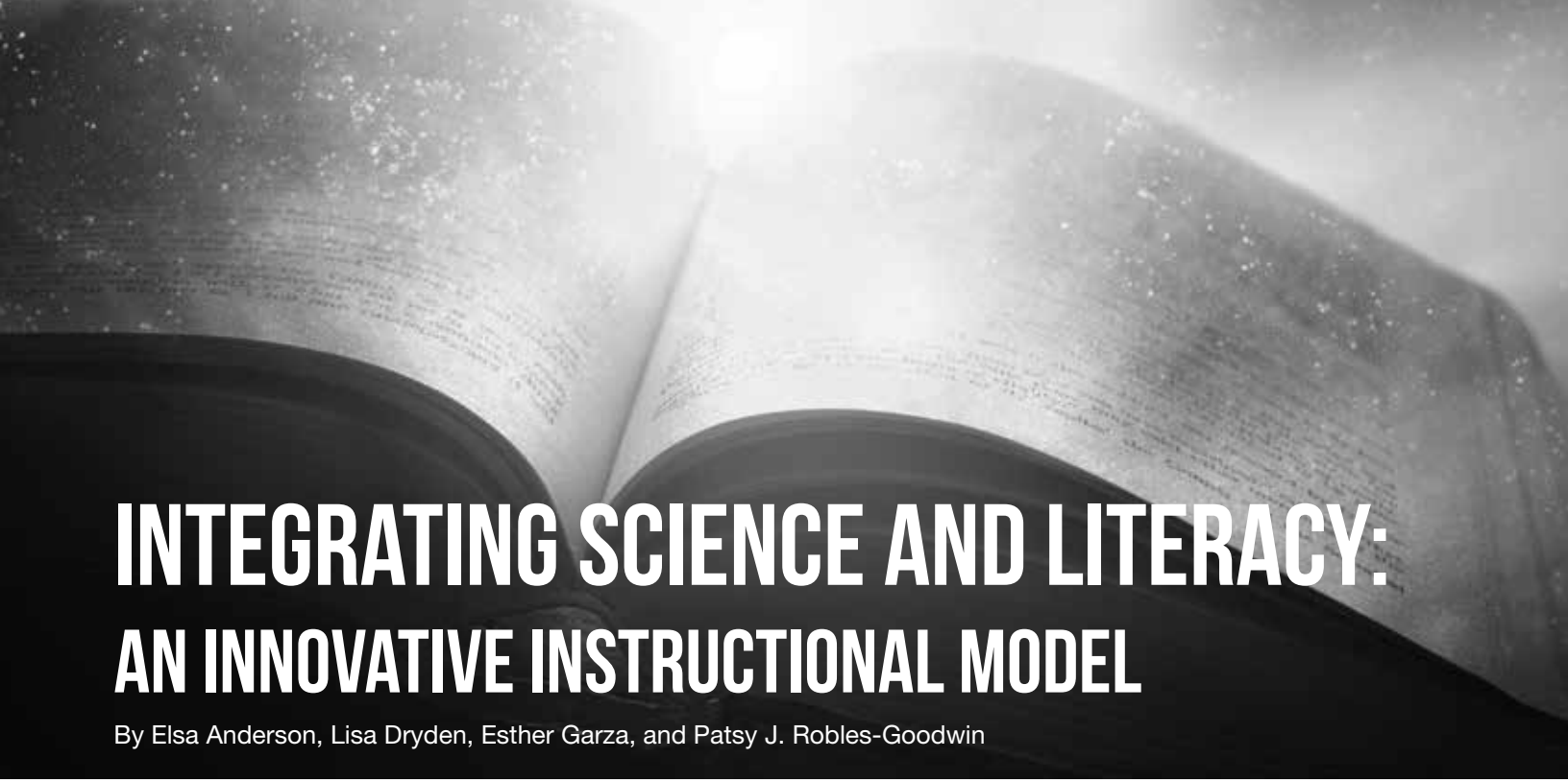

INTEGRATING SCIENCE AND LITERACY: AN INNOVATIVE INSTRUCTIONAL MODEL

By Elsa Anderson, Lisa Dryden, Esther Garza, and Patsy J. Robles-Goodwin

Abstract: This article describes an instructional model for integrating children's literature and language arts into the elementary school science curriculum. This science-literacy instructional model is an adaptation from the original 5E model of scientific inquiry. The model demonstrates how reading, writing, listening, and speaking can be incorporated into science instruction and how the use of fictional children's literature, in addition to nonfiction, can engage the learner and facilitate mastery of content and opportunities for problem solving and critical thinking.

