# Discussion of Disciplinary Literacy in the Science Classroom

Julie L. Szabo

**Abstract:** Disciplinary Literacy in the science classroom is often overlooked as part of a science curriculum. Instead, teachers focus on content area reading which is a generalized approach applied across all disciplines. This manuscript explores what disciplinary literacy is and provides a comparison to content area reading. It examines a supporting theory of disciplinary literacy and discusses science's distinction as a unique discipline. In addition, current implementations and recommendations for classroom utilization of the technique are addressed. We, as science educators, need to recognize the essentiality of science disciplinary literacy to appreciate why our profession may need guidelines regarding how to implement this method for the benefit of our students.

## Introduction

The goal for science educators is for their students to attain complete comprehension in the material being taught. The discipline of science is vastly different from the others when considering vocabulary, sentence structure, syntax, and materials utilized. It is not enough that we simply teach the information in the science classroom with the same approach that it would be taught in English or social studies. For science students to understand the content, disciplinary discourse must not be neglected.

For some time now, content area reading has been the "hot topic" regarding how to tackle this conundrum. However, some educational experts claim that content area reading offers only generalized strategies across all disciplines. Herein may lie the downfall of content area reading. Students should not be learning social studies the same way they learn English or the same way they learn science. There are obvious differences. Yes, it is important to be able to read and comprehend information across content lines. However, thinking like a scientist is different than thinking like a historian. The techniques and approaches to texts and content are unique.

Enter disciplinary literacy. It is a teaching strategy tailored to the specific discourse required in each subject area. "The nature of the disciplines is something that must be communicated to adolescents, along with the ways in which experts approach the reading of text" (Shanahan & Shanahan, 2008, p. 51).

Initially, we, as educators, need to know what disciplinary literacy is and how it differs from content area reading. From this comparison, we can begin to decide if it is truly necessary to introduce yet another way to present, teach, and learn in science. Next, we must know if theory supports disciplinary literacy in science. Theory will help establish basal information in support of or against this push to a new means of teaching and learning. This is a way we, as educators, must complete our due diligence before implementation of new practices occurs in our classrooms.

Additionally, we need to determine what makes science education for children truly distinct. We must know what in the approach for science instruction differentiates it from other core disciplines. Finally, we must explore what fellow educators are doing to promote disciplinary literacy and how experts evaluate those practices.

## Understanding Disciplinary Literacy in Science

### *Levels of Literacy*

Considering three types of literacies in (Shanahan & Shanahan, 2008, p. 44) may help to understand what disciplinary literacy is. Sitting at the base is Basic Literacy which includes the building block of reading for elementary school students. It is where there is concentration on sight words and decoding. Next, Intermediate Literacy focuses on reading to learn instead of the learning to read while in upper elementary and middle school. Comprehension skills are taught and applied while different text types are introduced.

At the top level, Disciplinary Literacy emphasizes more specialized approaches to reading content within middle school and high school. The student no longer can apply how they read and use data in one subject area to the way they use it in another subject area. "In literacy development, progressing higher in the pyramid means learning more sophisticated but less generalizable skills and routines" (Shanahan & Shanahan, 2008, p. 45). Within this pyramid, we can see how disciplinary literacy in science would be more specialized based on its location in the pyramid. It builds on the other literacies, yet it must incorporate higher degrees of specific strategies than would be learned with Basic Literacy and Intermediate Literacy.

### *Comparison with Content Area Reading*

There has been discussion by educational experts regarding disciplinary literacy in the science classroom. Why are they in support of this approach (sometimes overwhelmingly over content area reading)? Some experts believe that content area reading is a one-size-fits-all practice with no focus on the intricacies of the science discipline. If science has its own discourse, it should be approached differently than other core subjects. The Shanahans note that content area reading is just a general skill set that assists students in learning from any text. In fact, they contend that these methods would be utilized by a "novice" when looking into a text (Shanahan & Shanahan, 2012, p. 8).

When Shanahan & Shanahan compared disciplinary literacy to content area reading, there were two very telling phrases to distinguish the difference. Where disciplinary literacy is applied to "unique uses and implications of literacy," content area reading can "help someone to comprehend or to remember text better [with little regard to type of text]" (Shanahan & Shanahan, 2012, p. 8). Application across any text suggests that it is a method which does not concentrate on higher order thinking in a specific content area. There can be no expectation of student success in science if there is no definitive concentration on what makes science distinct.

