ON AND OFF SCHOOL GROUND:

A DISCURSIVE APPROACH TO SCIENCE AND ENVIRONMENTAL EDUCATION

by

Giuliano Pagy Felipe dos Reis
B.Sc., University of Brasilia, 1997
Licentiate, University of Brasilia, 1999
M.A., University of Brasilia, 2003

A Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the Department of Curriculum and Instruction

ON AND OFF SCHOOL GROUND:

A DISCURSIVE APPROACH TO SCIENCE AND ENVIRONMENTAL EDUCATION

by

Giuliano Pagy Felipe dos Reis
B.Sc., University of Brasilia, 1997
Licentiate, University of Brasilia, 1999
M.A., University of Brasilia, 2003

SUPERVISORY COMMITTEE:

Dr. Wolff-Michael Roth, (Department of Curriculum and Instruction)

Supervisor

Dr. David Blades, (Department of Curriculum and Instruction)

Departmental Member

Dr. G. Michael Bowen, (Department of Curriculum and Instruction)

Departmental Member

Dr. Geraldine Van Gyn, (School of Exercise Science, Physical & Health Education)

Departmental Member

Dr. Paul Hart, (Faculty of Education, University of Regina)

External Examiner

Supervisory committee: Dr. Wolff-Michael Roth (Supervisor), Dr. David Blades (Departmental Member), Dr. G. Michael Bowen (Departmental Member), Dr. Geraldine Van Gyn (Departmental Member) and Dr. Paul Hart (External Examiner)

ABSTRACT

This dissertation is the result of a two-year ethnographic study conducted with schoolteachers, students, and public educators in Victoria, British Columbia. Using discourse analysis (DA) as a method and theory to analyze participants' talk during interviews and other interactions in the course of their naturally occurring school-related activities, the present dissertation describes and articulates curricular and instructional implications of the observed practices to science classrooms and environmental education initiatives. The use of DA as analytical tool and the general significance of the findings to science and environmental education are what bring the individual chapters, originally written for different journal audiences, into cohesive focus. Data collection took place within two different instructional and institutional instances (or activity systems): In- and out-of schools. This, in turn, allowed for a more refined understanding of the issues those crossing the boundaries between the different activity systems might face, a point often overlooked in educational research. The conclusions amount to the complementary aspect of non-school and in-classroom activities for the improvement of science and environmental learning and instruction. Moreover, they expand the knowledge about the ways science and environmental education can be enacted in those learning settings, also introducing an alternative approach to the investigation of the learning processes in this two overlapping educational fields.

TABLE OF CONTENTS

TABLE/CHAPTER	LIST OF TABLES	PAGE

FIGURE/CHAPTER	LIST OF FIGURES	PAGE

ACKNOWLEDGMENTS

I thank the teachers and their school districts, and public educators—especially those who became personal friends—who not only made me feel at home in this new episode of my pilgrimage in this world, welcoming my family and I to Canada, but also allowed me to witness, record, and learn from their magnificent work. Without them, this project would never have become a reality. All the staff from the Department of Curriculum and Instruction and my committee members for their constant encouragement, support, availability, and friendliness, they have my grateful thanks. Also, to those whose paths have crossed mine in the period I spent working in the A420 office ("lab") and whose help, competency, and friendship have taught me what it takes to be a good researcher—especially to Leanna Boyer for the careful editing. I acknowledge the generous financial support received from the Social Sciences and Humanities Research Council of Canada (SSHRC) and the Natural Sciences and Engineering Council of Canada (the CRYSTAL program), without which I would not have been able to divulge my academic work. The biggest gratitude is reserved for the women of my life (Juliana, Ana-Julia, and Maria-Luiza), my parents (Carmen and Elmio), and my supervisor (Michael Roth). For accepting me as part of what they are—a family, parents, and supervisor, respectively—they have profoundly changed my life in ways they can never imagine. THANK YOU! Finally, thanks to God, who has made all things possible.

CHAPTER 1

INTRODUCTION

This dissertation is the result of an ethnographic study conducted with schoolteachers, students, and public educators in Victoria (British Columbia). Using discourse analysis (DA) as a method and theory to analyze participants' talk during interviews and other interactions in the course of their naturally occurring school-related activities both in- and out-of-school, I describe and articulate curricular and instructional implications of the observed practices to the joint work of science classrooms with public environmental education initiatives.

In the present introduction I set the stage for reading the dissertation by providing a road map (preliminary resources) for the five different but related substantive chapters that were originally written for publication as articles. (The original format in which articles were submitted to journals was preserved as much as possible in this dissertation.) I also included a reflexive (personal) account of how the chapters developed, from their origins to the actual form. Likewise, I offer a brief description of the context in which data collection took place—i.e., the people that participated in the individual studies and the sites where they performed the activities I registered. Further relevant and specific descriptions are provided whenever necessary within every chapter. Last, I devote attention to the general process (or strategies) for my data collection process.

General introduction to sections

The core chapters of the dissertation (chapters 3, 4, 5, 6 and 7) are divided into three sections: "Scouting Out New Terrain," "On School Ground," and "Off School Ground." A summary of all core chapters is offered in Table 1.1. Although one could certainly imagine an alternative assemblage, the current subdivision is intended to reflect specific themes that are shared by groups of chapters. It is my hope that readers will benefit more from this approach.

The first section, "Scouting Out New Terrain," explores autobiographical aspects (chapter 2) that mediated my decision to use discourse analysis (along with interaction analysis, ethnography and grounded theory) to investigate participants' discourse in the contexts of interviews and interactions both in- and out-of-classroom to describe and articulate the role of fun, uncertainty, media, and emotions in/for science curriculum and instruction. This section also contains an example of analysis that illustrates and anticipates the analyses found in the subsequent pages. The second chapter in this section (chapter 3) represents my original effort in using DA. In sum, chapters 2 and 3 together became for my introduction on how I started to learn to do my research.

The second section comprises those studies whose main corpus of data is the interactions and discourses of teachers and students in the classroom setting ("On School Ground"). However, these studies equally deal with the issue of crossing the boundaries between school and out-of-school situations. For example, in dealing with how students and teachers talk about field trips (chapter 4), my focus remains on how those experiences compare to participants' routines in the school setting. Likewise, when media is used in the classroom (chapter 5), it is commonly done to establish a connection with

the world outside the classroom—newspapers are generally not considered to be educational tools per se in science and environmental education.

The third section includes those chapters whose data analysis directly embraces out-of-classroom interactions—i.e., conversations that took place "Off School Ground." This section (like the previous one) does not loose sight of the issue of crossing the boundaries between in- and out-of-school settings. For instance, the uncertainty instructors are sometimes faced with in outdoors experiences (chapter 6) has explicit implications for questioning behaviors that have been so well documented for in-class situations. Similarly, the use of an emotional language on the part of public educators (chapter 7) was observed in and has practical significance for the two distinct environments. This, in turn, supports the claim that different activity systems—e.g., in- and out-of- school—can often times look very similar in the eyes of those crossing their boundaries.

The organization of respective chapters should not mislead readers in assuming that the locality where interactions occurred was the only criterion used for splitting them up in different categories. In fact, the division is meant to facilitate a coherent reading of separate but interrelated articles and to feed the conclusions that will be drawn in the last chapter (Conclusion).

Overview of individual chapters: A reflexive account of how each text developed

To elaborate, chapter 3 (*Environmental Education in Action: A Discursive Approach to Curriculum Design*) is dedicated to the study of how designers of environmental education (EE) programs account for their design decisions—e.g., plans and actions. Chronologically, it was both the first study I conducted and also the first

opportunity I had to use discursive psychology (DP) as an analytical tool. In this chapter, I look at environmental education designers' discourse in terms of the discursive resources—or interpretive repertoires—they use to (a) make their position, (b) to make their talk do work, (c) to tell a story about events, and (d) to reveal their identity. Drawing mostly on interviews, I identified five main repertoires: (i) relevance, (ii) knowledge transferability and translatability, (iii) emotionality, (iv) expertise, and (v) empiricism. I also exemplify discourse analysis as a useful method to be used in environmental education research (and science education for extension)—i.e., one that walks away from the exclusive focus on *what* is said to include *how* it said on a sociological (interactionist) basis (chapter 2). The characterization of the culture of environmental education curriculum design has important implications for curriculum design in both the fields of EE and science education as it sheds light on the curriculum enacted by a community of environmental educators and designers who also do science education. This, in turn, allows for an explication of the ways curriculum design in the field is discursively constructed (accounted for) and advances into a more refined study of such repertoires in face of the effectiveness of the actual doings of the interviewees.

From a reflexive perspective, chapter 3 results from my desire to better understand some of the programs I was initially introduced to when I arrived in Canada. Leanna Boyer (a fellow researcher who was working on her interdisciplinary MA with my supervisor) is a close friend of the director of a local NGO that runs popular environmental programs on Vancouver Island. Before I arrived to Canada from Brazil, Leanna mentioned the possibility of working with the organization she was familiar with and I thought it would be a great idea to have a "coach" to guide me through this new

enterprise. Leanna's research interests were neither in the formal educational arena nor in the science component of what she witnessed as a volunteer for the NGO. Consequently, there was a spot available for me to get started in my research. In my work with the NGO I came across another public educator running a different local environmental program that caught Michael Roth's and my attention.

Immediately, I started wondering how these public educators would describe their own work and the possible implications of their vision to what they actually do when interacting with students. The original idea was to see how their discourse was concretely realized through their performance in the field. I interviewed as many environmental education program designers as I could locate on the Island—there were not many. After I concluded my interviews, Michael suggested I should be careful not to take what the interviewees said as an accurate account of what they do within the context of the programs they designed. Instead, given the fundamentally social aspect of interviews, both interviewee and interviewer are immediate resources for what they say to one another in the interview situation. People in such contexts try to make sense of what they say to themselves and to others, thus presenting themselves in a favorable light through being convincing and coherent—and "one becomes 'accurate' by being convincing" (Lutz, 1988, p. 414). It took me a while to get a handle on the idea, but after forty some drafts and reviews from a peer-reviewed journal and my committee members, the text became what it is now and provides an innovative way of looking at science and environmental education curriculum design.

In chapter 4 (*When Fun is not Fun: Pupil's Discourse on Fieldtrips*), I take a look at what students and teachers say about science fieldtrips. Based on observations of

regular in- and out-of-classroom activities, the purpose of this chapter is to describe how students and teachers discursively depict (reconstruct) their science fieldtrip experiences. The premise for this chapter is that comparisons between science fieldtrips and science practiced in the classroom setting (an activity system on its own) are likely to arise amongst participants (teachers and students) crossing the boundaries of such activities within the course of their interactions, thus informing science learning and instruction in general. Although science fieldtrips may be complimentary to in-classroom science instruction, I conclude that just being out in nature does not always guarantee a pleasurable science learning environment. This, in turn, makes *fun* an immeasurable but important emotional component in/for in- and out-of-school science learning.

The idea for chapter 4 came after I analyzed the tapes of a classroom lesson where students worked collaboratively on a presentation after coming back from a field trip to a local beach. Back then, I noticed that whenever students were in the privacy of their own group, they talked about the beach activity in a way dissimilar to what one would have expected—which was possible to realize only after the conclusion of the presentations. At the same time students were trying to organize their experience according to the criteria of what a scientific work should look like—with hypothesis, method and conclusion sections—they expressed a certain degree of dissatisfaction with the activity. In the course of debating about another field trip they would have preferred and other interactions with the teacher, students ended up talking about how fun plays a role in learning and teaching. This provided me with rich naturally occurring in-classroom conversations for approaching the topic of science fieldtrips and their resemblance to classroom activities.

Although the activity initially offered an opportunity for critical evaluation, students, in some instances of their work, searched for reasons for doing (and liking) what they did, thus conforming to their teacher's stated expectations. More so, this attitude seemed to have originated from and reinforced by the teacher. As contradictory as it may seem, these behaviors are not considered to be defective, but instead are evidence of the types of classroom negotiations students and their teacher engage in to make sense of what they do. The study presupposes that students have valuable input to offer about what (and how) they do in- and out-of-school, a point often neglected in education research. Once again, DA proved to be useful analytical tool for the purposes of my work and the quality of data available to me.

In chapter 5 (*Public Understanding of Science and Newspapers: A Framework of Analysis in/for School Science*), I draw on classroom observations, interviews, and newspaper articles to introduce a framework for analyzing newspapers that manifests the resources provided by print media science reports for the sense-making of readers—such as headlines, photographs, and space allocation. My framework offers an alternative way of looking at newspapers in science classrooms as tools to make sense of school science content knowledge by connecting it to the everyday life of students. I also provide a case study of a high school biology teacher reading a newspaper article to her classroom to illustrate what resources teachers use to make sense of science news report for their students. The approach I propose is of particular interest to those science educators who want to profit more from introducing media into their classrooms as means of enhancing students' aptitude and ability to read and respond critically to public representations of

science. It also contributes to the appreciation of how images of science and its endeavor are discursively built into the structure of this type of public texts (newspapers).

Personally, I feel as though chapter 5 has been in the making for three years now. When I first contacted Michael in 2004 and talked about my research interests, I mentioned the desire to write about media (newspapers in particular). Having used print media in my own teaching for years, I saw them as means to connect classroom science with student's daily life experiences: Media brought meaning to what I was doing. However, my use of media was very naive in the sense that I was not aware of the ways media provide resources for their own interpretation, thus privileging the construction of a biased account of facts. This is an often-overlooked aspect of media in/for science education in general. Not knowing exactly how to approach the topic, Michael and I started developing an original framework of analysis at the same time I collected hundreds of newspapers articles regarding water-related issues—sewage treatment, water meter installation, water boil advisory news, water shortages, etc. Eventually, in 2006 Pei-Ling Hsu (another fellow researcher on my research team) commented that the high school teacher she was working with had read a newspaper article in her classroom. She added that the same teacher had explained her reasons for using newspapers in an interview. This was the missing data I needed to bring sense to my writing at the time, which also made me change my data selection. From a sociological perspective, my desire to study media for educational purposes and to understand the role of what is left unsaid to be filled in by media's audience required me to look at real practices. This is what readers are confronted with in this chapter.

In chapter 6 (*Uncertainty as a Context and Resource for Changing Traditional Teacher Questioning Behavior*), I contemplate the possibility for uncertainty to be used as a context and resource for modifying traditional questioning behaviors in science learning environments, therefore generating authentic science-like experiences for students. In science classroom settings, the questioning behavior of teachers is generally associated with a type of inquiry that seeks known information as means of evaluating students' performance, which thereby results in the re/production of inequalities in the display of knowledgeability (i.e., the ability to evidence the *possession of knowledge* through tests or other traditional assessment tools) and prevents students' access to a genuine experience of practices that resemble the conditions of uncertainty under which scientists operate. On the contrary, questions to which answers are not previously known by participants provide students, instructors, and teachers with an opportunity to engage in science-like activities more authentically. Drawing on data collected within the context of an outdoor environmental education program, I show how not knowing can lead to forms of science learning and instruction that reflect the scientific culture more accurately. I also reinforce the claim made in chapter 4 that field trips can be a valuable addition to in-class science instruction—their open-endedness offer rich grounds for uncertainty to take place.

The idea for chapter 6 was conceived after field observations in which I noticed that an instructor had experienced an unexpected situation with one of the instruments used to take water quality measurements at the saltwater lagoon. Having seen how she managed to avoid the problem later on, I wanted to know more about how exactly that first situation compared with her subsequent teaching. On the same day, I remember

seeing her interact with a student who seemed to have difficultly in providing her with the correct unit for the temperature measurement he had just taken. In comparing the two situations, I realized that the uncertainty the instructor was faced had indeed affected her questioning behavior from one situation to the other. In this sense, what is not known can be used as a resource and context for science education to be experienced more authentically. Contrary to traditional perspectives on education and my perspective on the role of teachers as carriers of knowledge, the unknowability of situations can favor learning and instructional opportunities outside school—which is a point that deserves more attention in science and environmental education research. Similarly to what I stated in chapter 4, in no way should my findings be seen to contribute a defective view on the way participants conduct their business in the contexts I investigated. Once again, my data evidences the types of out-of-school negotiations students and instructors engage in to make sense of what they do.

Finally, in chapter 7 (*A Feeling for the Environment: The Role of Emotions in the Pedagogy of Environmental Education*) I discuss the place of emotions within the pedagogy of the public domain of environmental education, thus going further on the study of the emotional repertoire identified in chapter 3. Based on two case studies, where participants account for their educational praxis both in interviews and in their interactions with others within the context of the programs they have designed, my study reveals that emotions are a driving force behind public environmental education—indissoluble from its motives, objectives, and cognitive components. I conclude by asserting the importance of integrating instruction with emotions that come to bear in the

process of learning about/within the environment to improve similar ecological (and scientific) experiences that are crucial in/for the current environmental debate.

The idea for chapter 7 emerged out of my conversations with environmental educators (chapter 3) and my observations of students and teachers (chapter 4). Chronologically, it was the last chapter to be conceived. Over time, I started noticing how the discourse of the people I was working with was loaded with emotional references to their doings. (I was myself using the same language—or repertoire—more and more in my own discourse). Likewise, the use of that emotional language was not disconnected from a cognitive perspective on learning—meaning that it was not all about emotions. Therefore, I decided to investigate the role of emotions on the pedagogy of environmental education from the perspective of instructors' discourse in diverse situations (i.e., out in the field and interviews). Although the topic has been investigated before, the original contribution of my research is that of utilizing ethnographic materials (interviews and interactions with students) rather than questionnaires in my analysis. Besides, neither the participants nor I were aware that this would be a topic of study at the time of data collection, which adds validity to the study.

Is this dissertation about science education or environmental initiatives?

At first glance, each of the five substantive chapters in this dissertation touches on apparently disconnected topics: from the analysis of the discourses of EE curriculum designers to the investigation of how uncertainty becomes a resource and context to modify questioning behaviors in science instruction. Collectively, however, they are the result of a large (two-year) ethnographic study carried out with certified schoolteachers and public educators who have been working collaboratively over the last five years to

improve science education and the environment. In this sense, and for the specific case of my database, the practical boundaries between these two types of education—science and environmental—are fuzzy and any attempt to differentiate the two within the present work is not only out of the scope of my research, but also a task that would possibly demand an extra chapter o its own.

There is a scientific component identifiable in what participants do in/for the natural environment. Conversely, the environment is a theme constantly present in participants' actions in/for their science lessons. Although confusing at first sight, the miscibility of science and environmental education not only provides teachers with great flexibility to decide *what* part of the prescribed curriculum is being covered when their classes participate in such activities, but also *how* to go about it. Ultimately, lessons are customized to attend to specific needs of different groups—such a diverse body of students and teachers should not be expected to perform identically across settings and activities no matter how much they resemble each other. Therefore, this dissertation is about both science and environmental education and their mutual contributions to one another, and whenever one term is used the reason has been to address the specific journal audiences that every chapter was originally written for.

As the title suggests, I have decided to consider science learning and instruction through participants' actions when (in preparation for/ resulting from/ talking about) doing environmental education. In this context, even chapter 5 (*Public Understanding of Science*…) pertains to both domains of science and environmental education. For example, in the case study of a high school teacher reading a newspaper article, one can see that the very site of cancer—i.e., our body—is an integral part of the environment.

(The eventual controversy of dichotomizing the natural environment from our human body is discussed in chapter 7 – *A Feeling for the Environment*….)

There were two specific EE programs that I followed for my data collection—and it is not uncommon to find local schools that have participated in both of them. Briefly, these programs are structurally different but aim at the improvement of conservationist practices amongst participants through a hands-on and emotional types of learning. For instance, one of these programs takes place at a local saltwater lagoon where students attend a short rowing lesson, collect information about the water quality, and are given the opportunity to learn how the first inhabitants to that area subsisted (a First Nation perspective on land use). This program also requires students to attend a pre-visit session at their own school, where a large-scale watershed model is used to illustrate the functioning of a watershed and the impacts that some of our common household activities have on the environment.

The second program has placed 4,000-dollar aquaria in the hallway of 12 schools in both school districts where I have done fieldwork. Leaving students with the dual responsibility of caring for the animals that are in the aquaria and mentoring younger students to do the same, this program is now being implemented elsewhere (Brazil). Together, both programs have been delivered to thousands of students over the last decade and they have been so successful that they are now offered through one NGO. The design of each program is presented in more detail in chapters 4, 6, and 7. A series of illustrative images (taken by me or broadcasted on local TV) are shown in Figure 1.1.

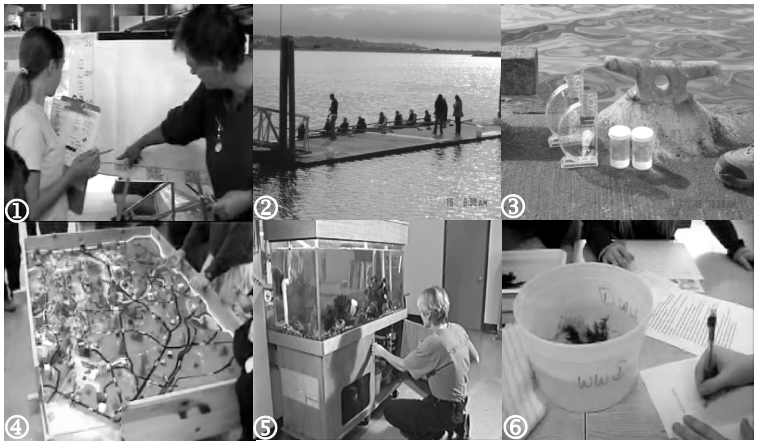


Figure 1.1. Different snapshots of the two environmental programs I followed for my research. (1) Interaction amongst instructor and students. (2) Rowing at the saltwater lagoon. (3) Instruments used for taking water quality measurements at the saltwater lagoon—in this case, a hydrometer. (4) Watershed model used in interactive demonstrations. (5) Saltwater tank in the hallway of a school I visited (School District #1). (6) Group of students engaged in a classroom activity that aims at preparing them to care for animals in the aquarium and also for their mentorship duties. Image (5) was taken from a short clip broadcasted on local TV. I personally took all the others.

Who are the people I have worked with and where did I collect my data?

Before readers can fully grasp what this dissertation sets out to accomplish, it is necessary to understand that its ethnographic nature required me to follow people in the course of their normal schooling activities. Although every chapter contains information that is pertinent to each study individually, there are common background features regarding participants and places. For example, the term *public educator* refers to those people who are not certified teachers, that is, they operate most of the time in out-of-school settings. The word *teacher* is reserved for certified teachers who work within the school districts that allowed me (and sometimes one of my fellow researchers) to videotape their lessons and talk to their students. As pointed out before, this distinction is arbitrary, based solely on participants' primary site of actions (school or non-school environments), and serves to delimit fragilely the boundaries of the three main sections

that constitute this dissertation. Most importantly, these are not underlining discriminatory terms for competency or teaching quality of the experienced professionals I worked with—I do not follow any ranking conventions. Therefore, I collectively refer to both teachers and public educators as *instructors*: they share audiences (students) and objectives when working together, or else the likelihood of satisfaction in their combined doings would be very small. As for the students, they are all part of the local public school system and were mostly middle-schoolers.

I collected data primarily at two sites: (i) local public schools participating in the environmental programs I was following and/or (ii) the saltwater lagoon where one of the EE programs took place (and which structure is further described in chapters 4, 5, 6, and 7). The classrooms I visited were part of either one of two local school districts I contacted. School District #1 (pseudonyms for places and people are used throughout) is comprised of approximately 20,000 students and nearly 50 schools, out of which nine are middle schools and seven are secondary schools. Specifically, I have been to three middle schools (chapters 4, 6, and 7) and one high school (chapter 5) in this district. School District #2 has nearly a dozen schools serving approximately 8,000 students, and I interviewed one teacher from this district (chapter 3).

The saltwater lagoon is a migratory bird sanctuary at the base of a local university property. Boating and sight-seeing are amongst the present uses of the lagoon. There are several factors effecting the lagoon's recreational (including swimming and fishing) and intrinsic habitat values, the most immediate being the increasing concentration of pollutants in the water due to the fact that the lagoon is the outlet of a watershed. The inappropriateness of the lagoon's general health has been scientifically investigated, but it

also made visible via the on-site measurements made by middle school students—pH, salinity, and turbidity—along with the comparison of their sampling results with what is considered to be an ideal situation that is introduced to them in the form of graphs and interactions with instructors (Figure 1.1).

In general, human impacts on watersheds is the topic of a school activity that students engage in prior to their visit to the lagoon. This activity involves the use of a watershed model—i.e., a solid interactive three-dimensional birds-eye view of a river or stream and the surrounding landscape. There are many of these Styrofoam-based models in the city, and students themselves have built some of them. (I interviewed the teacher who pioneered their use on the island.)

Forms of engagement

The activities and interactions participants were engaged in were recorded on video camera and transformed to digital format. Those conversations considered relevant to the objectives of my research were then transcribed for further group analysis with other members of Michael Roth's research team; We have come to call ourselves the Cultural Historical Approach to Critical Thinking at the University of Victoria (CHAT@UVic). Field notes were also taken within the context of my data collection. In some cases, interviews were recorded using a voice recorder. As a researcher who is a non-native English speaker, these means of data collection represent affordable media for transcribing and revisiting places and situations whenever necessary for my writings. Besides, they are aligned with the theoretical framework of my choice (see chapter 2).

Although my presence was never ignored, especially among the children (it is not unusual to have students waving and showing off for the camera), I avoided getting

directly involved with those activities I videotaped. This was a methodological decision that manifested in the early stages of my work based on a naïve understanding of research objectivity. Nevertheless, participants' (instructors) constant search for improvement, their openness to new ideas, and my eagerness to make a more substantial and immediate contribution to science education research has led to the eventual incorporation of some of my personal inputs (suggestions) to their practice—the importance of which are yet to be analyzed. In the end, I cannot disregard the fact that the course of activities would have been different if I was not there to interact with those teachers, public educators, and students.

This introductory chapter is intended as a tour through the structure of this dissertation. It is an overview of how I see each individual study (initially written towards publication) relates with others to make up one concise traditional-like doctoral dissertation. It is my hope that this brief background on study participants and places inspires readers to contemplate the general implications of the totality of this dissertation for science learning and instruction and public environmental education initiatives. The potential importance of additional investigation of some of the issues brought up here and the continuity of my own research are discussed in chapter 8 (*Conclusion?*).

Table 1.1. Summary of the five core chapters in his dissertation showing sections, titles, and potential contributions towards science learning and instruction in general.

Section/ Chapter	**Purpose or Contribution of observed practices to Science Education**
Scouting Out New Terrain	
Chapter 3 –Environmental Education in Action: A Discursive Approach to Curriculum Design	- Identify interpretive repertoires (IR) utilized to construct (design) curriculum. - Exemplify the use of discursive psychology (DP) as a method for doing research in the field of EE.
On School Ground	
Chapter 4 – When Fun is not Fun: Pupil's Discourse on Fieldtrips	- Discuss the role of fun as an important component of science activities. - Compare different settings (in- and out-of-school) for science learning and instruction.
Chapter 5 – Public Understanding of Science and Newspapers: A Framework of Analysis in/for School Science	- Propose a framework of analysis of newspapers in/for the public understanding of science in schools. - Illustrate what resources teachers use to make sense of science news report for students.
Off School Ground	
Chapter 6 – Uncertainty as a Context and Resource for Changing Traditional Teacher Questioning Behavior	- Explore the role of uncertainty as a tool and resource for the promotion of authentic science experiences. - Discuss the role of fieldtrips as important sites for science learning.
Chapter 7 – A Feeling for the Environment: The Role of Emotions in the Pedagogy of Environmental Education	- Investigate the role of emotions in the practice of public environmental educators. - Discuss the importance of integrating cognitive and emotional aspects of learning in the field of EE.

Section I

Scouting Out New Terrain

CHAPTER 2

ON A THEORETICAL FRAMEWORK WITH PERSONALITY

This dissertation is the result of a two-year ethnographic study conducted with schoolteachers, students, and public educators in Victoria (British Columbia). Using video-mediated ethnography and discourse analysis (DA) as method to record and analyze participants' interactions in the course of their naturally occurring school-related activities, the present work describes and articulates findings with important educational implications of the observed practices to science classrooms and environmental education initiatives.

In the present, chapter, I begin by recounting some autobiographical aspects that bear on the writing of this work, which will allow readers to understand how my research agenda stems from my professional history both as a teacher and as a PhD student. If the personal is inherently intertwined with the professional (Roth, 2005b), leaving this significant aspect of my academic journey untold would betray the very reasons that brought me here. Next, I describe and account for choosing DA. I use an example originally taken from my database to familiarize and prepare the reader for the type of analytical work I conduct throughout the dissertation. I also make evident how this approach differs from a more traditional (folk) psychological one, where experimental manipulations are interpreted in terms of experimenters' common-sense ideas of what was going on (Harré & Gillet, 1994). Likewise, issues of validity and objectivity are discussed to assure that my data analysis and overall research have met the expected quality standards for a work of this nature.

Autobiographical aspects

It is necessary that I share part of my personal and professional experiences with readers for reasons beyond mere rhetorical intimacy. These stories form the backcloth necessary for readers to appreciate my motivations to use particular forms of inquiry and methodologies. Over the last three years my research agenda has been intimately associated with my own story in/with education. In other words, my choice of a particular theoretical framework was not accidental, but resulted from aspects of my own particular perspective appropriate ways of approaching educational issues of.

This dissertation is a product of my personal trajectory in education as a science and biology teacher. Even though I have been doing formal education for more than a decade now—my first steady teaching job as a science teacher for grades 5 and 6 at an urban middle-class private school in Brazil dates back to 1996—I feel that education is still foreign to me. Sigmund Freud, the famous Austrian psychoanalyst, once argued that education is an impossible profession (along with government and psychiatry itself). I certainly do not disagree with him—what does it mean to educate or to be educated after all? According to American writer Richard Bach, we are all "learners, doers, and teachers" (1977, p. 58).

