literacy in early childhood science education. Consequently, children need to be actively involved in learning science when they are young because it will help them develop domain-specific knowledge and skills. Despite the acknowledged or accepted importance of early exposure to science, the methods that should be used to teach scientific literacy through classroom practices and the student learning outcomes that should result are debatable (Smith, Loughran, Berry, & Dimitrakopoulos, 2012).

This paper presents a study that explored how using science-themed books in shared-book experience classes may influence children's scientific literacy. The instructional approach in this study was the *shared-book experience*, which encouraged struggling readers' oral communication in a social learning context. During the classes, children's comments and questions were collected to examine, because the data shed light on the students' meaning-making process. The purpose of this study was to find out the kinds of children's questions and comments made in the context of shared-book experiences, to examine the types of scientific thinking processes revealed in the questions and comments, and to look for evidence that scientific literacy development was facilitated. Specifically, scientific literacy in this study was defined as knowledge and skills overlapping in literacy and science.

Science, Literacy, and Interactive Learning

It is a commonly held belief in content-area literacy that integrating reading and the content-area curriculum may be a way to help students experience success in both subject areas (e.g. Vacca, Vacca, and Mraz, 2014). Presently, the Common Core Learning Standards (CCLS) encourage the infusion of literacy skills into content-area subjects such as social studies, math, and science. Based on the CCLS, it appears that facilitating literacy development in early grades is essential to promoting content-area knowledge and skills children need in later grades and more importantly, to be prepared for the onslaught of scientific and technological advancements of the 21st century.

Developing vocabulary and concepts is one of the most important elements of content-area literacy instruction because readers use words to "construct meaning" from the text (Vacca, Vacca, and Mraz, 2014). Informational text comprehension is dependent on the level of vocabulary (Liebfreund, 2015), and it is widely accepted that teaching vocabulary and concepts is the key to success in the content-area learning. Literacy instruction must facilitate the development of vocabulary and concepts as the "building blocks" for scientific knowledge.

Additionally, science and literacy have many process skills in common. Making inferences, asking questions, drawing conclusions, and predicting outcomes are examples of those common skills. Armbruster (1993) wrote:

> Reading and doing science are not antithetical but rather similar processes drawing on the same cognitive base. Both are interactive-constructive processes that require critical thinking and reasoning. The same skills that make a good scientist also make good readers; engaging prior knowledge, forming hypotheses, establishing plans, evaluating understanding, determining the relative importance of information, describing patterns, comparing and contrasting, making inferences, drawing conclusions, generalizing, and evaluating sources, etc. (p.347)

Padilla et al. (1991) have argued that certain scientific thinking processes, such as prediction, may be enhanced by structuring reading instruction as a problem-solving activity. Rutherford (1993) also suggests that asking questions is an important process skill that children can learn during reading.

The shared-book experience has been widely used for both narrative and informational books in order to teach different age groups (e.g. Hicks & Wadlington, 1994; Holdaway, 1982; Scott, 1994; Scheffel, & Booth, 2013). This approach has proven effective because of the social, interactive method it uses to teach reading. Other studies have illustrated the interactive nature of story reading and suggest implications for developing the use of story reading as an instructional strategy in the classroom (Cochran-Smith, 1984; Flood, 1977; Morrow, 1988). These studies also imply that reading a book to a child is not sufficient for maximum literacy growth; the talk surrounding the text is more important in developing children's literacy development. It is the interaction between an adult and children during learning that helps construct meaning from text (also see Dombey, 2003; Ninio & Bruner, 1978).

Westby and Torres-Valasquez (2000) argue for the demands of increasing literacy ability in the current world and emphasize the importance of “instructional conversations” to facilitate children’s “knowing, doing, and talking” science (p.105). Using a sociocultural framework supported by Vygotsky, they recommend that teachers use questioning strategies to guide students into thinking processes and constructing meaning. According to Vygotsky (1962), high-level cognitive processes can emerge through these kinds of adult-child interactions. Students acquire knowledge as well as routines for regulating their use of that knowledge. Vygotsky (1978) described intelligence as growing out of social interaction, making a strong claim for the social origins of cognition. From this perspective, the read-aloud and question-and-answer activities, as parts of the shared-book experience, ensure adult-child social interaction, with the adult serving, initially, as mediator between text and child to make or take meaning from the text. The event gives the child both a model of adult reading and a support system during the child’s transition to independent reading.

Procedure and Shared-Book Experience

This study was conducted in an elementary school that serves students from both suburban and urban areas in New York. A group of seven struggling readers in first grade was selected to receive remedial reading instruction using a pull-out model of instruction. The seven students scored below 25% percentile on the Metropolitan Readiness Test. The students were six and seven years old, with diverse ethnic backgrounds. Six students were considered minority students in terms of ethnic backgrounds, with four students whose home language was one other than English. There were four girls and three boys in the group. Studies on the approaches for emergent or beginning readers have found that young children can use and reveal reading strategies as they read (Mason, Peterman & Kerr, 1988; Sulzby, 1985), and that it is not necessary for children to be fluent readers in order to study the circumstances under which they become strategic readers (Elfant, 1990).

