TAF Journal of Advances in Humanities and Social Sciences JAHSS
2018, **4**(6): 258-266

PRIMARY RESEARCH

Meeting in the middle: The challenge and promise of supporting stem learning through Language and literacy infusion

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Keywords
Literacy
STEM
Digital
Science

Received: 5 October 2018
Accepted: 9 November 2018
Published: 11 December 2018

Abstract
This paper describes the findings of an intervention that aims to support inquiry science text reading in urban high schools in Chicago and help teachers and students take better advantage of the learning opportunities IBLEs offer. It is believed that a good deal of important science learning is inaccessible to those who don't understand interpreting the culture of power. Here, understanding—in terms of understanding how scientists write, speak, and read—represents power. We explain how we worked to address students' Inquiry-Based Learning Environments (IBLE) content learning and inquiry activities by providing a system of tools and routines that support students' interaction with text and representations in science and offer evidence indicating that such support can improve IBLE learning. These strategic literacy support tools appear to make the role texts play a bit more apparent to both teachers and students. Our findings suggest strategic literacy support tools appear to be a useful contribution to activity systems in classrooms and can help learners move toward an apprenticeship into deeper science learning.

INTRODUCTION

IBLEs are meant to support students' introduction to, and apprenticeship into, scientific practice. Ultimately, learning science through engaging in IBLE teaching and learning environments should help learners understand the practice of science while developing broad scientific literacy. However, learning science through IBLEs was designed to be, and is arguably different than learning science through traditional classroom and bench science approaches. IBLEs make new demands on teachers and students, particularly with respect to reading. Students must more purposefully read texts while conducting investigations. They also must read a richer variety of texts to acquire the information necessary to understand relevant phenomena and successfully complete investigations. The texts are often are more structurally complex and content-rich than texts in more traditional, textbook-driven classrooms. Teachers need ways to support student reading of inquiry science texts often while also involving them in the use of cognitively demanding and lengthy (extending over multiple weeks) inquiry science learning.

In this paper, we describe the findings of an intervention that aims to support inquiry science text reading in urban high schools in Chicago and to help teachers and students take better advantage of the learning opportunities IBLEs offer. We explain how we worked to address students' IBLE content learning and inquiry activities by providing a system of tools and routines that support students' interaction with text and representations in science and offer evidence indicating that such support can improve IBLE learning. In this intervention report the research questions guiding our effort are: "To what extent, if any, do teachers find value in the IBLE strategic literacy classroom supports?" "What, if any, evidence suggests that teachers believe that the IBLE strategic literacy classroom tools and routines support science learning?" What, if any, evidence suggests that teachers take ownership of the tools and routines in teaching and learning?".

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The Role of Text in Inquiry-Based Curricula

One way IBLEs can help learners perceive and acculturate to scientific practice is by providing opportunities to investigate important and engaging issues. In other cases, IBLEs present authentic dilemmas likely to engage students, such as planning the site for a new school to meet the needs of a sensitive ecological system (Abdullah et al., 2015; Blar, Jafar, & Monawir, 2015; Edelson, 2005).

Yet many youths, especially those who have not been well served by schools, cannot read well enough to take advantage of this new generation of curricula (Heller & Greenleaf, 2007; Saadia, 2015; Unsworth, Lockhart, et al., 1994; Veerachaisantikul & Chootarut, 2016). Our approach to this challenge is to direct our attention to IBLE teaching and learning with texts and representations. Today's IBLEs typically fail to elucidate for students and teachers the role that text plays in scientific practice (Gomez, Gomez, Kwon, & Sherrer, 2014; Bruna, Vann, & Escudero, 2007; Shams, 2016). We conjecture that the problem— how to support adolescent literacy while improving IBLEs' utility for students in under-performing schools—is multifaceted and thorny. The instructional issues are deeply intertwined with the ecology of instruction (Gomez et al., 2014).

