Linguistics and Education 43 (2018) 1–12

Contents lists available at ScienceDirect

Linguistics and Education

journal homepage: www.elsevier.com/locate/linged

Integrating disciplinary-specific genre structure in discourse strategies to support disciplinary literacy

Natasha Anne Rappa[a], Kok-Sing Tang[b,*]

[a] School of Education, Murdoch University, 90 South St, Murdoch, WA 6150, Australia
[b] School of Education, Curtin University, 1 Kent St, Bentley, WA 6102, Australia

ARTICLE INFO

Article history:
Received 19 January 2017
Received in revised form 6 December 2017
Accepted 21 December 2017

Keywords:
Disciplinary literacy
Scientific explanation
Genre
Classroom discourse strategies
Metadiscourse
Metalanguage

ABSTRACT

Classroom discourse plays an important role in shaping how students learn science in the classroom. Past research has examined how content area teachers use a variety of generic discourse strategies to foster classroom interaction and content mastery. However, few have focused on how teachers' discourse strategy can be used in more specific ways to build subject-specialized genres of the discipline, such as scientific explanation. The purpose of this study is to examine how science teachers integrate disciplinary-specific genres in their discourse strategies to engage their students in thinking about the conceptual and epistemic aspects of the discipline. Through a three-year design research, four science teachers learned a genre-based instructional method designed to explicitly teach students how to construct scientific explanations. Lesson observations from these teachers before and after they learned the genre-based instruction were video-recorded and analyzed. It was found that with the incorporation of the genre-based instructional method, a discourse strategy that we call meta-discoursing was employed in new ways to facilitate the teaching of the explanation genre. Using multiple exemplars, we describe the ways in which this discourse strategy was enacted in tandem with the genre-based instructional method to facilitate disciplinary literacy through classroom talk.

1. Introduction

Oral discourse strategy is a crucial component of classroom teaching and interaction in all content areas. A common discourse strategy is the use of questioning to arouse student interest, monitor their understanding, and promote thinking (Wragg & Brown, 2001). Past research on such discourse strategy reveals the predominant use of a triadic Initiate-Response-Evaluate (IRE) dialog where the teacher *initiates* a question (I), elicits a student's *response* (R), and then *evaluates* (E) the correctness of that response (Mehan, 1979). Because the IRE dialog is often seen as a didactic and controlling structure (Lemke, 1990), many researchers and teachers have looked for ways to modify this questioning strategy to make classroom talk more engaging (Edwards & Mercer, 1987). One common approach is to make the last move in the triadic exchange less evaluative and more of an extended "follow up" (F) to scaffold students' construction of knowledge (Boyd & Rubin, 2006; Wells, 1993), thus turning the exchange into an IRF or IRF-RF-chain of questioning (Mortimer & Scott, 2003). Building on this approach, several techniques have been identified to make the "follow up" move more dialogic, such as Socratic questioning (Hogan & Pressley, 1997), reflective toss (Van Zee & Minstrell, 1997), revoicing (O'Connor & Michaels, 1993), and constructive challenge (Chin, 2006).

The above-mentioned research has identified many useful techniques teachers can use to improve their pedagogical repertoire. These techniques are not specific to a discipline and, as such, they can be used in all content areas. Although such general techniques are versatile as they can be applied across all academic subjects, the trade-off is that they are limited in facilitating disciplinary-specific talk in the classrooms. In science education for example, specialized genres such as scientific explanation, report, and argument are commonly found in science texts and discourse in the classrooms (Wellington & Osborne, 2001). These genres are also linguistically and epistemologically distinct from other text genres that children are more familiar with (Halliday & Martin, 1993). Therefore, they require more specific ways of facilitating students' mastery of disciplinary-specific discourse through classroom talk. In this respect, few studies have focused on disciplinary-specific discourse strategies that can be used to build the specialized genres of the discipline in the classroom.

* Corresponding author.
E-mail addresses: natasha.rappa@murdoch.edu.au (N.A. Rappa), kok-sing.tang@curtin.edu.au (K.-S. Tang).

https://doi.org/10.1016/j.linged.2017.12.003
0898-5898/

The purpose of this study is, therefore, to explore how disciplinary-specific genres can be incorporated into classroom discourse so as to support students in developing disciplinary literacy, or the specific ways of talking, reading, writing, and thinking used in a discipline (Moje, 2008). Specifically, through a three-year research partnership with four secondary school science teachers in Singapore, we developed an instructional method called the Premise-Reasoning-Outcome (PRO) to teach students the genre of scientific explanations (Tang, 2015, 2016a,b). The participating teachers and students learned about the PRO method and incorporated it into their discourse. We then compared video-recorded lesson observations from these participants before and after they learned the PRO method in order to examine their discourse with and without a disciplinary-specific genre structure. From this comparison, we observed the teachers used a new discourse strategy which we call "meta-discoursing," to help their students learn the explanation genre. The focus of this paper is to illustrate this meta-discoursing as the teachers integrated the PRO method into their existing discourse strategies.