## Theory Supporting Disciplinary Literacy in Science

When considering the utilization of science disciplinary literacy methods, as educators we must determine whether they have a theoretical basis. Most of what we do in the classroom is backed by sound educational theories and disciplinary literacy should be no different. Because the heart of any content lies in its discourse, seeing if this theory can support the science disciplinary literacy approach is vital. But how can we define discourse? In James Paul Gee's text, Introduction to Discourse Analysis (2001), he holds the following view:

> "Discourses" with a capital "D," that is, different ways in which we humans integrate language with non-language "stuff," such as different ways of thinking, acting, interacting, valuing, feeling, believing, and using symbols, tools, and objects in the right places and at the right times so as to enact and recognize different identities and activities, give the material world certain meanings, distribute social goods in a certain way, make certain sorts of meaningful connections in our experience, and privilege certain symbol systems and ways of knowing over others (i.e. carry out all the building tasks above). ( p. 13)

Aiming to prove the validity of disciplinary literacy with Discourse Theory, Spires et al. (2018) worked to expose the differences of disciplinary literacy in the four core areas: ELA, science, history/social studies, and math. Essentially, they wanted to reveal that each content area had its own special discourse which requires an approach specific to that subject. After assessing each of the four core subjects to determine the specific practices in each, they conducted focus groups with educators in each area. Their results endorsed the expansion of Discourse Theory to disciplinary literacies, helped develop comprehension of disciplinary literacy concepts, and added to existing data on disciplinary literacy. Discourse Theory "views literacy not as tools but as social practices within a community and analyzes how language is used differently in different contexts" (Spires et al., 2018, p. 1426).

Another finding from Spires et al. (2018) which further supports the Discourse Theory and exposes the differentiation between the disciplines revealed that disciplinary literacy includes three disciplinary literacies: source literacy, analytic literacy, and expressive literacy. Educators who shared a content area showed similarities within the literacies they employed (Spires et al., 2015, p. 1424). History/social studies teachers would primarily utilize source literacy, math teachers would use analytic literacy, and ELA teachers would use expressive literacy. Science educators would function using analytic and source literacies. This was explained by noting that scientists utilize source literacy when substantiating present outcomes with past outcomes. Regarding analytic literacy, "science experts also conduct analytical readings in ways similar to mathematicians" (Spires et al., 2015, p. 1425).

## Distinction of Disciplines

In support of a unique method for literacy in the science discipline, consider the Next Generation of Science Standards (NGSS). These standards are a somewhat recent set of guidelines that have created an even wider breadth between science and other subjects, illuminating their differences. These standards, developed by practic-

ing scientists which include Nobel laureates, cognitive scientists, and science education researchers, implicitly call for the disciplinary approach in science. Introduced in 2013, NGSS not only furthered the differentiation between science and other core subjects, they made distinctions within the science field. A science educator must be cognizant of and incorporate the "Three Dimensions of Science Learning" which is comprised of practice, crosscutting concept, and disciplinary core ideas (Next Generation Science Standards, 2020). Each of the three dimensions plays an equal part in science instruction and comprehension.

We, as science educators, need to do more than only help students comprehend information and recall text better as is encouraged in content area reading. We must carefully plan to incorporate the Three Dimensions of Science Learning: "Crosscutting Concepts" which investigate relationships within the four science domains; "Practices" which focus on science and engineering, concentrating on inquiry and practices essential within the fields; and "Core Ideas" which are the main ideas through science and engineering (Physical Science, Life science, Earth and Space Science, and Engineering) that build as students progress through grades (Next Generation Science Standards, 2020). This sets science apart from other disciplines and fosters the need for science educators to focus on thinking like a scientist. The specific discourse in science further justifies the need for the disciplinary literacy approach.

## Research and Recommendations

### *Research*

Studies which examine the current use of disciplinary literacy in science show a variance from one classroom to another. While teachers are attempting implementation and there are standards which provide guidance (such as NGSS and State of Ohio Science Standards), having guidelines regarding what is expected to be taught is a stark contrast to guidance to how it should be taught. Some research suggests close reading, adaptive primary literature, or even apps for science disciplinary literacy. However, incorrect interpretation, adaptation, and/or implementation of these techniques may alter the intended outcomes for students. In fact, studies have been conducted which demonstrate this point.