Many learners arrive in late middle school and high school with limited experiences reading complex expository text genres. These limited experiences may have come about for at least two reasons: (1) students' exposure to science reading may have been through textbook reading which often demands a "locate the answer, find the facts" kind of reading, and (2) teachers, especially those in schools with many struggling readers, develop a practice of reading to students or create extensive power point presentations that illustrate the main points of the readings, thus circumventing the need to have students read the text closely. Consequently, students enter upper grades and high school without understanding the particular demands and features of science texts (Unsworth, 2005) and have experienced and view reading as an undifferentiated skill.

Though science teachers may realize that many of these young people are struggling readers, they are often ill equipped to address this challenge (Heller & Greenleaf, 2007). At most, science pre-service teachers will receive one course in content-area literacy support decoupled from routines and tools that tightly couple science and the literacy that supports science content. Our research examines and supports methods that can help IBLE students and teachers take full advantage of inquiry-based texts.

What does it mean to take full advantage of these texts? To really engage in inquiry, learners must understand how integral texts are to the scientific process. From journals, to trade books, to periodicals such as Scientific American, texts are the most public and persistent manifestation of the nature and practice of science (Lemke, 1990; Unsworth, 1999, 2005; Wells, 1998). Students need to understand that texts embody the analysis, critique, and general advances of the discipline. Texts take various forms. For example, in inquiry science learning, students use multiple text sources to acquire, analyze, and produce new information as part of a class or individual inquiry, for peer review, or for teacher comment. IBLE texts might include Internet source materials, textbook readings, and trade book supplements. Teachers sometimes assign readings when they introduce a new unit or subunit (e.g., to provide a conceptual basis for conducting and discussing an inquiry). They may assign readings to support the inquiry (e.g., to reinforce concepts developed during lab activities) or to help students create a final product (e.g., to develop a class presentation or a final research paper). Reading and understanding science materials is a primary method for acquiring and using community knowledge. Indeed, as Heller and Greenleaf (2007) and Norris and Phillips (2005) suggest, reading itself encapsulates much of the inquiry process. They point out that active reading of science embodies many inquiry steps, such as questioning, analyzing, and synthesizing.

Several scholars (Goldman & Bisanz, 2002; Unsworth et al., 1994) have noted that science texts can be challenging for students not prepared for active reading. Often written in formal, third-person discourse, science texts can be particularly difficult for struggling readers to comprehend. Sentences often are complex, with many multi-clausal sentences (Fang, 2006). Vocabulary is a particular challenge. Even when written at grade level, science texts frequently include difficult words and phrases that, though not directly connected to the unit, are an important part of the message. Science texts also may use familiar vocabulary in unfamiliar ways. It is reasonable to anticipate that readers (or less skillful readers) new to a domain need supports to enable them to read complex content-area texts. Such supports can help them correctly disambiguate the semantic (e.g., vocabulary and conceptual), pragmatic (e.g., global or local language use), and syntactic (e.g., multiclausal) elements of texts.

There are metacognitive needs in reading science texts that must be met if learners are to successfully access science content. Students must learn to recognize the structural elements in text, embedded representations (charts, graphs and tables), and they must engage in reflection and evaluation of the role of these elements with respect to how con-

ISSN: 2414-3111
DOI: 10.20474/jahss-4.6.3

tent is being presented. With respect to specific reading elements that impact science learning, students must learn to identify claims and evidence (or main and supporting ideas), organize and synthesize ideas to create the "gist" or summary, and understand syntactic complexity and science vocabulary. Developing meta-awareness via explicit modeling and by providing regular opportunities to apply strategies and review materials can help students who are underprepared comprehend why and how members of scientific practice communities use text to support science knowledge acquisition and development. Expert readers have at their disposal, and apply, a toolkit of strategies during this interactive-constructive process. Readers who are less expert lack this toolkit or facility, thus often fail to gain information from text to use in the inquiry process (Dole, Duffy, Roehler, & Pearson, 1991; Holden, 1996; Pearson & Dole, 1987). Such readers are likely to be less fluent and conceptually aware participants in their practice community because they have no, or minimal, understanding of the discipline's core concepts (Spence, 1998). Both electronic and paper-and-pencil-based tools can help provide this kind of conspicuous support for literacy activity in science classrooms.