2. Theoretical perspectives

2.1. Disciplinary literacy

This study is situated within the research on disciplinary literacy. Disciplinary literacy refers to the ability to use the specialized language and practices of a discipline to access and construct knowledge in that discipline (McConachie et al., 2006; Moje, 2007). In recent years, curriculum reforms and standards around the world are putting more emphasis on disciplinary literacy instruction in science (National Research Council, 2014).

According to Shanahan and Shanahan (2008), there are two research areas that influence the conceptualization and development of disciplinary literacy. The first area comprises studies that examine the cognitive and epistemic practices engaged by experts in a discipline and compare them with those of novices. Informed by the cognitive sciences, initial studies tend to examine the reading and sense-making practices of students vis-à-vis scientists in order to derive implications for the design of disciplinary literacy instruction (e.g., Holliday, Yore, & Alvermann, 1994; Kozma, Chin, Russell, & Marx, 2000). During the period leading to the Common Core Standards and the Next Generation Science Standards in the USA, there was an increasing emphasis on using literacy to support scientific inquiry and practices (Pearson, Moje, & Greenleaf, 2010), notably in the practices of constructing scientific explanation, engaging in evidence-based argumentation, and communicating multimodal information (Tang and Danielsson, 2018).

Within the research in explanation and argumentation, several researchers have developed literacy tools to engage students in the practices of scientific explanation and argumentation (see Duschl & Osborne, 2002). For instance, the Science Writing Heuristic (e.g., Hand, Prain, & Wallace, 2002; Nam, Choi, & Hand, 2011) was developed and used as an epistemological tool to help students understand how scientific claims are made through argumentative investigations and activities. Others have also developed frameworks based on Toulmin's (1958) model of argumentation to scaffold students' writing process in constructing scientific explanations (McNeill & Krajcik, 2008; Sandoval & Millwood, 2005).

The second research area is informed by systemic functional linguistics (SFL), which examines the language processes in knowledge creation and communication within a discipline (Schleppegrell, 2004). SFL is a theory of how people use language to make meanings in specific social contexts (Halliday, 1978). As the language of science is unique (Lemke, 1990), students need explicit teaching about its specialized genres and language conventions in order to effectively participate according to scientific norms. In particular, the genre of explanation poses a challenge for many science learners (Halliday & Martin, 1993).

According to Martin (1992), a genre has distinct functional stages that can be identified on the basis of lexical and grammatical shifts in the text. An explanation genre comprises three functional stages called phenomenon identification (what is being explained), implication sequences (series of logical clauses), and closure (Veel, 1997). The implication sequences stage is the defining characteristic of an explanation and it has two prominent linguistic features: a relatively high proportion of action verbs and the use of conjunctions (e.g., because, when, however) to construct logical relations across clauses and sentences (Martin, 1993). Unsworth (2001) attributes the "language of reasoning" in an explanation to the patterns of logical relations formed by conjunctions. Much of the analysis on scientific explanation within SFL focuses on written explanations (e.g., Halliday & Martin, 1993; Unsworth, 2001).

2.2. PRO instructional method

Based on the above-mentioned areas of research in disciplinary literacy, Tang (2015, 2016a) developed the PRO instructional method to support students in learning one of the epistemic processes of science – the construction of scientific explanations. The method involves identifying and using three components of a scientific explanation: premise (P), reasoning (R), and outcome (O). Informed by Braaten and Windschitl's (2011) work, the *premise* is the basis or "first cause" of an explanation and can comprise well-established laws, theories, or big ideas accepted in the scientific community. The next component of the explanation is the *reasoning* that follows logically from the established knowledge in the premise. Based on work in SFL (e.g., Unsworth, 2001), this reasoning process is built up from successive clauses connected by conjunctions. Eventually, this sequence of reasoning connects to the *outcome*, which is the phenomenon to be explained in the explanation.

The following example illustrates the PRO structure in a scientific explanation to the question, "why does a solid have a fixed shape and volume?" (Tang, 2015):

Premise (P)	There **are attractive and repulsive forces** that hold the molecules in the solid in fixed position. (*This is accepted knowledge commonly taught in most secondary school science curricula*).
Reasoning (R)	The strong attractive forces **prevent the molecules from leaving** their positions (*This is a causal effect from the above premise of attractive and repulsive forces*) <u>while</u> the repulsive forces, which act when they are too close together, **prevent them from collapsing**. *Thus*, the molecules can **only vibrate** about their fixed positions <u>and</u> they are **held together** in a regular pattern
Outcome (O)	<u>Therefore</u>, a solid **has a fixed shape and volume**.

• <u>*Underline*</u> denotes conjunctions joining independent clauses
• **Bold** denotes main clause consisting of the main process (verb) and participants (noun).

In a previous study, Tang (2016a) examined the impact of the PRO instructional method on student writing in science. Based on a corpus of examination papers collected over two years, it was found that students' written explanations that exhibit a PRO structure were graded better by the teachers, thus suggesting that students who wrote with a PRO structure were able to produce conceptually better explanations.

2.3. Scaffolding classroom talk through meta-discoursing

Although there has been some progress in disciplinary literacy on both the epistemological and SFL fronts, much of the