The materials used for this study were selected by a first-grade teacher, a reading teacher (one of the researchers), and an administrator who served as a curriculum specialist using the following criteria: 1) informational text 2) science-theme or topic based on a variety of science concepts from the first grade curriculum, and c) appropriated readability as Holdaway (1979) and Routman (1988) recommended.

Considering the readers’ ages, the reading teacher used “science big books” that are “easy to read oversized copies of nonfiction picture books about science with informational structure” (Sancore, 1991, p. 211). The size of the big books and their illustrations enhance engagement and student curiosity. These big books are accompanied by smaller, normal sized versions of the book used for independent reading. The highly patterned structure provides support that enables children to read themselves.

These books were read during a total of eight shared-book experiences, each lasting 30 minutes. Time was provided for discussions and questions, while taking into consideration the children’s attention span and tasks to be completed. Each shared-book experience was completed in three separate sessions, which normally occurred over a one-week period. The sequence of the three sessions proceeded as follow:

Session I: Reading the text. The group gathered together for a 30-minute session. A teacher began by showing the children the cover of a big book and discussing the illustration and theme of the book. The aim was to involve the children and to tap their experiential background with regard to the theme. Then, the teacher continued to read the text while participation by the children was encouraged. The teacher employed the following strategies:

- The teacher introduced a big book, an enlarged version of a picture book, and positioned the book in a way that children could see the print and pictures.
- The teacher encouraged children to make predictions about the text based on the book's cover, title, and illustrations.
- The teacher read the text pointing to each word, reading the text as naturally as possible, in order to model good reading behavior.
- The teacher stopped at strategic points to ask questions about what was being read.

Session II: Rereading the text. In the second session, the teacher provided children with the opportunity to participate in the readings; recall vocabulary, ideas, and information; as well as demonstrate reading strategies and language conventions. Students were continuously encouraged to make comments and ask questions.

Session III: Responding to the text. A normal size book, the same version of the big book used in the earlier sessions, was given to each student, and they had the opportunity to read the book independently. After the independent reading, students were encouraged to respond to the book through discussions in pairs or small groups, structured by the teacher. This exercise was conducted in order for the readers in this remedial class to have an opportunity to follow the reading behaviors modeled by the teacher in the shared-book experience.

Findings from Children's Comments

The children's questions and comments were collected during eight shared-book experiences presented over a total of 24 sessions in a school year. The comments were categorized using analytic techniques, including pattern-matching and time-series analysis (Yin, 2008). They were then coded modifying the systems described by Yaden, Smolken, & Conlon (1989) and by Morrow (1988). Eight different types of the children's questions and comments were identified (see Table 1). It should be noted that Detail (49%), Labeling (16%), Interpretation (19%), and Inference (6%) accounted for a total of 89% of all the questions or comments across all the sessions. Overall, the children asked questions to build meaning based on the text and the pictures, but there were also questions connected to their prior knowledge and experiences.

Table 1. Categorized Children's Comments

Types	Description	Examples
Real World Connection	Questions and comments connecting action, event, animal, nature, etc. with similar examples from children's experiences.	"How come they look like Christmas trees?" "How come their feet are shaped like ducks?"
Meaning of a Word/Phrase	Questions and comments about the meaning of a word or a phrase.	"What's a bog?" "What is a stream?"
Detail	Requests for elaboration or additional literal information.	"How come their tails are flat?" "How come he has a curly shell?"
Labeling	Questions and comments about the identity of an item, feature, action, etc.	"What kind of whale is that?" "What are those long points on her hand?"
Interpretation	Requests for interpretation of an action, event, or illustration.	"How come the lightning is green and lights the sky?"

		"How come he is going into the water to get the fish and the leaves in his mouth are popping out of the water?"
Prediction	Interrogative form of a guess about a future action, event, or identity of animal/object.	"Can it be a monkey?" "Is it a moth?"
Inference	Requests information being implied but not explicit in text or illustration.	"Can't the owl see him because he has blue eyes?" "Why does the flower look like it's dying?"
General	Questions and comments unrelated to the text or illustration.	"Can we draw the animals?" "Who is going to read?"

Table 2 describes the frequency of children's talks categorized as process skills applicable to both reading and scientific processes. Labeling, making predictions, interpretations, and inferences occurred more often in the first and second sessions of the shared-book experiences. The children's talk during Session I (Reading) constituted 42% of the total number of questions asked across all sessions. The children's talk in Session II (Rereading) and in Session III each accounted for 33% and 24 % of the total number of the talks in the sessions.

As described in the procedure, the teacher spent more time in guiding students in reading the books in the first two sessions. Many of the children's questions or comments were elicited by presentation of the illustrations as well as the teacher's prompts.