Keywords: literacy, children's literature, science learning, instructional model, integration

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In this article, we discuss an approach by which a group of university professors created a model to integrate science and literacy for elementary English Learners (ELs). This model is based on the 5E Model for Science (Barufaldi, 2002). The original 5E model includes these five phases: Engage, Explore, Explain, Elaborate, and Evaluate. Our adapted model maintains the same phases but shifts the focus to the integration of literacy (reading, writing, listening, and speaking) into the science content. Research on the original 5E Model indicates that the model increases mastery of content as compared to other instructional models as well as increases student reasoning and motivation (Bybee et al., 2006).

Often in our experience, however, teachers find that developing and maintaining student engagement in science class can be a daunting task. Science has a language of its own, a highly specialized academic language that many students have difficulty understanding. Student engagement suffers when students have difficulty comprehending and connecting with the content. Additionally, teachers have limited instructional time to plan separate opportunities for students to experience both literature and science.

The 5E Adapted Science and Literacy Model provides opportunities for students to use academic language with teacher support, provides opportunities for student engagement and provides time for teachers to use children's literature to teach reading and writing by integrating it in the context of science.

The starting point for the 5E Adapted Science and Literacy Model is the use of children's fiction and nonfiction textsin the context of science. In doing so, fiction text paves the way to nonfiction science texts and to the hands-on experiences that follow. Students enter the science topic (in our example, the topic of force and motion) through a relevant connection with familiar text.

The idea of reading and writing across content areas has grown widely in acceptance; using literature in science or social studies is not as foreign a concept as it may have once been. The increased use of literature is likely based on research on best practices about

integrating literacy and content, supported by the growing number of practitioner books written on this topic in the last 15 years (Bean, Readence, & Baldwin, 2011; Harb, 2007; Litner, 2011; Vacca & Vacca, 2011). This focus on the increased use of nonfiction came as a response to growing accountability in the form of standardized testing (Plummer & Kuhlman, 2008). The thought that most students appeared to be more familiar with fictional material in both reading and writing than they were with nonfiction created an impetus for nonfiction across grade levels. Many educators believed that the shift from literature to nonfiction facilitated achievement on standardized tests (Young, Moss, & Cornwell, 2007).

Currently, as the pendulum swings, an interest in fictional literature is once again emerging. A balanced approach that combines both fiction and nonfiction seems desirable (Cox, 2012a; Cox, 2012b; Galda,Liang & Cullinan, 2016; Norton, 2010; Reutzel & Cooter, 2015). Additionally, subject integration, particularly the integration of English language arts into other content areas, can alleviate limited instructional time and engage the learner (Allington, 2012; Bean, Readence, & Baldwin, 2011; Plummer & Kuhlman, 2008; Sackes, Trundle, & Flevares, 2009).

The Power of Literature

Sometimes, unexpectedly, our students unknowingly surprise us with affirmations that we really are making a positive difference in their education. We recall one such example of an ordinary day when a first-year fourth-grade teacher in a low socioeconomic urban school suddenly had the power of children's literature revealed in the most natural of ways. A small guided reading group had just finished reading *Sylvester and the Magic Pebble* by William Steig (1969) together and then transitioned into their math lesson. Working independently, many of the students were struggling with their math story problems. Feeling the frustration of trying to solve the challenging story problems, one student blurted out to the entire class, "I am confused, perplexed, puzzled, and bewildered!" Not only had this student used a direct quote from *Sylvester and the Magic Pebble,* he had used these sophisticated words in the appropriate context. The student's unprompted use of high-level vocabulary words he had been exposed to only moments before solidified the power of children's literature for this young teacher.