Nevertheless, in my own practice I attempted to make sense of my practices before trying to convey meaning for my students. I imaged that if I was not firm in my motivations for teaching, it would be difficult to convince my students of the importance of going to school to learn.

Ultimately, I found few answers for many of my questions. By the time I finished my teaching program, educating had become one of those things in life that was "easier

said than done." As a general concept in social theory, the word "education" began to evoke different imagery than when I entered university; it had lost its poetry and gained contours of military metaphors, such as "battlefront" and "war." The reality of my classes (the battlefronts) proved to be more ambiguous where the opposing interests of students, fellow teachers, and administrative staff were engaged in a competitive struggle for the predominance of a single ideology. So much for the sacred ground I once thought the classroom to be (or could be).

Within this context, I soon decided to do research that would be useful to others in the same situation—i.e., practitioners in search not for recipes or prescriptions on how to conduct their business, but looking for clearer descriptions and understandings of their actions so that they could make better informed decisions during the course of their teaching. I decided to interview and observe a group of biology high school teachers to investigate the pedagogical significance of their use of particular types of books in/for their practice. Aside from the lack of research on the topic, I was struggling with the use of the same types of books. I wanted to offer teachers (including myself) a resource for the possible uses of such books and then expand their ability to choose the best material for their context—from their own perspective rather than my own vision of what they should be doing. If I had one intention, it was to avoid blaming teachers for what they were doing. These were my baby steps into the qualitative research tradition—ethnography to be specific—where I was beginning to find the appropriate tone for my academic aspirations. Besides, and without realizing it at the time, through the course of my fieldwork and data analysis my inclination towards grounded theory and discourse analysis (DA) became salient. In other words, I approached fieldwork without any well-

defined pre-categorization of teachers' discourses, which in turn allowed me to learn from the analysis of participants' individual discursive accounts of practices rather than doing a verifying type of research, where my notions of what I imagined was going on in their practice were confirmed or disconfirmed.

Next, I wanted to do a PhD—I always had the feeling that without it my work would never be complete. More importantly, I would need a PhD to continue working with teachers and their classroom realities. However, after experiencing graduate school at the masters level, I decided to start with a more elaborate research agenda, one that would allow me to continue working with teachers and textbooks with an environmental focus and use DA in order to provide practitioners with an alternative way of looking at science education. The most difficult challenge was to find a supervisor up to the task—I had not met many people fitting this (demanding) description. Michael Roth happened to be this person: He has been working with teachers and students from an ethnographic perspective—i.e., he does direct, first-hand observation of daily behavior of participants when engaged in their school-related doings, including participant observation and conversations with different levels of formality (from non-recorded talks to semi-structure interviews (e.g., Roth & Barton, 2004)—but also investigated science textbooks (some studies are collected in Roth, Pozzer-Ardenghi, & Han, 2005) and environmental-related issues (e.g., Roth, Riecken, Pozzer, McMillan, Storr, Tait, Bradshaw, & Pauluth Penner, 2004), and made use of DA as an analytical tool (e.g., Roth & Alexander, 1997).

In one of my first emails to Michael while we were discussing the possibility of working together, I laid out my research intentions to which he promptly replied with resounding support. Indeed, working with Michael far exceeded my initial expectations: I

was to commit to submitting manuscripts for publication. This was a bonus to everything I could have ever wanted, an opportunity that would enable me to avoid a vampiristic type of research. (I borrow this term from a recent and insightful conversation I had with one of my committee members on a bench just outside the Faculty of Education cafeteria. Briefly, it refers to the type of research that is parasitic and self-beneficiary in its nature, thus hardly ever giving anything back to or promoting positive changes in the community who welcomed it).

Once in Canada, Michael exposed me to a different approach to DA known as Discursive Psychology (DP)—discussed below—and expanded my understanding of theoretical aspects of ethnography and grounded theory. (Michael's choice is grounded on assumptions about knowing as socially situated and represents an epistemological position that I embraced over time as I started understanding it more clearly). Through one of his MA students, Leanna Boyer, I was introduced to experienced public teachers and environmental educators who helped me kept rooted in the reality of the science classroom.

For the first time I was part of a collaborative research team—ten members at the time. We met frequently to analyze data in the form of video clips and/or transcriptions of interactions and read and discuss manuscripts produced within the group. This method is known as Interaction Analysis (IA) and refers to "the empirical investigation of the interaction of human beings with each other and with objects in their environment" (Jordan & Henderson, 1995, p. 1). According to the principles of this method,

> [K]nowledge and action are fundamentally social in origin, organization, and use, and are situated in particular social and material ecologies. Thus, expert knowledge and practice are seen not so much as located in the heads of individuals but as situated in the interactions between members of a particular community engaged with the material world. Seeing cognition as socially and ecologically distributed has methodological consequences:

> Interaction Analysis finds its basic data for theorizing about knowledge and practice not in traces of cranial activity (for example, protocol or survey interview data), but in the details of social interactions in time and space, and particularly in the naturally occurring, everyday interactions between members of communities of practice. (…) Another widely shared assumption among practitioners of Interaction Analysis is that verifiable observation provides the best foundation for analytic knowledge of the world. This view implies a commitment to grounding theories of knowledge and action in empirical evidence, that is, to building generalizations from records of particular, naturally occurring activities, and steadfastly holding our theories accountable to that evidence. Underlying this attitude is the assumption that the world is accessible and sensible not only to participants in daily human interaction but also to analysts when they observe such interaction on videotape. Analytic work, then, draws, at least in part, on our experience and expertise as competent members of ongoing social systems and functioning communities of practice. (Jordan & Henderson, 1995, p. 2-3)

Ultimately, IA's socially situated nature is rooted in ethnography and conversation analysis (CA), among others. More so, it is consistent with my use of grounded theory (data-driven emerging analytical categories) and DP (see below), which draws considerably on CA despite the fact that it treats social phenomena as discursive products with no statements existing independently of phenomena that correspond to them (Hammersley, 2003a). Overall, my work focuses on interactions—it does not (and should not) "get into people's heads" (I can still hear Michael repeating this sentence over and over during our meetings)—and my analyses are influenced by my expertise as a competent member of the community where I collected data. Altogether, my participation in such meetings and the fact that I was immersed in a strong research-oriented environment has changed my understanding of objectivity, validity, and consistency. In the end, I matured as my research came of age (and vice versa). Now, I am a better inquirer of educational phenomena.

Discourse analysis: Methodological principles

My data collection took place within two different instructional and institutional settings : in- and out-of schools, and they are considered distinct activity systems. An

activity system refers to human activities in general and comprises the group of interrelated elements that are inherent to these actions—for example, all the interactions under study here and the different context and participants involved. The essential task is to present situations as systemic wholes, where tools, division of labor, rules, community, outcomes, subject, and the object of the activity are all considered to be inseparable from one another (e.g., Lee, 2006). In other words, it is the sum of identifiable components of the situations resulting from the interactions created and carried on by participants. By investigating both settings I was able to describe and understand the issues students and teachers face while crossing boundaries between school and outside school; a point often overlooked in science and environmental educational research.

Common to both settings is oral discourse as a crucial means of communication among students and teachers during the course of their activities, which is consistent with my interest in the analysis of discourse. Aside from other actions like gestures and the use of tools available in the environment, most of what was accomplished by participants was made available to me (the analyst) through speech that was recorded and transcribed to compose my database (i.e., verbal utterances and exchanges produced by participants in the normal course of their activities or during interviews. This definition presupposes talk as a medium of action that is both context-dependent and context-renewing). In this way, and in congruence with DP, whatever participants said during the normal course of interactions or in their descriptions of the social world (during interviews) were treated as a topic of study alongside what they were consequently able to achieve with these discursive actions. This is a *non-individualistic* perspective on discourse that does not take utterances as paths to stable mental characteristics hidden behind individuals'

personalities. Indeed, participants do what any member of their community would do by employing cultural resources that are publicly available—shared methods for sense-making—in contextually variable ways (Hammersley, 2003a). If not, the observed social coordination of actions would not have been possible. In other words, "the discursive subject is one of us" (Harré & Gillet, 1994, p. 26) and this is a potent "safeguard" (Sanders, 2005, p. 60) that ensures my claims are descriptively accurate in that the people I worked with are doing what I say they are. This is also a methodical principle of DP that often challenges conventional ethnography because it does not assume that the social-psychological task of understanding human behavior must necessarily take into account self-reports (or memory accounts) to confirm the validity of the ethnographer's observations and claims. Individual accounts are discursive constructs in themselves and it is commonplace that these can be inconsistent (vary) across situations (as an example, see Irez, 2006). Although some might be tempted to assign intentionality to participants' discursive actions, there would be no supporting evidence to substantiate eventual claims. In the present tradition of DP, the acceptance of the reality of discursive inconsistencies produced by members of the community reinforces the dangers that are associated to searching for mental aspects working behind (and previously to) talk during interactions observed.

In order to clarify some of these points, take for example, the following question: How is it possibly to know that the presence of the observer does not *destroy* the very possibility of *valid* discourse analysis? That is, maybe people in classrooms and interviews say things they do not *really believe*, just because they *think* it sounds better. In fact, students may do this because a teacher is present, even in the absence of an

outside observer. From a DP perspective, a question of this nature is not a pertinent question. The analyst (myself) can only work with what interaction participants make available to one another, and therefore also what is made available to him/her and nothing else. Whether people are *pretending* or not, this is out of the interests of DP; it focuses on the way—*how*—issues are managed in interaction. "It is a systematically non-cognitivist approach [that] puts aside questions of the existence of cognitive entities and processes (technical and everyday) in favor of a focus on how cognitive entities are constructed in and for interactional practices (Hepburn & Wiggins, 2007, p. 10). And this has been considered one of the acclaimed achievements of DP. On the other hand, there have been series of unresolved issues discussed in more detail in a series of articles published recently (Hammersley, 2003a, 2003b, 2003c; Potter 2003b, 2003c). For example, data recordings are not congruent with social interactions themselves, they are a result of the decision-making processes of the analyst(s) (i.e., discriminatory process of data editing on the part of the person(s) conducting the research). This is to say that the recordings are selective and considered analytically separable from the totality of interactions that are absent from the analysis. Likewise, questions arise about the status of interpretations available to members of a community: on what grounds can we assign them to the member's interpretation? (In this sense, intelligibility among members is still considered the strongest answer). To what extent are the analyses just an occasioned construct in an ad infinitum process that undermines not only possible generalizations of the research findings, but also negate the usefulness of the entire approach?

Regardless, the difficulty to consider (or search to determine) the *motivation behind actions* to the *original* action remains—motivation being a *psychological* factor

for understanding the *origin* or *cause* of actions. Some may argue that one cannot (or should not) ignore participants' *interpretation* of whatever occurred. Put differently, both researcher and actors can (or should) *interpret* events in the hope that this research-as-conversation would illuminate more fully what is going on—or at least what they *think* is going on.

However, from a DP analytical instance, the original interactions under study are gone by the time researchers come to select any particular set of conversations. Therefore, what remains already exists as yet another opportunity for a different set of interactions—i.e., participants explaining to the researcher what they were trying to make out of the conversation originally recorded. Noticeably, this is not the same as what they were able to achieve, thus being out of the objectives of the present dissertation. As pointed out before, to consider these two types of distinct interactions similar would be to ignore the (different) context in which they occurred and how participants contribute to make the situation what it is (rather than what participants intended it to be). What speakers produce as an utterance might not have the desired effect—the outcome of interactions is uncertain (Austin, 1962).

Although I certainly agree that *pure* description or objectivity is impossible, to invite participants to offer an *interpretation* of events in which they partake and ask them for reasons for doing what they did is a risky business. Actors may not even know the reasons for an act and might give the researcher an *interpretation* of their actions that result from their (participants) negotiations to manage the new setting (interview) in favor of their point of view over others with whom they also interacted (researcher included). In sum, participants' interpretations change over time and according to the context of

their interactions. Again, this is what I was looking for with my research and might the interest of people from different research traditions to explore more deeply.

Nevertheless, these controversial aspects of DP serve the purpose of reminding readers that every method or theoretical framework is limited in some sense. What if someone else had done the fieldwork? Would the whole ethnographic work be reported differently? Yes. There are matters of emphasis and orientation that cannot be ignored. Different people (researchers) do pick their way through research differently, and this is inherent to any type of study. However, these accounts should not affect the essence of the story to be told. According to Ball (1993), "There are no reliability and validity coefficients for the researcher who is observing and interviewing participants in the natural setting. The presence, the effect, and the biases and selections of the researcher cannot be removed from qualitative research" (p. 43). Similarly, terms like grounded theory can sometimes mislead researchers into neglecting these matters of biased emphasis and orientation (Gary & James, 2006). (It is not possible for anyone to abstain himself from any preconceived notions of the materials he/she collects. Whoever does the interviews, for instance, most likely develops an idea from those participants that enter into his analysis.)

To familiarize the reader with DP, I offer a sample analysis of a real classroom situation extracted from my database that is not included in any other chapters. The objective of the following description and analysis of a classroom situation is to demonstrate the type of analytical work that I use in this dissertation, and which allowed me to corroborate the claims of each of my individual studies. Particular to this example

is the illustration of a type of questioning behavior that teachers display in their classrooms.

Larry is an elementary teacher in the public school system in British Columbia. Through a partnership with a local university, Larry has allowed a graduate student from my research group, Bruce, to conduct research in/with his class. As part of their mutual agreement, Bruce taught Larry's class how to use iMovie™—a video editing software for Macintosh computers—to produce short video clips about some of their educational experiences outside the classroom. The main objective of the research was to develop an innovative tool for students and teachers to enrich their field trip experiences by documenting them more intensively—which would allow for a reflexive practice on their part and the generation of data for further study.

The episode occurs after students completed the first project several days before, when they worked on the material they collected during a visit to a local park. In this case, the teacher describes this activity as "practice" for a subsequent science project to begin the following week at the same park. The activity consists of students producing a video about a recent dance lesson.

During one of the computer lab sessions, Larry starts by asking students individually what it meant to edit a movie (a general action across sessions). After what seems to be satisfactory answers, he would say "okay," thus marking both the end of the conversation with one student—positive evaluations are terminal (Mehan, 1979)—and the initiation of the same routine with another. After a while, Larry stopped "playing this game" (Larry's own words) and addressed the class as a whole[1]:

---

[1] The use of square brackets indicates additions to the text and double round parentheses indicate enclosing transcriber's comments. The use of square brackets in different lines marks the start

01 Larry: This isn't everybody. I haven't quite asked everybody, but, ah, three quarters
02 of the people that I've, that I've asked so far couldn't tell me what it means to
03 edit a movie, even though we have been doing it for two months↑ And Bruno
04 [researcher] told you every day↑ And it's written on the board every day↑ (.)
05 the words that we use. And I ask you out of the blue what it means to edit the
06 movie the answer should be that quick ((snaps his fingers)).

After asking students to quiet down, Larry starts off by assuring that what he is about to say is not for everybody. In doing so, he acknowledges that he has not asked all students about the meaning of editing (line 01) and does not hold every student accountable for his present action (speaking to the entire class). Yet, he states that he has spoken to three quarters of the students (lines 01 and 02) who could not tell him "what it means to edit a movie", even though they ("we") have been doing it for two months (line 03). In this last sentence, Larry not only makes evident the learn-by-doing characteristic of the activity (through the associated use of the words *"means"* and "doing it"), but he also includes himself as part of the lesson: "[*W]e* have been doing it" (line 03). In contrast, it is the students who were told by the researcher what to do—"And Bruno told *you*" (line 04)—making it clear that he (as the teacher) knows Bruno's instructions.

Larry's expectation that the word "editing" would be part of students' repertoire ("words we use", line 05) shows that he was searching for a known answer—ultimately, he is trying to assess the students ("I ask you … the answer should be that quick" [lines 05 and 06]). The fact that he raises his pitch, especially when saying "everyday" (lines 04 and 05), suggests that he is disappointed (he draws students' attention to what he says by modulating the pitch in his commentaries) even though students successfully performed

---

and end of overlapping speech and their position is in alignment where the overlap occurs. Transcriber's comments are enclosed in double parentheses. Arrows indicate a shift into a higher (↑) or a lower (↓) pitch in the utterance-part immediately following the arrow. The convention (.) indicates a less than 0.1s gap between utterances.

editing actions during all the sessions with occasional help from Bruno and Larry himself.

Overall, the teacher depicts his students as incompetent regarding the project they were working on. And this image is evoked once again in the following situation, which takes place minutes later:

01	Larry:	So, if I say to you "edit your movie", what does that mean? The next time
02		you'd better be able to answer me or you gonna have to write out a little
03		report to me, so do you can tell about it. How silly for being in here two
04		months and you don't know these words: transitions, titles, affects, sounds,
05		and the thing that came before we did this, the first one was you had to cut
06		out clips, didn't you? And someone used the word delete. So, when I ask
07		you to edit your video the first thing you do is delete↑ scenes you don't
08		need. Of course, to get your video that you want you delete everything you
09		don't need. Then you add it transitions, titles, effects and sounds. The first
10		thing you did was what?
11	Students:	Delete ((only a few students reply))
12	Larry:	The first thing was what?
13	Students:	Delete ((more students answer this time))
14	Larry:	Delete the stuff you don't want. That's what you do in the video, and then
15		you added. Everybody?
16	Students:	Transitions, titles, effects, sounds ((students say the words in unison as the
17		teacher points to the words on the whiteboard))

In his questioning, Larry insists on the meaning of the word "edit" (line 01). According to him, students should be able to answer the interrogation in the future or else they will "have to write out a little report" on the topic (lines 01, 02 and 03). In other words, students either ought to learn what the teacher wants (considers relevant for the situation at hand) or they will have to do more work to show that they have mastered the idea. In the end it is up to Larry (the teacher) to assess the circumstances and decide what is the appropriate action to take. The fact that Larry cannot elicit the *right* answer from his students represents the inappropriateness of the students' actions: "How *silly* for being in here two months and you don't know these words" (lines 03 and 04).

As Larry continues, he talks about an unidentified "thing that came before we [they] did this [project (?)]" (lines 04 and 05). He comments on the fact that students "had to cut out clips" (line 05)—what "someone" called delete. By putting together the words *cut* and *delete* he gradually introduces the use of the word *edit*. "Delete" is repeated two more times (lines 07 and 08), suggesting a strong association between the two words delete and edit, indicating their importance to the answer the teacher wanted from his students. However, this is not all: Students need to add "transitions, titles, effects, and sounds" (line 09) in order to successfully edit a video. Having revealed the complexity attributed to the idea of editing ("transitions, titles, affects, sounds …" [line 04]), Larry builds upon its sophistication through his explanation—he knew the answer to the questions that he was posing to the students.

Finally, right after providing the information on editing, Larry recapitulates his teaching by asking about the first thing students did (lines 09 and 10). As only a few students replied to his inquiry (line 11), he is compelled to ask it once again (line 12). This time, more students reply (line 13) and Larry agrees to what they say by repeating their answer ("Delete the stuff you don't want" [line 14]). Next, he points to the words on the whiteboard and invites students to read them out loud—"Everybody?" (line 15). The students say the words in unison (lines 16 and 17) displaying what can be taken as a direct outcome of what Larry is teaching.

The two excerpts I analyze here indicate to me that Larry's discourse places more importance on knowing the correct meaning of the word edit than the quality of the actual editing that the students achieved. What is more, his questioning behavior inhibits a more genuine response because the students are not allowed to be uncertain about their doings

(as most people are in the course of action) and are pressed to provide Larry with a certain answer. This, in turn, contributes to the negotiation of students' appropriate reply to the teacher (Mehan, 1979).

When Larry addresses his class collectively, it is difficult to distinguish whether pupils were managing a way out of the immediate (and pressing) situation by repeating words they might not understand, or whether their answers reflected some previous understanding about the teacher's talk. The fact that the teacher talks to the entire classroom also represents a situation where not every student is assessed evenly—and those few answers uttered by three quarters of the students are taken as valid for the entirety of the class. Hence, the teacher's questioning can be seen as a discursive move assuring that students are learning. Indeed, this public production holds all students "accountable for hearing and remembering such knowledge even if they were at that point members of the hearing audience rather than participating speakers" (Baker, 1992, p. 11).

The episodes show that Larry's questioning behavior is associated with a traditional perspective on education where teachers are supposed to retrieve the right (known) concepts from students—and school culture continues to maintain this perspective (e.g., Gall, 1970). The traditional teaching that goes on in Larry's classroom episodes, I argue, is partly explained by the fact that he knows in advance the answer for what he is looking for, a condition that shapes the interactions between him and the students. At this point, it is legitimate for the reader to ask: Was it Larry's intention? How can I interpret what Larry intended with his actions? Would or could he have adopted a different questioning pattern had he not known the answer to his question? Any answers

to these questions regarding Larry's specific case would be speculative at this time and as such they are deemed irrelevant to the objectives of my research and inappropriate for the analytical approach I espouse in the present work. In this sense, asking Larry would be to put him in a different situation as a research participant with distinctive consequences for my analysis; he would not have been the teacher addressing his students anymore, but the teacher who is now analyzing and justifying some of his previous actions—the context of the classroom is not the context of an interview and my interest lies in the former.

Importantly, I do not suggest that Larry (or anyone else for that matter) acted wrong-headedly. No one knows his classroom like he does and he is considered a good teacher by his peers. Consequently, he knows what it takes to get his students through the day in a manner that is considered acceptable to the broader school community he participates in—which includes parents and the children themselves. In this sense, Larry does not teach by himself as he is expected to perform his job up to a certain quality standard set by others (official curriculum and educational policy).

Larry's actions can only make sense in relation to the culture that he is embedded in and to the particular situation I analyzed, which should not be taken as an indicator of a pattern concerning a limited display of behaviours (issue of generalizability). His classroom excerpts are not intended to fully grasp the range of the possibilities of science activities in schools. What he does (say) might—or might not—be part of other classroom realities. However, the possibility for the occurrence of similar actions by others (teachers) remains. This is to say that I accept the fact that uncertainty (not knowing the answer for a problem that emerges in the classroom) might take place in his pedagogy in particular and other school situations in general. Indeed, "there can be no

way to predetermine what students will find uncertain or ambiguous in their in situ enactment" (Sherman, 2004, p. 448). The fact is that the formal structure Larry's actions are embedded in—official curricula, limited availability of time and resources, and a high student/teacher ratio—tends to intentionally favor the predictability of planning activities over a less formal praxis. After all, "teachers do formulate objectives, teach to meet them, and continuously evaluate whether what students have done is indeed what they should be doing" (Sherman, 2005, p. 203). Ultimately, I am simply interested in some of the generalities (those observed) of the community Larry represents as means to better understand the educational process from the perspective of which his practice is but one possible case (concretely realized). The same is valid for all situations comprised in this dissertation and from which there are lessons to be learned about science and environmental education.

CHAPTER 3

ENVIRONMENTAL EDUCATION IN ACTION:

A DISCURSIVE APPROACH TO CURRICULUM DESIGN

Abstract

Why do designers of environmental education do what they do for the environment? More importantly, how do they account for their design decisions (plans and actions)? Using the theoretical and methodological framework of discourse analysis, I analyze environmental education designers' discourse in terms of the discursive resources—or interpretive repertoires—they use to make their position, to make their talk do work, to tell a story about events, and to reveal their identity. Drawing on observations and interviews from a larger program concerned with understanding environmentalism and environmental education, I identified five main repertoires: relevance, knowledge transferability and translatability, emotionality, expertise, and empiricism. Using this approach I characterized the culture of environmental education curriculum design, which has important implications for curriculum design in the field.

Introduction

Although what one calls environment is culturally mediated (Ingold, 1992), the fact remains that there is no dwelling in this world without the non-human component. Peoples' lives are inevitably surrounded by references to the natural environment worldwide. For example, almost on a daily basis, evening television newscasts feature weather phenomena with reference to global warming and other consequences of human impact on nature.

In the educational arena, environmental educators have the potential to influence the knowledge of future generations about weather and the environment in general by designing appropriate curricula. However, why do designers in environmental education do what they do? More so, what can one find out when asking designers to talk about their design decisions (what and how they design curriculum)? To articulate some of the salient issues, I draw on the following episode from my study. When Anthony, an environmental education curriculum designer, was asked about the peer-teaching component of his program, he answered the following:

01 Anthony: I guess when I was at the university, one of the things that I um I got it up there, up on the wall ((points to the door)), I am trying to remember who actually devise that one, but how, it just states how you [learn
02 Interviewer: [Oh, ok.
03 Anthony: And, and you've seen that many different times, many different ways, and different people have done it, but, you know, they talk about the fact that just talking to each other you don't learn very much, that's why you have the video camera, because you wanna go back over at several times, right?
04 Interviewer: Yes.
05 Anthony: 'Cause you not gonna get it all.
06 Interviewer: ((Slightly laughs))
07 Anthony: So, we don't learn by just talking to people, we have to actually physically um have something, so you get a pen and a paper and you're writing ideas down so that's another thing you gonna learn better by that, but then if you actually, if we sat down and we went back over this then you would learn a bit more and then if you, then you went back through and read something to me and we learn from, we will learn a lot from that sort of process. So, one of the things that we were looking at is the fact is if we give kids lots of knowledge and lots of practice, but then once they think, we think that they are ready, then they go and take that and try to teach to someone else, explain to them what they've learned then we will find out whether or not they've actually got fairly good at that. So that's one of the things we miss I think in all of education: we never let the kids go and tell us, other than a test, what they've learned.

What can one learn from this excerpt of an interview about environmental education curriculum design? In the classical approach to studying knowing and learning, the excerpt would be considered an expression of this individual designer's opinion. From this position, the researcher has sampled just one opinion from one individual

subject—there are potentially as many opinions as there are people. Without doubt this would then be very little, requiring me to conduct a substantial number of interviews in order to get a broad representation of what environmental educators think about designing and why and how they address pressing environmental issues through education.

An alternative approach to the analysis of discourse—discourse analysis—has evolved over the past two decades in sociology and social psychology in the wake of which the new field of *discursive psychology* emerged (Edwards & Potter, 1992). From a discourse analytic perspective, *how* a person says something and the kind of resources (s)he draws upon indicates more than the content of his or her (individual) talk about what (s)he knows, believes, or feels. For instance, in taking this perspective to the interview excerpt one can actually find out about the culture of environmental education more generally by articulating and explicating the *discursive resources* Anthony used to support his position that students should be provided with the chance to interact (teach/learn) with their peers and teachers should assess students differently (turn 07). More so, Anthony talks in the way he does, both from a content and a form perspective, because he legitimately presupposes that his interlocutor, specifically, and other environmental curriculum designers, generally, understands *what* he is saying and *how* he is saying it. In other words, what he says and how he says it are general features used in a particular community or culture broadly.

By providing an explanation, Anthony also references the situation in which he finds himself: the interview is recorded, which gives the interviewer a means to go back over the interview repeatedly (turn 03). Anthony builds a case about using a record

(video) for learning by repeatedly going over the material. In the same way, children in environmental education learn by collaboratively going over records (notes and books) they have available during their interactions with peers (turn 07).

In this excerpt, by saying that letting students explain what they have learned to someone else is a way to "find out whether or not they've actually got fairly good at that [what they have learned]" (turn 07), the designer appeals to a common sense (indisputable) fact that those who teach (practice) also learn. A context in which children transfer and articulate what they know in a form other than a test is appealing to common sense and has been identified as an important discursive resource—questioning a statement supported by this resource would mean questioning the apparent (Roth & Lucas, 1997). This discursive resource is supported by an action by means of which Anthony points to a piece of paper that is "up on the wall" over one of the classroom doors (turn 01); something he learned in university and that states that people remember ninety percent of what they teach as opposed to (an apparently inadequate) ten percent of what they simply hear.

What is more: like going over some text or video recording—tools that are meant to facilitate the achievement of conclusions in an academic work—teaching is a means of assessing someone's knowledge in this specific situation, allowing for the evaluation of those involved in the process. The designer appeals to the experiences associated with the formal educational system: The most important information for marking is located in tests regardless of any other possible and observable indicatives of learning (e.g., attitudes, gestures, and talk). This is a traditional conception of teaching widely practiced among an older generation. During class, important facts are supposed to be recorded in a

notebook and exactly re-presented on a test by all students so that their success can be measured. However, Anthony is critical of the insufficient way school works even though he makes reference to a *banking kind of education* (Freire, 1987) where knowledge is deposited in the heads of students ("we give kids lots of knowledge" [turn 07]). He talks about giving students a chance to do something that is not made evident through report cards, a way of telling teachers what students have learned "other than [on] a test" (turn 07). Therefore, this teaching and learning type of situation that goes on amongst those who attend his program not only allows for the transfer and dissemination of information, but also is counted as a relevant resource for both learning and evaluation. As I discuss below, his discourse draws on resources also employed by critical environmental educators interested in having their students bring about concrete change in their community (Roth & Barton, 2004).

I now extend this form of analysis by considering the social situation in which the designer talked. He faced the interviewer, himself a member in the environmental education community. While talking, the designer presupposed not only the intelligibility of his talk but also the credibility of the discursive resources he rallied to substantiate his main point. If it were otherwise, Anthony would have no grounds for talking the way he does. He presupposes that the interviewer understands and leaves unquestioned the way in which he substantiates his claims. In other words, Anthony's talk takes as fact that the generalized other—here represented by the interviewer—already understands both the discourse content *and* the supporting discursive resources. For the discursive resources to support his argument, Anthony has to assume that there is little likelihood that he would be challenged. Discursive resources, such as common sense, therefore constitute forms of

talk that interaction participants from a particular community do not, or are unlikely to, defy; they are resources for supporting a particular position individuals take. Thus, the fact that the interviewee drew on common aspects of schooling is in part a result of the particular interview situation in which he found himself with the interviewer. Notably, in other interviews generated from my research team, the interviewer and interviewee repeatedly question the very nature of their mutual knowledge (Roth & Middleton, 2006).

