A discursive approach for analyzing teachers' discourse of introducing and promoting science activities

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Abstract

The National Science Education Standards state that all students should experience quality science instruction rooted in authentic experience and most science researchers encourage teachers to guide students to access science more authentically. However, little is known about how teachers introduce or promote these science activities to their students. The purpose of this ethnographic and discourse analytic study is to investigate the ways in which a high school biology teacher discursively represents the activities of scientists to students. We collected data in the form of observations and field notes and we videotaped lessons in an eleventh-grade biology class. Drawing on discourse analysis to investigate the kinds of *interpretative repertoires* the teacher uses to introduce science activities, our analysis identifies six types of repertoires, reports frequencies and demonstrates repertoires change through interaction, demonstrate their frequencies and investigate their interacting work. The nature of the discursive resources teachers use has important implications for improving science education quality because of the likely influence on students' image of science and allows us to understand how discourse is conveyed and how it reflects the contexts of communities, language and common sense assumptions in science classrooms.

Key words: Discourse Analysis, Interpretative Repertoires, Introducing Science

1. Introduction and study purpose

The American Association for the Advancement of Science (AAAS) and the National Research Council (NRC) argue that K-12 science education needs to move beyond didactic instruction to a more constructivist, inquiry-based pedagogy where students engage in authentic, long-term science investigations (Soloway, Pryor, Krajcik, Jackson, Wisnudel, &

Klein, 1997). Many studies investigated how teachers use different strategies, activities or teaching tools to make authentic science accessible to students (Bencze & Hodson, 1999; Cunningham & Helms, 1998; Lee & Songer, 2003; Soloway et al., 1997). However, little research has investigated the discourse teachers use to introduce, describe and promote scientific activities to students, for example, as part of career preparation courses. Because teachers are the front-line personnel in the education system, what teachers say contributes to students' first impression, or image of science. Investigating *interpretative repertoires*, namely, discursive resources, allows us to understand how discourse is conveyed and how it reflects the contexts of communities, language and common sense assumptions. Therefore, identifying these interpretative repertoires and investigating their frequencies and interacting work is the central focus of the study.

2. Theoretical framework

In the past, psychologists have typically seen language as a resource and a medium, providing clues as to what is going on inside people's minds. Through experimental manipulations and procedures, language has been used to indicate people's underlying competence. Discursive psychology, however, takes language as part of discourse and as its topic, using rigorous analytical procedures in everyday life or institutional settings to examine how people construct things. In discursive psychology, language is not neutral but essential to how views, beliefs, and attitudes are constituted in each situation (Edwards & Potter, 1992; Potter & Wetherell, 1987; Roth, 2005). Discourse analysts' interests have been in how mentalist notions are constructed and used in interactions rather than in trying to explain actions as a consequence of mental processes or entities (Potter, 1996). The concept of *interpretative repertoires* first appeared in Gilbert and Mulkay's sociology study in biochemistry laboratories. They found that scientists employ certain stable interpretative forms and repertoires, but that these recurrent interpretative resources are used with great flexibility to generate radically different accounts of social phenomena (Gilbert & Mulkay, 1984).Talk presupposes a lot of stage setting and unquestioned, mundane and commonsense statements which function as background assumptions (Roth, 2005). By using discourse analysis, we attempt to identify these unquestioned background utterances – *interpretative repertoires* –a lexicon or register of terms and metaphors drawn upon to characterize and evaluate actions and events (Potter & Wetherell, 1987, p. 138) to investigate the discourse of introducing science.

