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Applying the Think-Aloud Strategy to Improve Reading Comprehension of Science Content

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Abstract:
This research was designed to investigate the effectiveness of using the think-aloud strategy to improve the reading comprehension in the content area of science. Based on state standards assessments, many early elementary grade students who were considered fluent readers struggled with evaluative science comprehension. In this quasi-experimental case study, the researcher used a self-created set of lessons using the think-aloud strategy for science as the intervention. The target group of this study consisted of two classrooms totaling 48 first-grade students identified as regular education or gifted. The treatment group received instruction using the think-aloud strategy during the science block. The control group received the regular instruction of the school district's science curriculum without the think-aloud strategy being incorporated. Results of using the think-aloud strategy during science instruction significantly increases a students' comprehension of science text. Findings from this study assisted with improving student learning by providing teachers with an instructional method (the think-aloud strategy) in the science-content area and in enabling every student to experience a certain degree of success in the evaluative comprehension of science text. The findings from this study were useful to teachers, administrators, school district personnel, and curriculum developers to improve comprehension levels in all students by implementing the think-aloud strategy.

Keywords: Reading comprehension, think aloud analysis, content area reading, think alouds, science education

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Reading is a fundamental skill needed to succeed in life. Reading comprehension skills are not only crucial in the educational setting, but also they are a means to function effectively in society (Oliva & Gordon, 2012). According to Oliva and Gordon (2012), the U.S. Government passed the No Child Left Behind Act of 2001 to determine ways to help prepare American students for the future in a technologically growing society, to be competent nationally by revising current curriculum, and to assess students through standardized tests. There is an

increasing number of students, especially in the urban areas, with poor comprehension skills (Delpit, 2006).

Reading comprehension involves the construction and reconstruction of content meaning (Sweet & Snow, 2003). Previous research show that the literal form of comprehension is the easiest because it requires only surface-level understanding. The evaluative comprehension skill is more difficult because the use of higher order thinking skills are needed. Higher order thinking skills involved with evaluative comprehension skills include making text-to-text, text-to-me, and text-to-world connections (Alonzo, Basaraba, Tindal, & Carriveau, 2009).

It is important for students to receive direct instruction of strategies in order to develop evaluative comprehension. According to Pardo (2004), many students do not have the vocabulary or prior experiences necessary to make the connections with text and meaning. The think-aloud strategy is a method widely used for instruction characterized by the teacher modeling the thinking process by verbalizing thoughts while reading aloud for students (Dunston & Headley, 2002). The think-aloud strategy allows students to monitor their thinking process through the use of reading strategies while engaged in the science text in order to gain comprehension of what they are reading. Thinking aloud while reading science text can help students to learn the metacognitive process involved in comprehension. Some examples of think-aloud strategies that can be used while reading science text are making inferences, making connections, summarizing, questioning, and interpreting. The more think-aloud skills a student is equipped with, the better he or she will be at problem solving while interacting with science text. This research study investigated the effectiveness of using the think-aloud strategy to improve reading comprehension in the content area of science.

Although past studies demonstrated a positive correlation between fluency and comprehension (Chard, Vaughn, & Tyler, 2002; National Reading Panel, 2000), there are instances that implicate other factors effecting comprehension skills aside from decoding and fluency (Williams, 2005). Research showed that students with poor comprehension skills may display normal performance on phonemic tasks but impaired performance on semantic processing tasks (Weekes, Hamilton, Oakhill, & Holliday, 2008). Phonemic tasks involves decoding words. Semantic processing refers to the ability to recall abstract words and accessing knowledge about category relations between words and category priming for spoken words (Nation & Snowling, 1997). Inability to engage in evaluative comprehension becomes a problem when students perform poorly on the Criterion-Referenced Competency Test.

A study conducted by Peterson-Brown and Burns (2011) showed that semantic association of information was recalled better than information that was not semantically associated. Recent research showed the effectiveness of the use of direct teaching of metacognitive strategies to increase comprehension levels in students (Boulware-Gooden, Carreker, Thornhill, & Joshi, 2007). Content instruction is a strategy that appears to be more effective than the strategies approach and the basal comprehension lessons because it allows students to focus on interacting with the text in order to make the connections with the ideas presented in the text (McKeown, Beck, & Blake, 2009).

Research showed an emphasis being placed on using books, strategies approach, and metacognitive strategies to teach reading comprehension; however, there is still not clear guidance on how to progress instructionally with teaching reading comprehension in the science-content area (Austermuehle, Kautz, & Sprenzel, 2007; Kuhn, 2000; O'Reilly & McNamara, 2007). Also, there is a lack of evidence and research on the effect of teaching reading comprehension to elementary students in the science-content area through think-aloud activities.

Findings from this study will add to the body of research that supports the use of the think-aloud strategy to improve evaluative science comprehension skills in students. The think-aloud strategy focuses directly on important ideas and on making connections and is likely to support students in building a coherent representation of the text they are reading.

Purpose of the Study

The purpose of this study was to determine if the use of the think-aloud strategy would improve the evaluative science comprehension of elementary students. According to school district curriculum for first-grade students at a Title I elementary school located in northwest Georgia, these elementary students had been identified as fluent readers. The independent variable was the think-aloud strategy used by the teacher to model comprehension. The dependent variable was the level of evaluative comprehension achievement in first-grade boys and girls, and the control group variable was defined as the regular instruction of the school district curriculum.

The think-aloud strategy is the process of "talking about the reading strategies you are using and the content of the piece you are reading" (Wilhelm, 2001, p. 19). In this study, the operational definition of the think-aloud strategy was the thinking process modeled during the think-aloud strategy that included making predictions, creating images, connecting information in text with prior knowledge, monitoring comprehension, and overcoming problems with vocabulary or comprehension (Gunning, 1996). The think-aloud strategy and think-aloud activities were integrated into the science instruction of the treatment group. The control group received regular instruction, which is the process of teaching the science-content area without the integration of the think-aloud strategy or think-aloud activities

Theoretical Framework

The theory that supports the possible positive effects of instruction on reading comprehension is known as the schema theory by Anderson (1984). This theory illustrates the importance of teaching general knowledge and generic concepts to foster comprehension of text materials (Anderson, Spiro, & Montague, 1984). Teaching general knowledge and generic concepts can be done through the use of semantic mapping and graphic organizers that provide a mental representation of abstract words that allow students to make connections using their prior knowledge or experiences (schemata) to achieve comprehension. The theory of schema is compared to a mental filing cabinet that allows a person to continue to learn by retrieving previous information, categorizing, and reorganizing that information to fit the new information that is learned. This is based on the notion that, in order for something new to be learned, there needs to be a connection made with something already known.

The definition of oral reading fluency is the ability to read a text, orally and silently, with appropriate speed, accuracy, and expression (Rasinski, Blachowicz, & Lems, 2006). Reading comprehension is much more than decoding and fluency; it is also influenced by background knowledge, culture, and experience. In order for students to understand what they are reading, they need to be equipped with the information necessary for comprehension before being introduced to the text. Reading comprehension refers to the act of understanding and constructing meaning from written words. It involves active and intentional thinking in which the meaning is constructed through interactions between the text and the reader (Ruddell, 2006). Reading comprehension is also related to semantic word association. Previous research showed students with poor comprehension skills displaying normal performance on phonemic tasks but impaired performance on semantic processing tasks (Weekes et al., 2008). Some students with poor comprehension are able to read the text they are given and have the same phonological

awareness as their peers who have normal comprehension; however, their semantic skills are different.

Research Questions

The following research questions guided this study:

1. What is the effect of implementing the think-aloud strategy on the evaluative science comprehension achievement of first-grade students from a Title 1 school who are identified as fluent readers?
2. What is the development rate of the use of think-aloud skills in first-grade students?
3. Which think-aloud strategies are most frequently used by first-grade students?