The purpose of this chapter is to explicate the discursive resources environmental education designers draw on to buttress the description of their design decisions (motives, plans, and actions). I analyze these resources as legitimate representatives of the community of practice they belong to which, in turn, requires specific patterns of language use. For that reason, understanding *how* they say what they say provides insight into the broader culture in which the talk originated and has considerable implications for environmental curriculum design. I also show how discourse analysis can be a useful method in the toolkit of environmental education researchers and educators.

The discursive (psychological) approach

In this chapter I take a discursive analytic approach to investigate the unquestioned mundane assumptions (or *interpretive repertoires*) that environmental education designers use to support their claims in the description of their actions. For that purpose, I not only focus on a content analysis—*what* is being said—but also *how* what is said is built up in the course of the interactions with the interviewer. The analysis of such repertoires has been more revealing than the particular opinions and attitudes being expressed and supported (Roth & Lucas, 1997). This approach also permits an evaluation of the function their discourses have with respect to the particular activity system they

found themselves in (an interview) and understand the unconscious expression of emotional and motivational dimensions of their experience (Roth, 2005a).

My analysis follows the principles of *discursive psychology* (Edwards & Potter, 1992). In discursive psychology (DP),

> the focus is on what people are doing, and how, in the course of their practices, they produce versions of reality and of cognition. They describe the world, formulating particulars that are relevant, providing its moral flavor and highlighting its casual power (Potter, 2000, p. 35).

Therefore, only discussing the content of talk would misinform my approach to language through abstracting participants from the interaction. Rather, I choose to analyze how constructions of their experiences (as experts in the field of EE) are situated, embodied, displayed and accounted for (e.g., Potter, 2005). The interviewees build, through discourse, a public image of their curriculum thereby representing the community they are part of: a living curriculum for the apprentice (Wenger, 1998). This approach is somewhat different from what other discourse analysts (e.g., Coulthard, 1977/1985; Fairclough, 1995) have been doing in a more critical tradition. On this note, Hammersley (2003a) writes:

> Originally, the philosophy that provided the basis for critical discourse analysis was a form of Marxist critical theory, whereas discourse analysts like Wetherell [in DP] have drawn more on feminism, anti-racism and post-structuralism. However, with a recent shift on the part of some critical discourse analysts towards a reliance on Foucault, the differences have narrowed; although there remain important divergences in the approach to analysing data between the two traditions. (p. 775)

Accordingly, it would be tempting but misleading to assume a "set of codified procedures that could be put into effect and which would lead to another set of entities known as 'results' [similar to quantitative and positivist methodologies]" (Wetherell & Potter, 1993, p. 101).

For the purposes of my analysis, the (verbal) accounts of individual participants are concrete realizations of patterns in their culture more generally. That is, while there may be as many opinions in a culture as there are individuals constituting it, the discursive patterns generally and the discursive resources specifically are limited (Gilbert & Mulkay, 1984; Potter, 1996b). This approach runs counter to the tendency to treat beliefs and attitudes as unitary psychological constructs that can be measured by means of questionnaires and interviews (Roth & Alexander, 1997) and which has been adopted elsewhere in the field of environmental education research (e.g., May, 2000; Rickinson, 2001).

The larger community of environmental educators is composed of a variety of people designing activities for different audiences (elementary, high school, undergraduate, and graduate students) in equally diverse sites (aquarium, forest, wetland, and lagoon), thus taking different positions. Nonetheless, they constitute, and consequently represent, a kind of culture in which they address recurring problems (education and environment) and explain (articulate) what they do in common ways. Thus, the expression *culture of environmental education curriculum design* is used throughout and refers to participants' peculiar (collective) ways of articulating their doings that emerged during the interviews, which has curricular implications to the school system they work in and towards.

Although the discursive possibilities for this community are finite, this is not to say the language they employ is unique—any tentative isolation would neglect the fact that they all speak the same language and participate in other communities with some overlapping and exchangeable characteristics—but rather their articulation of the topics

during the interviews are common, both in terms of content and form. In this sense, for example, weather reporting (e.g., Gough, 1997) would pertain to a community of news reporting (media), which does not mean a person cannot participate in (have access to) multiple communities and identify commonalities. Specifically in my case, those I interviewed participate in actions that are proper for a certain group, which constitutes a community of shared practices—and they were contacted and addressed as environmental designers since they have designed and participated in the activities they talked about. At the same time this condition to take part in the research delimits my database, it embraces the notion that the environmental education design culture I refer to is not a monolithic concept.

The designers I interviewed have a familiar form of discourse they use to legitimize the description of their actions and I can study culture through the investigation of their discourses about what they do. These ways of accounting point to shared grounds of activity that are inextricably part of cultural competence or "culture in action" (Baker & Johnson, 1998, p. 231). The interviewees were not cogitating and then telling me what they were thinking. Quite the contrary: they were responding to my questions in-context and drawing on immediately available resources, presupposing that I already see and understand what they were saying. In some ways, they were not even saying anything new but were helping me to see what was already available in my understanding.

The interview excerpts that I include in this chapter are concrete realizations of the (potentially infinite number of) general possibilities that exist for designers of environmental education and even though a person uses what seems to be a unique

repertoire, it is still a resource that is available to other designers. More importantly, I recognize it as a repertoire or else it would have been opaque to me—this, in turn, helps to ensure validity in my analysis. There is an indissoluble interrelationship between interpreter and interpretation and whatever I come to identify in my database is available to me "because we are all members of a species that commonly inhabits and shares the same universe and the experiences it offers, sharing understandings and sharing meaning making" (Thomas & James, 2006, p. 788). I do not make the claim that these designers' discourse is typical of all environmental educators, but they certainly are cultural possibilities. My portrayal of their discourse offers important insights into the role they play in environmental education curriculum design and thus may inspire recognition of similar experiences in others.

Within the discursive tradition I espouse here, my analytical lenses focus on what interviewees do with their discourse and not on what others think of their praxis. This observation also contributes to differentiate DP from other analytical tools and underscores its usefulness for my objective—to describe the culture of environmental education curriculum design. If anything, these people appropriate the discourse of this community, which grants them a certain degree of participation in it—peripheral or not. In the end, they make themselves understood to me and to others in the field and the quality and acceptance by others of what they do/say is out of the scope of my study at this moment.

Data sources

The interview excerpts used in this study come from a rapidly increasing database concerning environmentalist movements and environmental education, which my

research group has been building over the past eight years. This database, which is the result of several ethnographic studies among different environmentalist groups and the educational opportunities they design for students and residence in their community, also includes ethnographic studies in classrooms and interviews with environmental educators not attached to the environmentalist groups. More specifically, the present chapter is embedded in the trajectory of the research group that studies learning and knowing science from a sociological perspective at the levels of a local quasi-rural community (Roth & Lee, 2004; Lee & Roth, 2003a, 2003b), a coast wide community eelgrass mapping project (Boyer & Roth, 2005), and environmental education programs designed and delivered to school children (Roth & Barton, 2004). It is within this context of past and present research that my data emerged.

Semi-structured interviews constituted the major source of data[2] and were either voice-recorded or videotaped and transcribed as soon as possible. Interviews took the form of conversations that lasted forty minutes on average. Even though I have interviews as my preferred data collection strategy, I do not advocate them as a neutral data-gathering instrument. Instead, I consider them to constitute social processes in which my own research background and interests guided me through and the kind of questions asked (Lee & Roth, 2004). These processes leave their indelible mark on the interviews as recorded events and transcribed text. What the interviewed environmental educators said during interviews always was in response to this form of activity, understood to contribute to a research project, rather than in response to some question that they may face while designing curriculum. Whether the two forms of responses have any

[2]Other data sources include one interviewee's talk on a TV program in which he commented on the curricular activities he designed.

relationship and the extent of this relationship cannot be assumed beforehand and I therefore take it as an empirical matter. (It is the task of interested researchers to show whether there is consistency and complementarities between the talk in the two situations.) Likewise, my research interests oriented participants just as they articulated what was important for the social-interactional situation at hand. At the same time, the interviewees also knew about my membership in the environmental movement and environmental education communities; this, too, oriented them in their responses.

I analyzed my database both individually and collectively—with my research group—following the principles of interaction analysis (Jordan & Henderson, 1995), which is an interdisciplinary method to analyze data by involving groups of researchers. I organized meetings with the members of my research group and we analyzed selected portions of my database with the purpose of better understanding the discourse of environmental educators through their use of discursive repertoires (agreed-upon criteria). During analysis sessions, which were recorded as a matter of course, we discussed the data I presented and generated hypotheses that were subsequently confirmed or disconfirmed.

In conjunction with a grounded theory development (Strauss, 1987), in which analytical categories were identified as my analysis progressed (and not before it started), interaction analysis allowed me to collaboratively construct a better understanding of the work in progress and the final empirical assertions. At the same time, this process assured the credibility of my findings as I engaged in peer debriefing with my colleagues and archived all drafts of notes and early versions as a means of recording my unfolding understanding—progressive subjectivity (Guba & Lincoln, 1989). Ultimately, the

interaction analysis process combined with the use of grounded theory made the process of interpretation less problematic as I reached agreement on what I observed emerge from the data.

Accounting for curriculum design decisions

In the following sections I analyze the resources environmental educators use in accounting for their curriculum design actions when being interviewed. I am not interested in their individual beliefs, motivations, or attitudes. Rather, I am primarily interested in the ways in which they articulate these dimensions. In this discursive approach, I therefore bring to light interviewees' interpretive repertoires (resources) and exemplify this methodology in the specific context of the analysis of interviews I conducted with designers.

The designers I interviewed were asked to describe their programs (actions) and freely talk about their motivations, successes and associated problems. I identified five interpretive repertoires in the designers' discourse: relevance, knowledge transferability and translatability, emotionality, expertise, and empiricist. Each discursive resource is explicated and exemplified in the sub-sections that follow and are grouped according to the similar use interviewees made of them.

Accounting for motives

Interviewees used three repertoires to present fundamentals—the whys—of the programs they designed, hence their motives: relevance, knowledge transferability and translatability and emotionality. Relevance repertoire refers to the image of an indispensable job, a kind of service that is necessary and that has not been identified or

properly addressed at an earlier time by someone else. What designers do is unique and that is exactly why they do what they do. This repertoire was normally employed in a personal context, the designers expressing their beliefs in what they have designed.

Whenever designers said "we have to" they obliged themselves to their work (moral membership) and accounted for their actions by making it clear that there was nothing else they would be doing. Thus, they do what is necessary—i.e., they do what needs to be done. A need, therefore, always focused on an object: what is needed is needed for something, a product that results from the transformation of an object. This implies that designers have an image—in their "mind's eye" (Van Aalsvoort, 2004, p. 1637)—of the result they want (and an idea of how to achieve it) embodied in an object. In other words, designers (subject) saw in their students (object) the locus where they could act upon as they embodied their need for doing what is necessary (their job). In practical terms, through their work interviewees concretely realized one of the many possibilities that were at their disposal, what made possible the establishment of a *motive*. Activities are directed and organized around a motive that is promoted by the designer, who in turn, envisions that participants in their programs understand the relevance of the program and learn to change the ways they participate in the world. Take the following quote from Gabrielle, a professor at a local university:

Gabrielle: (1) [Be]cause I think that's one of the major problems is that you frequently have really well meaning people out there (2) trying to solve environmental real problems (3) 'cause they see environmental problems in the environment, (4) but they have no knowledge of why some of these problems are big issues, (5) but if you have a basic ecology awareness, food chains, and habitats, and loss of habitats, and why loss of habitats is going to obviously result in loss of organisms.

Initially (1), Gabrielle's discourse is driven by a realization of a problem—an environmental issue of some kind (4)—that has been overlooked, therefore, of some

relevance to the community. Ultimately, her goal is to modify that specific situation she had qualified negatively or else it would be perpetuated. In this way, she makes her own work (solution) as relevant as the issue she identified (5).

Gabrielle has been developing environmental education courses for undergraduate and graduate programs for over twenty years and not only has the ability to identify a relevant problem but also knows what to do to solve it. She speaks from a personal perspective ("I think" [1]), which is that of an expert (experienced teacher/designer) who is trying to solve a problem that has been personally identified. In addition, Gabrielle acknowledges the existence of "environmental real problems" the public needs to recognize and solve (2, 3). Yet, she is dealing with a different situation, one of the "major problems" according to her: the lack of knowledge of those "well meaning people" (1). In other words, although these "people" are spending their time and energy on responding to environmental challenges, these same people could be more effective if they knew "why these problems [the ones they fight] are big issues"; the only solution being the kind of "basic ecology awareness" she offers (5). What she does is relevant for all these people out there, who have less knowledge and need to be educated. Her argument becomes unquestionable in and through her discourse.

Gabrielle does not elaborate on why the people she mentioned try to solve environmental problems (even though they do not fully understand the issues). Likewise, she does not explicitly state what difference this knowledge would make for "well meaning people" (1). She supports her claims by drawing on the presupposition that school knowledge transfers to events outside school (knowledge transferability) and that knowledge makes a difference in the performance of actions (knowledge translatability).

This also makes salient that school-based activities are not meaningful per se, but only if they can be applied in different situations in life.

Interviewees' use of the relevance repertoire also invokes the concept of lifelong learning, which contributes to changing students' attitudes toward the natural surroundings. This is illustrated in the following excerpt of an interview with Carolina, an environmental educator who runs saltwater aquarium programs elementary schools:

Carolina: (1) And they [students] really need to learn how to think and where to get that knowledge (2) in order to be able to do that, in order to be able to think about bigger issues, and (3) so I think it's a way of providing them with the basics (4) that they need to be able to be effective stewards.

Carolina was responding to my question about the main objective of her program. She starts by accounting for the knowledge students should know how to find (1), the "basics" (3) students need in order to "think" (2), and to be "effective stewards" (4). Carolina therefore concentrates her efforts on a transformation that will make a difference in the decision-making circumstances her students may face as soon as they move out from the formal/informal situations of the activities, or "bigger issues" (2). For that purpose, she also makes use of locally available resources to facilitate the transition as they are of immediate relevance to the potential participants (teachers and students).

In summary, the program (and curriculum) Carolina designed introduces students not only to knowledge, but also to the way of doing real things in real communities. The designers invoke the notion that the knowledge being introduced through their programs is useful in the real world (practical ways), where real environmental problems exist (knowledge transferability) and where this very own knowledge can be translated into an active involvement towards the same environment (knowledge translatability). Along these lines, Carolina's discourse is about participating in and coming to understand

environmental action. Whatever is done is relevant for the local community because it is necessary. Otherwise, people would continue acting without knowing why they do what they do (and do not do something else). Knowledge, in this case, is itself a relevant (and necessary) improvement in these people's lives because it is transferred to daily activities and translated into change in participation. The situation would be just as true as students would transfer to school some of the same aspects of the social and physical (natural) reality that they confront in their after-school realities—and designers recurrently incorporates examples of peer collaboration in support of this construct. Peers play an important role in the non-formal (everyday) context as people interact with peers so naturally that this kind of interaction goes without saying; learning therefore is likely to take place unnoticeably—in contrast to formal educational settings (teacher-centered). It is the transferability and translatability of everyday knowledge: What students do in real life situations can now be used in real school-based situations, an unspoken agreeability on the value placed on the approximation between school and life outside it.

Designers also use an emotionality repertoire in accounting for the subjective aspects of their doings—similar to high school students who account for the role of religious experience and subjectivity (Roth & Alexander, 1997). Emotional repertoire refers to the designers' intimate grounds (talk) about what they do. Even though they associate their acts to the opportunities they had in childhood and at university to interact with nature, the emotionality repertoire goes beyond any natural explanation and accounts for an immeasurable characteristic of their actions, the grassroots of what they do. The emotional repertoire refers to the strong relationship they have developed with the environment over the years and how it shapes their identity. Designers talk about

liking what they do and doing what they like; an exuding passion, to use an analogy put by Monique, another designer, who made the following comment in the final part of the interview:

> Monique: (1) I think it [being an environmental educator] comes from love of the teaching and love of the environment and (2) if you have those two things that's more important than all the science knowledge. . . . (3) If you have a PhD in science and you're babbling on all this information because it's really good information, (4) if you don't have the passion there, for the audience or for the environment, that's not gonna go anywhere.

Monique uses words like "love "and "passion" (1, 4) to talk about being an environmental educator. In her discourse, these attributes are depicted as more important than scientific knowledge itself (2, 3). Designers are expected to make the excitement they feel explicit when doing what they like, so that they can inspire others to do the same—as in an Dewey-like conception of teaching (Wong & Pugh, 2001). They do what they do by free choice and this image of fulfillment strongly contrasts with the idea of knowledge for its own sake, merely "good information" (3). There must be an extra ingredient, without which the message is "not gonna go anywhere" (4). It is generally well accepted that people have a better sense of fulfillment when they participate in something they are passionate about. And Monique conveys this message through the use of emotionality repertoire—such as that she makes her argument unchallengeable.

Accounting for competency

When talking about their decisions, designers draw on an expertise repertoire. The use of this resource is supportive of both co-authorship and pedagogical claims that are related to their praxis.

In their discourse, designers make salient that their programs are not individually conceived, but are accomplished through a collaborative process. They make reference to other people and programs that influenced their ideas and contributed to their expertise. An idea is not created de novo, but rather adapted from courses and events designers have experienced in their life trajectories. In the following excerpt, another interviewee (Nina) talks about program design. She is an environmental educator working in the geographical area of this study since 1993:

01 Interviewer: Would you say you are a designer?
02 Nina: Well, I think it's evolved out of the first organization that I was involved in 93, so I kind of took that and expanded on it and um I don't take credit for any of the work that I do because I think that really good environmental education is a product of a social ecology that um evolves from educators of life, minds coming together whether they be formal teachers or um environmental educators outside a formal setting and so it's that community that evolves, so it's Anthony, it's Larry, it's Carolina, it's, it's Julianna, it's you, it's, it's my volunteers who always come with their own ideas that are wonderful, it's the formal school teachers that come and give us their feedback, it's the kids themselves, it's the things that we read, it's the things we look at on television, it's the conferences we go to.
03 Interviewer: Okay.
04 Nina: So I would never say: "Oh, yea. I've created that and look what we've done, right, with my idea." It is not like that.

Nina starts drawing on her biography (turn 02) to introduce her explanation of whether she considers herself as a designer even though her participation in the interview required that she be a designer. Nina recalls work she did as an environmental educator when she first moved to the city (where this study takes place). She worked for an organization that had a "touch-and-feel" type of approach to environmental education—an approach she further "expanded on." Nina explains that "really good environmental education" is not an individual achievement but rather the sum of the efforts of a diverse group of people—"formal teachers or environmental educators outside a formal setting,"

"volunteers," "kids,"—working together toward the same objective; they are "educators of life" (turn 02).

Situations ("conferences") and materials available in the public arena ("things we look at television" and "things that we read" [turn 02]) also contribute to the construction of this social network of knowledge where co-authorship is embedded. By declaring herself a participant in that network, Nina builds her expertise by distributing accountability; she makes it impossible to accredit just one person for what is being done (turn 04) and rallies support for her actions by pointing to others who have preceded her.

Nina's use of this repertoire attributes relevance to what she does. She used to be very direct—her expertise allowed her to say exactly what needed to be done and how—but she has "evolved" to a different and more "creative" attitude, as she pointed out in a different part of the interview. After eleven years, Nina realizes that this is not "where the ideas come from, the creativity comes from." She is pleased with her new condition ("it's nice") in which her satisfaction justifies the abandonment of old attitudes. She describes the designing experience as having a positive impact on her teaching, which she perpetuates through the new way she relates to the public. Nina knows that what she does now is what her audience (students and teachers) wants and needs. She can now teach something she would never have a chance to learn and teach by herself. Hence, she expands her students' learning possibilities as well. What is more: by evoking the terms "social ecology" and "community" (turn 02), Nina relates her work to a situated view of learning (Lave & Wenger, 1991), where knowledge is not something that people carry around with them wherever they go, something which exists independently and context-free in the heads of individuals and that is so general that can be applied whatever the

situation might be. The many different contributions Nina can get to improve her doings the better. Simply put—drawing on the analogy of thread and fiber (Roth & Lee, 2004)—any individual (single fiber) presupposes the life of his/her community (thread) as much as the community presupposes the individual. The thread is more than the sum of its parts (each individual fiber) and knowledge emerges as a collective praxis (strong) rather than merely individualistic (weak).

Designers not only know what and why they do what they do but they also know how to do it in the educational context where they perform their activities. It is about their competence in taking a "good idea" and making it into what they are doing today, as Anthony put it. It is a different form of expertise, required for those operating within the context of schools, where a traditional kind of pedagogy is still predominant. To illustrate this way of accounting for their praxis, it is worth examining the following excerpt taken from the interview with Anthony, who has been teaching in public schools for over 25 years:

01	Anthony:	The biggest thing that I'm also try not to worry about is that whether or not it's um in the curriculum that I have to teach, you know, like there's certain things that everybody has to teach every year and a lot of the things I found don't fit into my science. . . . So there is seldom that we actually fit into what I am supposed to be teaching at science, so I think hardy anything I teach in grade six science fits into the grade six science curriculum.
02	Interviewer:	It's because the curriculum is not good enough or. . . ?
03	Anthony:	((Turns his face away from the camera and looks down)) Well, it's just because that's the way it's written.
04	Interviewer:	Okay.
05	Anthony:	((Turns face back to camera and nods head silently.))

In this excerpt, Anthony is critical about the school science curriculum he is supposed to use as a resource (turn 01). As he further puts it, this is the "curriculum" (he air-quoted the word) he is expected to teach, which in turn is "not always that most interesting." As he explanation why he is not worried about whether or not what he does

is in the science curriculum, he sets himself as the one who best knows what is important for his students to walk away with at the end of the year. What happens to what he is "supposed" (turn 01) to teach in science? Could it be that it is not as scientifically relevant as what he is teaching and that goes beyond what is prescribed?

Anthony's ability to teach what seldom fits into what he is supposed to be teaching at science (turn 01)—like writing and language—reinforces the use of an expertise repertoire that assures he has what it takes to make the curriculum fit into his (and his students) reality. He talks from the perspective of the classroom, the very site where curriculum is (commonly accepted) to be applied and not re-designed. It would take a specialist, of the same caliber of those official authorities who wrote it in the first place, to change this situation. By setting himself as equal to the official authorities, Anthony draws on his own pedagogical expertise as a teacher (curriculum practitioner) to apply his ideas to his curriculum praxis. To make this work for him, Anthony has to have a clear understanding of his actual situation, *what* needs to be done, and *how*.

When saying that "it's just because that's the way it's written" (turn 03), Anthony is careful when talking about this delicate subject (curriculum) because he is part of the system of which he is critical. He creates a *contingent field* in his discourse. This contingency (or *modalisation)* reflects a trade-off between known local contexts and the desire to make generalisable statements (Veel, 1998, p. 138). In other words, he is careful of talking about others. The fact that he faces away from the camera and avoids further comments by simply nodding his head are *gestural* indicatives of that avoidance (turn 05).

The deployment of the same expertise repertoire can be supportive of a second situation, where the specialist justifies the official kind of work that has been done. It is the flip side of Anthony's discourse, but a different perspective that is identically buttressed. The following extract from Gabrielle's interview exemplifies it:

01 Interviewer: You said that um you didn't pay much attention to the curriculum…
02 Gabrielle: ((Starts laughing.))
03 Interviewer: Um, is, is . . .
04 Gabrielle: ((Laughing)) Well, there is no environmental education in it!
05 Interviewer: Okay.
06 Gabrielle: You know ((laughs)).
07 Interviewer: Okay, so it is not the case it isn't good enough but…
08 Gabrielle; No. For many, many, many years there wasn't. And, in fact, it was a win [in] 1995 that, you [know . . .
09 Interviewer: [Oh, yes?
10 Gabrielle: Oh, yeah. I sat on many ministry committees in this province over the, over thirty-year period, trying to get environmental education formally into the school curriculum. … [E]nvironmental education has not been, in my view, um formally um really um—how would you put it?—not only as a not prescribed, even today it's a, it's a recommended, you know ((slight smile)) and, even today, I mean, here's ((bends down to reach a box on the floor and take a copy of the Ministry's Guide)) the current Ministry's guide that is probably the best kept secret in BC [British Columbia].

What is written in the curriculum was meant to have an impact on teachers' work at the classroom level, but if it does not have the desired effect it is not Gabrielle's fault (as an official designer) that her work has become the "best kept secret in BC" (turn 10). She locates the problem elsewhere, that is, not in her actions. Like Anthony, Gabrielle eschews complete responsibility for curriculum design and has her authority unquestioned; she preserves the image of an expert who has sat in many committees over the last 30 years and still holds the necessary pedagogical expertise to write and evaluate curricula. Otherwise, how would she come to know about something that others have neglected ("well kept secret")?

Accounting for practicum

The designers all associated either a field trip or another empirical component with the curricula they designed. In these curriculum features students are expected to experience the world. Designers therefore used an *empiricist repertoire,* which I denote as any discourse that refers to the inscription of experiences with the physical world in the bodies and minds of the students. In this manner, what is so vividly and meaningfully lived cannot be forgotten, so that students learn science and change their attitude towards the environment.

Larry: (1) We really made a big effort to design a program that kind of address all the different learning modalities, (2) all the different ways we learn, and the different ways we think about things, the different intelligences that students have when they plug themselves to a task. (3) So, it's very much hands-on, very tactile. (4) The kids actually are lowering down the Secchi disk over the side [of a dock] and pulling the rope back up. (5) So, they feel the salt water in their hands and they can smell all the specimens up close and they can hear things that are happening around them. (6) So, we try to get them really involved.

Larry is an environmental designer who has been doing environmental education for over 18 years and has a master's degree in environmental education under Gabrielle's supervision. Recently, he was a recipient of a distinguished education award and was also described as *a teacher of teachers* in an article that announced the award ceremony. The above excerpt was taken from an interview he gave to a local TV channel about the program he designed. It contains a personal explanation of the reasons why his program is hands-on (3). As he talks, the TV clip features images of the actions students perform; actions that would, according to Larry, address "all the different ways" students learn (2). It is a very powerful description because it he explains the learning benefits of the outdoors: the feeling of "the saltwater in their hands," the smelling of the living creatures, and the hearing of what is "happening around" (5). No book or blackboard can bring all

these sensations to life, so school does not suffice (reinforcing, once again, the relevance of the activities designed). This is a statement that practice is unique: Nature has a remarkable influence on students without the need for all the structure provided by classrooms and teachers. Teaching for the environment requires teaching about it and also learning from it. Larry is convincing in the way he structures his narrative; he states his claim (1), he explicates (2), reinforces (3) and exemplifies it by ultimately adopting the perspective of the students in describing the activities (4, 5). Finally, he associates the idea of addressing "all different learning modalities" (1) with "real" involvement (6), a desired mixing.

Designers talk about how practical experience serves the purpose of teaching students the language of science—i.e., to talk science (Lemke, 1990)— and initiating them as legitimate peripheral participants (Lave & Wenger, 1991) in the scientific community. Nina engages the empiricist repertoire when she talks about girls doing science in the following interview excerpt:

Nina: (1) [S]cience, especially for girls, can be rather intimidating. (2) And they look at instruments, and they look at graphs, and they get turned off. (3) They don't understand the point of it, there's no relationship between a Secchi disk and turbidity and what is going on um in a local beach or in a local pond or a local anything, stream. (4) So, it's to try to make these instruments of science more meaningful to them, to show them that they have a use, they have a purpose, (5) and the purpose is ultimately conservation, in my mind. […] (6) And we usually use salmon as a base line because they already are well acquainted with that species, (7) but it could be used for, could be in relationship to anything that lives in the water. (8) So, number one is to get over that intimidation and to show that these scientific tools and ways of looking in the world are meaningful and that the purpose of them is (9) to basically fall in love with the world, save the world, the same world they hopefully fall in love with.

In her account, Nina specifically talks about the relationship between science and girls and how it is intimidating for girls as it is to everyone (1). She goes on to say that students are unfamiliar with the *genres of science* (Lemke, 1990), or its formats of

reasoning, speaking, and writing (2); also very alien to their ordinary experiences (3). Particular to this alien experience are scientific instruments. According to Nina, exposing students to scientific tools (8) is actually a way of teaching what (environmental) science is all about (4, 8): conservation (5), which is connected to anyone's lives (6). It is a generalisable approach (7) also supported by an emotionality repertoire (9). What matters is not the accuracy of the measurements taken, but the fact students are doing something they would not have the opportunity otherwise; all the data collected is not used outside the program and still students are constantly reminded during activities that what they do is what "real scientists" do (relevance).

Discussion

This study was designed to investigate the discursive resources environmental education designers employ when accounting for their actions: the off-the-shelf and bespoke resources that are selectively drawn on and reworked according to the setting (Potter, 1996a). This is a different way of analyzing discourse in the field of environmental education research. I identified three main topics that emerged in interviewees talk about their design activities—motives, competency and practicum—which were supported by the use of five specific interpretive repertoires: relevance, knowledge transferability and knowledge translatability, emotionality, expertise, and empiricist (schematically summarized in Figure 3.1) Each repertoire is taken as a way of talking to support a point of view independent of the particular perspective takes. Thus even if two or more interaction participants have differing points of view, they may support them using the same repertoire, which is taken as shared (Roth & Lucas, 1997). This allows designers to support their claims in the face of an interviewer, whose

commitments they may or may not know. In the course of talking about their actions in terms of motivations, expertise and practice, designers not only use the various discursive resources available to hem, but also reconstruct an specific culture that are part of their identity (i.e., environmental educator designers).