This scenario is a brief example of the many educational benefits that literature has to offer students. Many experts agree that in addition to enhancing vocabulary development, literature develops a love for reading, enhances cognitive development, improves writing skills, fosters moral and social development, and expands the acquisition of knowledge in unlimited areas of interest (Allington, 2012; Fox, 2013; Galda, Liang, & Cullinan, 2016; Howard, Camp, Hail & Hurst, 2014, Norton, 2010; Reuzel & Cooter, 2015). As students read and listen to stories, their ability to make accurate inferences and predictions increases (Allington, 2012). Students also improve their ability to summarize, paraphrase, and retell stories (Allington, 2012; Laminack & Wadsworth, 2015). Finally, stories that present moral dilemmas and social injustices provide students the opportunities to acquire compassion and empathy for others (Almerico, 2014; Lintner, 2011; Tyra, 2012).

For us, there is no disputing the merit and educational value of including children's literature across all content areas (Bean, Readence, & Baldwin, 2011; Richardson, Morgan & Fleener, 2009; Vacca, Vacca & Mraz, 2011). Integrating children's literature into

the science curriculum can be especially beneficial by motivating students to learn scientific content and by stimulating their interest in the world around them (Castle & Needham, 2007; Monhardt & Monhardt, 2006; Sackes, Trundle, & Flevares, 2009). Both fiction and nonfiction texts can provide the venue for exploring and investigating numerous science concepts (Cox, 2012a; Cox, 2012b; Plummer & Kuhlman, 2008; Sackes, Trundle, & Flevares, 2009). Quality children's literature can also engage students in critical thinking and in researching science topics of interest (Cox, 2012a; Sackes, Trundle, & Flevares, 2009). Thus, we are reminded that children's literature can enhance students' understanding of complex scientific concepts. The integration of meaningful, relevant science related literature into the curriculum increases students' learning opportunities by building background knowledge and enhancing comprehension of sophisticated scientific ideas (Cox, 2012a; Cox, 2012b; Plummer & Kuhlman, 2008; Sackes, Trundle, & Flevares, 2009).

However, in this era of high stakes testing and the demands placed on teachers for high test scores, both children's literature and the science curriculum tend to be neglected as teachers search for more time in their day to prepare for standardized testing (Plummer & Khulman, 2008). We believe that the Adapted 5E Science and Literacy Model allows for the inclusion of reading and writing with learning scientific information. Many experts remind us that language arts can enhance students' scientific achievement (Brassell, 2006; Collard, 2003; Cox, 2012a; El-Hindi, 2003; Plummer & Kuhlman, 2008; Sackes, Trundle & Flevares, 2009).

It is our hope to continue developing science learning, and therefore, we want to share a sample science and literacy model that we believe enhances critical thinking while enabling students to acquire and retain scientific knowledge.

The Model

As mentioned earlier, the framework for our model originated from the 5E Model in Science (Barufaldi, 2002). Traditionally a science content model, we adapted it to include a strong focus on literature and the application of all components of the language arts: reading, writing, listening, and speaking. The original model is included as Table 1 and the adjoining table, Table 2, provides a visual description of a sample lesson using the 5E Adapted Science and Literacy Model.

Description of the Sample Lesson

The lesson is connected to third grade Texas Essential Knowledge and Skills (TEKS) for Science and for English Language Arts and Reading. Integration of both content areas is evident throughout the model and exemplified in the sample lesson.

Learning Objectives and Language Objectives are aligned to the TEKS. ESL strategies are integrated throughout the lesson. These strategies, aligned with the English Language Proficiency Standards (ELPS), provide language support for ELs and best practice for all students.

The Adapted 5E Science and Literacy Model

Engage: Science and Literature

We engage students through reading and writing, and we start with children's literature. Through the use of the two books mentioned in Table 2—*If I Built a Car* (Van Dusen, 2007) and *What Do You Do with an Idea?* (Yamada, 2014)—we create engagement and motivation. The literature enables students to connect with the topic of vehicles (later used to teach force and motion) and with the general concept of ideas and creativity through which both texts connected. They enter the content at the point of comfort, without the need for prior academic language that we later build.