Students must understand how to approach text to comprehend its message. To do this effectively, expert readers deploy strategic approaches to understanding text. In the reading-to-learn framework, these approaches include understanding the text structure (i.e., having a meta-awareness of text as a structural thing), including its title, subtitles, transition words, syntax, vocabulary, argument, supporting ideas, and so forth. Less skillful readers require explicit instruction in recognizing and using text structure as a vehicle for meaning making and negotiation with text. They need expert guides, such as teachers, to help them develop this knowing how. They also need concrete tools that encapsulate the reading strategies of successful readers and render this guidance and skill building explicit, or conspicuous.

Our strategic literacy approach supporting IBLE science text reading involves weekly use of annotation, double-entry journals, and summary writing. Annotation helps students understand the content and become involved with the text. The act of annotating makes it difficult for readers to just skim through text without focusing on the important aspects and content within the text. Annotation shows critical information for quick reference by students. Because of this, annotations can be used as study guides for exams, as well. The purpose of Double-Entry Journal (DEJ) is to give students an opportunity reflect on, and analyze what they have read and monitor what they understand. In so doing, they become more involved with the material they encounter. Students can do Double-entry Journals for essays, procedures for lab activities, and other text that are assigned in class. Doing reading in science in this way will help students to monitor and improve their comprehension and vocabulary. Summary writing highlights for students their ability to critically and analytically describe elements of a text that capture gist of what they have read.

RESEARCH DESIGN, STUDY CONTEXT, AND METHODOLOGICAL APPROACH

Lopez High School: Ownership, Belief, Use

This study took place in 12 (3 teachers) of the 27 (7 teachers) ninth-grade science classroom periods in Lopez High School (pseudonym). There were approximately 329 of 450 ninth grade students in our program. Two teachers opted to not be a part of the study. For comparison purposes, we collected reading data on the other ninth-graders in the school. Lopez serves 2,100 students approximately 90% of whom are considered low-income, based on eligibility for free or reduced-price lunch. The students are 68% Hispanic, 28% Black, and 2% White and 9% nine percent are designated "limited English proficient." During the period reported here, only 21% of the students at Lopez met or exceeded reading standards, based on the Prairie State Achievement Exam, and only 10% of students in science met or exceeded standards on the same test. In addition, of the total 450 ninth graders tests on a reading measure, The Degrees of Reading Power assessment, more than 300 had independent reading comprehension levels two or more years below grade level.i.e. that many of these students could not independently read text written above the fifth- or sixth-grade level. In this study we were particularly interested in three broad categories of impact:, classroom use, characteristics of use, perceptions of ownership.

Classroom Observations

To learn about classroom practice, we observed classroom implementations throughout the year with a focus on classroom practice and science learning. Two classroom observers were located at the school full-time and worked cooperatively with the teachers to support tool use and overall implementation of the program. They systematically observed classroom practice, in part through use of an electronic laptop observation protocol. The protocol was essentially an electronic checklist of teacher and student practices around text and inquiry activity, including behaviors, discourses, questioning, and so on. The observation tool

ISSN: 2414-3111
DOI: 10.20474/jahss-4.6.3

also provided space for narrative field notes. We observed and documented 16 hours of science classroom instruction each week for 35 weeks, for a total of 560 hours of coded science classroom activity. Each hour of classroom activity coding contained minimal information about the curriculum lesson, the text(s), the support strategy(ies), the form of instruction, and the class grouping as well as information about the teacher and the participants.

