Disciplinary Literacy in Middle School Science: Reading, Writing, and Talking as Active Learning Processes

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Excerpt from Foregrounding the Disciplines in Secondary Literacy Teaching and Learning: A Call for Change

An Alternative Conception of Literacy and Learning in the Subject Areas: Disciplinary Literacies

If those interested in secondary school education were to reconceptualize learning in the subject areas as a matter of learning the different knowledge and ways of knowing, doing, believing, and communicating that are privileged to those areas, then perhaps a more compelling argument for integrating literacy teaching and subject area teaching could be made. It may even be the case that no argument would need to be made, but rather, that teaching young people how to access, interpret, challenge, and reconstruct the texts of the disciplines would become accepted practice. The work of reconceptualizing will require that teachers, teacher educators, and researchers alike recognize the role of three central aspects of disciplinary learning: discourses and practices, identities and identifications, and knowledge.

Discourses and Practices in Disciplinary Learning and Literacy

To accept this reconceptualization, however, requires a radical rethinking of what constitutes a discipline and, in turn, a secondary school subject area. A number of theorists have argued that the subject areas can be viewed as spaces in which knowledge is produced or constructed, rather than as repositories of content knowledge or information (Foucault, 1972; Halliday & Martin, 1993; Hicks, 1995; Lemke, 1990; Luke, 2001). Even more important, knowledge production in the disciplines needs to be understood to be the result of human interaction.

Knowledge production in the disciplines operates according to particular norms for everyday practice, conventions for communicating and representing knowledge and ideas, and ways of interacting, defending ideas, and challenging the deeply held ideas of others in the discipline. For example, in science, a norm of practice is that researchable problems be carefully defined and systematically and repeatedly studied before claims can be made about phenomena. Particular forms of evidence-typically empirical or observable forms that derive from experimental study-are required to make claims.

In history, by contrast, the norms of practice differ. Historians, like natural scientists, study researchable problems systematically, but the means of obtaining evidence and the forms that provide warrant for claims differ. The time period in which a claim is situated matters tremendously to an historian; thus, temporal context is one dimension-among many other dimensions-a reader of historical texts must know, uncover, or examine as she or he reads (Bain, 2000; Wineburg, 1991). To read a history text requires particular metacognitive and cognitive processes to come into play, processes that are demanded by the social and cultural practices, or the discourses, of the discipline itself (Wineburg, 2005; Wineburg & Martin, 2004). According to Bain (2006), for example, "Historians have long defined history as investigation, casting themselves in the role of detectives seeking plausible explanations for historical events, trends, and controversies" (p. 2080). This investigative work requires interactions with texts, but these interactions take on specific practices unique to the work of historians (Shanahan & Shanahan, 2008; Wineburg, 1991).

Mathematicians engage in what seem like similar practices of questioning, contextualizing, representing, proving, and consulting (Bass, 2008), but the actual practices and forms of representation used to convey concepts in mathematics are radically different from those of history. Mathematicians would not consider themselves investigators, but would rather be seen as problem solvers or proof seekers who work through the logic of a problem context to arrive at claims regarding mathematical abstractions. How mathematicians read texts also differs from the reading practices of other disciplines (Shanahan &

Shanahan, 2008). Moreover, how claims are made public differs across subject areas, as are the types of texts produced and the role that various texts play in providing war- rant for claims (Bass, 2008).

Part of learning in the subject area, then, is coming to understand the norms of practice for producing and communicating knowledge in the disciplines (Bain, 2000, 2006; Gee, 2001; Hicks, 1995; Lemke,1990; Moje et al., 2004; Wilson & Wineburg, 1988; Wineburg, 2005; Wineburg & Martin, 2004). Part of that learning also involves examining how disciplinary norms for practice are similar to or different from the everyday norms for practice. Such learning requires understanding deeply held assumptions or themes of the discipline (Lemke, 1990). Equally important is the ability to navigate across the practices and discourses valued in the disciplines and those valued in young people's everyday lives.