Recent Research

Benefits of Metacognitive Strategies

Alonzo et al. (2009) discussed how comprehension is an important component to literacy, and the levels of comprehension include literal, inferential, and evaluative. Student assessment scores in this study showed inferential and evaluative comprehension to be more challenging than literal comprehension.

Additionally, a research study conducted by Weekes et al. (2008) was designed to determine the factors that contributed to reading comprehension difficulties in students. It is agreed that students with poor reading comprehension have difficulties connecting the meaning of words compared to age-matched peers who have normal reading comprehension. The experiment pointed out that students with poor comprehension were less sensitive to abstract semantic associations between words as a result of poor gist memory. Weekes et al. (2008) found that gist memory was necessary for text comprension as well as inference making, reasoning, and similarity judgments. Weekes et al. (2008) discussed how there was a difference in students with poor comprension ability to recall semantic words, rather than phonological words. It was also noted that all of the items were familiar to both groups of students so the level of recollection was not based on familiarity of the words. The reason why the recollection of the DRM words was low for the students with poor comprehension was because the words were abstract. As a result of this, students with poor comprehension lacked the ability to categorize the abstract information in order to make the necessary connection needed for comprehension.

Moreover, the research conducted by Boulware-Gooden et al. (2007) indicated that teaching metacognitive strategies and vocabulary significantly affects reading comprehension. Metacognition is defined as “Enhancing (a) metacognitive awareness of what one believes and how one knows and (b) metastrategic control in application of the strategies that process new information” (Kuhn, 2000, p. 178). This particular study was integral because its findings strongly suggested that direct teaching of vocabulary and metacognitive skills will increase reading comprehension in students. Carlisle and Rice (2002) found that these skills are needed in addition to phonological awareness so that the students can monitor their understanding of the text. According to Pressley (2006), comprehension is not enhanced merely by reading more text. The difference between students with normal comprehension and students with poor comprehension is the number of strategies they are equipped with while reading a text.

Likewise, Schellings, Aarnoutse, and van Leeuwve (2006) found that reading strategies were related to reading comprehension. In order for reading to take place, two levels were involved: word identification and comprehension of sentences and text. The participants who were identified as high comprehenders verbalized more about comprehension than the low comprehenders on texts. There was a negative correlation between reading strategies and reading

error. The results also showed a significant correlation between reading strategies and reading ability (Schellings et al., 2006).

Furthermore, Hagaman, Casey, and Reid (2012) investigated the use of strategy instruction using the self-regulated strategy development model (SRSD; Graham & Harris, 2005) to teach "the read a paragraph (RAP), ask myself What was the main idea and two details?, and put it into my own words paraphrasing strategy to increase reading comprehension in elementary students (Hagaman et al., 2012, p. 111). The characteristic of the SRSD model is explicit instruction and systematic (develop background knowledge, discuss it, model it, memorize it, support it, and independent performance).

The results of this study showed an increase in reading comprehension based on the students' ability to recall and answer short-answer questions. This suggested that teaching the RAP strategy using the SRSD model increased reading comprehension.

Metacognitive Strategies and Comprehension of Science Text

A research study conducted by Leopold and Leutner (2012) showed that there were positive effects of the drawing strategy instruction on science text comprehension. Notably, previous research showed that 10th graders were not using the necessary think-aloud metacognitive skills necessary for text science text comprehension (Schellings & Broekkamp, 2011).

Correspondingly, a research study conducted by O'Reilly and McNamara (2007) showed that reading skills assisted students with science knowledge and had a significant effect on achievement scores for students. In general, this research study showed that science knowledge and reading skills were significantly correlated. This research study also showed that the use of metacognitive reading strategy knowledge was a weak predictor of science achievement and only significant in positive course grades (O'Reilly & McNamara, 2007). Hands-on learning and learning from text are important characteristics of any content area (Neufeld, 2005). Being explicitly taught comprehension strategies can help students read more effectively in other content areas.

By the same token, the research study conducted by Braasch and Goldman (2010) showed that students who had more prior knowledge performed better on science concepts being taught through the text-weather system.

Finally, Reutzel, Smith, and Fawson (2005) found that teaching a family or set of comprehension strategies embedded in a collaborative, interactive, and engaging routine (transactional strategies instruction; TSI) was more effective than using the single strategy instruction (SSI), which is a series of comprehension strategies taught one at a time, in helping students to achieve in science comprehension as measured by a state, curriculum-based measure of comprehension standards. This research study showed that young students enjoyed reading and discussing science information books, and they suggested that teachers use informational text to teach young students reading comprehension strategies through the use of the TSI strategy. The average first-grade student spends only 3.6 min per day interacting with informational texts (Duke, 2000). Early elementary schools are focusing instruction on narrative texts. The elementary classroom reading areas contain more narrative texts than any other genres. According to Moss (2005), content-area reading should begin in early grades so that students are introduced and prepared for reading and comprehending texts of increasingly difficult concepts.

Benefits of the Think-Aloud Strategy

In the research study conducted by Cummins and Stallmeyer-Gerard (2011), one learns of the significant effect of synthesizing interactive read alouds and think-aloud minilessons on students' comprehension of informational texts.

Additionally, research conducted by Marcell, DeCleene, and Juettner (2010) discussed the process of teaching reading comprehension by allowing the students to be involved actively in the process through the guidance of the teacher, instead of the teacher taking on the active role of scaffolding and teaching multiple-comprehension strategies. There were many instances where the teachers would teach different kinds of metacognitive strategies in isolation. The students would appear to understand the metacognitive strategy and the process involved in using them; however, when it was time to apply the strategy independently toward comprehension, the students were confused and were not able to figure out which strategy to use for the particular text encountered and how to use it. This was because not only were the strategies taught in isolation but also the students were used to the teacher taking an active role in practicing with the strategy. The authors of this study suggested using the reciprocal teaching model, which is the process of explicitly teaching, modeling, and practicing four strategies through the interaction with multiple kinds of text within the students' zone of proximal development. This strategy involved scaffolding and the gradual release of ownership of the teacher to the students that prepared them to be able to read to learn.

Meyers, Lytle, Palladino, Devenpeck, and Green (1990) also showed that primary students' think-aloud comments were correlated to their understanding of the text. The students who were able to reason and infer through their think-aloud statements were able to show their comprehension of the text through coherent retellings.

Yang (2006) explored the relationships between reading strategies and comprehension-monitoring strategies and their functioning to assist readers with the process of comprehension. Reading strategies are the problem-solving strategies used for better understanding of text, whereas comprehension monitoring entails the awareness that there is a problem encountered while reading the text. Both of these strategies can be used simultaneously; however, readers should be able to use both in order to achieve in critical reading.

Also, research studies conducted by Smith (2006) and Walker (2005) showed how directly and explicitly teaching comprehension strategies through modeling using the think-aloud approach had a profound, positive effect on student comprehension growth. This research study used the think-aloud mysteries approach to engage students actively in learning comprehension strategies in a fun way while reading text.

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The study conducted by Caldwell and Leslie (2010) proved that using the think-aloud strategy while reading resulted in more inferences and recall of the text compared to not using the think-aloud strategy while reading. Students were able to generate more causal statements during recall when they thought aloud (Caldwell & Leslie, 2010).

In the same way, Meller, Richardson, and Hatch (2009) discussed the importance of using children's literature and read-alouds to allow the teacher to model reading strategies and provide background knowledge, foster critical thinking, and increase reading comprehension in primary classrooms. The authors suggested using high-quality children's literature to engage

students in read-alouds. The discussions and critical conversations taken place are what contribute to the critical element of children's literature. In order to engage primary-age children in discussions about literature, they suggested that it is important to ask critical questions.