To understand science learning and how students and teachers used the strategic literacy tools and routines, we collected an array of student work and observed growth in use and quality of tool use, over time, which will not be described in detail here. The student work consisted of written responses to questions about concepts and processes (analysis questions), annotations written in the classroom textbook, double-entry journals, extended-response text, summaries written for Summary Street analysis, Summary Street results, science lab reports, and end-of-unit project work.

Ownership of the Tools and Routines

In this section we describe our efforts to understand ownership of the reading-to-learn tools and our analytic approach to understanding interview transcript content. The interviews are the primary data source that informs the results that follow this section.

We interviewed Lopez teachers, who were in our study, three times during the year: in October, February, and May. These interviews focused on teacher beliefs about science and literacy, perceptions of their practice, professional development experiences, and changes in their understanding and use of the literacy supports over the school year. Each teacher interview was audio taped. Questions were semi-structured and open ended. An important role of these interviews was to provide an opportunity to learn how our design could be iteratively adjusted to better support teachers and students.

Interview Protocol Analysis

Completed interviews were transcribed and subjected to thematic analysis. Teacher and student interviews were analyzed separately. Analysis involved a three-step process. First, we analyzed the interview transcripts for evidence of perceptions about the literacy support tools, challenges in tool integration (for teachers), and perceptions about tool value. We created code categories for these broad groupings.

In the second step of our analysis, we re-examined the transcripts with an eye toward understanding ownership, belief, and use issues with respect to the support tools. Transcript excerpts initially coded for evidence of perceptions about the tools and tool challenges were coded to identify perceptions of ownership, beliefs, and use. Tool ownership refers to comments suggesting that teachers or students have embraced or rejected the tools as part of literacy support for science teaching and learning. Tool belief refers to comments suggesting that teachers (or don't believe) that the tools have value, given their teaching or learning goals. Tool use refers to comments offering examples of how the tools have been used in the service of teaching and learning. At this secondary level of coding, after identifying the comments, we then coded ownership, belief, and use comments as positive or negative.

At the third stage of coding, we analyzed the data within each broad category (e.g., perceptions about tool challenges) and within the more refined categories of positive and negative tool ownership, belief, and use.

At the fourth and final stage of coding, we analyzed perceptions of positive and negative tool use, ownership, and belief with respect to patterns and themes within these categories. For example, a student's comments that were coded as positive ownership about annotation were coded as perceiving that the tool helped her learn science subject matter. After coding for positive and negative comments, we identified themes within each sub-group. In some cases, transcript excerpts were moved to other categories as our understanding of the themes became more refined.

FINDINGS: ENHANCING IBLE SCIENCE LEARNING THROUGH STRATEGIC SUPPORT FOR TEXT

In this report, we describe several analytic goals. Specifically, we were interested in (a) teacher support for tool use, (b) teacher ownership and (b) teacher beliefs about the tools, including valuing the tools as a means for helping students use text to understand science concepts. We particularly wanted to know if the tools met teachers' goals for science concept development during instruction and whether the teachers felt the students read more closely, learned more about science concepts, and transferred this knowledge into other activities, such as assessment and inquiry processes.

Our results are encouraging. In general, the teachers were pleased with the literacy support tools and frequently used the tools, Despite the fact that using the tools in conjunction with science instruction is more time consuming, and arguably more challenging, than traditional textbook read-and-response activities, teachers found a great deal of value in the literacy support tools.

ISSN: 2414-3111
DOI: 10.20474/jahss-4.6.3

We recognized that the act of annotating was foreign to students (even more so because they were being allowed to annotate science articles in their school-issued IES curriculum unit textbooks) and required much more literacy-related work than they were accustomed to performing in a science classroom. One teacher, who early on saw the challenges her students faced in becoming accustomed to annotation, described her initial effort to instruct students in article annotation.