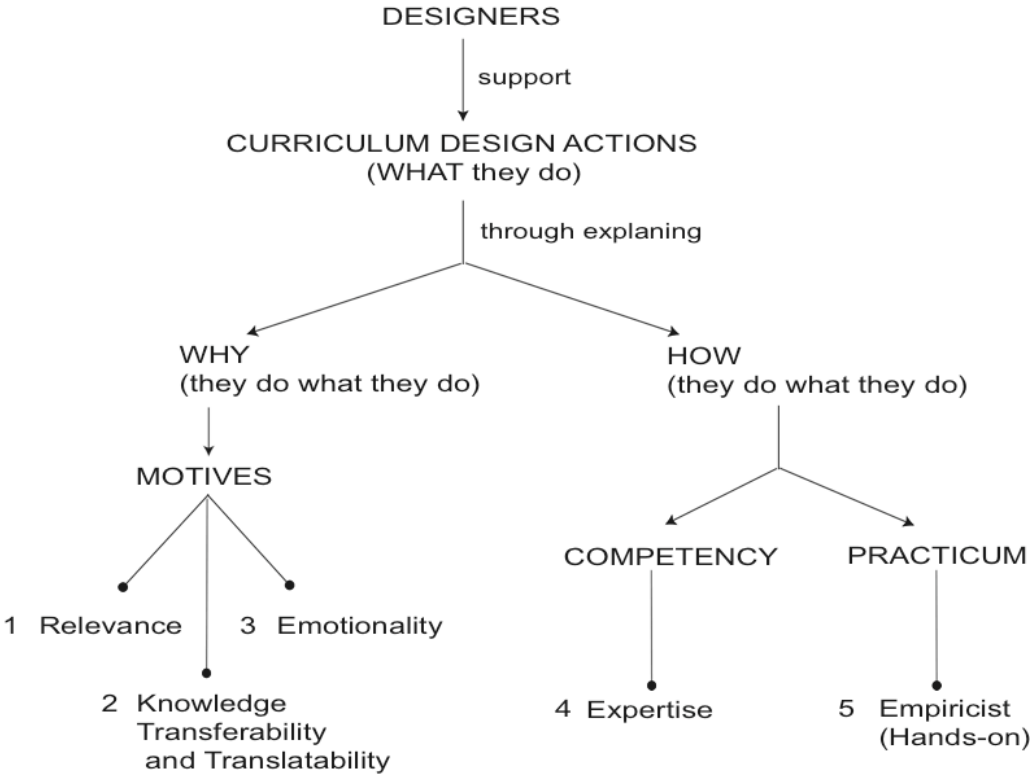


Figure 3.1. Summary of the analysis of the discursive resources used by designers during interviews.

First, as designers account for their *motives*, they draw on the *relevance* (1) of what they do and on the possibility of *knowledge transferability* and *translatability* (2). They identify an environmental problem not yet addressed and give their contribution towards a possible solution that is up to their students to carry on. In that way they invoke

the uniqueness of their design actions based on the assumption that what is learned in school is transferred to life outside it and vise-versa—eventually, it is about making the distinctions between learning in and out of school less sharp. Also in support of their claims on motives for their doings, designers draw on an *emotional repertoire* (3), which invokes the existing sentimental and passionate bond between the environment and the successful environmental educators: People are what they like (and are meant) to do.

Second, designers described their *competencies*, another topic that appeared in my analysis. In this case, their savvy was supported through the use of an *expertise repertoire* (4). What designers do is not created from scratch but results from individuals with diverse experiences coming together and sharing ideas. By giving and receiving input overtime, their expertise builds. Designers also draw on the expertise repertoire to account for their knowledge of the educational system they need to tailor their programs to.

On the one hand, they gave an explanation for the activities they designed in terms of a kind of *practicum*, the third topic present in my data. Programs would not be what they are without the presence of this *empiricist* component. Here, they buttress the description of the importance of hands-on activities using an *empiricist repertoire* (5), which invokes the long-lasting and science-introductory nature of practical experience that is an effective way of teaching the (relevant) language of science—what *real* scientists do in the *real* world—and providing for the apprenticeship of those involved with them. Another form of common sense talk deployed by the designers is that what is experienced is better retained than what is learned through books, chalkboards and

videos; resources generally available at schools (and that consequently has a lower chance of positively impacting students' lives).

There is a contradiction in designers' discourse that I have not pointed out yet. Although physical experience (hands-on) is a key element in their programs for the desired knowledge transferability and translatability to happen, school-based learning is still essential and one is not complete without the other. From the designers' perspective, they objective a change that is beyond the walls of the school, but that is not possible there alone. In other words, as designers create programs with the goal to transcend school, they ended up needing the same formal structure. Here, they manage the apparent conflict by (indirectly) accommodating the idea that school curriculum is insufficient, meaning that their design goes where school itself does not (another claim on the relevance of what they do). It is never the case of stating whether one is better or worse than the other, but the reconnaissance that without school actions would be completely different than what they look like now.

In this study I pursue a second, parallel objective: exemplifying discourse analysis as a powerful method for environmental education research. Discourse analysis makes it possible to explicate *how* what is said is supported in a way that it becomes uncontroversial rather than naively focusing on *wha*t is being said as if it was a property of each one of the individuals (content analysis). Such an approach appears to be more suitable for democracies, where every individual is allowed to have his or her personal perspective on some (controversial) collective issue, but where, in order for (environmental, scientific) literacy to emerge as a collective practice, interaction participants have to have something shared, on the basis of which they can work together

and debate the issues (Roth & Lee, 2002). Their discourses share common ground with the researchers and among themselves as they represent a certain culture, the culture of environmental education curriculum design.

By describing designers' discourse, I not only explicate important ways in which curriculum design in the field is constructed, but also step towards a more refined study of such repertoires in face of the effectiveness of the actual doings of the interviewees. This requires ethnographic studies of the kind that my research group has been conducting for the past nine years. For now, I provide teachers and environmental educators with a different way of analyzing what people in the field do with their discourses, so that it can be taken into account in the design of curriculum and instruction that is inclusive of an argument-based pedagogy. The way interviewees talked about their praxis not only revealed a different facet of doing research but it also sheds light on the curriculum enacted by a community of environmental educators and designers.

Section II

On School Ground

CHAPTER 4

WHEN FUN IS NOT FUN: PUPILS' DISCOURSE ON FIELDTRIPS AND THE IMPLICATIONS FOR SCIENCE TEACHING

Abstract

In this study, what students and teachers say about fieldtrips is analyzed to assess the impact of fieldtrips on science learning and instruction in general, for comparisons with the classroom setting (an activity system on its own) are likely to arise in their talk. With curricular and instructional purposes, the present chapter draws on discourse analysis (discursive psychology) to describe participants' articulation of their fieldtrip experiences, and formulate possible implications of their perspectives to their involvement in science activities outside the school. Based on pupils' talk, and contrary to the commonly held assumption that fieldtrips might always represent a different opportunity for learning to take place, I conclude that just being out in nature does not always guarantee a pleasurable learning environment—*fun* is an immeasurable and important emotional component in students' learning. My discussion is of interest to science educators who regularly find themselves in out-of-school learning contexts.

Introduction

As humans we are inherently curious about nature. Children constantly examine creatures in the backyards of their homes and schools, asking parents and teachers the many *whys* about their surroundings. Yet as parents and teachers we end up putting "these same children into sterile, constricted environments and make them sit still and be quiet when their bodies and minds want to be engaged and active" (The North America

Association for Environmental Education [NAAEE] and The National Environmental Education & Training Foundation [NEETF], 2001, p. 2). In other words, what begins as authentic inquiry experiences (self-oriented and motivated) ends up, at best, in mere routines that grant survival through the school years—the same experiences can also negatively affect students' participation in and feelings toward learning in school in general (e.g., Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Pollard, 1996). Environmental education (EE), however, offers opportunities for science learning through personal and out-of-the classroom educational experiences that help to develop and increase pupils' natural affective and effective relationships to the natural environment (e.g., Battersby, 1999; Palmberg & Kuru, 2000). Consequently, EE complements and expands in-school science instruction rather than being an alternative to it.

Recently, concepts such as Environment-Based Education (EBE) and Environment as an Integrating Context (EIC) have been developed to emphasize the specific benefits that arise from using the environment as a learning context and tool in school and non-school programs (NAAEE & NEETF, 2001 and State Education and Environment Roundtable [SEER]). Although there are positive indicators of the success of many initiatives (e.g., Rickinson, 2001), the environment per se does not account for all the claimed benefits ascribed to these experiences. Put differently, claims about the value and effectiveness of field trips in enhancing science education through EE initiatives would best be understood in terms of the different forms of interaction amongst participants and the tasks at hand—as opposed to the merely physical presence of students in nature rather than in the classroom. If the formal structure of the classroom

is reproduced in these out-of-school settings, there may be little hope for new forms of learning to occur. From this view, the way students and teachers discursively articulate their perceptions of their experiences both in and out of the classroom setting must not be overlooked (Griffin, 2004). However, early studies mostly investigated the topic through the use of interviews and did not focus on school-related naturally occurring talk. Ultimately, students' learning conditions are inseparable of their teachers' and both their perspectives represent opportunities for improvement of their daily coexistence at school.

This study is designed to theorize the structural similarities and differences of in- and out-of-school learning environments for science education purposes in general and science instruction in particular as they emerge from students' and teachers' interactions. I am particularly interested in pupils' articulation of the opportunities being offered to them and the ways in which such opportunities mediate their overall learning and their teacher's instruction. I seek to re-evaluate the possibilities fieldtrips provide for complementing and enhancing the learning and teaching of science and the environment in schools.

Theoretical framework

In this study, I draw on discourse analysis (DA) as method and theory to analyze students' and teachers' talk. Discourse analysis is an approach to the analysis of talk that has evolved over the past two decades in sociology and social psychology—in the wake of which the new field of discursive psychology emerged (Edwards & Potter, 1992). Specifically, discourse analysis is the study of how talk (and also texts) is used to perform actions. Discursive psychology is the application of discourse analysis to issues in psychology, providing a novel perspective on a wide range of psychological phenomena

(Potter, 2003). Using discourse analysis allows me to (a) analyze what research participants say, but also how they say it, and (b) evaluate the function their talk with respect to the particular activity system in which they find themselves in. Ultimately, this method tells researchers much more than the content of any individual written piece of information and do not take whatever participants say as referring to any internal psychological events or reflections of individuals cognitive mechanisms (Roth, 1997).

Methods

The excerpts used in this chapter are extracted from an increasing database concerning science and environmental education that my research group has been building over the past decade. This database includes not only documental studies with textbooks, newspapers, and journals but also ethnographic studies in classrooms and interviews with educators from different organizations and the educational opportunities they design for students and residents in their community. Approximately 40 hours of video documenting science/environmental activities in diverse settings and situations constitute my major source of data.

Research participants

In this study I focus on a sixth-grade classroom that is a member of the public school system in British Columbia (Canada). I followed those students while engaged in two different environmental education activities that fulfilled aspects of the science component of the prescribed curriculum (http://www.bced.gov.bc.ca/irp/sci_6.pdf).

Although distinct in their format and temporality—one took place on a beach and the other at a saltwater lagoon eight months apart from each other—these two initiatives

represent out-of-school learning environments (field trips) and were designed to compliment in-class science learning and instruction.

The class is composed of approximately 25 students (the majority of them being females). The school in question is also known for being inclusive of children diagnosed with special needs—such as attention-deficit hyperactivity disorder (ADHD). There is a 30% component of first nation children as well. As for the teacher, she has taught for twenty years and done water related courses put on by university science professors and school district personnel. During these years she has been actively involved with the local environmental education initiatives discussed here.

Instructional settings

Two environmental education programs—a daylong exploration of marine systems and a rocky intertidal scientific study—were designed by public environmental educators. For both programs the educators provided the teachers with resources for in-class preparation before the fieldtrips. For the lagoon program the educators offered two demonstrations during an one-hour long program: (a) an interactive watershed model demonstration that covered hydrodynamic concepts related to watershed function and issues arising from humans' toxic inputs and alteration of the landscape and, (b) a demonstration of the equipment used during the fieldtrip to measure water quality (pH, turbidity, temperature, and salinity) and collect samples of marine organisms.

For the beach program in-class preparation, students were introduced to the topic of scientific methodology and were required to create a hypothesis that could be tested in the beach environment; students designed and set up a study concerning their hypothesis. For example, the teacher formed the students into groups that are as functional and

balanced in ability as possible. The one group I followed (chosen randomly) was interested in confirming the theory that animals that spend more time exposed to direct sunlight tend to be paler than those in the shade. In the process of testing their hypothesis, they decided to use a rock as a reference for color and used it to compare the color of small crabs found in different locations on the beach (with different exposures to sunlight). Each group created its own recording sheet and was expected to become proficient in using it by the time students went to the beach. At the pre-visit sessions, they were also introduced to the use of transects for field study purposes. The groups formed for every step of the program (pre, during, and post program) were different.

Both programs had follow-up activities. After going to the lagoon, students engaged in a one-day in-classroom activity that was designed to review some important concepts associated with the visit. The teacher prepared the materials utilized in the activity—a number of stations with different sets of questions so that groups of students could rotate amongst them and work collaboratively to answer. The follow-up to the beach program was done differently. The students prepared a display illustrated with pictures taken from the field with a digital camera supplied by the teacher to present their conclusions drawn from the testing of their hypothesis (a summary of their experience). Moreover, students were required to present the display orally to their classmates and then to another class where parents were invited. The preparation lasted 10 days with four one-hour sessions each week. For the purposes of this study data from the post field trip follow-up was analyzed. This data is made up of video footage and associated transcripts of formal and informal discussion of the students during on-going work within their group and whole classroom interactions.

In both programs, students typically work collaboratively with their peers and instructors assisting with the activities primarily act as facilitators, helping the students to carry out their own work of interpreting and recording the meaning of their (students') observations. The lagoon program had more instruction; thus requiring frequent interventions from instructors (public educators) who assisted students with developing their observation skills and water sampling techniques.

Analysis

I analyzed the database following the principles of interaction analysis, an interdisciplinary method of involving groups of researchers in the analysis of interactions (Jordan & Henderson, 1995). During these analysis meetings—which I record as a matter of course—we discussed the data being presented and generated hypotheses that were subsequently confirmed or disconfirmed. In conjunction with a grounded theory development (Strauss, 1987) it allowed me to collaboratively construct a better understanding of the work in progress and what it would look like at the end. At the same time, this process also assured credibility to my findings as we engaged in peer debriefing and archived all drafts of notes and early versions as means of recording my unfolding understanding—which is referred as *progressive subjectivity* (Guba & Lincoln, 1989).

Fieldtrips and classrooms: What students and teachers have to say?

Educators often assume that taking students out of their familiar learning environment—the classroom—and placing them in a new learning environment provides them with better learning opportunities. They can assume that taking students out motivates them and improves their engagement in (and commitment with) the learning

opportunities being provided (Ramey-Gassert, 1997; Rennie, Feher, Dierking, & Falk, 2003). How do students experience and perceive activities that are designed to complement in-classroom instruction? Do students share teachers' expectations? Is there a better place to be, in or outside the classroom? In the following subsections, I analyze students' and teacher's talk about fieldtrips. Their articulations provide me with rich analytical resources to access their perspectives fieldtrips. My results challenge the taken-for-grated assumption by teachers that out-of-school activities are always appropriate venues for learning to take place differently than in the classroom.

Fieldtrips or classroom: Where to be?

Teachers most often agree with the commonplace view that going outdoors helps students learn. In fact, the word fieldtrip is part of the British Columbia Ministry of Education science curriculum vocabulary (BCME, 2005). Fieldtrips represent a hands-on approach to learning, where pupils are presented with the opportunity to use their senses more fully. Students themselves often favor this type of activity over regular classroom lessons—indeed it is not surprising to find teachers and students opting to one situation in detriment of the other. Take the following to exemplify it.

In this first circumstance, students are gathered around the displays they produced as a follow-up to a fieldtrip to a local beach—the purpose of the visit being that of verifying a hypothesis of their choice they came up with during a science lesson back at school. As they were setting up their display and the time to report their findings was approaching, Juliet (teacher) addressed the whole class:

> (1) The way I would like to do this [the presentation] is I'm going to say, ask this group ((points to one of the groups in the classroom)) to go first. They will stand in front of their group and they'll talk about MP [local beach]. Some of the things that I would like you to

> comment on are: (2) What did you learn at MP that you couldn't have learned maybe from books? (3) Something that tells me that being outside and seeing them for real, and touching them for real, made a difference. (4) So you need to work this with your group. (5) You also need to tell me something about your hypothesis and the creatures that you've looked at. ((Interrupts and calls one student's attention)) Something about your hypothesis and the creatures that you've found and that you've looked at, (6) but mostly I want to know if it would've been better for me to give you a handout of twenty five things and give you a test on it or (7) would've it been better to have taken you out to MP. (8) So I need to have some feedback from you. (9) So I'm gonna give you about three minutes to plan your presentation.

Initially (1), Juliet tells the class how she wants the presentations to be done. Using one group as an example—to which she points in the beginning of her talk—she asks that each group comments on what they have learned at the beach that they would not have learned from a book (2). The teacher's question leaves little room for an open (and possibly negative) evaluation; it was positively posed, already presupposing that something was learned: "What did you learn that you couldn't…?" (2). She asks for evidence that the activity "made a difference" (3), presupposing that fieldtrip activity was different from the classroom and therefore the students learn differently. Juliet foregrounds the notion of reality—"seeing them for real, and touching them for real (3)—by referring to the students synæsthetic experience on the beach and contrasts it with the experience of books (2). Juliet introduces these points at the beginning of her talk (2, 3, and 4) before reminding students about their hypotheses (5), thus indicating the relative importance placed on what is being said.

Juliet continues by asking the students to include in their presentations comments about whether it would have been better to be given a handout of "twenty five things" (6) and write a test, rather than going to the beach (7). Furthermore, Juliet's use of the adverb "mostly" (6) preceding the utterance testifies to its importance. Here, the first request is repeated in a different fashion; she still seeks support for the initiative, the difference now being that students are required to imagine what would have been better for the teacher to

do with them—which, in turn, requires a value judgment. The teacher's discourse is used to suggest that students can decide (indirectly through their response to the teacher's call for evaluation) what it is better for them. They choose and therefore have to take responsibility for what they do; they make the decision. In a way, the teacher stacked the odds as she framed the choice to be between memorizing 25 items or going on a fieldtrip; choosing to stay in the classroom over the outdoors experience involves the risk of compromising their participation in activities of the like. Even though the teacher says she needs "feedback" (8), a certain amount of expectation rises from this point onward, pressing students for a certain and anticipated answer.

The fact that the teacher says that students still need to work with their groups (4) associated with the few minutes she granted them to *plan* their presentation (9) indicates that her request is new, just now becoming part of the task at hand and demanding some extra group work. Juliet enlarged the primary goal of the activity—testing of a hypothesis and preparation of the display—to include feedback on the effectiveness of fieldtrip compared to book learning. However, her discourse framed a contrast between classroom and fieldtrips in a way that reveals her preference for the fieldtrip. Her discourse manifests a distinction between activity systems—the classroom and (vs.) the outdoors—and elicits students' comments on that distinction as part of what is to be evaluated. This, in turn, privileges one of the two potential sides of the discussion—against or in favor of—and allows one to ask: How to mark such a subjective comment?

The differentiation between the two learning environments can turn Juliet's argument on itself: while exalting the outdoors activity, her discourse depreciates her own classroom work and glorifies the work of others, the public educators and

interpreters who are in charge of the outside classroom activities. Juliet does not make available to her students—and therefore the researcher present—why she undervalues her own classroom as learning environment. (From the theoretical standpoint I adopt here, any private intentions she might have had are not of interest, only what she makes available to all those present in and through her talk-in-interaction.) In the next section, I analyze how students use the teacher's initial request as a resource for assessing their participation in the same activity.

Fieldtrips or classroom: Fun or no fun?

Although considered complimentary to science in-class instruction, fieldtrips do not always represent what students want to do or places where they want to be—which reflects (and affects) their level of emotional engagement in such activities. In the case of Juliet's class, both her opening words and stated preference for fieldtrips appear to have mediated how pupils talk about their experiences. The following conversation within one group of students illustrates this perspective:

01 Sarah: Okay. So, what made it [the activity] better? Going there [and just look at
02 Carl: [The munch. Oh.
03 Sarah: Because the tide you can [really-
04 Carl: [It's hands-on, hands-on experience. We wouldn't get to see all the different stuff you [just-
05 Jonathan: [Yeah.
06 Sarah: [But what we-
07 Carl: [Read about it and it was, it wouldn't be as much fun just sitting here reading in class.

Sarah initiates the group conversation by asking, "what made it [the fieldtrip] better?" (turn 01) reiterating what the teacher had requested. Carl refers to "the munch" (turn 02) before coming to realize what Sara is talking about ("Oh" [turn 02]). Her grammatical form, using the adverbial conjunctive "because" links "better" and the

"tide," constructs the experience of the tide as one of the concrete benefits of the fieldtrip (turn 03). As for Carl, he considers that the label "hands-on" (turn 04) speaks for itself and for the benefits of the activities: "It's hands-on, hands-on experience" (turn 04). Here, he points out that "hands-on experience" is unique: Students "wouldn't get to see all the different stuff" if they have stayed in the classroom (turn 04). Jonathan agrees ("Yeah" [turn 05]).

Sarah attempts to take the discussion in a different direction ("But…" [turn 06]) but Carl finishes his line of thought: "It wouldn't be as much fun just sitting here reading in class" (turn 07). In this last statement, Carl not only introduces the word fun to the conversation, but he also makes salient the co-dependence of the pair (hands-on experience; fun) in opposition to (sitting in class reading; not as fun). He says that the classroom might not be so boring after all ("as much fun as" [turn 07]). In other words, getting "to see all the different stuff" (turn 04) is "fun" (turn 07)—which, in turn, is a critical emotional component of the activity under discussion. Whatever the definition of fun might be for Carl, his discourse links it to the "hands-on" aspect of the fieldtrip. Likewise, the association between classroom and reading (thus with books, unreality, and boringness) is stabilized in the general discourse of the participants (the teacher and some of her students.

Interestingly, the students' talk was similar to the teacher's as they attempted to construct arguments in support of the beach activity. Carl ends up articulating one specific facet of classroom activities (reading) and implies that it might not be appropriate for learning. He neither gets to see different things in the readings he does nor

to have as much fun with them. However, the discussion does not come to end as Jonathan, another student in the group, comments on the matter[3]:

08	Jonathan:	Not that it's fun. You don't want it to be fun. They wanna it to be educational ((air quotes the word)).
09	Carl:	And fun.
10	Jonathan:	Yeah, I guess. But it's easier to learn something if it's done hands-on. ((Teacher passes by and takes out a ruler from his shirt)). Yeah.
11	Sarah:	Because like in books you can't do the tides like it's not exactly the tide goes out just tha:t much ((she uses her right hand thumb and forefinger to indicate width)).
12	Carl:	Yeah.
13	Sarah:	At eleven o'clock like they can't say that, [they weren't there.
14	Carl:	[Yeah.
15	Jonathan:	It's easier to learn if it's hands-on. Yeah

In his first statement (turn 08), Jonathan denotes something ("it") as not fun but as "educational." Because Carl has talked about both classroom and the fieldtrip, the referent of Jonathan's "it" is not initially clear. However, a close analysis of what Carl says before and after (turns 07 and 09) and how Jonathan subsequently responds to him (turn 10), makes it likely that they both talk about fieldtrips; Jonathan uses the conjunction "but" (turn 10), thus indicating that the topic of discussion has not been changed.

Jonathan presents an alternative way of seeing fieldtrip experiences: they are not supposed to be fun because they are supposed to be educational (turn 08). From a logical perspective, the implication "not fun" implies "educational" is false only when the first term is true and the second false; a fun activity can also be educational. Although his classmate (Carl) insists that fun is associated with their experience ("And fun" [turn 09]), Jonathan is not assertive ("Yeah, I guess" [turn 10]), indicating that educational implied not fun. Jonathan then adds another concept to the discussion of a hands-on experience,

[3] Colon indicates stretching of sound it follows.

"it's easier to learn." He therefore does not make a statement that contradicts Carl he instead introduces a new terminology, "easier" (turn 10), to talk about the same issue.

The word educational assumes an allegorical meaning when Jonathan air quotes it; he uses a word from the school vocabulary to indicate personal discrepancy. His discourse constructs a context for his experience of fieldtrips—they are not educational if they are fun—which he claims are teachers', "they[their]" (turn 08), common understanding. The air quote relativizes and ironizes the term "educational." He shifts the personal pronoun "you" to "they," contrasting what students ("you") experience and what teachers ("they") intend: "*You* don't want it to be fun. *They* want it to be educational" (turn 08). In this way, Jonathan introduces new relational pairs—(education(al); not fun) and (hands-on; easier learning)—and thereby articulates, similar to Carl, a dichotomy between learning and enjoyment. Moreover, his use of the third person plural pronoun ("they") sets up a contrast familiar in everyday English talk: Us, the speakers, versus them, the specific and generalized others.

Similarity between out-of-school and classroom activities arises in that a possible distinction between the two settings becomes blurry implicitly in the participants' talk—especially in Jonathan's (Figure 4.1). The only unanimous difference between the two settings is the hands-on aspect of the fieldtrips; other than that, Jonathan considers going on the fieldtrip an educational experience as much as it is staying in the classroom.

In her turn, Sarah returns to making the tides the topic of talk (turns 11, 13). She relates the experience of tidal processes ("the tide goes out") to the tenuousness of books adequately re-presenting tides ("in books you can't do . . ."). She questions the validity of the information in textbooks ("they can't say that, they [publishers and authors] weren't

there"). It is theory (paper) against practice (reality)—and Sarah invokes the reality the teacher talked about in her opening words ("seeing them for real, and touching them for real, made a difference" [03]). She articulates a contrast between what students can see during fieldtrips with things they only see described in books. Carl agrees to what Sarah says (turns 12, 14). Once more, a student echos the overall teacher's position on the benefits of the fieldtrip over those of classroom activities: "It's easier to learn from hands-on" (turn 15). His last sentence demarks the end of the discussion and avoids further conflicts with his peers. The group moves on with the preparation for their presentation.

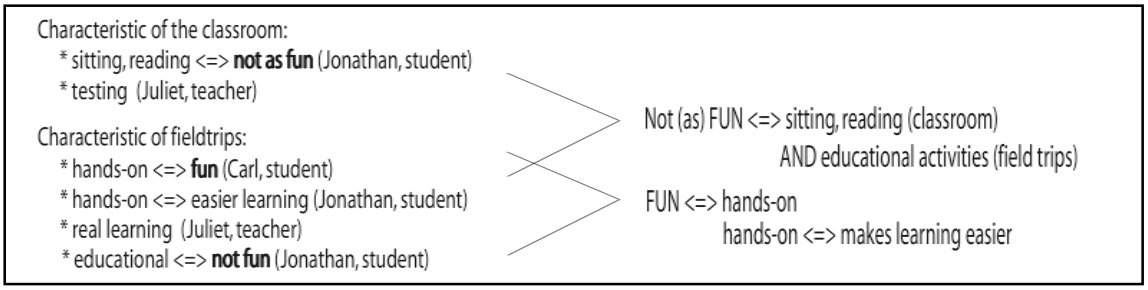


Figure 4.1. Existing associations among some of the characteristics of classroom and fieldtrips, as elicited from some participants' talk.

During the episode, the fact that hands-on is a better activity than reading books in the classroom is taken for granted by participants (it is not challenged), being the fun component of it a matter for further debate. It is worth of note that the teacher never asked students whether they had fun or not during their visit to the beach. Therefore, the mention of fun by two of the students in the group brings reveals its value for in- and out-of-classroom activities within the science curriculum.

The word fun has various meanings—some might even take it as representing off-task and unfocused behaviors associated with informal settings (e.g., a family reunion

day, barbecuing, skateboarding). It is not my objective to come up with a complete conceptualization of its meaning, but rather to highlight its importance to learning as it is verbally produced by the students themselves. In further analyses I use fun and enjoyableness interchangeably, both referring to the pleasure students express fieldtrips. As I progress in the analysis, some of the features of what constitutes fun are unraveled.

Fieldtrips or classroom: Is testing a problem?

The distinctions made evident by the students and the teacher in the previous section may lead some to believe that they would be consensual. Their talk provides evidence that the converse is the case. Take, for example, the interaction that took place days before the final presentation, when students had just returned from the fieldtrip and were brainstorming the first ideas for their project. In this situation, Carl reminds Jonathan that what they are doing counts towards their science grade:

01	Carl:	This is a report. This is for our science mark.
02	Jonathan:	Do you what's really annoying?
03	Carl:	What part of that?
04	Jonathan:	We have to do the science report as a replacement for a skiing trip.
05	Carl:	I know ((looks upset).
06	Sarah:	For a what?
07	Jonathan:	A replacement [for our skiing trip
08	Carl:	[That Moses Point trip was, was a replacement for a skiing trip ((makes a face, arching his eyebrows)). That's what they filled the skiing thing in for and with ((slightly smiles)).
09	Sarah:	And we wouldn't have tests on the skiing.
10	Carl:	I know.
11	Jonathan:	That would be cool.
12	Carl:	I really wouldn't test the snow ((makes a face)).
13	Jonathan:	Oh, yeah.
14	Carl:	((Inaudible)) (.)
15	Jonathan:	What's the velocity of when you were sliding down the hill and hit a tree!
16	Carl:	The bonk ((slightly smiles)).