The research study conducted by Gillam, Fargo, and Robertson (2009) demonstrated that having the ability to paraphrase passages was correlated to expository text comprehension. The researchers wanted to study the different types of statements made by students of expository texts. The types of statements made orally by the students while they interacted with the text were examined to determine their relationship to reading comprehension performance.

By the same token, the research study conducted by Kelley and Clausen-Grace (2008) illustrated that there was a positive effect of teaching metacognition through the use of the think-aloud strategy on students' reading comprehension in various genres of text, including nonfiction text.

Summary

Research shows that explicitly teaching metacognitive skills can increase reading comprehension in students. It is especially effective when students are repeatedly exposed to the teacher thinking aloud during content instruction so that students are able to internalize and apply the thinking process that should take place while interacting with a variety of text. The think-aloud strategy is a method widely used for instruction characterized by the teacher modeling the thinking process while reading aloud for students (Dunston & Headley, 2002). This particular instructional practice is observed only during the literacy block of a classroom setting. Reading comprehension strategies are usually taught during the reading block.

Students are now recommended to problem solve, communicate, and think critically when reading science text (National Reading Panel, 2000). As students are moving through the primary education concept of learning to read and into the intermediate level of education of reading to learn, reading is now a key factor in science achievement (O'Reilly & McNamara, 2007; Reutzel et al., 2005). Reading comprehension skills must be taught in the science content-area classrooms because the students are faced with the task of comprehending the content-area text without the understanding of external and internal text features and the thinking process necessary for the evaluative comprehension of the science text they are reading.

Using the think-aloud strategy while interacting with science text will likely support students in building a coherent representation of the text they are reading because of the research that supports the use of the think-aloud strategy during the literacy block.

Methods

The purpose of this case study was to determine the effectiveness of using the think-aloud strategy to improve the reading comprehension of first-grade students in the content area of science. Although many students in early grades are reading fluently based on state standards, they struggle with evaluative science comprehension. The United States has recently adopted the common core standards as part of a national curriculum that supports the integration of reading comprehension into all of the content areas. Students are now recommended to problem solve, communicate, and think critically when reading science text (National Reading Panel, 2000). As students move through the primary grade-level concept of learning to read and into intermediate grade levels of education of reading to learn, reading is now a key factor in science achievement (O'Reilly & McNamara, 2007; Reutzel et al., 2005).

The think-aloud strategy is a method used for instruction characterized by the teacher modeling the thinking process while reading aloud for students (Dunston & Headley, 2002). This research study investigated the effectiveness of using the think-aloud strategy to improve the

reading comprehension in the content area of science. The key characteristic of the think-aloud strategy is the process of the teacher modeling for students how skillful readers think and the students doing the following six elements of the think-aloud strategy in order to become successful readers: taking a picture walk and commenting aloud, thinking aloud to self, verbalizing inferences, formulating questions, linking up background knowledge, and sharing thoughts while working through the texts (see Appendix A). The justification for the research design chosen to implement this study as well as the process that was taken to analyze the results is included in this chapter.

Participants

The target group of this case study consisted of 2 first-grade classrooms, totaling 48 students, chosen through the use of the convenience and purposive sampling approach. One of the Grade 1 classes (Group 1), consisting of 24 students, was assigned to the treatment group and received the science comprehension instruction through the incorporation of the think-aloud strategy in nonfiction text. The other Grade 1 class (Group 2) made up the control group and received science instruction without the incorporation of the think-aloud strategy.

The site of the study took place in a Title I public school located in northwest Georgia. The majority of the students who participated in this study came from low-socioeconomic backgrounds. There were 90.4% of the students who qualified to receive free or reduced-price lunch. The student enrollment distribution was by the following races and ethnicities: 0.2% American Indian, 57.0% African American, 0.7% Asian, 37.2% Hispanic, and 4.1% White. The grade level taught in this school ranged from prekindergarten through first grade.

Instruments

Permission was granted by the Pearson Publishing Company to use the DRA-2 as an instrument in this study. The DRA-2 is the assessment that was used as pre- and post-assessments of students' evaluative science comprehension skills (Beaver & Carter, 2009). During the administration of the DRA-2, the students received a science text at their independent reading levels to read. The students were asked comprehension questions orally that came along with the DRA-2 kit. The students' answers were recorded by the researcher and scored according to the guidelines of the rubric that accompanied the DRA-2 kit. The possible range of score for this assessment is 7-28. The scores received for each question were tallied for Group 1 and Group 2 and were recorded on a table and analyzed. Research shows the DRA-2 to be reliable and valid. It has internal, test-retest, passage equivalence, and interrater and expert rater reliability. The DRA-2 is valid because it measures what it was developed to measure: accuracy, fluency, and evaluative comprehension (Beaver & Carter, 2009).

The second instrument was the Think-Aloud Sentence Starter Form developed by the researcher and use during the implementation of the study (see Appendix B). The think-aloud sentence starter form consists of sentence starters that can be used to think-aloud about a text that is being read in order for comprehension to take place. The researcher developed Think-Aloud sentence starters for the varying levels of comprehension by aligning each statement with the procedures in part one of the think-aloud strategy in this study. The science texts that Group 1 read during the course of the study had stopping points inserted at the end of each paragraph. Each student was given the direction to read each passage and stop wherever he or she saw the word stop (which was located at the end of each paragraph) to verbalize his or her thinking. The students were digitally recorded while thinking aloud, and the information from the recording was used by the researcher to transfer onto the Think-Aloud Sentence Starter Form in order to use tally marks to record and analyze the frequency and types of think-aloud statements used by

each student. Input from the Think-Aloud Sentence Starter Form was summarized and reported in the Results section of this study.

The third instrument was the Student Observation Checklist (see Appendix C) developed by the researcher to document Group 1 implementing the think-aloud strategy during the course of the study and during the DRA-2 post-test while reading the science text. The Student Observation Checklist consists of a checklist of questions that can be used to observe and record the students' behavior while using the think-aloud strategy with the text that is being read in order for comprehension to take place. The researcher developed the Student Observation Checklist by aligning each question with the procedures in part one of the think-aloud strategy of this study. Group 1 was instructed to think aloud at the stopping points on the pages of the science text during the administration of the DRA-2 post-test, which was digitally recorded. The information from the digital recordings of each student was transcribed and transferred onto the Think-Aloud Student Implementation Form by the researcher. Input from the Think-Aloud Student Implementation Form was summarized and reported in the Results section of this study to assess whether Group 1's evaluative science comprehension level improved as a result of the use of the think-aloud strategy and to analyze the utilization of the think-aloud strategy of first-grade girls and boys.

Research Design

This was a quasi-experimental case study that determined the effects of using the think-aloud strategy on the evaluative science comprehension achievement of first-grade students. The independent variable was the think-aloud strategy used by the teacher to model comprehension. The dependent variable was the level of evaluative comprehension achievement in first-grade students, and the control group variable was the regular instruction of the school district curriculum. In this study, regular instruction was the process of teaching the science content area without the integration of the think-aloud strategy or think-aloud activities in order to increase evaluative reading comprehension of science text.