We just did it step by step. So it was an article on Easter Island. So I had them first go through and pick out vocabulary, the rectangles [difficult unit vocabulary], and the triangles [other difficult vocabulary]. Like I told you, my kids were like, "I'm not triangling anything, nothing is hard, everything [is] easy," and they were offended by meaning [sic] identifying difficult words. I played it off like [by telling them to look for difficult] multi-meaning words, and then they were better with it. Then I just went through stuff, and then I had them to try it on their own.

Supporting Science Instruction with Conspicuous Literacy Support Tools

In what follows, we offer specific teacher commentary, adding our analysis concerning teacher use of the conspicuous literacy support tools to bring their students into scientific practice classroom communities through close reading of science text. Here we describe three thematic areas of interest drawn from teacher interviews and professional development meeting transcripts related to teacher experiences and perceptions of the literacy support tools. These areas are (a) teachers' tool use and challenges associated with tool use (e.g., how they integrate the tools into science classroom instruction), (b) teachers' perceptions of literacy tool value, and (c) teachers' sense of tool ownership and ownership of literacy as a problem they want and need to address in their science teaching. integral to supporting science teaching and learning. We then offer some illustrative commentary about tool use, ownership, and value—as well as specific challenges gleaned from student interviews.

Classroom Use: Pacing and New Ways of Thinking about the Role of Science Text

Perhaps because integrating literacy support tools into classroom instruction is new to many teachers and not the way text typically is treated in most high school science classrooms, our classroom observation data suggest that teachers are more likely to slowly work through the text in the initial months of the school year. In interview responses, the three teachers reported they found this task challenging, noting the difficulty of modifying their usual approaches to bringing students into the scientific classroom community. For example, the teachers frequently projected an image of the text on a screen (a strategy we prompted during professional development meetings) to help guide students through the task. This approach, which facilitates close analysis of the science text as a whole class activity, takes time, but helps focus student attention on the science language and structure within the text. The following teacher's remarks offer a window into students' initial interactions with the literacy support tools. They highlight the challenge of foregrounding science text in classroom instruction when students lack experience in the task:

So they were pulling again from their underline [annotation]. I was encouraging them to use their own words and some of them got that and some of them didn't. I have kids who really struggle with a couple of things, the kids that really struggled with English language to begin with, they had a hard time and would just write, they just copied it. But then they realized that when they got to Summary Street that they had just plagiarized; big huge chunks that were just plagiarized. But I have some kids that really struggle, so I think that [the] steps kind of helped them.

The following teacher's comments illustrate the dilemma of instructionally fitting the tools into the perceived requirements of "keeping pace" with the science curriculum while acknowledging that students learn more with the tools, albeit at a slower pace. She noted that the pace of science instruction with text support integration was slower than she was accustomed to, but suggested that the slower pace seemed to be worth it when she measured the costs (slower pace) against the benefits (students who are better able to discuss the science topic):

I have to leave, slow down, give more time to write, give more time to read, and dissect the reading. But it has also increased the amount of discussion that we are able to have, which is nice, because the kids are . . . making complete thoughts, and they are making connections. Yeah, I mean it is just sort of paced, but I think they are getting it.

Similarly, another teacher's comments point to the challenge of pace because the class, as a whole, has to spend longer with text than teachers have done in the past:

Well, through this year so far, I have noticed first of all that our pace seems much slower. Whether it was spending a week on the reindeer article or even just going through the decision-making process, which wasn't in an article although there was some reading going along with it, everything is taking a little bit longer.

ISSN: 2414-3111
DOI: 10.20474/jahss-4.6.3

Teacher Perceptions of Tool Value: Benefits and Challenges

When we asked the teachers what was beneficial and/or challenging about the tools with respect to science teaching and learning, their responses revealed their personal struggles to interact with science more through the text (reading and writing) during instruction. In addition, they grappled, and continue to grapple, with paradigm challenges around the benefits of engaging with science text versus spending the majority of instructional time preparing for, or analyzing, lab activities. As is the case for many science teachers, bringing students into the scientific practice classroom community has traditionally meant doing lab work and other active science. In the following example, the teacher articulated her conceptualization of science as she drew a contrast between the literacy work of science and doing science: Well, I think that hardest thing about this is I think you have the most success when you do some specific writing work with them, and it is hard to do that because you want to do the science, but I think that you do have to teach them to write the thesis sentence and you do have to teach them how to take these ideas and put them into their own words and that is not easy to do.