After being informed that the presentation is for marks (turn 01), Jonathan poses the question “Do you know what’s really annoying” (turn 02). Carl follows by formulating a clarifying question: “What part of that?” (turn 02). In his response to Jonathan, Carl also indicates his partial appreciation for the activity—the entire experience was not dull. Jonathan talks about the fact that the report is a “replacement for a skiing trip” (turn 04). In this case, it is not so much the present experience per se that is “annoying” (not fun), but the missing opportunity of going skiing—they would rather be skiing. Carl agrees, making available his emotional stance in his facial expression and voice: “I know” (turn 05). Without being told to do so, the students compare one situation with another (what is happening vs. what could have happened); thus they articulate for each other and for the analysts their emotional engagement in the activity.

The fieldtrip as a replacement for a ski trip is new to Sarah: “For a what?” (turn 06). Jonathan starts explaining the situation (turn 07) when Carl intervenes, “that’s what they filled the skiing thing in for and with” (turn 08). The use of the pronoun “they” to refer to teachers and school administrators is similar to the use made by Jonathan, which acknowledges the distributed responsibility for what happens in their classroom. Sarah articulates testing as a topic, which therefore comes to be salient and relevant: “And we wouldn’t have tests on the skiing” (turn 09). Carl agrees (“I know”). Not having tests thereby becomes a resource for supporting an argument for doing the fieldtrip. Although Jonathan seems to agree to this line of thought, “That would be cool” (turn 11), Carl responds in negation of the idea of testing skiing: “I really wouldn’t test the snow” (turn 12) and creates a facial expression that exhibits aversion. Jonathan continues by proposing a way to test skiing: “What’s the velocity of when you were sliding down the

hill and hit a tree!" (turn 15). Carl agrees at this time by referring to what would be the sound of a skater hitting the tree, "the bonk" (turn 16).

Here, if the apparent difficulty with testing is acceptable from an educational point of view, Jonathan expresses that it should not be a problem at all. Tests actually can be "cool." This, in turn, does not match the idea of being tested as expressed by the teacher in the first episode. Jonathan is willing to do whatever it takes to go skiing—even tests! Without saying, he realizes one way of making the skiing trip testable. In other words, what initially posed as a problem now is acceptable in this new circumstance.

In the present section, students are talking about the issues associated with the present activity they are engaged in—making a presentation. They are displeased with having missed the skiing trip—for which Jonathan could even think of a "cool" test. On the other hand, they are expected (by the teacher) to support its replacement with the fieldtrip to the beach, even thought they might not have taken so much enjoyment out of it—at least relatively to the ski trip. Although an educator may assume that fieldtrips are motivational, in this situation students' emotional involvement with the activity is not guaranteed. Ultimately, fieldtrips might contribute to make learning "easier" because students get to see things "for real," but it does not secure them a good time (despite the teacher's preferences).

Fieldtrips or classroom: What to do?

It is important to have students evaluate what they do in ways that they are not only pleasing their teachers to get better grades but also contributing to realize the objectives of the lessons in more genuine ways. This means that if they only challenge the status quo among themselves and in small groups—which would not allow the

teacher to come to an understanding of their needs and wishes—their actions might be insufficient to bring about relevant changes. At the same time, the teacher who asks students to evaluate curriculum alternatives has to be open to the possibility of receiving negative feedback. My data support that feedback time can be a good occasion for curricular changes to be discussed, and that they are not always opportunities for teachers to get positive evaluations of their actions. The following exemplifies this perspective.

Approximately eight months before the previous episodes took place, students went on a different fieldtrip that consisted of a daylong exploratory activity at a local salt-water lagoon. After the fieldtrip students engaged in a similar task of reporting on their learning preferences for either books or fieldtrips, with a third option for a combination of the two. Juliet addresses the class in the following episode:

> (1) I would like you to listen and I would like you to do some voting, so put your hand out like this ((stretches out her right hand)). Up is yes, so so and no, alright? ((each answer implies in a different hand position)). (2) I'm just gonna do some research for you ((talking to the researcher)), my own little questionnaire. (3) Putting your hand up, ready to vote, tell me if going out on fieldtrips helps you learn. Ready to vote? Go. (4) ((Most vote yes)). Thank you. Hands down. (5) How many of you—ready to vote?—would prefer to learn from a really pretty colored textbook in the classroom? Vote. (6) ((Most vote no)). Okay. So it's about the same again. (7) How many of you would like to have a combination of the two? Ready to vote? Wait. Ready to vote? Vote. (8) ((most vote so, so)). Okay, thank you.

Here, Juliet instructs the students "to do some voting" with their hands (1). She also adopts the role of investigator: "I'm just gonna do some research for you, my own little questionnaire" (2), as she says to the researcher (myself) present. Then, she asks students if fieldtrips help them learn in general (3). The voting result is mostly positive (4). Next, she asks students to make a choice, to reveal their preferences for either fieldtrips—unanimous choice as a good venue for learning to happen—or some (unidentified) "really pretty colored textbook" (5). In this sentence, the use of both

adjectives “pretty” and “colored” in reference to “textbook” denotes the kind of textbooks that are visually appealing and it also suggests that Juliet is presenting a certain balance between the two options. In addition, “the classroom” (5) is the place for the book to be used—“sitting and reading,” as Carl has pointed out before. The contrast between fieldtrips and classrooms (textbooks) is designed such that students choose between a fieldtrip and classroom tasks with a diminutive and ironic use of the words, “pretty, little colored” textbook.

Although there are other ways of doing environmental science in the classroom—aquarium and terrarium studies, experimental work involving sow bugs—work is again depicted mostly as textbook work. As in this class, textbook work generally is associated with testing, and there is at least an implicit reference for testing to be done. Most students vote “no” (6)—a similar result to the previous episodes. The teacher’s use of the adverb “about” with the quantifier “the same” and the conjunctive “again” is strategic in that any specific count would require a specific decision, whereas the uncertainty associated with “about the same” allows her leeway in choosing among alternatives. The third and last option is very similar to the first one in that it is not a matter of preference: Students are asked to image what it would be like “to have a combination” of fieldtrip and textbooks. They mostly vote that it would be “so, so.”

Juliet singles out Mark (student) and asks him about his preferences:

08 Juliet: So, what would you prefer to have?
09 Mark: What you mean?
10 Juliet: Well, I said going on a fieldtrip, having a book, or a bit of both and you said *nhea* to both of them, to all three of them. So what would you rather do?
11 Mark: Probably go on a fieldtrip. ((One student says something inaudible)). But, it doesn’t, ’cause, ’cause sometimes you don’t like the fieldtrips, so it’s just like sending out a textbook.
12 Juliet: Aha. Fair enough. What sort of fieldtrips do you find, you feel that way about?
13 Mark: When we go to a museum and they talk, talk about stuff they did last year.

		((Inaudible)). ((Students muttering "that's boring"). You already know. Or they just talk about it for an hour and half and you don't do anything.
14	Juliet:	Oh. I see, so the sort of talking-head fieldtrip? ((Class mutters in agreement)). They just take the head and put it in a different room and it talks? ((Class muttering indistinctively)).
15	Mark:	((Inaudible))
16	Juliet:	So you much prefer to be physically involved [like
17	Mark:	[Right
18	Juliet:	[active on a fieldtrip. ((Class mutters in agreement)).
19	Mark:	((Nodding))
20	Juliet:	So, would you say going to the museum and just walking and looking is not what you'd call an interactive fieldtrip? ((Some students cut in and talk. The teacher manages to get back to Mark)). So, if you went to um… the museum, and there was just people talking about olden times and that sort of things, that would not be the same as the fieldtrip we did with Nina and the rowing.
21	Mark:	((Nodding)) Yes, not as good.
22	Juliet:	Not as good.

Juliet's question—"So, what do you prefer to have" (turn 08)—puts Mark on the spot, as he is now required to articulate his preference in public. With his response "What do you mean?" (turn 09), he avoids stating a preference for a moment; as he asks the teacher what she means, Juliet now is forced to articulate the context of her question again and more specifically. In her next turn, she summarizes the alternatives and Mark's voting history. She thereby exposes the fact that Mark has not articulated a clear preference, as his answer was the same in both instances, which in fact reflects her own assessment of the overall preference of the class as a whole ("about the same"). In this context, therefore, asking Mark for his specific preference is a move that sets his answer up as the deciding vote. "So, what would you rather do?" (turn 10).

This time, Mark responds with a more specific statement of preference, however, his use of the adverb "probably" sets up a situation where he could still change his response. He continues by providing a possible explanation for the modifier "probably": Sometimes fieldtrips are not the preferred curricular choices, especially when one does not like them, in which case they are "just like sending out a textbook" (turn 11). Here,

then, the textbook is associated with negative experiences of schooling (as shown for Jonathan and Carl, see Figure 4.1). Likening something to textbook work therefore becomes associated with the negative aspects of curricular experiences, whether it be fieldtrips or classroom tasks. Interestingly, Mark does not refer to himself, but uses the pronoun "you" along with "sometimes." This is a discursive move that shifts agency away from him. Whereas Juliet asks him about his personal preference, Mark responds by talking generalized preferences ("you"). He expresses the possibility of experiencing fieldtrips in a negative way without stating that this is how he views the situation. Once again, the distinctiveness of the two activity systems (classroom and outdoors) is not as sharp as many environmental educators might expect (compare with the relevance repertoire discussed in chapter 3).

Juliet takes the response as "fair enough" (turn 12), thus accepting the possibility of such experiences to be real. But in asking Mark about the specific type of fieldtrip that is like a textbook, he is confronted with having to further articulate the context in which fieldtrip experiences are negative. Mark talks about going to a museum, where "they talk about stuff they did last year" (turn 13); others chime in—"that's boring" (turn 13)—and therefore support Mark,. Whatever "they," whoever this might be, "did last year," is not something of interest to Mark because "You already know" (turn 13). Here again, he uses the indefinite "you" rather than the specific "I." In some sense, the "you" is inclusive, implying that others (including students) already know.

Mark continues to specify the aspect of a museum visit that turns a fieldtrip into a negative experience: "They just talk about it for an hour and a half and you don't do anything" (turn 13). Here, the indefinite others who do presentations in the museum, do

the talking, thus relegating the indefinite audience to mere listeners. Again, Mark's use of "you" both turns agency away from himself, so that he does not clearly articulate his personal preference, and is inclusive in that it allows for other students to have the same experience. That is, Mark articulates museum visits as the source of negative experience without committing him or a specific number of peers to this position.

By using a specific denotation "talking-head fieldtrip," Juliet explicitly states that she not only knows of such situations expresses the negative connotation that comes with the term in the general culture. She elaborates, "they just take the head and put in a different room and it talks?" (turn 14). Mark is not the only one to concur. For the second time, the teacher sounds surprised—"Oh, I see" (turn 14)—before acknowledging the possibility of her students not sharing her enjoyment of fieldtrips. If students are to have fun, Mark's talk suggests that novelty is an important component. In the end, he agrees with Juliet that he prefers to be physically involved (turns 16, 17, 18 and 19).

Subsequently, Juliet provides a summary of what she has heard Mark say (turn 20). In the process, she introduces the word "interactive" as opposed to going to a museum and "just walking and looking" (turn 20): Museums are depicted as places where people talk about "olden times" (turn 20). Likewise, the teacher pushes for a positive evaluation of the fieldtrip: "That would not be the same as the fieldtrip we did" (turn 20). Mark partly agrees ("Not *as* good" [turn 21]), introducing uncertainty about his own preferences. Noticeably, he has not talked about the "olden times," but about the things the unspecified "they" have done during the preceding year (turn 13). The teacher concludes with a comparison that sets up a contrast between the museum (informal

setting) with the outdoors activity (non-formal setting) they had recently participated in (metonymically indexed by its rowing component).

After talking to Mark, Juliet calls on another student, Marco, who has been demonstrating willingness to participate in the discussion (he raised his hand constantly)\. He draws Juliet's attention to the fact that museums can be fun, even though there is not much hands-on involved:

23 Juliet: Okay. Marco you were going to say something.
24 Marco: I was gonna say but, like, I've said that a lot of people like different things, if you're just talking and they talk about something you already knew that would be boring, if you're like walking around in a museum, like with art and culture, that'd be kinda cool [I like that.
25 Juliet: [In what way?
26 Marco: It's like looking and learning about like.
27 Juliet: Oh. So, you like just walking and looking? [Rather than-
28 Marco: [Yeah, looking at art, because I like art.
29 Juliet: But rather than-
30 Student: Standing there [and hearing them.
31 Juliet: [Rather than rowing and that sort of thing?
32 Marco: No, that's fun but, I mean, I would've like-, we, I would go to a museum and it would be fun just as rowing.
33 Juliet: Okay.

Marco draws on some of the discourse Mark has just provided to articulate a different perspective and he similarly does so without committing specifically to it (turn 24). Different people like different things. Marco first re-articulates the boring nature of listening to "something you already knew" (turn 24), but then proposes a different way of being at the museum "that'd be cool": "Walking around, with art and culture" (turn 24). Initially invoking a possibility, Marco then commits to wandering about as a preference. Yet Juliet wants Marco to be more specific, "In what way?" (turn 25). Marco specifies "looking" and "learning" as aspects of the type of visits he enjoys, but before he can articulate the learning object ("about") Juliet formulates surprise (she uses the interjection "Oh" (turn 27), a recognition of precisely what an enjoyable visit contains "just walking

and looking." She begins a comparison, but leaves open what the second part in the comparison would be, "Rather than-."

The unfinished comparison invites completion. But Marco, who has begun to talk prior to Juliet's end of the utterance reiterates what he has said before, "looking at art," and then clearly states a preference "I like art" (turn 28). Here, he commits to a preference, which contrasts the use of a non-specific "you," and specifies the nature of his liking, "art." Juliet in turn restates the last two words of her previous utterance "rather than," prefaced by the conjunctive "but," which states opposition. In her turn, Juliet therefore reiterates her request for a completion of the comparison. She does so in three ways. First, in repeating the "rather than," she invites Marco to complete the comparison. Second, in using precisely the same phrasing, she co-articulates an admonishment that the previous request has not been fulfilled satisfactorily. Third, in using the conjunction "but," she acknowledges Marco's articulation of a preference all the while stating that this is not a sufficient or anticipated completion that the pending comparison requires.

Another student offers a candidate articulation as completion: "Standing there and hearing them" (turn 30). Juliet, in turn, offers to complete the comparison between the museum and the fieldtrip to the saltwater lagoon, "Rather than rowing and that sort of thing?" (turn 31). As the tone of her voice rises, the utterance can be heard as a question, rendering the stated situation as a possibility rather than the definitive case to be entered in the comparison. But Marco does not accept this as the term to be entered in the comparison, "No," and then articulates the referent "that" to be "fun" (turn 32). He begins a contrast "but," followed by a formulation of what is about to come, a statement about what he really means "I mean." There is another unfinished sentence "I would've

like-," followed by a statement that "going to a museum would be fun just as rowing." The effect of his utterance is to increase indecision, as Marco states more than one preference, thereby leaving it open whether he prefers one type of fieldtrip over another. Although he begins with stating a clear preference for the museum, he has now, following the teacher's repeated request to compare his preference with an alternative, changed to declare equal preference for both.

In this last section, students articulated different ways of making fieldtrips more appealing to them. As my analysis shows, students do not talk about learning preferences in terms of in- or out-of-classrooms settings, but rather the quality and nature of their doings in the two environments and the problems stemming from the similarities between them.

Discussion & implications

This study was designed to investigate how students and teachers articulate preferences for different types of science activities, including fieldtrips intended to provide science experiences through EE initiatives. Fieldtrips that are to increase students' interest and motivation frequently do not fulfill this design goal: Fun may not be fun at all. Some researchers suggest that education loses out when entertainment (thus "edutainment") becomes a major consideration (e.g., Wymer, 1991). My analysis shows that in their face-to-face talk students—both in the teacher's presence and absence—take a less unquestioned position. Simply taking students on fieldtrips will not necessarily lead to interest, enjoyment, or learning (e.g., Dillon, 2003), which my study suggests can potentially compromise students' engagement in any work they perform. To be emotionally positive, curriculum experiences need to involve novelty and ownership.

Moreover, fun is central for students. They talk about wanting learning to be fun even if this is contrary to what generalized others ("they") want—a discrepancy that has been also reported elsewhere (Griffin, 2004). Teachers, exemplified here by Juliet, may be looking for support with outdoors activities to establish a contrast between the classroom (mostly depicted as reading textbooks). Ultimately, the originality (novelty) of the activity and the personal involvement of students are important attributes in activities regardless of testing. This result runs contrary to the notion of what is traditionally considered "educational" by students and teachers. Many teachers presuppose that changing settings (classroom/fieldtrips) has the potential to contribute to enhancing students' interests and motivations and thereby enhancing their learning processes. The cases reported suggest that some situations in which participants find themselves are not unlike structured classroom lessons, which students articulate in terms of the image of sending textbooks into the field.

Students' description of their fieldtrips indicates the fact that they sometimes do not enter a different activity system when leaving the classroom—a possible and salutary transition successfully described elsewhere (Roth & Barton, 2004) and that ultimately concurs to the public interest of education in general. The failure students experienced in the past allows them to engage in the kind of reflexive thought publicly exhibited here, indeed, a *secondary experience* according to a progressive (Deweyan) view of education (Miettinen, 2000). For example, the denotation "talking head" articulates a museum situation that turns students into spectators rather than active learners. In such situations students merely listen, just as when a newsreader or correspondent appears through the camera in close-up shots (e.g., Fairclough, 1995) as the audience (viewers/students) looks

on. This is associated with a vision of what environmental education (and science education to an extent) should be when it was accepted that accurate information would be enough to change people's values, attitudes, and behavior for the better (e.g., Gough, 2002). It partly results both from the environmental education institutionalization process (Gruenewald, 2004) and its commodification, where knowledge is attributed buying and selling value as students become the object of change, merely replicating the performances of others (Lave & Wenger, 1991). The separation of the goal of the activity from the activity itself reduces the activity and its participants to a mere means, leaving little room for reflection (Doll, 2002).

The notion of agency help us to understand why learning is expansive and inherently motivating when students frame curricular tasks and contexts. In such situations, they take control over their conditions and, by framing what they need to know to achieve their goals, expand their own action possibilities. Agency works in two ways. First, in taking control over an aspect of their curriculum, students exercise their power to act (agency); and second, by doing so, they expand their power to act (agency), which inherently is motivating—students' *control belief* has been reported to influence their performance (Pintrich, Marx, & Boyle, 1993). Ultimately, students should be given opportunities to engage in making decisions about what kind of activities enrich learning and allow them to perform actions that they identify as learning. The fact that these students might be experientially challenged—what is now being referred as Nature Deficit Disorder (Louv, 2005)—should not downplay the importance of what they have to say about the fieldtrips they participate in. In the end, "the consideration of children's

goals, emotions, and interests is important in constructing a nurturing classroom culture" (Zembylas, 2004, p.716).

CHAPTER 5

PUBLIC UNDERSTANDING OF SCIENCE AND NEWSPAPERS: A FRAMEWORK OF ANALYSIS IN/FOR SCHOOL SCIENCE

Abstract

Throughout the world, science teachers are told to allow their students to make sense of school science content knowledge by connecting it to the everyday life. Newspapers are among the recommended resources and tools to be used in science classrooms for this purpose. Also, they have shown the potential to influence the way science and the scientific enterprise are perceived publicly, thus mediating the public understanding of science generally and the scientific career choices students make more specifically. However, research focused on the use of newspapers for the popularization of science in schools has ignored the resources actually provided by media reports for the sense-making of readers such as headlines, photographs, and space allocation. Therefore, the present chapter draws on ethnographic materials (classroom observations, interviews, and newspaper articles) to introduce a framework for analyzing newspapers that manifests these interactions amongst those resources. I also provide a case study of a high-school biology teacher reading a newspaper article to her classroom to illustrate what resources teachers use to make sense of the news report for their students. This investigation shows how the content of science in newspaper reports and the structural organization in which they are embedded work together to mediate readers' interpretive actions by distinctively placing importance on certain aspects of what is reported. The approach I propose is of particular interest to those science educators who want to profit more from introducing media in their classrooms as means of enhancing students'

aptitude and ability to read and respond critically to public representations of science. It also contributes to the appreciation of how images of science and its endeavor are discursively built into the structure of this type of public text (newspapers).

Introduction

Mass media consumption is a pervasive activity in our ordinary lives, sometimes creating a mediated reality indistinguishable from life itself (Lind, 1998). The fact that media producers use effective strategies to sell their stories—or sell audiences to advertisers (Fairclough, 1995)—makes media play an influential role by determining a specific cultural framework that provides a reference point for validity and acceptance of what is socially desirable (Pellechia, 1997). As a result, people relate in diverse and powerful ways to what is presented to them in the media. For instance, media has been associated with aspects of public controversies (Hagendijk & Meeus, 1993), nationality identity (Strelitz, 2002) and education for citizenship (Dimopoulos & Koulaidis, 2003). Statistical data corroborate the pervasiveness of media in our lives. For example, two-thirds of adult Canadians surfed the Internet in 2005, out of which roughly 60 percent used it to read news or sports, or to conduct their online banking (Statistics Canada, 2005). In the print media sector, consumption is no less impressive. Not only has paid-for daily newspaper titles recently surpassed ten thousand worldwide for the first time in history, but more than 450,000,000 copies are sold every day on the planet—a fact that defies conventional wisdom in the current era of electronic media (World Association of Newspapers, 2007).

Mass media content in general is both an indicator of public thinking about science and the scientific processes and a resource for that same thinking. This is to say

that media texts reflect the conceptions held by the relevant editorial bodies of what the audiences want or need to know about science as much as they reflect what people already know about it. In elevating or downplaying information in certain ways, media mediate not only the way people interpret media reports but also their (people's) disposition to seek similar texts (Einsiedel, 1992; Norris, Phillips, & Korpan, 2003) and their particular interests in scientific careers. Ultimately, media have become increasingly important to the public understanding of science, contributing to inform and educate individuals about science-related issues (e.g., Korpan, Bisanz, Boehme, & Lynch, 1997; Wellington, 1993).

The continuous and influential exposition of science in media (whether involuntary or unconscious) makes the incorporation and critical evaluation of these materials into schools seem inevitable, especially because of the widespread practice of urging teachers to enable students to link school science to their everyday world (Elliott, 2006). For example, the British Columbia Ministry of Education's Integrated Resource Package (IRP) for grade eight science states that media education is one of the cross-curricular interests that guide each component of the curriculum to make education relevant by developing students' abilities to think critically and independently about issues that affect them and encourages them to identify and examine the values contained in media messages and cultivate the understanding that these messages are produced by others to inform, persuade, and entertain for a variety of purposes (British Columbia Ministry of Education [BCME], 1996). Similarly, the IRP for eleventh- and twelfth-grade biology states that literacy in the discipline "involves a critical examination and understanding of the ethical and social issues related to the use of information and

communication technology" (BCME, 2006, p. 12). Although media never was an educational tool per se (Anderson, 2002; Wallace, 2004), the benefits and limitations of the incorporation of media into science classrooms have been documented for reasons such as promoting or altering students' general interest in and perspectives on science by linking it with everyday life (Jarman & McClune, 2002; Phillips & Norris, 1999).

Among the media used for science education purposes, like the Internet (Linn, Davis, & Bell, 2004), TV (Long, Boiarsky, & Thayer, 2001) or films (Steinke, 2005), newspapers remain popular among teachers. However, how newspapers (re)construct images of science and the work of scientists through the combination of their content with other elements of the publication—including headlines, photographs, and space allocation—has received little attention. At this point one can still wonder at the relevancy of scrutinizing newspapers whereas school students probably have their attention draw to TV, Internet, and some magazines targeted for teenagers. If that is the case, then the introduction of newspapers could contribute to the expansion of what students read about science, so that they could choose and profit from a greater variety of media sources. Moreover, newspapers can offer more perspectives than TV (Wade & Schramm, 1969) and have certain linguistic and structural features that facilitate their use and retrieve of information, such as collectability, searchability, availability, and be stationary.

The purpose of the present study is to offer a framework for analyzing newspapers that manifests the intertwined nature of the general organization of a publication and the individual content of science reports. Just as newspaper staff attempts to draw readers' attention to certain science topics and issues, these elements become

resources that help readers to achieve meaning and coherence of what they read—also depicting science and the scientific enterprise in a peculiar way. Moreover, I offer an illustration of which resources readers use by providing a case study of a high-school biology teacher reading a science-related newspaper article in her classroom. In the science classroom context, an analytical approach to the use of newspapers is of interest to those who want to profit more from utilizing print media in their classrooms as means of enhancing students' aptitude and ability to read and respond critically to public practices at work to sell particular facts in and about science, thus expanding their ability to make informed decisions about possible scientific career choices. Otherwise, the recommended use of science news in curriculum design and assessment (e.g., Millar & Osborne, 1998; Wellington, 1991) tends to contribute poorly to building into readers' scientific literacy (e.g., Kachan, Guilbert, & Bisanz, 2006).

Method

In the present chapter, I introduce a framework of analysis of science-related reports in newspapers. This framework manifests the way newspapers articles' content and other elements of the publication work as resources for readers to make sense of what they read: a point often overlooked by research on the specific use of the press for the public understanding of science in educational contexts. I take a close look at one case study of a high school biology teacher reading a newspaper article to her students to illustrate what resources are drawn on by readers in a authentic situation of reading. The teacher did not carry out her lesson for my research interests, thus making available to me what she (as a teacher) communicates as important to assist students to learn.

For the purpose of this study, I chose to exemplify my results with the analysis of articles on the topic of dogs that can diagnose the presence of certain types of cancer in humans. There are three main reasons for my choice. First, health-related themes are amongst the most common in the print media brought into classrooms (e.g., Farman & McClune 2002; Hansen, 1994). Second, cancer-related issues strike people in vivid ways and on a daily basis—an estimated 159,900 new cases of cancer will occur in Canada in 2007 (Canadian Cancer Society & National Cancer Institute of Canada, 2007)—thus pressing the critical reader for positioning him/herself in relation to the events being reported. Third, cancer research has drawn media attention for many years. Fourth, the news involves a well known domesticated creature (dogs) and people in general tend to enjoy relationships with animals (Knight, 2005). These arguments altogether indicate that large amounts of materials related to the particular topic on cancer are available to be utilized in the science classroom. I have chosen not to include the editorial line of the papers in my analysis for I understand my framework works independently of any socio-political or economical bias.

All newspapers in my database were retrieved through the Canadian Newsstand Database, which provides full text access to articles, columns, editorials, and features published in forty-seven Canadian newspapers. I performed an advanced search for texts containing the words <dog> AND <cancer> AND <sniff> in CITATION AND DOCUMENT TEXT that returned 83 hits, none of which had pictures available. Among the total search results there were captions of pictures, stories of cancer-sniffing dogs that have detected cancer in non-research contexts, brief notes of research findings, citations of these same findings as examples of what dogs can/could do, and as a topic of comment

in a column, front page announcements, random texts with no connection with the topic whatsoever (not included), and repeated texts—i.e., same article or a shorter version appearing in different publications. In the particular case of the teacher of an eleventh-grade biology course, who used news media as part of her teaching, the article was retrieved in full at the microfilm section of my university library. I also include in my analysis an interview with the same teacher where she accounted for the general use of newspapers in her praxis.

In my analysis of the contents of newspaper articles I draw on discourse analysis (DA) as method and theory. Discourse analysis represents an approach to the analysis of talk that has evolved over the past two decades in sociology and social psychology—in the wake of which the new field of discursive psychology emerged (Edwards & Potter, 1992). Specifically, discourse analysis is the study of texts, how these are used to perform actions; and discursive psychology is the application of ideas from discourse analysis to issues in psychology, providing a novel perspective on almost the full range of psychological phenomena (Potter, 2003b). This perspective not only allows me to analyze what is written, but also how it is written, and to evaluate the function of discourse within the context where texts are embedded in (other elements of the publication). Ultimately, all the ethnographic materials included here—interview, classroom footage, and news reports— and the analysis of the discourse of news reports contribute to exemplify the use of the framework I propose for the analysis of media and the public understanding of science in science classrooms.

Newspapers articles: Principles of analysis

In an era where access to all kinds of information is nearly inevitable, the claim that "the world we inhabit is a media world" (Fleras & Kunz, 2001, p. 59) seems appropriate. Although the exact extent of media influence on their audiences is still a matter of debate (e.g., Brattstrom, 1999; Corner, 2000; McCullagh, 2002; Potter, 2004; Schudson, 2003), much of the discussion surrounding the public understanding of science in the media has taken place within the confinement of the so-called deficit model—i.e., the widespread idea that members of the public are ignorant of science (Wright & Nerlich, 2006). Likewise, research has assessed media content in terms of accuracy and adequacy of contextual factors and methodological details as if these texts were independent entities and their readers were passive (Evans & Priest, 1995).

From a socio-cognitive perspective, and for the specific case of newspaper science news, these past studies not only have privileged a faulty understanding of the discursive and structural resources newspapers contain for audiences to make sense of—thus mediating the public understanding of science—but they also neglect the significance of multiple interpretations for a broader perspective on science and the scientific endeavor. (These studies also hinder possible discussions of the inadequate methodical and theoretical aspects of these studies [Lévy-Leblond, 1992].)

The purpose of this article is to provide a framework for analyzing newspapers' science reports. This framework is based on the assumption that even though these types of publications apparently present scientific information in a factual manner, an enthymematic reasoning strategy (Locke, 2002), the matter of fact is that they also provide certain resources of common sense—unstated presuppositions—to persuade the

audience to make links in specific ways to reach desired (and often implicit) conclusions (Van Dijk, 1991). Thus, "just as newspapers are not in the business of educating their readers, they are not in the business of giving them facts either. (…) It is no part of a journalist's job to report the facts: he must report what he is told are facts" (Wilkie, 1991, p. 578).