Procedures

This study took place in 2 first-grade classrooms during the science block at an elementary school located in northwest Georgia after consent forms were received from the parents. One of the classrooms served as the treatment group (Group 1), and the other classroom served as the control group (Group 2). In the beginning of the study, both groups were given the DRA-2 comprehension assessment orally as a pre-assessment. The students read a science text at their independent reading levels and orally received the comprehension questions as a pre-test that consisted of text-related questions that fell within the literal, implicit, inferential, and evaluative categories. Group 1 received instruction from the use of the think-aloud strategy during the science block for 15 min a day, 5 days a week for a total of 5 weeks during the 2013-2014 school year. In order to model the thinking process using the think-aloud strategy, the teacher of Group 1 did the following in Part 1 of the think-aloud strategy:

1. Selected a trade book that was grade-level appropriate for the topic of study.
2. Previewed the text to look for unfamiliar vocabulary or confusing parts in the story and made comments aloud about what she was thinking when she encountered them in the text in order to clarify for the students the thinking process used to understand unfamiliar vocabulary.
3. Took a picture walk (i.e., flipping through the pages) to look at illustrations and nonfiction features with students and made comments aloud about what she noticed in the illustrations, asked questions about the pictures and subheadings, and made predictions

based on text features in order to clarify for the students the thinking process used to make predictions about what they were going to learn from the text.
4. Paused and made comments about what she was thinking while reading aloud to students in order to clarify for students how comprehension was taking place.
5. Articulated her predictions, confusing parts in the story, or connections with prior knowledge to help show comprehension of the text.
6. Closed the lesson by making a strong connection to the book or short review of the purpose of the story aloud to model to the students how to make connections (i.e., text-to-text, text-to-self, and text-to-world) in order to clarify for students how comprehension was taking place.

In Part 2 of the think-aloud strategy, the teacher gradually released the think-aloud process to students by giving them opportunities to make comments about what they were thinking after each paragraph that was being read to them. A chart with sentence starters was displayed for the teacher to record the amount of times each strategy was used to help with understanding the text using tally marks.

The following are the characteristics of the think-aloud strategies that were utilized by the students during this study:

1. Think-Aloud 1 involves the student taking a picture walk (i.e., flipping through the pages) to look at illustrations and nonfiction features and making comments aloud about what is noticed in the illustrations, asking questions about the pictures and subheadings, and making predictions based on text features.
2. Think-Aloud 2 involves the student thinking aloud by sharing uncertainties, questions, responses, feelings, and connections that appear during reading.
3. Think-Aloud 3 is characterized by the student verbalizing inferences that are made, including inferences deduced from new words and ideas, themes, illustrations, and photos.
4. Think-Aloud 4 is characterized by the student formulating questions that come to mind as he or she reads.
5. Think-Aloud 5 involves the student verbally linking up background knowledge as he or she comes across new information.
6. Think-Aloud 6 involves the student sharing his or her thoughts while working through confusing parts and applying fix-up strategies.
7. Think-Aloud 7 is characterized by the student making a strong connection to the text or short review of the purpose of the story aloud (i.e., text-to-text, text-to-self, and text-to-world).

In Part 3 of the think-aloud strategy, students were given an opportunity to construct meaning from text, one-on-one, with the researcher. Each student read the science text aloud and thought aloud after reaching each stopping point in the text. A digital recorder was used to record students' thinking aloud during each session. The researcher used the digital recordings of the students using the think-aloud strategy to administer two separate scores per student: the total number of statements the students made while thinking aloud and the number of types of think-aloud statements the students used during each session. Both scores were added together to conclude a total score for each passage. This allowed for the analysis of types of think-aloud statements and the frequency and development of the use of the think-aloud strategy for each student during the observation period.

Four science texts titled, *Parts of a Plant,* by Blevins (2004), *Living and Nonliving,* by Lindeen (2008), *What Is Matter?,* by Curry (2004), and *What Does Light Do?,* by Trussell-Cullen (2001) provided by the school district were used during the one-on-one sessions on separate occasions to record students' thinking aloud digitally as they read. Also, the researcher recorded students' utilization of the think-aloud strategy based on students' recordings onto the Student Observation Checklist.

Group 2 (the control group) received the regular instruction by their classroom teacher during the science block for 15 minutes per day of the school district's science curriculum without the think-aloud strategy being incorporated (Appendix D). The topics taught encompassed plants, living and nonliving things, magnets, and light using the same science texts used to teach the experimental group without the use of the think-aloud strategy.

The following is an example of the school district's science curriculum without the think-aloud strategy being incorporated:

1. The lesson begins with teacher activating student's prior knowledge of science topic. There is usually a graphic organizer such as the KWL chart displayed to organize student responses. The teacher records what students already know about the science topic introduced under the K column (What I Know), and records questions that the students have about the topic under the W column (What I Want to Know).
2. The teacher shows a videotape or read a text to students about the science topic.
3. The teacher scaffold students at the end of the science text. Student responses are recorded under the L column of the chart (What I Learned).
4. The teacher may engage students in a science experiment as an extension activity.
5. The students will be assessed on what they have learned through formal and informal assessments.

At the end of the 5th week of the study, both groups were administered the DRA-2 as a post-test in order to compare the scores from the pre-test (Beaver & Carter, 2009).

After the post assessment was administered, these data were analyzed by counting and comparing scores received for students' responses on the pre- and post-tests. Group 1 was given the task of utilizing the think-aloud strategy while reading the science text orally during the post-test, which was electronically recorded. The information gathered from the digital recording of each student from Group 1 thinking aloud during the DRA-2 post-test was transcribed and transferred onto the Student Observation Checklist and the Think-Aloud Sentence Starter Form by the researcher. Group 2 was not required to use the Think-Aloud strategy while taking the post-test. They were only required to read the science text orally and answer the comprehension questions on the post-test.

The rationale for this method lies on the notion that the students would internalize the different types of think-aloud statements learned through the use of the Think-Aloud Sentence Starter Form during the intervention and naturally use the ones they felt comfortable using on their own to think-aloud while reading the science text during the post-test. The post-test score of the intervention group (Group 1) and the control group (Group 2) was compared to determine whether thinking aloud while interacting with science text increases science evaluative comprehension.

Results

Forty-eight 1st-grade students participated in the study. The following section details the analytical process utilized to assess the study's research questions. All statistical tests were

conducted at $\alpha = .05$. The distribution of treatment and control students' pre- and post-test science achievement scores are displayed in Appendix E.

Research Question 1

This research question was, What is the effect of implementing the think-aloud strategy on the evaluative science comprehension achievement of first-grade students from a Title 1 school who are identified as fluent readers? The null hypothesis was that there will not be a statistically significant difference between the treatment and control groups on post-test DRA-2 comprehension scores after controlling for participants' pre-test DRA-2 scores. The alternative hypothesis was that there will be a statistically significant difference between the treatment and control groups on post-test DRA-2 comprehension scores after controlling for participants' pre-test DRA-2 scores.

A one-way analysis of covariance (ANCOVA) was conducted to determine if there was a significant difference between students who implemented the think-aloud strategy and students who did not on the post-test evaluative science comprehensive achievement (DRA-2 comprehensive) after controlling for participants' pre-test evaluative comprehensive achievement scores. The ANCOVA is appropriate when comparing two or more groups on a continuous dependent variable while controlling for one or more continuous variables (Stevens, 2002; Tabachnick & Fidell, 2006). The think-aloud intervention (Yes vs. No) was the between-subjects independent variable; students' post-test DRA-2 comprehensive scores was the dependent variable, and students' pre-test DRA-2 comprehensive scores was the control variable.

The purpose of the ANCOVA was to assess differences on post-test achievement scores while statistically controlling for the students' preexisting differences on science achievement. This strategy allowed the researcher to assess the impact of the think-aloud strategy on science achievement while eliminating students' preexisting differences on science skill, thus, eliminating it as a potential confounding variable in the statistical model.

The following ANCOVA testing procedures were utilized. First, the data were screened for outliers prior to assessing the statistical assumption. The students' post-test DRA-2 scores were standardized by group, and the resulting scores were utilized to identify outliers in the data. A data point was considered an outlier when the standardized score was greater than 3. This process did not reveal any outliers in the data.

