Adaptive Primary Literature
Disciplinary Literacy in a Science Classroom

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Abstract: Literacy is a fundamental part of a student's success and within the science classroom, yet science teachers do not take the time to teach content area literacy. Disciplinary literacy (DL) offers a meaningful way for science teachers to teach literacy instruction without sacrificing content instruction. One form of disciplinary literacy that is useful is Adaptive Primary Literature (APL). Textbooks in science classrooms often portray scientific phenomenon as absolute fact, without providing evidence to support the claims. This portrayal of information leads to a gap in the language of science used by professionals and the language of school science. Adaptive Primary Literature helps bridge the gap between the two. This paper reviews the need for DL and APL in science classrooms.

Introduction

Adaptive primary literature is a disciplinary literacy strategy that offers an effective way to incorporate meaningful literacy instruction into a content area classroom while also addressing the gap between the language of science and the language of school science. Reading and writing is not only beneficial in the classroom, but it also has implications beyond school as well. Yet so many students are not writing at grade level (Persky, Daane, & Jin 2003). Therefore, it is important that literacy is not just taught in English classrooms but throughout the school day. Content area teachers are not incorporating content area literacy practices, or instruction used to teach students general literacy skills, into their lessons because it takes away from subject specific teaching. Several disciplinary literacy strategies have emerged for use in the science classroom. One such strategy is adaptive primary literature. Adaptive primary literature involves rewriting primary source science journals to meet students' reading levels while maintaining the integrity of the language of science. Language of school science is often matter of fact without evidence, while the language of professional science is inquisitive and provides evidence. By rewriting science articles, adaptive primary literature is a strategy that closes the gap between the two science languages. This paper will review the difference between disciplinary literacy and content area literacy, answer why disciplinary literacy is important, and discuss adaptive primary literature as a means to incorporate disciplinary literacy into the science classroom.

Disciplinary Literacy and Content Area Literacy

When defining disciplinary literacy, an important distinction to make is the difference between disciplinary literacy and content area literacy. Content area literacy instruction has been around longer than disciplinary instruction to improve student reading and writing skills. When disciplinary literacy emerged as a strategy, the two meanings became confused (Shanahan and Shanahan, 2012). While both are a

means for teaching literacy the two are very different from one another. So, what are the primary differences?

Content area literacy focuses on the skills needed to learn from texts across all subjects. Content area literacy encompasses both vocabulary instruction and comprehension skills. Vocabulary instruction includes teaching students how to use mnemonic devices, and matching meanings to words. Comprehension instruction includes teachings students how to summarize, question, self-monitor, and visualize while reading (Shanahan & Shanahan, 2012). These comprehension and vocabulary strategies are effective for all subjects and, no matter the content, all subject area teachers should dedicate a portion of instruction to these strategies.

In contrast, disciplinary literacy instruction teaches the conventions of communication specific to that discipline. These are skills that cannot be used in all subjects. Comprehension and vocabulary instruction in disciplinary literacy varies subject to subject. In science, comprehension instruction includes teaching how to read and write the parts of a scientific paper, argumentation and sensemaking. While vocabulary instruction teaches students how to find relationships between vocab and analyze Latin and Greek roots to decipher meaning (Shanahan & Shanahan, 2012).

Content area literacy proved to be a successful teaching strategy however, it did not catch on in schools (O'brien et al. 1995). The biggest issue being that content area teachers did not adopt these practices into their teaching because it took away from content instruction. Content area literacy also falls short of teaching the true nature of communication within the discipline. Disciplinary literacy on the other hand, offers a more meaningful reason for content area teachers to incorporate literacy instruction into their everyday lessons (Shanahan and Shanahan, 2012).

Why Disciplinary Literacy?

Before we discuss the specific of adaptive primary literature and its usage, we need to answer why should science teachers adopt disciplinary literacy into their instruction? First, disciplinary literacy offers content area teachers a meaningful way to incorporate literacy instruction into their daily lesson plans. Second, disciplinary literacy, when compared to traditional science education, gives students a more authentic science learning experience that teaches the fundamental skills within science.