3. Study design

As part of a larger study on learning about science in school and in university

laboratories, we interacted with teachers and students for six months and videotaped more than 126 hours in different activits (students in career preparation courses, doing internships in science labs, reporting their findings). In this study, we exemplify our argument with data from 22 classroom sessions taught by an experience high school biology teacher—Elizabeth (a pseudonym) who has 26 teaching experiences. The biology class is in a public school in a middle-sized Canadian city and is also a career preparation course in which students require participating science activities to complete the course. In addition to teaching grade eleven biology, the teacher also arranges and conducts a variety of scientific activities in which career preparation students can participate. So, students usually rely on Elizabeth to get information about science activities and count on Elizabeth's arrangements to participate in these activities. Therefore, Elizabeth's discourse in the classroom as she presents these science activities is the central focus of our study. To explore the ways the teacher introduced science opportunities, we examined these 22 tapes and identified those sections where Elizabeth introduced science activities to students. During those episodes, the discursive features of interest in the study occurred with particularly high frequency, though they could be found elsewhere in the videotapes as well. These particular episodes total about 20 minutes and relate to four science activities: visiting a forestry laboratory, participating in a cancer research study, participating in a health expo, and taking part in an astronomy activity. To establish the credibility of interpretative research, besides finding coherence from earlier studies (Gilbert & Mulkay, 1984; Reis & Roth, in press; Roth & Lucas, 1997) and inviting disinterested peers and Elisabeth's evaluation, we also adopted several techniques- prolonged engagement, persistent observation, progressive subjectivity and member checks to satisfy the criterion of credibility (Guba & Lincoln, 1989).

4. Findings and analysis

In this study of one teacher's discourse over a 22-lesson unit, we identify six discursive resources used by Elizabeth to promote science activities. Each of these resources presents and constructs a particular dimension of science, scientific knowledge, and scientific skills. Thus, scientific knowledge is (a) *specialized,* (b) *atypical*, (c) *emotional*, (d) *relevant*, (e) *empirical,* and (f) *infrequent*.

Take the introduction of visiting a forestry laboratory as an example to demonstrate how Elizabeth uses specialized and atypical interpretative repertoire to introduce science activities. After the discussion with students about the forest laboratory research interests and scientific working situation, Elizabeth summarizes several reasons for participating in the science activity.

01 there are a lots of interesting jobs though available in:um in:um
02 biological fieldwork. most of them probably government funded,
03 essentially. SO: the forestry lab is a federal government um la:b and so it
04 has the electronic microscopes, you also: there are a couple guys out there, a
05 couple of: researchers who keep tarantulas, those are kind of fun to see, that
06 is just kind of a side issue. what I'm think about seeing theses, going on
07 these tours, um you get to see things like I just mentioned, but you get
08 to see what the workplace looks like if you were a scientist, a biologist
09 working for say the government um or the museum as we saw there on
10 the last tour.

In the Episode, Elizabeth uses discourse to create descriptions that have the potential to be resources students can use for visualizing what they would see if they were to go to the science-related site denoted: a government-funded workplace "the forestry lab" (line 03), professional scientific equipment "electronic microscopes" (line 04) and researchers (line 05). Elizabeth establishes the special nature of the laboratory by emphasizing that it is a government laboratory and that a powerful organization funds and therefore supports it. After introducing the federal laboratory, by using "so" (line 03), Elizabeth shows causality on what students will see in the laboratory—electronic microscopes, which are expensive, but are available to the laboratory precisely *because* the federal government runs it. Elizabeth also uses words to encourage students to see themselves as specialized personnel "scientists or biologists" (line 08) working for specialized organizations "the government or museum" (line 09) or for specialized field "biological fieldwork" (line 02). Furthermore, in the Episode, Elizabeth also uses atypical repertoire in introducing the science activity to students. Although she mentions the atypical aspects of the science activity "a couple of researchers who keep tarantulas – those are kind of fun to see" (lines 05-06), she also emphasizes that this is "just a kind of a side issue" (06). "Side issue" implies there are more important things to see and that those would be the specialized aspects of the science activity in Elizabeth's discourse. Here, she uses specialized and atypical repertoire at the same time to introduce the forest lab; one invokes the professional (typical) aspects and the other one invokes unusual aspects of science. However, she utilizes a *discursive device* "just a side issue" to privilege one repertoire over the other.

Besides specialized and atypical interpretative repertoire, we also identified an emotional repertoire, which invokes personal comments and emotions, relevant repertoire that invokes the closeness and relevance, empirical repertoire invokes actions, practices and technical experience, and infrequent repertoire invokes rareness, uniqueness and scarcity. From the interaction between Elizabeth's discourse and the students' response, we found that interpretative repertoire is spontaneous, interacted and contextual. Furthermore, we also count the interpretative repertoire frequencies and clauses to illustrate the different efficiencies of

different repertoires (as shown in Table 1). For instance, emotional repertoire, which used the least clauses, is a more efficient resource, but specialized, atypical, relevant repertoire needs more space and effort to articulate.