The next step in the analysis was to assess the statistical assumptions. Histograms of the participants' post-test scores were used to assess the normality assumption. The distributions of the treatment and control groups' pre-test DRA-2 comprehensive scores are displayed in Appendix E. The distributions of the treatment and control groups' post-test DRA-2 comprehensive scores are, also, displayed in Appendix E. Neither post-test distribution was markedly discrepant from a normal distribution. However, the small sample sizes in each group precluded the use of the central limit theorem to assume normality. A Kolmogorov-Smirnov test was conducted for each group as a secondary assessment of normality. The tests revealed that the treatment and control group distributions were approximately normal, $z = 0.97$, $p = .308$ and $z = 0.52$, $p = .948$, respectively.

The next step involved assessing the homogeneity or error variances and equality of covariance of regression slopes assumptions. Levene's test was not significant, indicating the two groups had equal error variances (i.e., homogeneity of variances) on post-test DRA-2 scores, $F(1, 45) = 1.76$, $p = .191$. Last, the final assumption of ANCOVA was homogeneity of regression slopes, which was assessed with an F test on the independent variable X covariate interaction term. The term was not significant, indicating the equality of regression slopes, $F(4,$

25) = 1.22, p = .326. This indicated that the relationship between pre-test and post-test science scores was consistent for the two groups. The descriptive statistics for the participants' scores at pre-test and post-test are listed in Table 1.

Table 1
Descriptive Statistics for Pre-test and Post-test Developmental Reading Assessment Science Scores

	Treatment group					Control group				
Variable	*N*	Min	Max	*M*	*SD*	*N*	Min	Max	*M*	*SD*
Pre-test DRA	24	12.00	23.00	17.33	3.31	24	10.00	27.00	20.54	4.63
Post-test DRA	24	22.00	28.00	24.58	1.74	23	12.00	28.00	21.09	3.40
DRA develop	24	1.00	14.00	7.25	3.65	23	-7.00	6.00	0.52	3.54

Note. Min = minimum; Max = maximum; DRA = Developmental Reading Assessment; develop = development.

The unadjusted and adjusted means are listed in Tables 2 and 3, respectively. The unadjusted means represent the values prior to adjusting for preexisting differences on science achievement. The adjusted means represented the tested values after adjusting for preexisting differences on science achievement. The ANCOVA test statistics are listed in Table 4. The ANCOVA revealed a significant difference between the treatment group (M= 25.10, SE = 0.50) and the control group (M = 20.55, SE = 0.51) on post-test DRA-2 science achievement while controlling for their pre-test scores, $F(1, 44) = 37.63$, $p = .000$, $\square^2 = .46$, power = 1.00.

Table 2
Unadjusted Post-Test Developmental Reading Assessment Science Scores

Group	*N*	*M*	*SD*
Treatment	24	24.58	1.74
Control	23	21.09	3.40

Interestingly, the difference between the group means increased after controlling for preexisting differences on science achievement. This demonstrated the importance of controlling for pre-test scores when comparing the two groups.

Table 3
Adjusted Post-Test Developmental Reading Assessment Science Scores

Group	*N*	*M*	*SE*
Treatment	24	25.10	0.50
Control	23	20.55	0.51

Forty-six percent of the variability in the students' post-test science achievement scores could be attributed to the treatment after controlling for the students' pre-test science achievement. Thus, the researcher rejected the null hypothesis because the *p* value was less than .05.

Table 4
One-Way Analysis of Variance on Post-Test Developmental Reading Assessment Science Achievement

Source	*SS*	*df*	*MS*	*F*	*Sig.*
Group	208.90	1	208.90	37.63	.000
Error	244.27	44	5.55		

Research Question 2

This research question was: What is the development rate of the use of think-aloud skills in first-grade students? The development rate of the treatment participants' use of the think-aloud strategy is displayed in Figure 1, which is a stacked bar graph of each week's student rate of usage of the think-aloud strategy in order to determine the development rate.

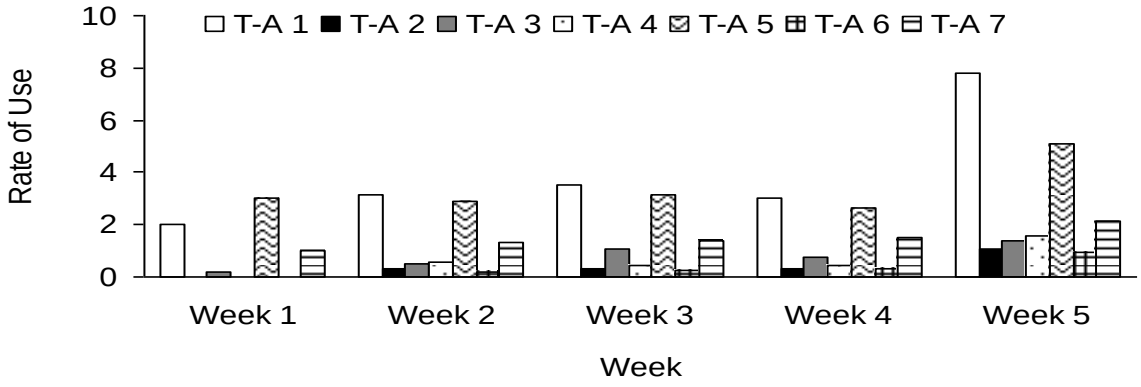

Figure 1. Developmental rate of the use of think-aloud skills in first-grade students. T-A = think-aloud.

The figure reveals an increased rate of usage of the think-aloud strategy from Week 1 to Week 5. During Week 1, the think-aloud strategy was used at the rate of 6.20, Week 2 at a rate of 8.94, Week 3 at a rate of 10.09, Week 4 at a rate of 9.04, and Week 5 at a rate of 20.00. This graph revealed a clear pattern of student development rate of the think-aloud strategy with an average growth of 3.98 each week of continuous exposure and usage of the strategy.

Research Question 3

This research question was, Which think-aloud strategies are most frequently used by first-grade students? The descriptive statistics for the treatment participants' use of the think-aloud strategies for parts of a plant, living and nonliving, what is matter?, and what does light do? are listed in Table 5 and Appendices G, H, and I, respectively.

Table 5
Descriptive Statistics for Use of Think-Aloud Strategy on Parts of a Plant

Think-aloud strategy	*N*	Minimum	Maximum	*M*	*SD*
1	24	1.00	8.00	3.17	1.74
2	24	0.00	1.00	0.29	0.46
3	24	0.00	2.00	0.50	0.78
4	24	0.00	3.00	0.58	0.83
5	24	0.00	6.00	2.88	1.96
6	24	0.00	1.00	0.17	0.38
7	23	0.00	4.00	1.35	1.23

The descriptive statistics revealed a clear pattern. Think-Aloud Strategy 1 was used with the most frequency for all four sections of the comprehensive science curriculum. The mean use of Think-Aloud Strategy 1 ranged from 3.04 (*SD* = 1.46) for what does light do? to 7.83 (*SD* = 2.76) for what is matter?

Think-Aloud Strategy 5 was the second most used strategy for all four sections of the comprehensive science curriculum. The mean use of Think-Aloud Strategy 5 ranged from 2.67 (*SD* = 2.18) for what does light do? to 5.08 (*SD* = 2.59) for what is matter? The statistics indicated that the dominant think-aloud strategies (i.e., Strategy 1 and Strategy 5) were used most frequently for students' understanding of matter.

Interestingly, Think-Aloud Strategy 6 was the least used strategy for understanding parts of a plant, living and nonliving, and what is matter? curricula. However, Think-Aloud Strategy 2 was the least used strategy for the understanding of light. Although none of the strategies were individually related to students' achievement development as suggested in Research Question 2, together, the think-aloud strategies proved to be effective for Research Question 1.