In their comments, teachers generally remain skeptical about the measurable benefits the tools provide. For example, they are not sure whether better reading in science directly translates to better outcomes on science exams:

It is hard to look at the success. I mean, you know you can say, "This student normally doesn't do well on a test and did well on this test." It could be because of their understanding of the article or something [else].

Similarly, another teacher voiced some frustration about direct measurement of success in bringing students to science through text:

I don't know, I don't know how I'm measuring my successes. I don't get to see as much what they have learned in reading in science, the next teacher on, will. I mean definitely I see that some of my successes have been with their vocabulary, I think their vocabulary by the time they get out of here has increased quite a bit, and I think I have a good way with words when I'm teaching the vocabulary to them. I try to come up with multiple examples.

The teachers have some ambivalence about the longer-term benefit, with respect to science learning, of giving over their science instructional time to using the conspicuous strategy literacy tools. Taken as a whole, however, their comments indicated that they felt positively about the immediate value of the tools to students and to their (teachers') own learning:

So, some of them [students] definitely do struggle, just I think out of pure laziness. Not their inability. But I do see an improvement in their reading skills. I think at the beginning of the year if I'd just given them a paragraph, like the Reindeer on St. Mathew's Island [an IES reading], if I had given that to them and then had them answer the questions, I don't think their answer would have been as thorough. Then I had them do the annotation, the double-entry journal, the essay, and I had them do the questions before the essay, but I think just by doing those different steps it made them read it, reread it, and so I think that helped them out a lot instead of just skimming it.

Embracing the Tools' Value for Instruction

As Heller and Greenleaf (2007) and others have noted, learning to see the materials as students will experience them is important in teacher development. In the following comment, one of the teachers described the benefit she derived during her summer professional development week experience of actually annotating one of the science texts from the IES unit that her students would later annotate. In her comments, she suggested that it was illuminating for her, as a science teacher, to experience the challenges of learning to use a conspicuous literacy support strategy:

Like when we annotated this text, I would have never tried to sit down and do it myself. I would have been like "They can do it." But it was very helpful to actually do that, see what kind of problems we came across so that I can anticipate what kind of problems they would have. [The] same with the double entry journal. Just going through all the steps helps, even with Summary Street. To kind of be in the kids' shoes, to know exactly what they're [facing], so I can say "Yeah I know exactly how it feels, and how it can be difficult."

In formal and informal discussions, the teachers described their teaching practice in flexible and reflective terms and, though they varied in their initial enthusiasm and understanding concerning what they were getting into in joining the research project, they have been eager to see whether the tools could indeed improve learning while not sacrificing science instruction:

I do feel that most of my students have a firm understanding of what we have gone over so far, so this would be both a benefit, because a lot of times in the past, I think I tend to as a teacher, I'm so excited I want to teach this, this, this and we just got rifling through things and I think the upper-level students in the classes can stay up with me, but not necessarily the middle or lower. I think this year everybody had got just as good of an opportunity to succeed with even the

ISSN: 2414-3111
DOI: 10.20474/jahss-4.6.3

higher students. I think that they have a better opportunity to improve their reading and writing, which is what most of them need. Even our best students, you read their summaries and they are just not quite up to where they should be for grade level, or even higher. And so they are getting a chance to do that. Now, pace-wise, we are going quite a bit slower than I'm normally comfortable with, but I also foresee in the future that we will be able to speed some of these things up as the repetition gets down.