Persuasion, in this sense, is a key element of my framework. It supports the idea that newspaper production is part of a bigger process of media marketization, an ambiguous site in which opposing interests from owners to audiences engage in a competitive struggle for control. For example, journalists are constantly forced to make rapid decisions that turn their description of science the product of their personal choices to present them in a fashion that is relevant to newspapers editors as well as to the large, anonymous and heterogeneous audience. Fundamentally, science stories are chosen, written and presented in ways to transform science news into a reality to be consumed by readers and at the same time maintain a financially satisfactory circulation level.

In sum, the rhetoric utilized in newspapers' science reports does not work independently of other structural components of publications—like headlines, presence and types of pictures, and space allocation—to make sense of the news and persuade readers. This process of accommodation of science in newspapers is also flexible enough to allow journalists to either pick different stories or modify the way they are portrayed.

Front-page news: Headlines and pictures

My framework (schematically presented in Figure 5.1) is based on the premise that the content of an article in and of itself denotes little; it is in its relation to other texts and other elements of the publication that meaning is constructed and mediated. The

analysis of press includes the analysis of photographic images, layout and the overall visual organization of pages to understand how these semiotic modalities interact with language in producing meaning. Nevertheless, even the details that are backgrounded (silenced) become evidence of the common knowledge the newspaper audience is expected to share.

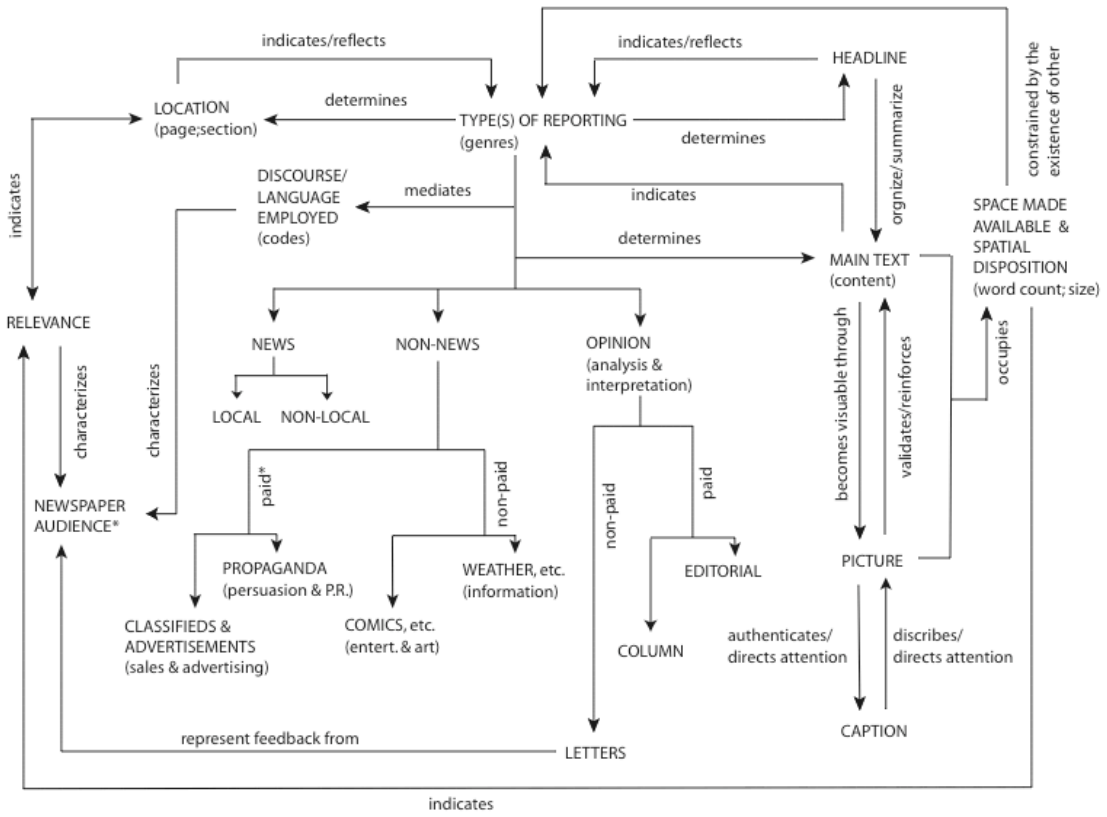


Figure 5.1. The framework developed for the analysis of newspapers show how the content of an article is related to other elements of a publication—which we argue are resources that mediate the interpretation of science reports. Some pairs involve double-headed arrows, meaning they mutually constitute one another in a dialectical relationship.

In the context of newspapers, there are elements of the publication that have the primary function of catching the readers' attention to what is being reported. For this reason, these elements are made more apparent to the reader in many ways: They usually

include short sentences with a differentiated (bigger) letter size (HEADLINE) and/or might have an inscription (PICTURE) containing a CAPTION or NO CAPTION. Moreover, the LOCATION (e.g., front page of the publication) and the SPACE MADE AVAILABLE (e.g., word count or percentage of the page occupied) are also resources that help indicate to the reader the IMPORTANCE placed upon certain reports.

HEADLINES express the top of the underlying semantic macrostructure (Van Dijk, 1988). In the production and reception of news reports they are particularly important because they define the most prominent information of the news item. For example, on the front page of the Times Colonist (January 12th, 2006), a local publication with an average daily paid circulation of more than 70,000 copies, one can read the following headline "The nose knows" ("The nose knows," 2006, p. A1). This headline (differentiated from the subsequent text by a larger font size) is three words long and indicates that the news report is related to "the nose" (singular) and the fact that it provides information about some unidentified matter. The sentence is affirmative, thus leaving little or no room for speculation: the nose *does* know. However, the context is also of uncertainty—what exactly does the nose know? This missing piece of information potentially persuades those interested readers to search the small text below the headline for more details.

The presence of a PICTURE of a dog's face in close-up helps the reader to infer whose "nose" the headline talks about—maybe the nose of the specific dog in the picture? Although the word "dog" is not part of the headline, the photograph readily implies it and becomes a resource for the reader to make sense of that particular front-page headline. In this way, the picture authenticates and directs attention to the headline

and the text that comes with it, possibly favoring this news over those without pictures (e.g., Davies, 1979; Halkia & Mantzouridis, 2005). Therefore, the choice of picture is not arbitrary but is motivated by the content of the main text and vice-versa. Since both picture and text (headline included) are not independent, the latter functions as a CAPTION that describes and directs attention to the picture. In the end, the picture serves a dual purpose: It illustrates the news and becomes a resource for the meaning making of readers.

The paragraph under the headline is forty-three words long and occupies roughly the same space as the picture (LOCATION and SPACE MADE AVAILABLE). It is located next to the "index & weather" section on the left bottom side of the front page, which contains two more news reports and three other images (Figure 5.2). The article reads as follows:

> Here's one more reason to love our four-legged friends. In a study conducted by California scientists, dogs showed an uncanny ability to detect cancer, even in its early stages, by smelling the breath of patients for telltale chemicals given off by cancer cells. Story, A2. ("The Nose Knows," 2006)

The introductory sentence states that the news article presents another reason for liking "our four-legged friends" (plural), one that readers are probably unaware of ("Here's another reason to love . . ."). The use of the word "love" in combination with "our . . . friends" sets the emotional tone of the report: Dogs do loveable things to us. Moreover, the possessive pronoun "our" identifies the author with what is probably the greatest parcel of his audience: those who like or own dogs. At the same time, it suggests that all readers feel the same about these animals: Dogs are our loved friends. If one takes into consideration that the headline reads "the nose" (singular) and that the text is about "our friends" (plural), then readers are faced with an expansion of the headline to include the noses of all dogs. All these discursive strategies—emotional tone and

generalization—work as attention-grabbing features that serve the purpose of increasing readers' interest in reading the remainder of the story by making a public matter particular.

As the text continues, it provides the reason for loving dogs by explaining what the nose knows: In a scientific research conducted in the US, dogs have showed an "uncanny ability to detect cancer, even in its early stages." Here, the sentence "study conducted by California scientists" contrasts with the use of the adjective "uncanny." It explains: Although the "dogs" in the "study" were able to smell "the breath of patients for telltale chemicals given off by cancer cells," the physiological mechanism behind this ability remains a mystery and the "scientists" involved in the experiment have not found the cause of the phenomena. Based on this observation, one does not expect to be informed on how dogs can differentiate cancer "telltale chemicals" from others that are given off by different life-threatening diseases (e.g., diabetes and liver disease). Noticeably, the validity of the information presented is assured on the grounds that a scientific experiment was performed—science certifies the unclear. This scientific endorsement of the inexplicable, in turn, helps expand the article's potential audience to include cancer patients, health professionals and researchers. The text ends with an indication (in bold) that the full "story" can be found on page A2, which can also be taken as an invitation for readers to refer to the full report inside the paper.

The general structure of the news (schematically represented in Figure 5.2) along with its location (front page) informs the reader about the relative RELEVANCE attributed to what is reported. Together, these elements not only prepare the reader for what is coming, but they also organize the reading and mediate the interpretation of the report.

They function as intertexts of one another, being used as backgrounds against which they can be read (Roth, Pozzer-Ardenghi, & Han, 2005). For instance, from the reading of this initial account of the story one can infer that most of the newspaper audience is interested in dog/cancer-related news—if not in scientific discoveries in general. In addition, these components of the news report allow the reader the opportunity to see the uncertainty of scientific investigation where causes of phenomenon are not always understood. Nevertheless, science remains as evidence in favor of what scientists do. By no means is the radical uncertainty of the scientific enterprise negatively portrayed in the text—or else the news would have lost its credibility and value.

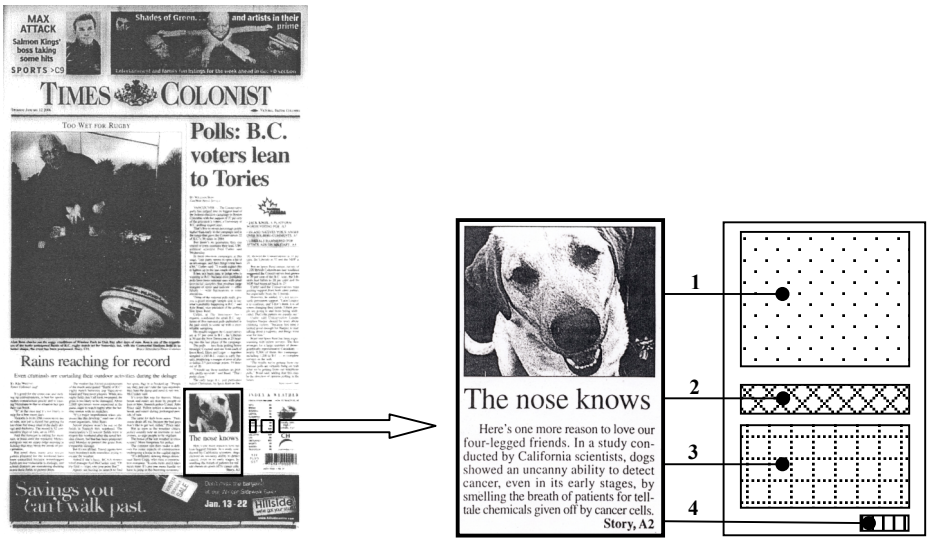


Figure 5.2. Detail of the front page of the Times Colonist (January 12th, 2006), showing in detail (amplified) a news report on the case of cancer-sniffing dogs. Also, a schematic representation of the front-page announcement is provided. (1) Picture, (2) headline, (3) text, and (4) indexical reference by means of which readers are referred to a particular page inside the publication.

Inside the news: The full article

Inside the newspaper (on the designated page A2), one can find another headline on top of the full article (Figure 5.3). This secondary headline reads: "Dogs show ability

to sniff out cancer" (Spears, 2006, p. A2) In this case, the headline is longer and more specific than the previous one. It clearly indicates that the report is about "dogs" (plural) and the fact that they have been able to demonstrate the "ability" to detect "cancer" by sniffing it out, which re-states (summarizes) what the front-page announcement introduced. The verb "to smell" (incidental) in the first account is substituted by the verb "to sniff," which is a more accurate word to describe what dogs do and it also ascribes intention to the action. After all, there is a purpose for sniffing that is less intentional than smelling.

The secondary headline is semantically similar to the front-page one in three ways. First, it is an affirmative sentence, which leaves little or no space for speculation on whether the cancer-sniffing ability of dogs is a matter of debate or personal opinion. This determines and reflects the type of reporting (genre) one would expect (overlapping of different genres is possible)—NEWS, as opposed to NON-NEWS (classifieds and advertising, propaganda, comics or weather reports) or OPINION (editorials, columns, and letters). Also, it anticipates and confirms the front-page announcement that the news report is of immediate interest to certain audiences (dog owners, cancer patients, and health professionals and researchers).

Second, the headline leaves unstated certain aspects of the news (although at this point readers are likely to know from the front page that the dogs' sniffing ability was investigated by scientists): How have dogs demonstrated this ability? Does this news apply to all types of cancer? Again, these omissions are an element that potentially directs readers to the full text in search for specific information. The existence of an introductory headline such as this allows for the remainder of the text to be placed in

many different LOCATIONS (pages and sections) within the publication (e.g., animals, health, life, international news, and science). Indeed that is the case in my database: the story was run in different sections across different publications, none of which were explicitly identified as science.

Third, the fact that this particular headline appears as a top story on the second page inside the publication corroborates the relevance of the news it presents (imputed previously by the front-page text and picture). If one takes into consideration Western cultures' pattern of reading (right to left), this headline and the accompanying text are one of the first stories the reader encounters.

Figure 5.3. Page A2 of the Times Colonist (Jan 12th, 2006) containing the full text announced on the front page.

The SPATIAL DISPOSITION of the text and space made available (dimensions and word count) reinforces the relevance imputed to the article both in relation to the page where it appears and to the news agenda of the day. The full article was referred to by the headlines and the picture is located in the top right corner of page A2, occupying

approximately 12 percent of the printable area of the page (438 words, which is an average for news stories [Wilkie, 1991]). The article reads as follows (the numbers in parenthesis mark the beginning of paragraphs in the original report):

> (1) Dogs can often detect cancer, even in its early stages, by smelling the breath of patients for telltale chemicals given off by cancer cells, a clinical trial in California shows. (2) The Portuguese water dogs and Labradors could, after brief training, sniff out which people had lung or breast cancer with accuracy rates between 88 and 99 per cent -- better than some laboratory tests. And they weren't thrown off by cigarette odour in breath. (3) Now the California scientists who did the study suggest this sniffing -- nicknamed dognosis, as well as Lab testing -- could be an extra screening tool for detecting cancer's first stages. (4) All cells give off waste chemicals. But cancer cells give off some distinct ones -- a mix of organic vapours such as benzene (also found in gasoline) and alkenes, which the body flushes away by exhaling. (5) Dogs can detect some chemicals diluted to a few parts per billion in air. Scientists have heard anecdotal reports for years about dogs that curiously sniffed owners who developed skin cancer, and stopped when the tumours were removed. (6) In Italy, researchers have been experimenting for at least three years with a machine to analyse the breath as a way to diagnose cancers. (7) Now five dogs tested by the Pine Street Foundation, a California cancer research group, showed an ability to identify or rule out lung and breast cancer correctly, at both early and late stages, about 90 per cent of the time. Both dog breeds performed at the same level. (8) And the scientists say their success with early-stage cancer is key, meaning the test could be valuable for detecting cancer when treatment has its best chance for success. (9) "Training was efficient and cancer identification was accurate," the team writes. "In a matter of weeks, ordinary household dogs with only basic behavioural 'puppy training' were trained to accurately distinguish breath samples of lung and breast cancer patients from those of controls (healthy people)." (10) In lung cancer, the study notes, chest X-rays and sputum tests (analysing mucus from the lungs) "have a high false-negative rate and therefore fail to detect many early-stage cases." Mammograms for breast cancer aren't perfect either, it says. (11) The handlers made five dogs (three Labs, two Portuguese water dogs) sniff the breath of 55 people with lung cancer, 33 with breast cancer, and 83 healthy people. The breath samples were collected in Ziploc bags; dogs and study volunteers never met. In all, the dogs sniffed samples more than 12,000 times over four months. They learned to sit or lie down if they smelled cancer, and to move on to the next sample if they didn't. (Spears, 2006, p. A2)

The first paragraph contains the same information as the front-page announcement and second headline. The word “study” (used previously) is replaced by the expression “clinical trial” along with the adverb “often” giving the news a less affirmatory connotation than both headlines. The amelioration of the possible impact of the report on readers continues in the second paragraph with the introduction of new facts: Only two breeds of dogs (“Portuguese water dogs and Labradors”) were used in the

study to investigate whether they could distinguish between "lung or breast cancer." The use of an auxiliary verb in the sentence "could, after brief training, sniff out" is congruent with the "accuracy rates between 88 and 99 percent." However, even though there is between 1 and 12 percent chance of fallibility, this percentage range becomes irrelevant in light of the observation that the dogs have performed "better than some laboratory tests." Furthermore, mentioning that the canines required "brief training" enacts the idea of a desirable controlled environment within which the research took place. Scientists subjected all of the dogs to the same training (independent variable), which possibly explains also why the dogs "weren't thrown off by cigarette odour in breath" (2).

The contingency of the "clinical trial" is again suggested in the next paragraph (3): The scientists "who did the study suggest this sniffing . . . could be an extra screening tool for detecting cancer's first stages"—after all, the dogs preformed "better than some laboratory tests" (2). At this point, the text suggests that the findings are generalizable, although not conclusive. This particular sniffing process was named "dognosis as well as Lab testing," both supporting the research aura involving the news and adding an imaginative play with the pairs of words diagnosis/dog and Labrador/laboratory tests, respectively.

As the text continues (4), it gets into more detail and explains how the composition of the waste chemicals given off by cancer cells is different than those regularly given off by "all cells": "a mix of organic vapours such as benzene (also found in gasoline) and alkenes." In addition, it describes the process that gives cancer patients a distinct breath—"the body flushes [those organic vapours] away by exhaling." The specialized language employed here not only presupposes that the article's audience

understands it, but also informs me of the relevance of what is described to the comprehension of the text. The association of gasoline to one of the chemicals helps make the term "benzene" more familiar to—if not interchangeable for—the reader.

Another piece of technical information is offered (5): "Dogs can detect some chemicals diluted to a few parts per billion in air," which prompts the reader to include the chemicals listed in the previous paragraph. Next, the possible origin of the project is given: "Scientists have heard anecdotal reports for years. . . ." In this way, the article creates the distinction between "clinical trial" and "anecdotal reports." Anecdotal reports have been in the media and medical journals for decades, as my database shows—e.g., "Dog's sniffs alerted woman to cancerous mole on leg" ("Dog's sniffs alerted woman to cancerous mole on leg," 1989, p. A2). Therefore, scientists were not the only ones that heard such stories, but have been the only ones in the position of verifying their veracity.

In sentence (6), the idea of diagnosing cancer by detecting the presence of particular chemicals given off by patients' bodies is not exclusive to the California group. In fact, another group in Italy has been experimenting with a machine that is based on the same principle. This, in turn, re-legitimizes the current research and re-validates the importance of similar enterprises. (My database also contains articles reporting on the presence of cancer chemicals in urine.) Later on in the text (7), one can learn that a (small) sample of five dogs was used. Also, the specific name of the "California cancer research group" is revealed, the Pine Street Foundation. Contradictory information is given here: The paragraph reads that dogs of both breeds "performed at the same level" and could rule out lung and breast cancer correctly "about 90 per cent of the time"—as opposed to the 88 and 99 per cent range stated in (2).

In the next paragraph (8), the word “success” is used twice. Not only have researchers reportedly self-assessed their findings as “successful,” but as a factor for improving the success of currently available treatments. Following this self-report, the voice of the research team—“the team writes” (how many members? Where is it written?)—is directly quoted in the next two paragraphs ([9] and [10]), where it reaffirms the importance of the study by using the word “accuracy” twice (“cancer identification was accurate” and “trained to accurately distinguish”). Quotes from experts (researchers) in the print media serve to provide context and give legitimization to the science news among other functions, for example, to explicate and outline implications (Conrad, 1999). The words “samples” and “controls” evoke once more the research aura that involves the news, similarly to what was discussed in sentence (2). Two tests for detecting early stage lung and breast cancer are named: “X-rays and sputum tests” and “mammograms,” respectively. Aside from the sputum test, which is briefly explained (“analyzing mucus from the lungs”), the other two seem to be taken as familiar to the readership.

Finally, paragraph (11) introduces more information on the method and materials utilized in the research. For example, one can learn here that the total number of cancer patients—both lung and breast—is equal to those in the control group (83), that Ziploc bags were used to collect participants’ breath, dogs and volunteers never met, and that (“ordinary household”[9]) dogs sniffed samples more than 12,000 times over four months—which clarifies what has been called to be either “brief” [2] or “ basic behavioral ‘puppy training’” [9]). If compared to the three years the Italian group has been “experimenting” with a machine, the research presented here is depicted as far more successful. One implicit contradiction is left unquestioned: The study was based on the

premises that a) there were cancer patients participating in the research, and b) currently known (and widely used) tests for detecting cancer have a “high false negative” (x-rays and sputum tests) or “aren’t perfect either” (mammograms); thus failing to detect many early-stage cancer cases. Therefore, how can researchers be sure that their “controls” (9) are healthy?

My analysis reveals that a positive image of scientists and the scientific enterprise is constructed in/by the text, where the basic information that is positively stated in the first sentence of the text is repeated over and over with different levels of clarification (Figure 5.4). The more information is provided the lower the level of certainty of the results achieved in the research, which runs counter to what one would expect after reading the headlines and the front-page short paragraph alone. However, the reading of these preliminary elements—headlines, short front-page text and photograph—associated with the high percentages of accuracy presented, the general positive self-assessment of the research by the team of scientists, and the possibility of failure of current breast and lung cancer tests (that were reportedly outsmarted by the dogs) help dilute any skepticism. The article depicts science as a collective activity, where scientists are persistent enough to train dogs for a period of months and verify the authenticity of “anecdotal reports.” On the same account, this communal perspective overshadows the possible ways in which individual differences are negotiated within these groups and favors the perception that intellectual contributions are equally provided by all team members.

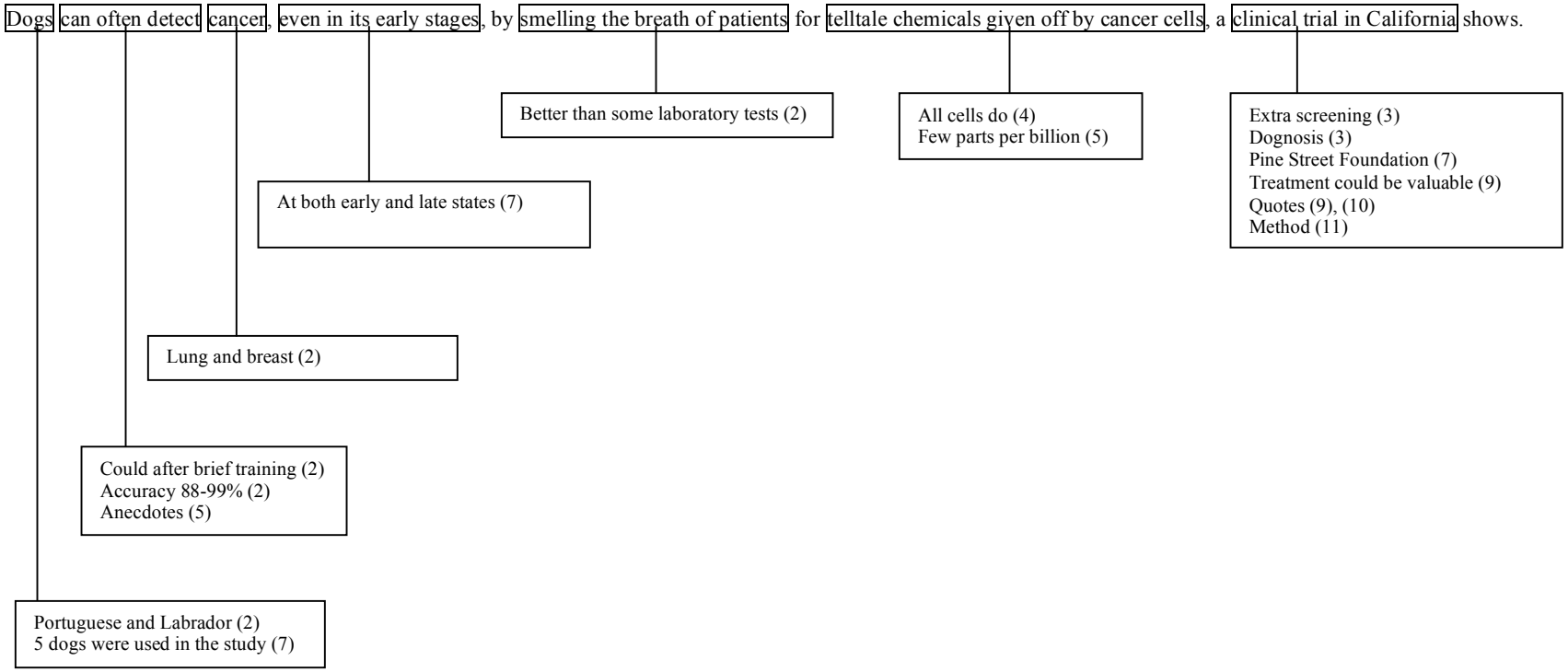


Figure 5.4. Schematic representation of how the topic sentence of the news relates to other paragraphs in the full text, where a clarification and repetition pattern can be observed. As the text unfolds, there is also an element of uncertainty that is made evident. Numbers in parenthesis indicate paragraphs in the original text.

After reading the full news article, one can also ask: What am I to make of the front-page picture of a dog? It tells little about the research itself, but illustrates (without identifying) one of the two breeds utilized in the study. If the reader is initiated on the subject of dogs (s)he will readily recognize it as a Labrador. The picture then can lead readers to focus on the information regarding the dogs' amazing ability as opposed to any missing critical information concerning the description of the research methods, the lack of absolute certainty, and the generalizability of the study findings. Fundamentally, these general and positive depictions of science and the work of scientists (reported elsewhere for media in general [Schnabel, 2003]) indicate a strategy for validating the total space an article occupies within the publication in particular and the worthiness of the news report to the newspaper audience in general. As in the case of the front-page announcement and photograph caption, not a single piece of criticism is offered, which leaves it to readers to decide what and how to creatively fill in the gap.

Newspaper articles: In the classroom

The taken-for-granted elements of newspaper persuasion create gaps in reasoning that may be filled out imaginatively by readers who use their experiences to assign meaning to what they read (Gee, 2001). Media in general and newspapers texts more specifically cannot be understood on their own, but can only be interpreted by means of other texts—a process generally referred as intertextuality (Bennett & Woollacott, 1987). This indicates that before reading and interpreting newspapers science reports, readers require a set of expectations and assumptions; it is only through and among these actions that the text will come to make sense. Intertextuality prepares us for the text at hand inasmuch as it prepares the text for us, so that "any resulting meaning, power, or effects

that the text may be seen to posses are in part a function of the already-read" (Gray, 2006, p. 25-26). Consequently, the resources of common sense also allow the emergence of numerous ways of interpreting news texts.

In the school context, the interpretation of media reports of science is a complex task with the teacher playing an important role (e.g., Ratcliffe, 1999). However, how do teachers read such news? More specifically, what are the resources they draw on to make sense of the news for their students? These and other subordinate questions are addressed in this section, where I analyze the way in which newspaper articles are introduced in science lessons. The purpose of this analysis is to identify those elements that are considered necessary by teachers to make articles understandable for students. When teachers add new information or link their readings to other events in their classroom, they make available to analysts the information their students need to understand the article. Ultimately, analyzing public readings of science newspaper articles in a science classroom allows me to identify the gaps between news reports and what students already know about some topic (and possibly the newspapers' peculiar way of representing the works of science). In the following, I first provide an exemplary case analysis of one biology teacher's reading of the same article that was featured in the previous section.

Reading students a newspaper article about cancer: A case study

Elizabeth teaches an eleventh-grade biology class and a biology career preparation course in a public school in a mid-sized Canadian city. She has nearly three decades of teaching experience and is currently the head of the school's science department. In Elizabeth's class, there are twenty-eight grade eleven students; twenty of which are taking a biology career preparation course. The eleventh-grade biology

curriculum is compressed into one semester in which students take daily biology classes for 1.5 hours. In addition, the career preparation students participate in various extra science activities that are organized by Elizabeth. The biology career preparation course receives funding from the school district, which allows the acquisition of certain learning resources such as science magazines, microscopes, and bus tickets for field trips. Furthermore, she uses other resources for her teaching, including newspapers.

During an interview Elizabeth was asked what science meant to her and how she integrates this understanding into her teaching. She answered by including an explanation of the reasons she uses newspaper in her classroom:

> Yeah I probably don't talk about it as much now at this level as I did when I was teaching grades eight, nine and ten, and then we, you know, um, I used to like to bring in newspaper articles all of the time, to relate science to everyday life, and then to talk also about the knowledge aspect of science, and the process aspect of science, and how that informs, you know, so much, so much of their environment, and their lifestyle, and umm, but also, always sort of with the disclaimer that it's one way of looking at the world.

In this part of her interview, Elizabeth draws on her use of newspapers to elaborate on the way she integrates her perspective on science into her teaching praxis. Newspapers are means of associating "science to everyday life," she says. In this way, she accounts for the relevance of the subject of her teaching to students' environment beyond their lives in school. Moreover, the news ties in with different aspects of science: "knowledge aspect of science and the process aspect of science and how that informs … so much of their [students'] environment, and their lifestyle." This is not to say that science is the only important subject in her students' lives (or and vise versa): "that's one way of looking at the world," she adds.