Data Analysis

The DRA-2 was given to Group 1 and Group 2 as pre- and post-tests. During the administration of the pre- and post-tests, the students read a science text at their independent reading levels and orally received the comprehension questions as a pre-test, which consisted of text-related questions that fell within the literal, implicit, inferential, and evaluative categories. During the post-test, Group 1 was given the task of applying the think-aloud strategy while reading the science text, which was digitally recorded and documented on the Think-Aloud Sentence Starter Form and the Student Observation Checklist by the researcher. The Think-Aloud Sentence Starter Form and the Student Observation Checklist were also be used by the researcher to document Group 1 implementing the think-aloud strategy during the course of the study. Input from the Student Observation Checklist was summarized and reported in the Results section of this study to assess whether Group 1's evaluative science comprehension level improved as a result of the use of the think-aloud strategy and to analyze the effective utilization of the think-aloud strategy of students.

The Think-Aloud Sentence Starter Form was used throughout the study to measure Group 1's ability to demonstrate competence in utilizing the think-aloud strategy taught during the 5 weeks of intervention (see Appendix D). The science texts that Group 1 read during the course of the study had stopping points inserted at the end of each paragraph. Each student was given the direction to read each passage and stop wherever he or she saw the word stop (which was located at the end of each paragraph) to verbalize his or her thinking. The students were digitally recorded while thinking aloud, and the information from the recording was used by the researcher to transfer onto the Think-Aloud Sentence Starter Form in order to use tally marks to record and analyze the frequency and the types of think-aloud statements used by each student. The researcher used the digital recordings of the students using the think-aloud strategy to administer two separate scores per student: the total number of statements the students made while thinking aloud and the number of types of think-aloud statements the students used during each session. Both scores were added together to determine a total score for the passage. This allowed for the analysis of types of think-aloud statements and the frequency and development of the use of the think-aloud strategy for each student during the observation period. Input from the Think-Aloud Sentence Starter Form was summarized and reported in the Results section of this study.

The pre- and post-test data from Group 1 and Group 2 were compared in order to measure the significance of the intervention. The data from the Student Observation Checklist were used to measure whether thinking aloud after reading each paragraph affected the evaluative comprehension of science text and were summarized and reported in the Results section of this study. The comprehension scores of Group 1 and Group 2 on the pre- and post-tests were recorded and analyzed at the end of the 5 weeks of intervention to determine the percentage of comprehension growth or decrease between and within the groups. This provided the observation of whether there was a statistical significance in the implementation of the think-aloud strategy in first-grade students and the effects of the think-aloud strategy on their evaluative science comprehension.

Discussion

This study examined the effectiveness of using the think-aloud strategy to develop the evaluative science comprehension in first-grade students. The primary purpose was to examine whether students receiving the intervention had greater comprehension in the content area of science than students who did not receive this treatment. The data showed a statistical difference

between the treatment group and the control group. There was a significant difference between the treatment group (M = 25.10, *SE* = 0.50) and the control group (*M* = 20.55, *SE* = 0.51) on post-test DRA-2 science achievement while controlling for their pre-test scores, $F(1, 44) = 37.63$, $p = .000$, $\square^2 = .46$, power = 1.00. Students in the treatment group gained 7.25 points on average compared to the control group that gained an average of 0.52 points from the pre-test to the post-test. The developmental rate of students utilizing the think-aloud strategy showed that, as time progressed, the utilization of the think-aloud strategy increased.

The students who were in the treatment group displayed higher gains in evaluative science comprehension than the students who did not receive the think-aloud instruction. The findings suggested that students had a better understanding of science content when it was taught along with the think-aloud strategy than students who only received science instruction without the incorporation of the think-aloud strategy.

During the think-aloud sessions, students were more engaged compared to students who received the daily science instruction without the use of the think-aloud strategy. The rate of the students' utilizing the think aloud skills showed that students utilization of the think-aloud sentence starters increased over time.

The results also showed that Think-Aloud Sentence Starters 1 and 5 were utilized the most by first-grade students. Sentence Starter 1 involved taking a picture walk (i.e., flipping through the pages) to look at illustrations and nonfiction features and making comments aloud about what is noticed in the illustrations, ask questions about the pictures, subheadings, and makes predictions based on text features. Sentence Starter 5 involved linking up background knowledge as students come across new information. This observation is aligned with Piaget's (1937/1954) theory of cognitive development, which suggests that children create structures (schemata) for thinking about things which change throughout developmental stages of their lives. The stages of intellectual development are the sensorimotor stage (birth to 2 years) when children rely on their senses when learning about their surroundings, the preoperational stage (ages 2 to 7 years) when children develop language and their thinking is egocentric, the concrete operations stage (ages 7 to 11 years) when children are less egocentric and able to problem solve through concrete experiences, and the formal operations stage (ages 12 years and higher) when children are able to use abstract language and concepts in order to learn (Ruddell, 2006). The students who were a part of this study were first-grade students between the ages of 6 and 7 years old. They are in the concrete operation state of development, which explains why their utilization of Think-Aloud Strategies 2, 3, 4, 6, and 7 was low. Usage of Think-Aloud Strategies 2, 3, 4, 6, and 7 requires a higher level of thinking and the use of abstract language concepts, which is usually experienced by older students.

Conclusion

The results of this investigation showed that, when first-grade students were repeatedly exposed to think-aloud activities and the teacher thinking aloud during science instruction, they were better able to internalize and apply the thinking process necessary for the development of evaluative science comprehension. The think-aloud strategy is a method widely used for instruction characterized by the teacher modeling the thinking process while reading aloud for students (Dunston & Headley, 2002). This particular instructional practice is observed only during the literacy block of a classroom setting. Reading comprehension strategies are usually taught during the reading block; however, this study demonstrated that it should also be taught during the science content area.

Students are now recommended to problem solve, communicate, and think critically when reading science text (National Reading Panel, 2000). As students are moving through the primary education concept of learning to read and into the intermediate level of education of reading to learn, reading is now a key factor in science achievement (O'Reilly & McNamara, 2007; Reutzel et al., 2005). Reading comprehension skills must be taught in the science content-area classrooms because the students are faced with the task of comprehending the content-area text without the understanding of external and internal text features and the thinking process necessary for the evaluative comprehension of the science text they are reading.

Using the think-aloud strategy while interacting with science text supports students in building a coherent representation of the text they are reading. It, also, gives the teacher a picture of the cognitive process that takes place in order for the reader to comprehend what he or she is reading. The teacher can watch for the following cognitive processes while the students are engaged in the think-aloud activity: activate background knowledge, make predictions, form mental images, monitor comprehension progress, and use fix-up strategies as they interact with the text. During read-alouds of science text, it is important to model the comprehension process by thinking aloud because it gives the students the opportunity to see the thinking process involved when interacting with a science text. Once the students have seen the different strategies used by the teacher while thinking aloud and have been given opportunities to practice utilizing those skills, they begin to internalize the process and are able to apply the skills on their own independently.

According to Vacca and Vacca (2008), teaching with text involves more than assigning pages to be read, lecturing, or using questions to check whether students have read the assigned materials. Teachers must, in turn, understand the bonds between reading and meaning making. It is also important that teachers build on what the students already know in order for them to make connections with what is being taught. In many cases, depending on the student's culture or home environment, the student encounters the use of Standard English only in school. This limited interaction with this dialect affects the student's ability to make meaning of the subject matter being taught.

The think-aloud strategy allows students to monitor their thinking process through the use of reading strategies while engaged in the science text in order to gain comprehension of what they are reading. Thinking aloud while reading science text can help students to learn the metacognitive process involved in comprehension. Some examples of think-aloud strategies that can be used while reading science text are making inferences, making connections, summarizing, questioning, and interpreting. The more think-aloud skills a student is equipped with, the better he or she will be at problem solving while interacting with science text.