Kok-Sing Tang's (2016) study found that although disciplinary literacy was being utilized, it was observed implicitly as part of another method instead of as a purposeful intention. Specifically, results revealed that mainly the Initiate-Response-Evaluate (IRE) model (a teacher centered and directed discussion) and implicit techniques for vocabulary were employed by educators. Unfortunately, the IRE "puts the thinking process too much on the teacher and less so on the students" (Tang, 2016, p. 227). This detracts from the disciplinary literacy the students should be experiencing which is so vital in science.

Another study examining current disciplinary literacy in the classroom was Casey Medlock Paul's (2017) study of close reading strategies. It examined teachers' approaches in pre- and post-professional development. Prior to the professional development "educators in all disciplines were primarily using intermediate literacy

strategies" (Shanahan and Shanahan, 2008, as cited in Paul, 2017, p. 165) which, as discussed in "Levels of Literacy" above, is insufficient for understanding specialized text because of its general approach to cover all subjects. In fact, they used content area reading versus disciplinary literacy. They were "not fully engaging in the deeper understanding made possible by disciplinary literacy" (Paul, 2017, p. 165). Additionally, the research revealed that even when teachers had exhaustive professional development, science teachers utilized techniques used by experts in other fields. They incorrectly implemented the disciplinary literacy practices best suited for their content for the benefit of their students.

### *Recommendations*

Because of these studies, both Tang and Paul had recommendations regarding science disciplinary literacy. Contrary to the implicit teaching in Tang's (2016) observations, Paul (2017) proposed that "teachers to also explain why precise terms must be used in science or how some words have different meanings in different contexts" (p. 230). This recommendation offers a move to higher level thinking regarding vocabulary teaching as opposed to utilizing I-R-E.

Paul (2017), as many educational experts have, circled back to the topic of discourse knowledge in a discipline and "being disciplinarily literate" (p. 168). She quotes Moje (2008) that "disciplinary literacy 'builds an understanding of how knowledge is produced in the disciplines, rather just building knowledge in the disciplines'" (as cited by Paul, 2017, p. 169). Paul's (2017) final thought "that teachers ought to strive to know and use the reading strategies used by experts in their discipline" (p. 168) is yet another statement which endorses the utilization of science disciplinary literacy.

There are no set guidelines specifying recommendations for implementation of disciplinary literacy in the science classroom. Research has shown that some science teachers are not explicitly utilizing disciplinary literacy as exemplified in Tang's (2016) study. Additionally, methods have not necessarily resulted in successful and correct utilization after professional development as witnessed in Paul's (2017) study. Obviously, every educator does not and will not teach the same way. However, if standards and guidelines are established regarding how to apply science disciplinary literacy to pre-service teachers, the chance of correct and continued implementation may be greater than what we currently observe. It is certainly possible that the establishment of standards would have a positive effect on veteran educators' instructional methods, as well, if they have a set of guidelines to follow.

## Conclusion

"Science is a form of culture with its own language" (Gee, 2004; Roth & Lawless, 2002, as cited by Fang, 2006, p. 492). Therefore, the rationale for disciplinary literacy in the science classroom is a worthy discussion. With the little time we have as teachers, we need to optimize every minute we have with worthwhile methods and strategies. Because disciplinary literacy concentrates on scientific discourse (which proponents view as an important piece to learning science) and it is theoretically sound, then it is a method on which we should focus in the science classroom.

Current outcomes in the field show varied ways science disciplinary literacy is being taught. There is no standard among science educators. However, I believe experts in education and science have the knowledge and investment necessary to develop recommendations (and possibly standards) for implementation. Additionally, it would be beneficial to teach the disciplinary literacy approach to preservice teachers as they complete their methods classes. Including it as part of a curriculum may make correct implementation in the classroom more effective and more likely to occur.

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### About the Author

Julie L. Szabo holds degrees of M.Ed. in Middle Childhood Education from the University of Toledo and M.S. and B.S. in Kinesiology from Indiana University. Julie finds differentiation and UDL to be keys to student success in the classroom. She is an advocate for implementing disciplinary literacy in science.