On June 13, 2006, I recorded Elizabeth reading the previously analyzed newspaper article at the beginning of her lesson. After entering the room and getting

ready for the day, she picks up two different-sized pieces of paper on her desk and moves in front of her desk. She then addresses the classroom:

(1) Alright. (3s) The news. Front page. ((Shows students a small piece of paper that seems to be a cut-out from a newspaper)). (2) Did anybody notice yesterday's front page? "The nose knows" with the puppy here, the dog? So (3s) ((Reads from a bigger piece of paper where the article has been photocopied and enlarged)) "Dogs show ability to sniff out cancer." (3) So, remember our presentation before Christmas on the sniffer dog? (3s) ((Looks around)) (4) So, if I could just explain a little bit about this. (5) (2s) La, relates back to the work that we did with a, with a presentation on on the ability of dogs of dogs to have this phenomenal um response, right? Amazing numbers of receptors and structuring their noses to allow them to detect. (6) It says here: "Dogs can detect some" There's only one person talking right now, it's me. "Dogs can detect some chemicals diluted to a few parts per billion." So, like little individual molecules basically that, you know, they're detecting, a:nd they actually use the same strategy that you saw in this news for detecting the presence of drugs, ((looks at the paper she is holding)) the dogs were trained um they don't have to come up and sniff the person's breath the person breaths into a zip lock bag and then the dogs test the air in the zip lock bags and when they detect certain (3s) ((clears throat)) (2s) when they detect certain chemicals that are given off by the body, right?, when the cancer cells are present um they're they sit down. And if they don't detect those chemicals they move on to the next test bag, ok? You know, so same strategy. Um. So, another pe pers um point here then it ties into biology is that um we've been looking at respiratory systems and talking about how animals need to get rid of basically nitrogenous waste that are breakdown products of when we digest protein, but there are other chemicals, right?, that are given off as your body is just carrying on its biochemical business and if you have cancer, then there are certain specific um chemical substances that um the body has to get rid of as waste, these include benzene and some other organic compounds and that's what the dogs that are trained to detect and it they came up with this idea because stories were around about people who had skin cancer and have the dog and the dog would just be very interested in the smell of this tumor on the skin and then once the tumor was removed they have their surgery, the dogs lost interest in it again. So, that kinda of led some researchers to, you know, to ss to actually test this out and run a controlled experiment. It's a very small experiment, only five dogs were used um however um you know it's also that's are other information there's um the Italian group that were they're working on trying to come up with a machine a breathalizer kind of machine, to analyze for these specific compounds that are known to be given off, right, by the body when there when cancer is present. The dogs were ninety percent accurate, which is very good, a lot of um tests that you have for things are not that accurate, right? So, so that was considered. They used Labs and they used Portuguese water dogs, so they figured probably most dogs would be able to to do it. Of course, biologists have to be funny, so they've two nicknames for this: dognosis and Lab testing. (Some students laugh as the teacher turns away to her desk)). (3s) So (3s) um (4s) Okay, I think that's only introductory stuff.

The teacher starts addressing the class without saying what she is going to do. Instead, she articulates two short phrases: "The news. Front page" (1). These phrases are

used in an isolated fashion—there are no connectors between the two of them—which makes them fragments in her discourse. Much like the headline of a newspaper whose function is to grab readers' eyes, Elizabeth draws students' attention to her right hand and what it holds. She makes it clear that whatever she shows is important and worth consideration: It not only made the news, but it was also in the front page. Elizabeth's use of the news in this case makes for newspapers reports in general to be taken as objective (unbiased) accounts of facts—which also corroborates her interview.

Elizabeth's palm is partly opened with the small piece of newspaper between her index finger and thumb as if she wants to make it visible to all in the classroom. Next, she poses a question to the class, asking how many of the students noticed the front page of yesterday's newspaper (2). This question, in turn, comprises the possibility that students might have in fact read the news. Also, it serves as an indication of what the teacher expects of the students—i.e., to be able to relate what is learned in the classroom to what is on the news. Elizabeth reads the front-page headline ("The nose knows") and describes the picture that accompanies it ("with the puppy here, the dog?") before reading the second headline and revealing what the report is about: "Dogs show ability to sniff out cancer." She then interrupts her reading to bridge for the first time the news with a presentation that took place in her classroom a few weeks ago: "So, remember our presentation before Christmas on the sniffer dog?" (3). This, in turn, legitimizes Elizabeth's action of bringing the news to school that day. After all, it is associated with what students have experienced in her classroom before.

Elizabeth elaborates on wanting to explain the content of the news report: "So, if I could just explain a little bit about this" (4). Once again, she bridges the news to a school

presentation students were involved: "[A] presentation on the ability of dogs to have this phenomenal [sniffing] response" (5). She gets more specific by adding that "this phenomenal response" is due to the "amazing number of receptors" and the structure of their noses, which is a piece of information that is not discussed in the original article. The use of the adjectives "phenomenal" and "amazing" (not in the original news report) indicates the value the teacher places on the news. Turning to the other sheet of paper she has in her left hand—which she indicates by looking at it while saying "It says here"—she reads, "Dogs can detect some chemicals diluted to a few parts per billion" (6). This sniffing capacity of dogs to decipher the slightest concentration of substances is explained by the teacher in terms other than those used in the newspaper: "like little individual molecules basically" (7). Here, not only is the numerical representation more discrete ("little individual" as opposed to "parts per billion" in the original), but the teacher's explanation is as imprecise as the article itself—the former points to a "few parts per billion" whereas the latter uses unspecified words on both ends of the sentence ("like . . . basically"). Therefore, what the teacher says is supported by the article and vice versa.

As Elizabeth continues, she once more bridges the news to a classroom activity and assumes students have read the news article, "they [dogs] actually use the same strategy that you saw in this news for detecting the presence of drugs" (8). She then describes the research method similarly to the way it appears in the news article—"the dogs were trained" (9). In the following part of her discourse, she articulates that this description of the method is one of the points of the article that relates to the subject she teaches—"another point here then it ties into biology" (10). At the same time, she

introduces another aspect that is associated to her teaching: “respiratory systems” (10). (The latter is yet another way of bridging the news to her praxis.)

The teacher’s vocabulary becomes more specialized: “Talking about how animals need to get rid off basically nitrogenous waste that are breakdown products of when we digest protein” (11). She mentions “benzene and other organic compounds” as some of the “other chemicals” that are given off as the body carries on “its biochemical business.” The teacher’s use of such terms presupposes understanding on the part of her students. When talking about the commonplace of eliminating substances due to our respiratory process, the teachers expands the applicability of what is reported to include a terminology that has been utilized in a the context of their lessons. More so, Elizabeth uses the words “animals” and humans (“we”) interchangeably, evidencing the similarities of our biological functioning processes with those of other animals in general and how the comprehension of one system can be applied to the understanding of others.

As Elizabeth continues talking, she mentions where the research idea originated: “because stories were around” (12) about people whose dogs could detect their skin cancer. The teacher concludes uncertainly by creating a causal relationship that is not present in the original article: “That kinda of led researchers to test this out and run a controlled experiment” (12). According to the teacher, it was a “very small experiment [in which] only five dogs were used” (13). After using an adverb of contrast—“however” (14)—she adds that a) there is an Italian group whose research is reportedly based on the same principle of detecting compounds that are exhaled by cancer patients and that b) the dogs were ninety percent accurate in the study. This was considered to be “very good [since] a lot of tests for things [the original text mention three tests for detecting cancer]

are not that accurate" (15). These last two pieces of information (*a* and *b*) make up for the "very small" scale of the experiment and possibly for the fact that (only) two breeds of dogs were used—Portuguese water dogs and Labrador (16). In the end, the generalization of the results—"they figured probably most dogs"—amplifies the importance and scope of the research.

The teacher finishes her reading by stating that the nicknames for the scientific methodology—"Dognoses and Lab[rador] testing" (17)—is a result of the obvious sense of humor of biologists: "Of course, biologists have to be funny." Elizabeth expresses amusement with the play on words, although she does not explicitly explain the humour. Some students laugh, either for having understood the parody or because of Elizabeth's indication that the terms were coined by "funny" scientists. Curiously, the original newspaper article does not mention whether the "scientists" in the study are biologists or medical doctors for that matter. In this last case, the teacher discursively approximates scientists (and what they do) to students' reality in two ways: Those scientists are not only interested in biology—i.e., the very topic Elizabeth's students are taking—but they also have a sense of humor—like all of us have (including students). Moreover, Elizabeth creates for her class the plausibility of a career as a biologist. "I think that's only introductory stuff," Elizabeth concludes before moving on with the other activities planned for the day.

Reading news in the classroom: What has science got to do with it?

My analysis of the news report and the teacher's reading of the same news have some implications for the use of newspapers in the classroom for the public understanding of science. The comparison between what the teacher does and the original

report points to the resources offered by the newspaper article that the teacher uses to make sense of what she reads to her students. Discursively, both the text and Elizabeth depict science as positive, and criticisms are offered to neither the study reported nor to the way it is represented. For example, although the sniffing protocol was repeated thousand of times (twelve thousand over a four-month period), Elizabeth and the original article do not discuss why researchers used such a small sample of five dogs when scientific experiments require larger numbers. Likewise, the headlines are presented first both in the teacher's discourse and in the publication, making for the generally positive tone of the news in those situations. Finally, the dog on the front-page picture was not identified in any of the two situations (teacher and news article), but it was used as an identifier for the news—which is (also) about dogs.

In a few instances, the teacher adds ideas and information that are not part of the original newspaper article in order to bridge the text to her classroom reality. For example, she talks about the nose structure of dogs and how the production of chemicals by the body is not an exclusive feature of cancer patients but of the respiratory system (the text indicates that all cells give off substances, but did not give any specific examples), and says that biologists are funny.

The fact that the teacher reads the article in a different sequence than the article reveals the importance that she puts on certain topics over others. Elizabeth places emphasis on how the information provided relates to previous lessons: She bridges and justifies what she reads to her students, confirming what she said in her interview. The use of a specialized vocabulary, although common to the article and to the teacher's discourse, is qualitatively different in each case and therefore reinforces the idea that how

readers use information is contextualized, a function of their level of shared involvement (membership) with the situation (Lucas, 1983).

Conclusion

The purpose of this article is to articulate a framework for the analysis of newspaper science reports for the public understanding of science in schools and to show what kind of resources teachers draw on to assist students in their sense-making of such reports. Eventually, newspapers' depiction of science can mediate students' scientific career choices as well.

There is a growing gap between the types of texts commonly encountered in people's informal science reading environments (e.g., newspapers) and the types of text that the public encounters during school science courses (e.g., textbooks). I offer sample analyses to show how print media provides resources for readers to make sense of science-related texts, and how readers such as a teacher use these resources to make sense of science for others. First, I look at the most perceivable aspects of the news article—headlines and pictures—and how their complementary succinctness and disposition within the publication work to capture readers' attention in anticipation of the type of text they are about to read. Next, I do an in-depth analysis of the full article's content and the ways in which interpretation related to other structural elements of newspapers (space allocation, headline, section, etc.). Lastly, I analyzed a classroom situation where a high school biology teacher read the same news article to her students, providing readers with an understanding of the resources the teacher draw on to explain the article to her class, the gaps between the information presented on paper and her students experience in the

classroom, and how the teacher's reading mediates students' interpretation of the news by filling in those gaps with information pertaining exclusively to her classroom context.

I conclude that there is more implicated in the production, reading and interpretation of science reports than the apparently objective narrative of events, where news writers give a biased account of reality and readers fill in the silenced parts of the text. Ultimately, the resources I identify in my framework also inform those concerned with how science is publicly presented in newspapers. For instance, in a recent longitudinal study of the New York Times, it was found that the science section has had an overall increase in length (Clark & Illman, 2006), which amounts to the visibility of science to the readers of that particular publication—who eventually had been more exposed and became welcoming to that type of news and their particular depiction of science. (The rhetorical issues at the semantic level and their long-term influence on what people recall from their readings have been discussed elsewhere [Carlston, 1987].)

Newspapers are produced mostly for everyday people. Consequently, they are used to make sense of people's world and to construct social actions and relations required in the labour of everyday life—print media make available various meanings, ideas, and versions of the world (e.g., Luke, 1996). Moreover, reading is a social practice that is part of our identity, with personal models and differences in social representations leading to different interpretations. However, more than being a common source of information for the average literate citizen and an important part of personal and community lives, newspapers can play important roles both as a source of information about science issues and a bridging medium between school and the real world. Students and teachers need opportunities to become familiar with different kinds of media so that

they not only become competent in navigating them but also in making judgments about strengths and weaknesses with respect to our culture's predilections (Roth, 2004a). This transfer of knowledge between settings may not take place automatically and the success of the process requires a good understanding of the rhetoric used by journalists to convince people of what they read and how this comprehension is mediated by other elements of the publication.

Based on my analysis, there are at least four questions that need to be addressed when media is used in the science classroom context: What are the facts being reported? What is the writer's account of what happened? How is meaning conveyed in articles through the discursive and structural organization of the pair individual text-whole publication? What are the possible interpretations of the texts?

The monopolization of media ownership that has been taking place in North America over the last several years has led to the utilization of the same or slightly modified text in many different publications on the same day. For instance, the article that Elizabeth read in her classroom was published in more than two dozen newspapers under the same authorship. In this context, an argument could be made against the use of newspaper media for educational purposes unless it is from a practice that is very well informed critically—which, again, is what I want to foster with the present chapter. Although I do not expect newspapers to explain every detail of the science enterprise, it is exactly what is left unsaid that gives students the opportunity to perceive and analyze certain topics from a perspective different than their own, an opportunity to confront different ideas. In themselves newspapers are not problematic. The issue is located in the failure to situate their production and content within the broader social context of

divergent and often contradictory public expectations in which they represent a symbolic resource. My framework offers a way of critically engaging with the various discursive elements of a newspaper article and understanding the mediational relationships between these elements with respect to making sense during reading.

Section III

Off School Ground

CHAPTER 6

UNCERTAINTY AS A CONTEXT AND RESOURCE FOR CHANGING TRADITIONAL TEACHER QUESTIONING BEHAVIOR: AN ARGUMENT FOR SCIENCE EDUCATION

Abstract

In science classroom settings, the questioning behavior of teachers is associated with a type of inquiry that seeks known information as means of evaluating pupils' performance. Questioning thereby results in the re/production of inequalities in the display of knowledgeability and prevents students from a genuine experience of practices that resemble the conditions of uncertainty under which scientists operate. Asking questions in which answers are not already previously known provides students, instructors, and teachers with an opportunity to engage in science-like activities. In this study, I present and contrast examples from an outdoor environmental education program to show how not-knowing is a context and resource for changing traditional questioning behaviors into authentic ones, thus leading to forms of science education and learning that reflect scientific culture. My ethnographic fieldwork and analysis, suggests that field trips may provide a valuable addition to in-class instruction. The open-endedness of such activities offers rich grounds for uncertainty to take place.

Introduction

Science presents people with a unique way of knowing the world—though certainly not the only one available (Ninnes, 2001; Roth & Lee, 2004). Therefore, one important aspect of science education resides in the possibility of leading students to an understanding of how knowledge is constructed and validated within the context of the

natural sciences. This, in turn, often occurs with scientists metaphorically and even literally groping in the dark, where they act but do not know what they are doing when they are doing it[4] (Roth, 2004b). Yet few opportunities are given to students to experience science in this way by their instructors—mostly due to the kinds of constraints inherent in the formal setting of schools (e.g., Christenson, 2004; Gough, 2002). For example, time restrictions, strict conformity to official documents or guidelines (themselves considered standards of quality to be put into practice), pressure from school administrators and parents for measurable results, and lack of availability of material and human assets are problems not easily manageable. The common idea that more is better also helps to compose this complex picture; teachers feel obligated to cover everything in the prescribed curricula (usually divided into isolated blocks) in the short time available, and still assess students accordingly. Ultimately, there is always a standard against which all answers given by the pupils are compared and the teacher generates feedback to students as to whether they are right or wrong.

In scenarios where teachers seek previously known correct responses by means of the teacher initiation/student response/ teacher evaluation (IRE) routine is the popular means of accomplishing such tasks (Poole, 1994; Scott, 1998). Consequently, it is not rare to observe students seeking validation as they wonder about whether or not they have had the activities right. Such concerns create tensions that eventually mediate students' genuine opportunities for knowing. One might expect this IRE routine to be explored in situations where the teacher does not or cannot know the answer beforehand. The question arises, what are some of the possibilities for learning science from questioning

[4] Although provoking, this statement refers to the fact that scientists (or anyone else for that matter) cannot control the outcomes of their actions.

in situations of uncertainty, that is, situations where it is clear that students' answers are not evaluated against some preformatted scheme?

The purpose of this chapter is to argue for the importance of uncertainty as a context and resource for changing traditional teacher questioning patterns—where the main objective is to immediately assess students' performance—into more authentic ones, that is, questioning patterns that create room for personal decision making and grant ownership of activities to students. In the field of science education, these alternative questioning patterns may promote understanding of the biased and uncertain ways science operates (as opposed to an equal distribution of opportunities for knowing). More specifically, I articulate how *not knowing* mediates the questioning strategies teachers use to enhance students' learning opportunities. I am also interested in the way students experience science through the mediation of teachers and instructors in out-of-school settings (e.g., field trips) and how these learning opportunities interact with the formal environment of schools.

Teacher questioning behavior: Evaluate or teach?

Learning situations are always co-constructed by students and teachers; it takes both teacher's and student's actions (even sitting still and listening) to make, for example, a lesson. In the classroom, teacher–student interactions mostly take the form of questioning (DeWitt, 2006) as a tentative measure of new knowledge that students have gained. Although question–answer and question-answer-evaluation sequences are typical interaction patterns—arguably designed to support student learning (Poole, 1994)—they also reflect and reinforce authority relationships in the classroom (e.g., Edwards & Westgate, 1987; Carlsen, 1991). In this sense, there is an inequity inherent to questioning

interactions: One individual (teacher) does the asking and therefore is the one who knows, and the other (student) does not do the asking and therefore is the one who does not know (Lemke, 1990). From a sociolinguistic perspective questioning routines in formal education are often used for evaluative actions in which the main objective is to assess what the questioned person already knows, rather than for teaching purposes, in which there is a great deal of interest in positively influencing students' achievement (e.g., Redfield & Rousseau, 1981).

Questions in formal education generally call for an expected response, which may not be offered when the possibility for disappointment and frustration becomes apparent to the student (e.g., Watts & de Jesus, 2005). Teachers predominately ask questions concerning facts to be recalled from memory; indeed, there appear to be few questions that engage students deeply in the subject matter at hand so that they could articulate their factual rather than conceptual understanding (Fairbrother, Hackling, & Cowan, 1997; Roth, 1996). This represents the orthodox tradition, in which teachers and students play out particular institutional divisions of labor along power/knowledge lines (Deneroff, Sandoval, & Franke, 2002; Hammersley, 1977).

If, on the other hand, questions are designed to elicit information not yet known—knowledge-in-the-making—along with the unfolding activities, then learning becomes possible, teaching becomes more effective, and educational possibilities are enhanced. Accordingly, if a certain level of uncertainty exists in the context of instruction, I may expect this to benefit all participants who can use it as a learning resource to get them beyond simply assessment situations. In this fashion, students are likely to have experiences that resemble those of scientists working on the cutting edge, where they do

not know what they will learn and often grope with uncertainty—an approach that some science educators and researchers have termed *authentic science* (Roth, 1995). Such an approach therefore has implications for what students learn about the process of science itself. If students understand their own actions as science-like, then the enterprise of science and the way in which it constructs knowledge can be demystified (Désautels & Roth, 1999) empowering personal decisions over that of perfect science as generally presented in the media, textbooks, and school science lab classes (e.g., Koosimile, 2004). Uncertainty also evokes the metaphor of chaotic systems for the development of curricula (e.g., MacPherson, 1995), where the unpredictability of open systems (non-Newtonian) can be a useful learning tool.

In this chapter, I argue specifically for the importance of uncertainty as a context and resource for modifying traditional teacher questioning behavior and therefore contributing to a more authentic approach to learning within the context of science education. My argument and analyses are grounded in discursive psychology as presented by Edwards and Potter (1992). In this particular discursive analytical approach I examine not only *what* people say but also *how* they say it and evaluate the function their discourse with respect to the particular activity system that they currently find themselves in. It also allows me to understand the unconscious expression of emotional and motivational dimensions of participants' experience (Roth, 2005).

At the dock: Uncertainty and the changing of questioning behavior

It has been already stated that teachers' questioning behaviors—although generally deployed to promote student learning—can take the form of two routines: one that elicits known information (with assessment purposes), and one that facilitates the

enrichment of students' participation in the task at hand (thus contributing to the continuation of the task itself). In science education, these two approaches represent different ways of considering the promotion and learning of science. In the context if this study, I suggest that uncertainty plays a significant role as it affects questioning patterns. To illustrate and discuss this perspective—and the states of knowing and not knowing in the interactions under scope—I make use of two examples from my fieldwork. Both examples involve the same instructor mediating different learning opportunities for students who are engaging in similar tasks during an environmental education program that I followed. The contrast of the two analyses below provide evidence for the importance of not-knowing as a context and resource for changing questioning behaviors in favor of the emergence of authentic science learning possibilities. The episodes used here are concrete examples from which my argument will unfold.

Context

The aforementioned program is a day long exploratory activity designed for upper elementary students, where groups of students are required to move through three different stations: (a) a physical challenge of rowing an open water scull or paddling a 22-foot First Nations Canoe (the so called *rowing station*), (b) a scientific study of a salt water lagoon (*dock station*), and (c) a First Nations cultural awareness development through a study of the traditional ecological knowledge that the First Peoples used to live in that environment (*wetlands station*). Participants are required to attend a watershed model demonstration as part of their preparation to the on-site visit. In general, the program aims at building self-confidence, self-esteem, first nations culture and environmental awareness, class cohesion, and self-respect.

Within the context of the program in question, the dock station represents the scientific part of the day. Here, students have the chance to take measurements of pH, dissolved oxygen, temperature, turbidity, and salinity to assess the water quality. They also collect samples of plankton for further study in the lab area (located in the boathouse), which contains magnifier lenses and an aquarium with sand dollars, crabs, snails, sea stars, clams, and mussels for closer observation. At this station, students use many of the same tools that are used by others in their community, participants in environmental research, activism and monitoring (dissolved-oxygen meter, pH strips, hydrometer, Secchi disk, plankton net, etc.). Teachers and students learn science by focusing on the health of the lagoon and its impact on the life of the animals that depend on it (including humans).

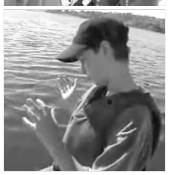
The excerpts analyzed below come from a rapidly increasing database concerning environmentalist movements and environmental education, which my research group has been building over the last decade as a result of several ethnographic studies among different environmentalist groups and the educational opportunities they present to their community. My field observations are mainly in the form of videotapes and contain naturally occurring talk among participants (teachers, instructors, and students). Specifically for the present argument, I selected portions of my data containing interactions of the same instructor with pupils in similar conditions (dock station), in what I observed to be the emergence of an uncertain occurrence and the way it mediated (changed) what I observed to be her overall questioning pattern. Moreover, I articulate possible consequences for science learning and instruction in general and the importance of field trips in this scenario.

Traditional teacher questioning behavior

Instructor questions are important tools that mediate the ways in which students relate to salient issues at hand. In fact, the questions constitute perhaps the most important tool educators have for maximizing student learning. However, authentic learning opportunities are not constrained simply because of the environment where interactions come about. In this sense, the IRE sequence is not exclusive to the school setting; it exists in (and mediates) situations outside the classroom. This, in turn, not only shows the stability of this particular questioning behavior across settings, but also how the mere assessment of knowledge (by seeking for known answers) contributes to an unequal distribution of learning opportunities even in places and activities where one would not expect this to be the case. I exemplify this notion in the following analysis of an excerpt from my database.

In the first case, Nina (instructor) and Daniel (student) are working at the dock station. Nina asks Daniel to pull up a string immersed in the lagoon that has a thermometer attached to it:





01	**Nina:**	What is this?
02	**Daniel:**	The… (2.0)
03	**Nina:**	What is that?
04	**Daniel:**	How cold it is [or how hot it is?↓
05	**Nina:**	[Yes, it's called thermometer. So,
06		read the red, there it is ((pointing))
07	**Daniel:**	It's at… ((looking at the thermometer))
08	**Nina:**	Don't, don't touch the bottom 'cause that'll affect the
09		temperature.
10	**Daniel:**	(2.0) It's at like nineteen.
11	**Nina:**	Uh, It's warm. It's gone up a degree since this
12		morning. Nineteen degrees what?
13	**Daniel:**	Nineteen degrees Fahrenheit.
14	**Nina:**	No.
15	**Daniel:**	ta…ah… deg…uh…ah… I just check it out
16		((nervously laugh)).
17	**Nina:**	Nineteen degrees what?
18	**Daniel:**	Ah, nineteen degrees (2.0) ((his arms are now arched
19		up and his palms open)) I forgot ((nervously smile and
20		let his arms drop)).
21	**Nina:**	That's okay.
22	**Daniel:**	I, I keep forgetting everything ((put his right hand on
23		the head))
24	**Nina:**	It's okay, it's alright, it's alright. ((She stands up and
25		puts her left arm around his back)). There's no such
26		thing as, as being dumb. Never forget that.

Daniel pulls up the string and the thermometer comes out of the water. Nina then asks him what it is (line 01). Daniel does not say much (line 02) before Nina asks him the same question again (line 03). This time Daniels replies with a description of the something, the nature of which appears to be unquestionable, perhaps because Nina has gestured in its general direction (line 04). Partly overlapping with Daniel's utterances, Nina agrees ("Yes" [line 05]), giving away the gadget's name ("thermometer") and asking Daniel to "read the red" as she points to it (lines 05 and 06). Daniel is looking at the thermometer (line 07) when Nina tells him not to touch the bottom or it will affect the temperature reading (lines 08 and 09).

Next, Daniel comes up with an approximate reading ("It's *like* nineteen" [line 10]) that is promptly recognized by Nina as surprising ("Uh" [line 11]) as she makes available some (new) information regarding an earlier measurement ("It's has gone up a degree since this morning" [lines 11 and 12]). Daniel's reading is acceptable. At this moment, she also asks Daniel for the correct temperature unit, "Nineteen degrees *what*?" (line 12). He does not hesitate in answering ("Nineteen degrees Fahrenheit" [line 13])—to which Nina negatively responds ("No" [line 14]). At this point, Nina's negative evaluation can be classified as a *continuation act* (Mehan, 1979). The function of such an act is to keep the interaction—mostly procedural in this case, when Nina is checking Daniel for both the measurement unit and his actions on how to get the temperature—moving until the answer demanded by her is obtained (as opposed to a *positive evaluation* that is terminal). More so, it can be also seen as a *repair* to what was answered by the student (McHoul, 1979). Daniel stutters and laughs nervously (lines 15 and 16). Nina repeats the question (line 17). Daniel gives it another try (lines 18, 19 and 20): His arms are now arched up and his palms are open. His body position indicates that he is trying to come up with the correct answer. Soon after, he gives up letting his arms drop limp ("I forgot" [line 19]).

In this situation, it is not that Daniel does not know or that he did not follow the instructions accordingly, but that he forgot the right answer. He appears to be disappointed with himself and, as expressed in talk and body orientation, his attitude is apologetic. What follows is an affirmative act from Nina that indicates she attempts to comfort the student ("That's okay" [line 21]). Daniel articulates an explanation, "I keep forgetting everything" (line 22). The explanation is in fact an acknowledgment of an

understanding to have failed. Putting his right hand on his head emphasizes his disappointment: It is not only a recurrent fact that he forgets, but also he keeps forgetting "everything" (lines 22 and 23). Here is no exception. Nina gets up and put her left arm around Daniel's back, embracing him in consolation. "It's okay, it's alright, it's alright," she says, "there's no such thing as being dumb. Never forget that" (lines 24, 25, and 26). They walk away from the string to do another activity on the dock without Nina's question being ever answered (neither by Daniel nor Nina herself). In the end, it seems that the temperature unit was not important to name so much as it was brought up for evaluation purposes. (Later on, in the lab, Nina discusses with a group of students the possible effects of the temperature increase on fish behavior, and plots Daniel's temperature reading on a chart without mentioning the temperature unit.)

Nina and Daniel: An analysis

In this first conversation, Nina did not probe Daniel's answers—Why is Fahrenheit not the correct unit for that particular situation?—nor did she query him about the presence of the thermometer (Why was it there in the first place? What is the importance of measuring the temperature? What is the effect of depth on the reading?). For the purposes of this analysis, it does not actually matter why she did not ask these questions, but only what she makes available to me in her talk-in-interaction. All this is most likely taken for granted due to the preparation students go through before going to the lagoon and the fact that thermometers are commonly handled in daily situations.

On the other hand, Nina's initial question ("What is this" [line 01]) is broad enough to include whatever explanation Daniel gives: He knows what the measuring device is for. Nina's subsequent and discursively overlapping reaction ("Yes" [line 05]),

indicates agreement with what Daniel was saying. Next, she adds what seems an important piece of information ("It's called thermometer" [line 05]) as if Daniel could not do it himself. This, in turn, is contradictory to the fact that Daniel already knows what the instrument is used for. In other words, even if Daniel did not know (or could not remember) the name of the device, how could Nina possibly tell if she did not ask him specifically for a name ("what's it called?")? Instead, she gives the name away and creates the impression that what she asked Daniel was not completely (or satisfactorily) answered. In addition, Daniel does not handle the thermometer appropriately, leading Nina to intervene one more time ("Don't, don't touch the bottom 'cause that'll affect the temperature" [lines 08 and 09]). In the end, Daniel is mostly trying to answer Nina's questions and follow her instructions. Knowing is unevenly distributed in this situation as Nina requests known information from Daniel, for whom this situation represents a double-task: He has to be concerned with displaying *what* he knows as much as with *how* to display it, which involves certain ways (often implicit rules) of talking and acting that are appropriate for that particular context (Mehan, 1980).