These findings could be of practical benefit in the classroom setting. The common core curriculum and state standards are requiring teachers to move from the traditional ways of teaching in isolation to more rigorous, engaging, and meaningful learning experiences. Student voices and interactions are now the center of the classroom learning environment. The multifaceted approach provided by think-aloud strategies to teach reading comprehension in the science content area is aligned with the common core curriculum state standards because of the rigor, student dialogue, meaningful and unisolated encounters with science text, and learning experiences involved in the content area of science.

These skills are needed in addition to phonological awareness so that the students can monitor their understanding of the science text. According to Pressley, Johnson, Symons, McGoldrick, and Kurita (1998), comprehension is not enhanced merely by reading more text.

The difference between normal comprehenders and poor comprehenders is the amount of strategies they are equipped with while reading text.

The think-aloud strategy presented in this research study can be used as a guide to support first-grade students' science comprehension process in the classroom setting. This study suggested that, when students were engaged in thinking aloud, they began to internalize the comprehension process that affected their evaluative comprehension of science text.

Limitations

The small sample size presented in this study may have presented a limitation to the degree that the findings could be generalized. The sample of participants in this study consisted of 48 first-grade students from a Title I elementary school in northwest Georgia. The majority of participants were African Americans from middle- to low-socioeconomic backgrounds. The participants in this study were chosen through convenience and puposive sampling, which could possibly have limited the generalizbility of the findings in this study. Because this study used the think-aloud strategy as a supplemental approach consisting of 15 additional min of instruction for 5 days per week for 5 weeks, it may have posed a threat to internal validity. This study explored the effectiveness of using the think-aloud strategy to improve the science evaluative comprehension levels of primary students who were already reading fluently and characterized as reading on grade level. Future research will need to be conducted to determine if the use of the think-aloud strategy will improve the evaluative comprehension levels in older students. Additional research could be done for a period longer than 5 weeks in order to have a better understanding of the rate of think-aloud skill utilization in students. More research could be done to determine the effects of the think-aloud strategy on the science comprehension of English language learners

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Appendix A
Process of the Think-Aloud Strategy Used by Students

1.	Take a picture walk (flipping through the pages) to look at illustrations and nonfiction features and make comments aloud about what is noticed in the illustrations, ask questions about the pictures, subheadings, and makes predictions based on text features.
2.	Think aloud to yourself by sharing your uncertainties, questions, responses, feelings and connections that appear during your reading
3.	Verbalize inferences that you make including inferences deduced from new words and ideas, themes, illustrations and photos.
4.	Formulate questions that come into your mind as you read.
5.	Link up background knowledge as you come across new information.
6.	Share your thoughts as you work through confusing parts and apply fix-up strategies.
7.	Make a strong connection to the book or short review of the purpose of the story aloud (text-to-text, text-to-self, and text-to-world).

Appendix B
Think-Aloud Sentence Starter Form

Place a tallymark each time you hear the student make the following statements.

Type	Sentence Starter	Number of Time Used
1.	I can see a… I predict that… I think this is…	
2.	Why did… This is confusing because…	
3.	This is really saying… The big idea here is…	
4.	I wonder… A question I have is…	
5.	I already know that… Something new that I've just learned is…	
6.	I don't understand… I'll reread this…	
7.	This reminds me of… This reminds me of…	

Appendix C
Student Observation Checklist

This checklist is to be used to document student utilization of the think-aloud strategy while reading science text.

_____1. Did the student take a picture walk (flipping through the pages) to look at illustrations and nonfiction features and make comments aloud about what is noticed in the illustrations, ask questions about the pictures and subheadings, and make predictions based on text features?

_____2. Did the student think aloud by sharing uncertainties, questions, responses, feelings, and connections that appear during reading?

_____3. Did the student verbalize inferences that were made, including inferences deduced from new words and ideas, themes, illustrations, and photos?

_____4. Did the student formulate questions that came into mind as he or she read?

_____5. Did the student verbally link up background knowledge as he or she came across new information?

_____6. Did the student share his or her thoughts while working through confusing parts and apply fix-up strategies?

_____7. Did the student make a strong connection to the text or short review of the purpose of the story aloud (i.e., text-to-text, text-to-self, and text-to-world)?

Student Comments after Each Paragraph (Think Aloud)

_____
_____
_____
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_____
_____
_____

Appendix D

Difference between Regular Instruction and Using the Think-Aloud Strategy

Regular Science Instruction	Adding the think-aloud strategy to Science Instruction
6. The lesson begins with teacher activating student's prior knowledge of science topic.	1. The lesson begins with teacher activating student's prior knowledge of science topic.
7. There is usually a graphic organizer such as the KWL chart displayed to organize student responses. The teacher records what students already know about the science topic introduced under the K column (What I Know), and records questions that the students have about the topic under the W column (What I Want to Know).	2. There is usually a graphic organizer such as the KWL chart displayed to organize student responses. The teacher records what students already know about the science topic introduced under the K column (What I Know), and records questions that the students have about the topic under the W column (What I Want to Know).
8. The teacher shows a videotape or read a text to students about the science topic.	Teacher previews the text to look for unfamiliar vocabulary or confusing parts in the story and make comments aloud about what she is thinking when she encounters them in the text in order to clarify for the students the thinking process used to understand unfamiliar vocabulary.
9. The teacher scaffold students at the end of the science text. Student responses are recorded under the L column of the chart (What I Learned).	Teacher takes a picture walk (flipping through the pages) to look at illustrations and nonfiction features with students and makes comments aloud about what she notices in the illustrations, asks questions about the pictures, subheadings, and makes predictions based on text features in order to clarify for the students the thinking process used to make predictions about what they are going to learn from the text.
10. The teacher may engage students in a science experiment as an extension activity.	3. The teacher shows a videotape or read a text to students about the
11. The students will be assessed on what they have learned through formal and informal assessments.	

	science topic. While reading aloud to students, teacher pauses and make comments about what she is thinking in order to clarify for students how comprehension is taking place. Teacher articulates her predictions, confusing parts in the story, or connections with prior knowledge to help show comprehension of the text. The lesson is closed with the teacher making a strong connection to the book, or short review of the purpose of the story aloud to model to the students how to make connections (text-to-text, text-to-self, and text-to-world) in order to clarify for students how comprehension is taking place. 4. The teacher may engage students in a science experiment as an extension activity. 5. The students will be assessed on what they have learned through formal and informal assessments. Part 2 of Think-Aloud Strategy (We do) 6. There is a gradual release of the think-aloud process to the students by giving them opportunities to make comments about what they are thinking after each paragraph that is being read to them. 7. A chart with sentence starters and strategies will be displayed to record the amount of times they were used to help with

	understanding the text. Part 3 of Think-Aloud Strategy (You do) 8. Students will be given an opportunity to construct meaning from text with a partner. (The teacher will read aloud the science text and the students will turn to their partners and say something aloud about what was just read to them). 9. Students will then be faced with the task of reading the science texts on their own and thinking aloud at each stopping point in the text.