We read aloud the first book, *If I Built a Car* (Van Dusen, 2007). We stop several times to allow the students opportunities to interact with this highly imaginative text and with the illustrations. Students prewrite by individually creating a list of things they would like to build and/or draw a picture of each. After reading *What Do You Do with an Idea?* (Yamada, 2014), groups create charts of their collective ideas. It is important to note that other books can be used with positive results. At the end of this article, we provide a bibliography of other titles that serve as suggestions for teachers. By the end of this phase, students have experienced both the concept of vehicles and of ideas about inventions from the perspective of their own prior knowledge. They have accessed both concepts using children's literature as a springboard. Additionally, they have talked, listened, and engaged in writing and/or drawing to process the information.

Explore: Science and Literature

During the next part of the lesson framework, we provide an assortment of books on the topic of force and motion. Having first accessed the topic through fiction, they next approach it through nonfiction picture books. Students read and share interesting portions of their books with other group members. Groups develop a list of questions they have on the topic (in this case, force and motion), and they search the books for answers to their questions. Providing an assortment of books at various reading levels and keeping English proficiency levels in mind scaffolds the learning for all students. Exploring then becomes an integral part of differentiation and best practice.

Explain: Science and Literature

After the exploration of text, students individually construct a four-frame storyboard illustrating what they consider to be the four most important facts about the topic learned from exploring the books. The illustrations must capture the most important information about each of their selected key points. Through this strategy, they have the opportunity to summarize, analyze, synthesize, and evaluate information in order to determine importance. In addition, in order to explain, they first have to reflect on what they read and make connections to prior knowledge. Reflection is key when literature drives the learning.

Elaborate: Science and Literature

Through writing, students go deeper into the science content. Writing provides an opportunity to process the learning and to make connections. Students use prior knowledge, connect to the texts read, and make generalizations. Scaffolding is provided through the literature previously read, which serves as a way to activate and build prior knowledge. In addition, opportunities to discuss the books and create visuals serve as prewriting that facilitates the writing task. Written reflection enhances problem solving, generating application and transfer of content knowledge.

Evaluate: Science and Literature

By listening to the writing of others and providing specific positive comments, students evaluate content and writing. This experience gives the listeners practice on intentional listening and allows the writers a way to share their thoughts and their learning in a safe environment with peers.

Implementing the Adapted 5E Science and Literacy Model

Last semester while working with a large urban school district, the professors had an opportunity to utilize the Adapted 5E Science and Literacy Model with approximately 31 elementary teachers, 400 elementary students, and 43 university preservice teachers.

Following a training of the teachers and the preservice teachers on the implementation of the Adapted 5E Science and Literacy Model, the elementary students participated in a science and literacy lesson using the Adapted 5E Science and Literacy Model. Professor observations, along with positive feedback from both classroom teachers and the university preservice teachers. indicated success and effectiveness of the lesson through increased student engagement, improved motivation, and expanded use of academic language. We observed students discussing scientific concepts and asking probing questions in small groups. Many students demonstrated an increased eagerness to write about the science information in their journals. The teachers also expressed delight that many of their students were engaged in more on-task talk throughout this lesson than their other traditional science lessons.

Final Thoughts

We appreciate the educational significance of children's literature, and we recognize the value of scientific knowledge for promoting reflective and critical thinking skills. Incorporating children's literature into the science curriculum provides a powerful means for students to understand the world around them, appreciate the role science plays in society, and develop skills for planning and conducting investigations as well as gathering factual information. This Adapted 5E Science and Literacy Model also provides an effective process for English Learners to acquire academic language.

Classroom teachers can benefit from this model as the combination of literacy events within the science curriculum provides ample instructional time in the school day for students to experience both literature and science. It is our goal that teachers recognize that the use of children's literature can increase opportunities for students to be engaged with scientific concepts, provide opportunities to develop reading and writing strategies, and motivate reluctant readers (Collard, 2003; Hapgood & Palincsar, 2006; Madrazo, 1997). Using a balance of both fiction and nonfiction literature, language arts can enhance science instruction, and the science curriculum can be used to provide relevant, meaningful, and interesting reading, writing, and discussion topics that other educators can easily replicate. We now invite teachers to attempt this adapted 5E Science-Literacy Model, and we trust that they will find their students more enthusiastic and engaged as well as have more daily instructional time for teaching science while using quality children's literature.

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