In a typical school day, young people in secondary school are expected to participate in the discourses of the disciplines, to incorporate those discourses with other discourses and identities they experience throughout the day, and to forge, or at least try out, new identities as they take up those discourses (Gee, 2000/2001; Luke, 2001). What this suggests is that teachers of subject areas need to provide young people with opportunities to examine the discourses they are learning in the discipline in relation to the practices, discourses, and identity enactments of everyday life.

Moje, Elizabeth Birr. (2008). Foregrounding the Disciplines in Secondary Literacy Teaching and Learning: A Call for Change. Journal of Adolescent & Adult Literacy, Vol. 52, No. 2, pp. 96-107.

IQ-MS Research Project

What have we learned in year one?

- Informational text comes in a variety of forms—multi-media (websites and videos), not just books and articles.
- Creating productive student dialogue around content takes planning and practice by the teacher.
- Teachers must model strategies for students, not just explain them.
- Student learning increases when disciplinary literacy strategies are used as a part of instruction.
- Disciplinary literacy strategies provide formative assessment data to guide instruction.
- Student engagement increases when disciplinary literacy strategies are used as a part of instruction.
- Implementation is easier when teachers are involved in a learning community to share and dialogue about strategies and lessons learned (school-based and between schools).
- Administrative support is vital in providing time for teachers to learn how to use disciplinary strategies effectively and grow in their own understanding.

Inquiring Minds: Reading to Learn and Innovate in Mathematics & Science

Project Summary

Science and mathematics as disciplines offer us ways to make sense of the complexities of our world. But, to understand these ways of knowing is complex in its own right. This understanding requires more of learners than the basics of reading, writing and communicating. It demands a special sort of literacy and thus special instructional strategies within each of the disciplines.

Inquiring Minds: Reading to Learn and Innovate in Mathematics & Science (IQ-MS) is a three-year research project to explore this special sort of literacy and uncomplicated its practices for middle grades teachers and their students. IQ-MS is a research and innovation project of South Carolina's Coalition for Mathematics & Science, in collaboration with S^{2}TEM Centers SC (*Solutions for Science, Technology, Engineering, and Mathematics Education*). This "disciplinary literacy" effort is a direct response to national and state student achievement data, expert advisement and interest expressed by instructional leaders in our state's school districts.

Disciplinary literacy is an advanced form of literacy requiring adolescent readers to have specific background knowledge about how to read purposefully, engage in productive dialog and write in meaningful ways in the disciplines; skills not often taught in English/Language Arts classes or the content area classes themselves. Disciplinary Literacy instruction engages learners with content in ways that mirror what scientists and mathematicians do to inquire and gain understanding in their disciplines. These abilities are essential to make sense of the complexities of science and mathematics.

The research aim of IQ-MS is to answer the following questions:

- What effect does professional development focused on disciplinary literacy strategies have on the instructional practices of middle grades mathematics and science teachers?
- To what extent does the application of disciplinary literacy strategies in mathematics and science classrooms improve student achievement in literacy?
- To what extent does the application of disciplinary literacy strategies in mathematics and science classroom improve student achievement in these content areas?

The innovation aims of IQ-MS are:

- To develop, via iterative processes, a professional learning storyline for instructional improvement in mathematics and science through the application of disciplinary literacy strategies.
- To develop a robust virtual library of vetted, disciplinary literacy resource materials for middle grades teachers.
- To sustain and scale instructional innovation through regional networks of mentors and other champions for STEM education with a disciplinary literacy focus.

The targeted populations for this research and innovation development are middle grades (6th-8th) mathematics and science teachers and their students in 10 schools located across the state of South Carolina.

The *Inquiring Minds: Reading to Learn and Innovate in Mathematics and Science* research project is made possible by a grant from Boeing South Carolina, with matching funding from BMW Manufacturing Co. and the state of South Carolina. For more information about the IQ-MS project, please visit www.s2temsc.org/researchprojects.