Appendix E

Distribution of Treatment and Control Students' Pre and Posttest Science Achievement

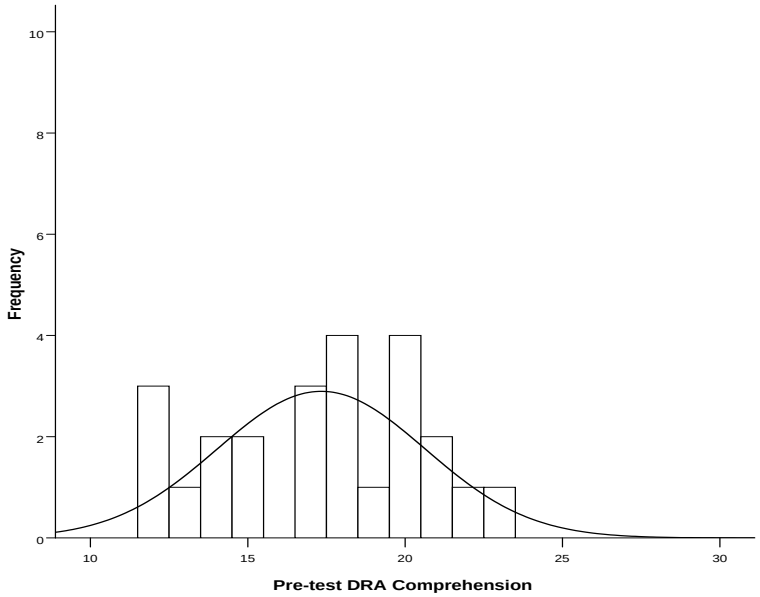

Figure 2. Distribution of treatment students' pretest science achievement.

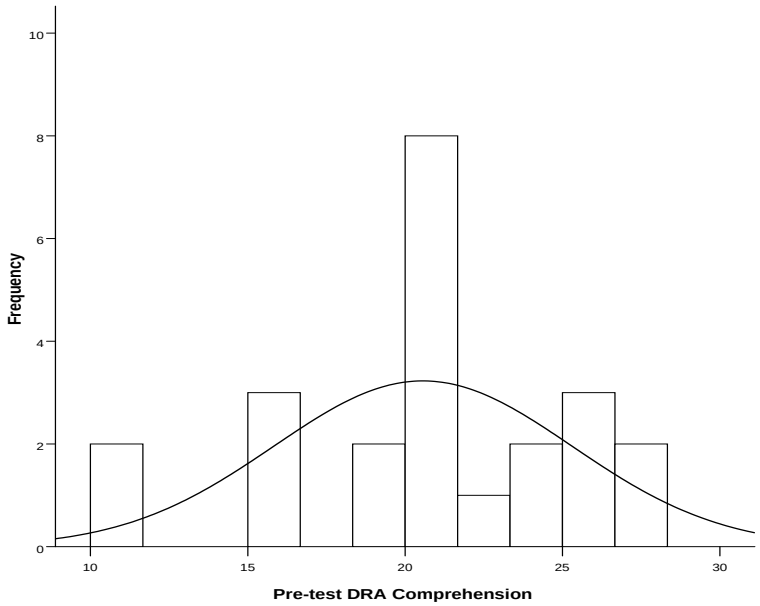

Figure 3. Distribution of control students' pretest science achievement.

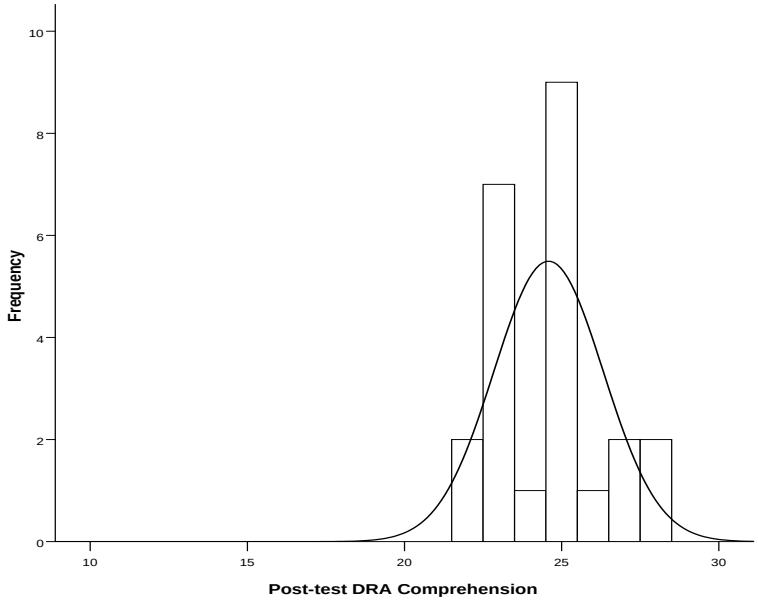

Figure 4. Distribution of treatment students' posttest science achievement.

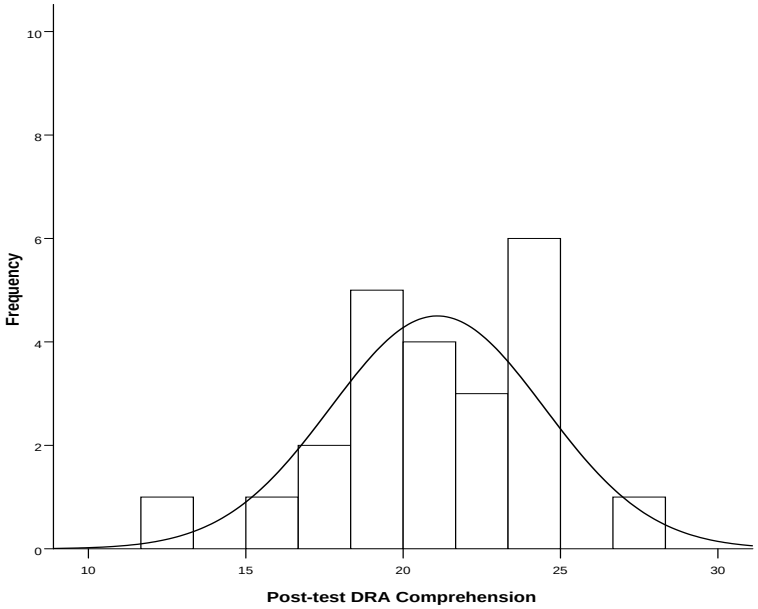

Figure 5. Distribution of control students' posttest science achievement.

Appendix G
Descriptive Statistics for Use of Think-Aloud Strategy on Living and Nonliving

Table 6
Descriptive Statistics for Use of Think-Aloud Strategy on Living and Nonliving

Think-aloud strategy	*N*	Minimum	Maximum	*M*	*SD*
1	24	1.00	9.00	3.50	1.82
2	24	0.00	2.00	0.33	0.56
3	24	0.00	7.00	1.04	2.01
4	24	0.00	2.00	0.46	0.72
5	24	0.00	7.00	3.13	2.17
6	24	0.00	2.00	0.25	0.53
7	24	0.00	3.00	1.38	1.17

Appendix H
Descriptive Statistics for Use of Think-Aloud Strategy on What Is Matter?

Table 7
Descriptive Statistics for Use of Think-Aloud Strategy on What Is Matter

Think-aloud strategy	*N*	Minimum	Maximum	*M*	*SD*
1	24	3.00	14.00	7.83	2.76
2	24	0.00	5.00	1.08	1.14
3	24	0.00	5.00	1.38	1.61
4	24	0.00	4.00	1.58	1.32
5	24	0.00	10.00	5.08	2.59
6	24	0.00	4.00	0.92	1.18
7	24	0.00	10.00	2.13	2.15

Appendix I

Descriptive Statistics for Use of Think-Aloud Strategy on What Does Light Do?

Table 8

Descriptive Statistics for Use of Think-Aloud Strategy on What Does Light Do

Think-aloud strategy	*N*	Minimum	Maximum	*M*	*SD*
1	24	1.00	6.00	3.04	1.46
2	24	0.00	3.00	0.29	0.75
3	24	0.00	5.00	0.75	1.26
4	24	0.00	2.00	0.42	0.58
5	24	0.00	7.00	2.67	2.18
6	24	0.00	2.00	0.33	0.64
7	24	0.00	5.00	1.54	1.47

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