Even though teachers might see the value of content area instruction, teachers may not see the usefulness of it for meeting their instructional goals (O'Brien, 1995). Content area literacy is not addressed in the standards and therefore teachers are not motivated to teach them. The mindset then becomes, teaching reading skills is "not my responsibility" among content area teachers, despite the fact that these skills have been shown to increase literacy and helps students build skills to monitor their own learning. In contrast, disciplinary literacy addresses skills mentioned in content standards. For example, the Ohio Learning Standards and Model Curriculum (2018-19) states that for grades 5-8 students must use various scientific processes including, analyze and interpret data, recognize and analyze alternative explanations, and think critically and logically to connect evidence and explanations. These and others mentioned by the Ohio New Learning standards are all skills that

can be addressed through incorporation of disciplinary literacy practices into science instruction.

This inclusion of application and inquiry skills across several grade levels in the Ohio Standards is a long-term investment in helping students' science achievement levels. In science, teaching scientific literacy skills throughout the year, helps build students' literacy skills to be used in all eight science disciplines taught within the Next Generation Science Standards (NGSS) (Drew et al., 2017). Therefore, science teachers can be confident that teaching literacy skills during a physics unit will also include relevant skills that students need in a biology unit. This provides the additional motivation for science teachers to include literacy instruction into their daily lesson plans.

The need for the long-term investment in disciplinary literacy during a school year and across grade levels is because scientific literacy in its fundamental sense, includes being fluent in the language, discourse, and communication systems of science. However, as it is traditionally taught in the classroom, scientific literacy is about learning the known facts of science by using a textbook (Norris & Phillips, 2003). The largest problem with this is that it ignores the process of science that occurs within the unknown. In practiced science, researchers are not finding questions to known facts that could be read in a textbook. They are finding answers to the unknown and accepting the answer that science produces until future science proves something different. Disciplinary literacy strategies, such as the science writing heuristic discussed later in this paper, engages students in this process of science that requires them to develop the skills needed to discover the unknown.

The other aspect of scientific literacy that traditional science education fails to recognize is the social dimensions of science that play a role in why we research different topics (Sørvik, et al. 2015). To adequately teach students scientific literacy, we must allow students to explore socially relevant questions with unknown answers important to them. The use of such techniques has shown to increase student autonomy and take responsibility in their own science learning (Ippolito et al. 2018). If students are asking questions that are meaningful to them and discovering answers on their own, the learning becomes that much more important when compared to learning trivial textbook fact.

Adaptive Primary Literature

Reading literature is an important practice in the professional science community. However, the primary reading in a science classroom comes from a textbook. Linda Phillips (2009) demonstrated the stark contrast between the language of science and the language of school science by analyzing journal texts and school textbooks. Phillips (2009) concluded that textbooks present statements as fact and rarely present proof while scientific journals are primarily argumentative in nature. She then pointed out that this has led to weaknesses among high school and college level science students. Students tend to interpret journal articles with absolute certainty, misinterpret the role of some statements in scientific reasoning and wrongly explain the meaning of the evidence from what they read. How do we bridge the gap between the language of science and language of school science?

Adaptive primary literature (APL) keeps the argumentative format of scientific articles but can be understood to K-12 students (Phillips & Norris, 2009). Teachers take primary literature on topics they are teaching and adapt the reading level to meet students understanding (Koomen et al., 2016). Many science teachers are not skilled at reading and interpreting the argumentative style of scientific articles themselves, however, working with primary literature helped teachers improve literacy instruction (Koomen et al., 2016). While working to produce APL products can improve literacy instruction and bridge the gap between language of science and language of school science, but there may also be reasons for concern. The APL products produced during the Koomen (2016) study were not all proficient at maintaining the meaning and the proper language discourse. Before teachers attempt APL, they should go through professional development to ensure integrity of literature adaptation. Teachers can also refer to the design guidelines laid out by Elon Langbeheim (2013). He discusses two design strategies for APL. The first is to make explicit the connection between theory and experiment. The second is to restructure the text to connect the theory to students' prior knowledge.