Table 1. Repertoire frequencies in each science activity discourse.

Science Topics	Forest lab		Health expo		Cancer		Astronomy		Total		
Regulations	8 quotas No charge		No limit quotas No charge		No limit quotas No charge		No limit quotas Charge				
Participation(N)	8 (5 waitlist)		2		14 (initial 22)		0				
Time	After school		School time		After school		After school				
Episode time	7.30 min		4.22 min		4.45 min		2.43 min		19.20 min		
Clauses (N)	111		59		81		53		304		
Repertoires	clauses	times	clauses	times	clauses	times	clauses	times	clauses	times	C/T
1.Specialized	77	13	14	10	17	11	16	9	124	43	2.89
2.Atypical	6	2	0	0	0	0	0	0	6	2	3
3.Emotional	2	2	4	4	3	3	5	5	14	14	1
4.Relevant	3	3	12	3	6	4	8	2	29	12	2.42
5.Empirical	0	0	0	0	4	2	3	2	7	4	1.75
6.Infrequent	0	0	2	2	15	7	0	0	17	9	1.89
Total	88	20	32	19	45	27	32	18	197	84	2.35

5. Discussion and implication

Through investigating these discourses in one classroom, we found that the teacher's promotion of authentic science is not only stated explicitly but also delivered implicitly by different unquestioned repertoires. In the study, we identify six interpretative repertoires: science (opportunities) as specialized, atypical, relevant, empirical, emotional, and infrequent. Each repertoire invokes different dimensions of science activities. Repertoires are generalized cultural patterns, ways of talking; people do not have to defend them, but use them in support of their claims in each situation. To be able to function this way, these repertoires have to exist for all participants (Roth, 2005). That is, these repertoires are intelligible and exist in the culture of the classroom which is shared by the teacher and students. Therefore, the teacher's talk about authentic science is never entirely her own; the talk presupposes its intelligibility and therefore also the shared nature of the repertoires. Furthermore, from the interaction between Elizabeth's discourse and the students' response, we found that interpretative repertoire is spontaneous, interacted and contextual. Although introducing the same activity to students, Elizabeth utilizes different repertoires to support her presentations in different contexts.

The counts of interpretative repertoire frequencies illustrate the different efficiencies of different repertoires. For instance, emotional repertoire, which used the least clauses ($C/T = 1$), is a more efficient resource, but specialized, atypical and relevant repertoires need more space and effort to articulate ($C/T > 2.35$). Although our study draws on only one teacher's discourse, her concentrated introductions to authentic science in the career preparation course, the only one of its kind in the city, combined with her long teaching experience allowed us to collect rich data on interpretative repertoires and the mundane and commonsense assumptions which exist in daily life. That is, because we are interested in language use rather than the people generating the language, and a large number of linguistic patterns are likely to emerge from a few people, small samples are generally adequate for investigating these phenomena. Furthermore, the thick description increases the transferability of the study to new situations.

From this ethnographic and discourse analytic study, we learned that the teacher introduces different science activities through several similar discursive resources to help her promote science opportunities to students. Our study illuminates the teacher's repertoires in the classroom and hopes to raise teachers' awareness about how they talk to students because of their likely influence on students' image of science. When we went back to the classroom to establish credibility of the study by member checking, Elizabeth illustrated her learning about introducing science activities.

> so it was interesting to see how things that I, things.that I learned to say out of their experience, um how those can be analyzed and labeled you know has particular um. you know categories of: of: conversation, or DISCOURSE ya: so it was interesting.

Through reviewing the findings of the study, Elizabeth felt very interesting to see how she got a message across and how her words can be categorized. When Elizabeth said "it was interesting to see how things I learned to say out of their experience" which indicate that teachers need to learn how to introduce these science activities to students, need to practice saying out of students' participating experiences. As an experienced teacher, Elizabeth arranges all kinds of science activities for students to participate in and receives much feedback from students. Therefore, interpretative repertoires which are used and demonstrated in the study allow us to better understand how science is introduced in science classrooms.

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