Table 2. Frequency of Process Skills

	Type	Number of questions and comments		
		Session I	Session II	Session III
Process skills	Labeling	19	16	18
	Interpretation	25	34	5
	Prediction	9	1	1
	Inference	8	9	2
Other		81	51	62
Total number of talks/percentage		142/ 42%	111/33%	83/24%

In addition to coding the talks according to the types listed in Table 1, the children's comments and questions were re-examined to determine whether there was any evidence of facilitated scientific literacy development. Some comments reflected their prior knowledge of scientific literacy, which they brought to the shared-book experience sessions, while other questions provided evidence of new science concepts that they were developing during the shared-book experience. Of the 336 questions asked by the children during the eight shared-book experiences, 138 questions were assessed as "science questions," or directly related to the domains of science such as scientific method or procedure (e.g. senses or measurement), life science (e.g. self-awareness or animal needs), or earth science (water or weather). Table 3 shows the list of books used for the shared-book experiences and the areas of science that each book led the children to explore.

Table 3 Scientific Concepts Elicited from the Books

Scientific Concept \ Book		A Beaver Tale by Rebel Williams and Illustrated by Philip Howe	Creature Features by David Drew	Hidden Animals by David Drew	Grumbles, Growls, Roars by Elizabeth Savage	City Storm by Rebel Williams	What will be the weather like tomorrow? by Paul Rogers and Illustrated by Kazuko	Living Things by Judith Holloway and Clive Harper	Animals Born alive and well by Ruth Heller
Scientific method or procedure	Senses				1	1			
	Measurement	1			1		1		7
	Classification			9	4		4	5	8
Life Science	Self-Awareness			1	1			1	
	Families	2	6	7	5		1	1	17
	Animal Needs	7		2	4		5	4	8
	Plant Needs							2	
Earth Science	Earth	1							
	Water	1					2		
	Weather					16	8		
	Solar System						6		
Total number 150*		12	6	19	16	17	27	13	40

*There were a total of 138 science concept questions. Twelve comments were coded into more than one category, making a total of 150.

The number of questions and comments regarding scientific concepts varied among the eight books from a low of 6 to a high of 40 with a mean of 18.75. The greatest number of questions was asked during the reading of *Animals Born Alive and Well*, followed by *City Storm* with 27 questions. The children were particularly responsive to the animal families and baby animals featured in the book. In these two books, the children responded to the realistic illustrations portraying animals and elements of weather and engaged in conversation regarding them. As previously explained, the books used in the shared-book experience were chosen because the theme of the book dealt with either one or two specific science concepts covered in the first grade curriculum, and the children's questions followed the science concepts highlighted in each book. Most of the children's questions did not deviate from the science themes presented in each book.

These results indicate that children's comments of scientific concepts were heavily related to the topics or the themes of the books. There was no significant difference over time in the number of total questions asked per book, or in the number of questions asked in any of the categories. Rather, the number of questions varied depending on the topics and illustrations of the books.

Conclusion

This paper presented an instructional approach, the shared-book experience using science-themed books, to promote scientific literacy at early ages. This paper analyzed the types of questions first-graders asked during the shared-book experiences. Based on the analyses, the findings of this study suggest the following:

First, a quantitative analysis revealed that the children's talk incorporating scientific concepts closely followed the theme of each book read during the shared-book experiences. Careful selection of books with a variety of scientific themes and motivating illustrations in connection with the science curriculum can provide opportunities for integrated curriculum practices. Current Common Core Learning Standards (CCLS) support the importance of having children "use illustrations and details in a text to describe key ideas" as they read informational text (NYS P-12 Common Core Learning Standards for English Language Arts & Literacy, 2010, p. 20).

Second, the results of this study suggest that Session I of the shared-book experiences was most productive in inducing children's talk regarding scientific process skills, whereas Session II was least productive. In the classes of Session I, the teacher modeled how to read a book and prompted students to generate more questions based on the text and illustrations. Consequently, adding more structured guidance to Session III may induce more children's talk on the books and therefore facilitate more scientific literacy development.

Implications

This paper shows one way of teaching science in a reading class. The process and results from the study shared in this paper can contribute to the formulation of instructional practices that facilitate scientific literacy development in struggling readers and other student populations. While this study was conducted with a group of first-grade struggling readers, the shared-book experiences may be used for any age or with a whole class (Hicks & Wadlington, 1994; Holdaway, 1982; Scott, 1994; Scheffel, & Booth, 2013). However, more research needs to be done involving children with above average achievement levels.

Additionally, more activities may be added as an integral part of the shared-book experience to strengthen Session III. For example, prior to the independent reading in Session III, the children may keep a science logbook to record scientific information. Children can then, with teacher guidance, use the log as a springboard for discussion. Other follow-up activities which are connected to the book children read to reinforce the scientific concepts and process skills can be developed as part of Session III.

A scientific inquiry begins with a question. Children, no matter their reading level or background, possess inquisitive minds that have to be nurtured. Teachers can encourage students to explore scientific vocabulary, concepts, and process skills from early ages with quality books using an interactive instructional approach such as the shared-book experience.

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