This teacher's comments show evidence of nuanced reflection about the challenges students have faced with text. She recognized that her upper-level (better readers) students had been able to keep pace with her efforts to cover the science material while her middle- and lower-level students had been less able to keep pace; in particular, because they had difficulty with the science texts. In contrast, she noted that though using the tools made teaching and learning "quite a bit slower," most, if not all, of the students had more opportunities to learn science than they had had in the past.

DISCUSSION AND CONCLUSION

Classroom observation field notes, characterized as implementation levels, and interview data reinforce our claim that though teachers found integration of the literacy tools and support for literacy, challenging, they believe that there was value in tool use. What teachers can tell us about the utility and challenges of conspicuous strategy literacy tool integration will help us in improving and refining (a) teacher understanding of literacy in science, (b) student ability to tackle, understand, and transform scientific text, and (c) literacy tools, instructional support, and professional development.

We now offer some observations and concluding remarks about the value of using strategic literacy support to bring students into a scientific practice classroom community in an IBLE science-learning context.

We believe that IBLEs have a blind spot— support for reading science text. For the most part, these curricula fail to help learners see how to use text for learning. Nor do they help science teachers develop effective techniques for making text an active part of instruction. The resultant practice problems are that learners may not effectively use texts associated with IBLEs to learn science, and their teachers are often ill equipped to help them. This is especially unfortunate for learners with a history of being educationally under-served, because gaining understanding of scientific concepts, activities, and research through reading is one of the most important ways of gaining access to the scientific community. As a matter of strategy, we explored these problems of practice by designing a set of strategic literacy support tools geared toward making the role of reading in science more conspicuous to teachers and adolescents. We determined that two early indicators of text support integration success would be (1) whether teachers employ the tools regularly and consistently in their classroom science instruction, and (2) whether teachers believed the tools were effective, were using the tools, and had tool ownership.

We think the interviews and observations presented here provide some evidence that teachers are coming to own the strategic literacy support tools as part of their practice system. For example, as we noted above, one teacher reported she felt that, though the practice of coupling reading with science using these tools may not benefit her classroom, it would provide a legacy from which other teachers down the road could benefit. We take the reference to future practice as a key marker of ownership. Further, teachers described the tools as useful in achieving the goal of teaching all children effectively. Teachers noted that adopting a tighter coupling between reading and science seemed to allow them to reach a broader cross-section of the classroom. Although we think these observations are evidence of some progress toward the creation of a coherent system of practice among teachers, other observations lead us to believe that the development of this practice system is far from perfect. Perhaps the most telling observation here is that teacher comments concerning the limitations placed on "science" teaching time by the time required to implement the tools imply teachers separated activities into two relatively distinct categories when thinking about their classroom teaching. On the one hand, they did science. On the other hand, they took time out to do reading. This represents clear evidence that though teachers may have engaged in strategic support for reading in science, the process of cohering these parts into an integrated practice is certainly not complete. Teachers who are focused on covering a broad range of science content have a ways to go toward adopting the goal of more tightly coupling reading with science. Looking at these observations and commentary through the lens of use and ownership has given us confidence that introducing strategic literacy support tools in these high school science classrooms has begun to create new sets of practices for science teachers and science learners. This is particularly encouraging given the profound roadblock that text presents to under-served learners in urban high schools in America.

ISSN: 2414-3111
DOI: 10.20474/jahss-4.6.3

LIMITATIONS AND RECOMMENDATIONS

We believe a good deal of important science learning is inaccessible to those who don't understand how to interpret the culture of power. Here, understanding—in terms of understanding how scientists write, speak, and read—represents power. We are encouraged at this point in the work because strategic literacy support tools appear to be a useful contribution to activity systems in classrooms. As they become integrated with classroom activity, we are at least cautiously optimistic that they can help learners move toward an apprenticeship into deeper science learning. These strategic literacy support tools appear to make the role texts play a bit more apparent to both teachers and students. Another important next step is to consider how, through professional development, pacing guide analysis, and science material improvement, we might begin to create a more seamless integration of the science/literacy effort.

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