How to Read a Scientific Article

Kooman et al. (2016) lays out the framework and standards for how teachers should first read an article and then the standards for evaluating the quality of adaptation. This section reviews the most vital parts for science teachers to understand so that they may participate in APL. In order for teachers to participate in APL they must first know how to properly read a scientific article.

Step 1 – Understand the Parts of the Journal

The first step to reading a scientific paper is understanding the parts of the journal. In order, any journal will have an abstract, introduction, methods, results, and discussion. The abstract is a summary of the whole paper. It provides an insight to the reader on the need to read it. This saves many researchers time because reading the abstract lets them decide if the whole paper is relevant to them. A teacher can read the abstract to know if this article is worth adapting for their unit. Next is the introduction. This section discusses what is already known on the topic and what question is being asked. An introduction on a plant hormone study might discuss what is already known about the hormone of interest. Next is the methods. This section gives insight into how the study was conducted. The primary purpose of reading the methods is to discover techniques that have worked in prior science. Scientists will use this to create methods for their future studies. Following methods is the results. The results report the raw data and statistics produced by the study. The results will then be used in the final portion of the paper, the discussion. In the discussion scientists make meaning of the results. They can lay out implications and discuss what future studies need to answer. The important part to understand in a discussion is it must report the results accurately.

Step 2 – Read the Paper to the Depth that is Important to you

The second step of reading a journal is reading it to the depth that is needed for you. This starts with reading the abstract. Once you know if this will be relevant to your needs you can read the introduction and discussion. To better understand the discussion, one must reference the results section when needed. Finally, if reproducing part of the study you can go back and read the methods section.

Step 3 – Look at the Graphs and Figures

One way to quickly get a feel for the article is step three. That's reviewing the pictures and figures. They are there to make quick meaning of the results.

Step 4 – Ask Questions

Step four, one should ask questions. Some important questions to ask are, What questions does the paper address? What are the conclusions of this paper? What evidence supports these conclusions? Do the results support these conclusions? To what level do the data support these conclusions? How can you evaluate evidence? Lastly, why are the conclusions important? These are questions readers ask to make meaning from the text. Teachers can make sure students ask these questions when they read the rewritten literature.

Step 5 – Discuss with Someone

After asking all these questions one should discuss with someone else. Discussion is important part of science discourse. Step five is part of the scientific disciplinary literacy that is important to teach students as well.

Conclusion

Disciplinary literacy is a tool that content area teachers can use to incorporate literacy instruction into their everyday lessons without feeling like they are wasting time or taking a way from content instruction. In science, one of the primary reasons to incorporate disciplinary literacy is to help bridge the gap between the language of science and the language of school science. Adaptive primary literature is one of the ways teachers can do that. Teachers can familiarize themselves with the scientific journals and then select journals that are on topic to their unit. Using Kooman's science behind the scenes standards teachers can be sure to create a grade level journal article that helps students engage in the true language of science.

Utilizing adaptive primary literature should be taught to both preservice and in-service teachers. I would also like to see a data base of APL where teachers can share what they have already written and peer review each other using the Kooman standards. This would lessen the weight put on teachers to create all their own literature pieces.

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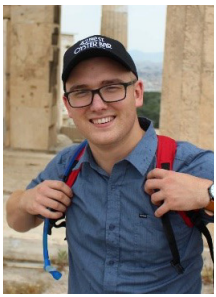

About the Author

Mack Pidgeon is certified to teach middle grades science and social studies. He believes that the most fundamental part to any classroom should be hands on learning that teaches skills necessary for adulthood. His future classrooms will consist of many simulations and literacy instruction.