Markedly, Daniel never uttered the word "dumb" or any of its synonyms, although Nina appears to have evidence that this is the way he feels (lines 25 and 26). What goes without notice is the fact that their interaction sets up the dumbness mood. Nina asks all the questions and it is up to Daniel to come up with the right answers, which he is unsuccessful at providing her with. Hence, the lack of room for Daniel to speculate (to be uncertain) creates the possibility for the sense of *failure* to emerge in the situation (the presence of the researcher with a camera cannot be disregarded). It is in the classical culture of schooling where students learn that "there is one right answer to any

problem, and any divergence from that answer is considered an error" (Goff, 1998, p. 40). Once more, the ways science works can be potentially seen as error-free.

Nina and Daniel are the subjects of the activity at hand—meaning they are both held responsible for making the situation what it is. Moreover, Nina assumes the position of the one who knows by asking questions to which she already has the answers. It is up to her (as the instructor) to decide when and if the given answer is sufficient, which reflects on how long the student may have to answer the question (e.g., McHoul, 1979). This, in turn, grants Nina authority over what Daniel knows (or does not know) and how he should express it; after all she is the one evaluating Daniel. In this sense, whatever Daniel says does not represent any impediment to the continuation of the activity (as it will be made explicit later on that day). The motive of the unfolding actions is quite evident: it is probing Daniel—as opposed to giving him an opportunity to exercise his creativity and argumentation towards the monitoring of the environment (and experiment science more authentically). Given that Nina does not deploy alternative paths to help Daniel with an appropriate response undermines the possibility of finding solid grounds where to start her teaching with Daniel.

Even though it does happen in the field, Nina's questioning behavior can be related to a traditional perspective of school where instructors are supposed to get the right concepts from the students and there is a certain school culture that helps maintain this perspective (e.g., Gall, 1970). Nina places more importance on knowing (the correctness of) words than in the quality of the actual process of collecting the information. The episode reveals an uneven distribution of opportunities for knowing. Daniel was expected to have learned something previous to his interaction with Nina, and

the fact that he was unsuccessful in demonstrating it is an aspect that can negatively mediate the assessment of his engagement in the task and his attitude towards instruction and schooling in general. Again, the student is pressed to display what his instructor asked of him, which does not necessarily match what he actually understood. The uncertainty Daniel displays reveals an immediate sense of inappropriateness—not to say failure—of his actions.

The traditional form of teaching reproduced in this episode can be explained, in part, by the fact that Nina knows in advance the answer that she seeks, a condition that shapes the interactions between her and Daniel (usually to the disadvantage of the latter). At this point, it is legitimate for the reader to ask: What would have happened if she did not know an answer to his question? Would he have asked anything at all? Would he have adopted a different questioning pattern (more genuine and less evaluative)? In the following section I analyze a situation in which Nina poses a genuine question to which she does not immediately have an answer.

Uncertainty and questioning authenticity: Some possibilities

In their laboratories and in the field, scientists face problems for which there are no immediate clear-cut explanations. Environmentalists and everyday folk involved in environmentalist causes, such as collecting mapping data, are often confronted with moments of uncertainty (Boyer & Roth, 2006). Here, the very uncertainty appears to be at the origin of a learning process, as the individuals involved come to better understand as they interpret the situation to construct some explanation. It through this dialectical process of prior understanding and explaining that uncertainties may be overcome. More

so, uncertainty is an important conversational resource, even in the face of uncertainty (Roth & Middleton, 2006).

To allow students and teachers to learn in similar conditions, where uncertainty is a context and resource that can lead them to seek and frame goals and solutions to problems that crop up, is to make their experiences more authentic. In the process, participants learn as they attempt to expand their action possibilities to reach those goals and solutions; their learning is expansive in the sense that they attain greater levels of agency (Engeström, 1987). This is contrary to the view commonly held that students are mainly to be assessed by their teachers. From this standpoint, questions can move activities forward as they seek information not yet known—and responses are uncertain—mediating opportunities for learning to take place. The following conversation enlightens this perspective:

Nina: ((After talking to Lara, she turns to check the marks on the rope)) (2.5) ↓That's right, okay. (0.8) But, my problem is: I don't have a measurement for this. So, what do you suggest we do? (1.5) ((Looks at Lara)) I know that this is probably two meters ((holds the rope with her two hands as a way of indicating the portion she is referring to)). And I know this:: is some unknown number. (0.9) What do you think we should do?

Lara: (2.1) Hmm… (2.2)

Nina: You are a scientist. You are out in the field. You've forgotten to do the measurement on your rope to give you an accurate reading. What do, what do you think you would do?

Lara: [(3.4)

Nina: [((Sighs))] I would take this to the lab.

Lara: ((Nodding))

Nina: And I think we can measure in the lab. So, you know what you have to do?

Lara: Uh um.

Nina: You're going to hold onto this. I'm gonna have to measure this out.

In this episode, Nina and another student (Lara) are at the dock station working on turbidity measurements. At some point, Nina finds out that the Secchi disk they are using for measuring turbidity contains no depth marks (on the rope) and she considers it a problem (lines 02 and 03). Although one of Lara's classmates is doing the same measurement on the opposite side of the dock, Nina does not refer to her to get a number. Nina passes on to Lara the responsibility of what to do, and whatever she decides is not for herself alone, but for Nina as well ("So, what do *you* suggest *we* do?" [lines 03 and 04]). As Nina continues, she speculates ("*I* know this is probably two meters and *I* know this is some unknown number" [lines 04 and 05]) before asking Lara the same question as before: "What do you think we should do?" (line 08). This not only underscores what she expects as an answer, but also demonstrates the inappropriateness of Lara's lack of immediate reaction to the question (lines 04). It is an "extended sequence of interaction" (Mehan, 1979, p. 287) that results from the instructor's persistence to get the expected (but non specific) reply.

Since she is the instructor, Nina is considered to be an expert. Therefore, her questioning could be easily taken as not genuine. In other words, Lara may presupposed that Nina actually knows the answer and is simply checking on Lara (like she did with Daniel). But that does not seem to be the case. It is most likely a surprise to Nina that there are no marks on the rope: She spends some time looking at the rope and her talk is alternated with some silent moments. Furthermore, Nina's first utterance ("That's right, okay" [line 02]) is not only almost inaudible (low pitch), but it is also not directed to Lara: strongly suggesting that Nina was coming to realize the situation at that very moment. Therefore, Nina's expectation of marks being there is not fulfilled (as expressed

in the surprise in lines 02 and 03) and a conflict between what she predicted would happen and what actually happens emerges: Why would the marks not be there in the first place?

In this episode, Nina is still the questioner and instigated the conversation (just as with Daniel), but it is a different type of situation. Measuring units are not the problem. The issue is how to obtain any measurement at all: Nina is now seeking uncertain information as opposed to known information. Through Nina's (new) act of questioning, she engages Lara in the decision making process; thus opening up the possibility of changing her (Nina's) state of actual knowledge from *uninformed* to *now informed* (Heritage, 2005). In this sense, even though Nina potentially controls how much time Lara has to answer the question (another formal feature of classroom interaction), the unfolding situation has more non-formalities as it permits "permutations of speaker-activity with respect to turn-taking" (McHoul, 1979, p.187).

Lara hesitates, "hmm" (line 09), indicating that she is undergoing some private perhaps pensive moment that constitutes a suspension in time when she deliberates and attempts to come up with an answer to Nina's request (most likely one that should sound right enough not to compromise her situation). Her utterance elicits another reaction from Nina, who does not allow her much time to elaborate or provide her with any specific hints: Nina articulates the problem by evoking the image of Lara as a scientist (line 10). Nina's narrative becomes personal this time ("*You* are a scientist. *You* are out in the field. *You*'ve forgotten to do the measurement on *your* rope to give *you* an accurate reading. What do *you* think *you* would do?" [lines 10, 11, 12 and 13]). Lara goes silent again (line 14) and her not answering makes the possible outcomes for the situation even more

unpredictable. The smoothness (order) of "instruction" is disrupted, permitting two or more possible re-ordered states of answers: A *bifurcation* (Schwartz & Asterhan, in press).

Finally, Nina suggests the instrument should be taken to the lab (line 15). Nina's recommendation indicates that she acknowledges that Lara might have different ideas about what to do ("*I would* take it to the lab"). Lara nods (line 16). Nina reaffirms the importance of taking it to the lab, where she "thinks" they can measure it in some appropriate way (line 17). Nina checks on Lara to make sure she understands what she has to do (lines 17 and 18). At this point, Nina starts giving Lara instructions on how to proceed (lines 17, 18, and 20). Lara hums (line 19) and Nina asks her to hold onto the rope (line 20). In the end, Nina is going to "have to measure" the rope out ("*I'm* gonna have to measure this out" [line 21]). Nina and Lara's interaction is different from the IRE pattern previously observed. A collaborative association emerges with genuine questions as opposed to an evaluative action. Nina is not only teaching to but also learning with the student.

By referring to the lab in the latter part of the conversation (only the word field is mentioned before), Nina emphasizes the idea of doing what scientists do, namely, to examine things back in the lab: A flexibility allowed by this kind of outdoor experience. Eventually, Nina is making all those instruments of science more meaningful to students and show that they are important for conservation purposes, as she expressed during an interview and that supports her attitude. She wants to get children (especially girls) "acquainted with the world of science and maybe for future careers that is not so intimidating and alien as they think it is."

Nina and Lara are the subjects of their actions. Clearly, Nina is still in control over turn-allocation (much like the previous excerpt with Daniel), leading the conversation towards a conclusion. This puts Nina in a privileged situation where she is not expected to give any answer, even though she might feel obligated to do so. The fact that Nina is uncertain about the answer—no matter the fact that she is designated as the instructor for that activity—leads to a change in her questioning. Whatever the outcome of the situation, Nina opens up possibilities for Lara to become involved (cooperatively) in solving the problem that emerged (although she forecloses it quickly for reasons to be presented below). This is so that one could easily take the conversation to had taken place between two students (and not exclusively between a student and her instructor). Whatever the solution for the situation is it becomes a resource for subsequent actions that have the potential to promote science and its doings. Important is the fact that Lara is not merely evaluated but takes part in an original situation where some unexpected trouble arises.

Teacher questioning revisited

In the first episode, I show how Nina, through adopting an IRE sequence in her interaction, inhibited Daniel from having a more authentic learning experience in that he was not allowed to be uncertain about his doings. Daniel ended up apologizing (using his body orientation and discourse) for his condition of not knowing while the instructor was urging him to not feel “dumb” about what happened. Also, this was a situation where Nina clearly knew the answer she was attempting to elicit from Daniel. In other words, Nina performed an evaluative action.

In the second episode, the same instructor faces an unpredictable situation whereby the completion of the activity lies in the solution of the problem. What is more, the uncertain context provokes a change in the questioning routine of Nina, who now is not simply evaluating Lara (student), but also opening up the opportunity for Lara to experience science more authentically. In this way, the uncertainty that Nina display has the potential to show Lara that it is okay to be uncertain without any consequences to the immediate evaluation of her performance. In this indeterminate situation, Nina's habit of overlooking the activity numerous times does not work. As a routinized action—mostly accomplished without reflection (e.g., Miettinen, 2000)—the normal course of her activity is disturbed, and a state of uncertainty and indetermination emerges. This makes the normal flow of action difficult for both Nina and Lara. Noticeably, Nina eventually figures out what to do to get a measurement with the unmarked rope, abandoning the questioning behavior she adopted with Lara.

The intent of Nina's questioning in the two episodes (with Daniel and Lara) is understood by the students or else she would not have posed the question in the first instance. From a speech act perspective, an utterance can make its intent available to the recipient (Austin, 1962). Nina questions and therefore calls for the responsibility of an answer. In this sense, Nina is undeniably responsible for the students' response. Students' only responded (or not) to what they perceived Nina to ask. Thus, in her asking, Nina was responsible for making available resources for the students' to formulate a response. In both instances, Nina and each student completed each other's turns as they served as contexts for each other's actions (e.g., Mehan, 1980). From this perspective, Lara's state of not answering and Nina's utterance of surprise should be taken neither as inappropriate

nor as their failure; both may have never experienced that situation before and cannot summon the necessary resources in the moment (the same being valid for Daniel). Notably, Nina does not articulate what she will do with the instrument in the lab (lines 20 and 21). By not being explicit about what she will do, Nina creates the possibility for Lara to do enact something she already knew or to come up with some new and untested ideas (guesswork). Nina was also careful not to bring other students' attention to Lara—as Nina told the researcher present—which may also explain why Lara did less talking than Daniel.

Besides pressing Lara for a personal answer, Nina makes evident the relevance of what is being done—what real scientists do—and contributes to the network of activities that deals with the environment in the community. It is also a chance to experience the kind of unpredictable problems scientists face when doing research, which help to demystify the idea that doing science is always a linear sequence of events. As a consequence, they have the potential to impinge on their experiences and values they hold onto the task at hand, a chance not generally possible taking into account the pace of a regular classroom and commonly associated questioning behavior. In other words, an unexpected situation becomes available and it pushes for an unknown answer, creating anticipation on the part of the participants.

Now, participants have the opportunity to experience (school) science more authentically, that is, be confronted with authentic questions rather than questions to which the answers are already known (and known to be known) on the part of the student. In this sense, therefore, participants give more importance to and consequently pay more consideration to the activities they are engaged in. Without saying they can also

experience some of the inherent difficulties that the field has to offer, which are good situations to not only see science differently, but also to nurture creativity and empowerment, and therefore an overall appreciation of the situations they take part in. More importantly, uncertainty is about opening up for the development of scientific literacy and the realization that scientific knowledge is shaped by socio-political and personal decisions (the "*I*s" and "*you*s") as shown in sociological studies of scientific knowledge (Pinch, 1990).

Whether Nina goes back to the Lara at the end of the day—which she does not—is not my immediate concern. My argument is in favor of the creation of more opportunities for episodes of this kind to happen. It is precisely in such episodes that mathematics and science students develop an appreciation of what these disciplines are about (Roth, 1995; Schoenfeld, 1985). Some may argue that the structure of the program is very formal with the same time constrains as the classroom. At the same time, these constraints should not prevent participants from being allowed to experience moments of rupture and exercise the power of their own creativity within each activity. If opportunities like these are not fully comprehended or taken advantage of, isolated actions will not be fruitful: "The teacher must intentionally cause enough chaos to motivate the student to reorganize" (Doll, 1986, p. 15). It is up to the designers/instructors to allow some extra room (time) in their programs and to become conscious about the importance of not being assertive with pupils on their actions taken during activities. Finally, the particular problem framing Nina offers has important consequences for the way Lara and Daniel can achieve a solution to their tasks.

Discussion & implications

The purpose of this chapter is to argue for the benefits of uncertainty in changing teacher questioning routines and for the promotion of authentic science situations in science education. My analysis showed that Nina's questioning behavior shifted through the day while interacting with two students. The turnabout occurred when an unpredictable situation took place—the Secchi disk used to measure turbidity lacked measuring marks. My analysis makes salient that an uncertain situation not only prompted Nina to ask questions to seek unknown information, but also provided an authentic science learning experience (and the promotion of science itself) regardless of the setting. My study therefore affirms the importance of students' coming to recognize the object/motive of their actions, that is, to become acquainted with the culture of science and the role of science in their community their communities. If students are not allowed to appreciate what they do, then a different emotional evolvement takes place, one that is more likely to shake them away on the opposite direction of the activities in which they participate.

My close examination (and comparison) of students' talk and others actions (gestures) in environmental education activities outside the classroom exhibits the importance of giving students a chance to realize the temporality and uncertainty of the scientific process of discovery, thus identifying points for improvement. Drawing on the framework of discourse analysis, I provide explanations for the nature of the learning experiences being offered to elementary students during part of an out-of-class environmental lesson (field trip). It turns out that although there are arrangements made for students to find themselves in the position of research scientists, there is more to be

apprized from this context. I suggest that instructors jointly work with students to identify and concretely realize the object/motive of their actions and decide which tools, instruments, and resources they need in order to accomplish their goals. This would allow for more self-directed solutions for any problems that both students and teachers might face during activities. "Helping learners choose, adapt, and invent tools for solving problems is one way to facilitate transfer [of what is learned] while also encouraging flexibility" (Bransford, Brown, & Cocking, 1999, p. 78).

As my analysis of the episodes show, even in non-school settings individuals may ask questions that have pre-figured answers, therefore leading to the same question-response-evaluation patterns characteristic of school settings. Furthermore, my analysis concurs with the view that the freeing of what are considered to be constraints in the classroom environment does not compulsorily create the context for different questioning behaviors. Indeed, the use of teaching strategies commonly associated with formal settings has been considered a major impediment to learning in other environments (Griffin, 1994).

Nevertheless, field trips can offer fertile grounds for authentic science practices because the kind of questions and answers depends on the number of possible interactions among participants, displays, and the task at hand. Furthermore, known in advance—which helps avoid the explicit presence of a grading system to measure students' performance and their immediate success or failure. In other words, authentic science experiences create room for anticipation and uncertainty to take place and represent powerful domains for the improvement of science education and appropriate sites for discussions regarding its development. In this context, the field of environmental

education (EE) is highly relevant since it is believed to be a good avenue for "rekindling students' interests in the relevance of science, because young people are concerned about the state of the environment" (Gough, 2002, p. 1204)—and this has been also observed elsewhere (e.g., Battersby, 1999). Consequently, these type of activities can bring an important contribution to learning as it complements and expands in-class instruction by introducing students and teachers to places and events that they would unlikely experience otherwise (Bamberger & Tal, 2007).

Ultimately, allowing uncertainty to emerge, like the Secchi disk measuring problem, can provide participants with opportunities to not only understand and take control (ownership) over the task at hand but also be introduced to the fact that scientific knowledge takes a few doses of personal decisions to be constructed and is not always a recipe with the right outcome/product (truth). In that sense, whatever scientists say involves a personal (and sometimes contradictory) standpoint. Learners thereby experience science in the ways scientists experience it rather than science as a body of knowledge that the informal educators already possess and disseminate. Such a realization would empower participants to argue scientifically in various situations and to realize object/motives of already existing activities that they participate in (or not) to whatever collective good is embraced by the community they are constitutive part of. This, in turn, allows the production of failure to be seen as a condition of students and teachers' existence in the social world (Sherman, 2004) as opposed to lack of skills/knowledge residing solely in the student.

This process of demystification of science evokes personal decisions (experiences) over that of science as presented in textbooks and (generally) by teachers

(due to certain constrains). It has been suggested that this approach works especially well when the object/motive already exists in the community, such as when students begin to engage in environmentalism and legitimately contribute to an existing activity (Roth & Barton, 2004). I recommend that the uncertainty of scientific inquiry should be made available to students in order to increase learning opportunities and create room for creative and original practices that favor argumentation in the scientific arena (either formal or not).

CHAPTER 7

A FEELING FOR THE ENVIRONMENT: THE PLACE OF EMOTIONS IN THE PEDAGOGY OF PUBLIC ENVIRONMENTAL EDUCATION

tree-hugger n. Informal. An environmentalist, especially one who supports the preservation of forested land and the restriction of logging. (answers.com)

Abstract

Emotions have been already recognized as important aspects of/for environmental education enterprises. However, the place of emotions within the public domain of such initiatives has not been appropriately investigated even though they represent an increasing and valuable contribution to the formal system of schools. In this chapter I draw on two ethnographic case studies to describe the role of emotions in the pedagogy of public environmental education. My analysis is based on participants' discursive accounts of their educational praxis and on their interactions with others within the context of the programs they have designed. My study reveals that emotions are a driving force behind public environmental education—indissoluble from its motives, objectives, and cognitive components. I conclude by asserting the importance of integrating instruction with the emotions that come to bear in the process of learning about/within the environment as means of improving similar ecological experiences, considered crucial in/for the current environmental debate.

Introduction

The role of emotions in learning and instruction in general are of considerable value for educators—they are capable of affecting pupils' school performance (Gläser-Zikuda, Fuss, Laukenmann, Metz, & Randler, 2005) and influencing decision making more strongly than scientific and sound reasoning (Ekborg, 2005; Grace & Ratcliffe, 2002). Furthermore, as my opening definition from a popular online encyclopedia shows, emotional expressions (hugging trees) and environmentalism are expressed in popular culture. Research in environmental education (EE) has shown that emotions are paramount to the success of the various conservation practices students are exposed to (e.g., Iozzi, 1989a, 1989b; Newhouse, 1990). However, several of these studies privileged an instructional perspective on behavioral and quantitative grounds (i.e., through pre- and post-testing scores), insisting on a disembodied perspective on learning (e.g., Sansone & Thoman, 2005). This, in turn, represents a valorization of the paradigm of rationalism as the only legitimate type of knowing about the environment, negating any feelings and emotions one might have for the environment as a legitimate form of knowledge (Gigliotti, 1990).

Especially for those teaching within the formal curriculum of schools, where cognitive performance is of prime concern in the context of examination (measurement) pressures, integrating emotional aspects of ecological knowing becomes difficult. Indeed, school based environmental practices education alone have been less than effective in fostering sound environmental stewardship (e.g., Barnett et al., 2006; Pruneau et al., 2006), which suggests that EE may be placed better within the informal and non-formal sectors of education (Gayford, 1999).

Environmental education programs originating outside schools not only contribute to the improvement of EE in formal school systems, but also represent underexplored grounds for research concerning the role of emotions in the pedagogy of environmental education. On the other hand, public educators (non-certified instructors) have not been included appropriately in past field research, suggesting that the potential influence of their emotional approaches to such initiatives may have been equally neglected. Hence, the present study draws on two ethnographic case studies conducted with public educators—themselves designers of environmental education programs in a Western province of Canada—to investigate the niche occupied by emotions in the pedagogy of public environmental education. My analysis is based on the discursive use of emotional language from accounts (interviews) of public educators' doings and interactions with students in the context of their programs (field notes and videotapes). Ultimately, any portrayal of these educators' emotional experiences regarding their teaching about/within the environment does offer an important advancement of the understanding of the emotional aspects inherit to EE in general and public EE in particular, and might inspire the recognition of similar experiences in others.

My analytical work is rooted in a discursive psychology approach to language where not only *what* is said, but also *how* it is said is my focus (Edwards & Potter, 1992). I therefore only pay attention to what resources participants make available through their discursive interactions (with others)—during interviews or when participating in activities—rather than attempting to access the mind (concepts, information). Given the fundamentally interactive nature of emotions it is not possible to speak of internal events that generate emotion language both describes and help to accomplish—namely

cohesiveness and agreements (Denzin, 1984; Ingold, 1992; Lutz, 1988). Therefore, participants' accounts cannot be taken as referring to any internal psychological events and reflections of individual's cognitive mechanisms (Roth & Lucas, 1997). This situates my work within the perspective of interacting individuals, thus problematizing the dichotomies of body/mind and individual/social (e.g., Lyon, 1995; Zembylas, 2007).

Method

To understand the pedagogical role emotions play in the public domain of environmental education, I draw on a rapidly increasing database concerning environmentalist movements and environmental education, which our research group has been building over the last decade. This database is the result of several ethnographic studies among different environmentalist groups and the educational opportunities they present to their community (e.g., Boyer & Roth, 2005). The interviews were either voice-recorded or videotaped and transcribed, and took the form of semi-structured conversations of an average length of forty minutes. At the time they were collected, our objective was that of getting a description of some of the environmental education programs being delivered in our locality from the perspective of those who designed them. I did not seek for personal accounts of how emotions fit in participants' experience as educators. Indeed, I never asked them to give such interpretation to their narratives.

Field observations were collected in the form of videotapes: three to four one-hour tapes were usually required to record one day of activities within the context of the selected programs. Our videotapes contain talk (interactions) among public educators, upper elementary teachers, and students as they participated in environmental education programs.

In my analyses, I focused attention on the portions of my data in which the emotional aspects of participants' pedagogy emerged in the course of our conversations and observations. In other words, I analyzed participants' discourse whenever they used emotional linguistic referents to talk about learning and teaching about the environment during interviews or when doing environmental education. Although emotional experiences cannot be captured completely in words, everyday language is nevertheless considered to be both a tool and a source of evidence as it offers satisfactory access to the variety of emotions that exist, economically providing detailed descriptions of emotional reactions (Clore & Ortony, 1988). Thus, from the discursive perspective I espouse here, emotion words have meaning only within the contexts in which they are used (Lutz, 1988).

Following the principles of grounded theory (Strauss, 1987), I did not have pre-conceived understanding (well defined expectations) of how emotions would be represented in my database. Consequently, what I call an *emotion* emerged from observing (describing) situations (behaviors and narratives of experiences) in which participants' use/choice of words (emotional vocabulary) and other bodily actions appealed to my (researcher) experience of emotions. All excerpts from interview and video transcripts utilized in my analysis are concrete realizations of the potentially infinite number of general possibilities that exist for the participants (researchers included). More importantly, I recognize it as such or else it would have been opaque to me. In the end, I participate in the same *community of practice* (Lave & Wenger, 1991) of those involved with public environmental education. Therefore, I share understandings of what an emotion is and how it can be expressed; and these understandings are not entirely

private to any individual in our cultural milieu, but part of an *emotional intersubjectivity situation* (Denzin, 1984).

Two tales from the field: Making the case for the place of emotions in public environmental education

The vast literature on emotions results from a large number of the possible approaches to the matter (Scherer & Ekman, 1984). Nevertheless, emotions remain the least investigated aspect of research on teaching and are considered to be deserving of more attention (Zembylas, 2005). This sentiment is equally true for the public domain of environmental education, where instruction is carried out by public educators in various non-school settings like museums, provincial parks, community centres, fairs, festivals, and local natural sites (beaches and lagoons)—sites that require more study in terms of their emotional load. For example, what is the role of emotions in the pedagogy of public environmental education when analyzing the following description of a public educator's own educational praxis?

01 Teachers would oftentimes come to me and say: "Watch out for so and so and so and
02 so." They'll point you know and they'll say: "that one active that one blah blah."
03 They'll label them and then they will point out to them to me potential behavior
04 problems and I have learned to just screen it out. I don't even listen to the names I don't
05 I don't even look at who (sic) she's pointing to because nature has it own way of
06 healing.

In this excerpt of an interview, Nina talks about teachers (in the general sense) coming to the program and pointing out students with behavioral issues. From a traditional perspective on education the teachers' behaviour is understandable: Because Nina is not familiar with the students, teachers provide information for behavior management purposes. Nina has chosen "to just screen it out" (04). In her description of the situation she expresses that she does not listen to the names nor look in the direction

teachers point to (04, 05). The use of "blah blah" (02) in her narrative resonates with the inattentiveness she reported, communicating to the interviewer the frequency and commonality of such events to the interviewee. Nina concludes, "because nature has it own way of healing" (05, 06). The use of the conjunction "because" indicates causality. Nina prefers not to listen to what teachers have to say about students' behaviour *because* nature will do her work, it will "heal" the students. In the interview setting, Nina stretches the word "because" as if anticipating something important she is about to say—and *what* Nina says (content) is relevant to our analysis as much as *how* she says it. Additionally, she smiles and raises her eyebrows, drawing the listener's attention to what she has to say—much like pulling the listener into the climax of her sentence.

In this context, Nina's choice of words is suggestive. First, assuming that someone is always healed from something and restored or rectified *to* what is considered a more desirable state of *normality*, Nina's use of the word healing evokes the metaphor that the "potential behavior problems" students exhibit in class (and not to her) are symptoms of a *disease*, which has its roots in the school environment and that affects pupils' health (either spiritual or physical). Second, the fact that nature has its *own* particular way of healing implies hat Nina is not trying to gain control over the process, but letting it take its natural course—which involves confidence in the way nature operates. Third, the use of the word healing creates the idea of the environment as a living and acting entity able to influence human behavior—and this is a very economical (effective) and powerful way of describing her personal relationship with the environment. Ultimately, Nina's discourse contains an emotional referent to her

pedagogical praxis—meaning that emotions play an important role in the way she performs public environmental education.

To articulate this and other associated issues I conducted two ethnographic case studies with public educators who have designed and delivered environmental activities in a Western province of Canada. The two public environmental educators featured here—Nina and Carolina—each represents a different public environmental program (together they work with over ten schools in two local school districts). Their programs contain intrinsic elements that reflect their approaches to environmental education learning and instruction in informal and non-formal settings. However similar in their focus on building environmental awareness, these doings exemplify distinguished (different) approaches to the pedagogical role of emotions and this distinctiveness allows for a broader understanding of the different ways emotions are embedded in similar actions. The following sections were organized to make this aspect of my analysis explicit, thus helping the understanding of such initiatives that are designed to support learning in schools.

Nina: Falling in love with the environment

Nina is an environmental education program designer and has been a public environmental educator for over a decade. She is also the founder of a non-profit society that works towards the conservation and restoration of marine ecosystems on a volunteer basis. Her organization offers opportunities for young students and other community members to explore the local environment, having organized and delivered educational activities for over six thousand students of all grades.

An environmental program co-designed by Nina for upper elementary students has gained public recognition (award) and increased exposure (number of participating schools increases yearly. It is a daylong program located on the campus of a local university that is kilometers away from the city where most of the students travel from. The students are first introduced to the place that is comprised of a saltwater lagoon, a freshwater stream that flows through a wetland, and a boathouse with associated rowing sculls, motorboats, and docks. Students are split into three groups and rotate through three stations: (a) the rowing station, where students row an open-water scull or paddle a 22-foot First Nations canoe, (b) the wetlands station, where students study the traditional ecological knowledge of the First Nation that formerly occupied the lagoon, and (c) the dock station, where students assess the health of the lagoon by taking water quality measurements (pH, temperature, turbidity, and salinity) and plankton samples and observing the invertebrate species growing on the docks and pilings. Plankton samples are then taken to the boathouse where dissection scopes are set up for viewing and a saltwater tank houses invertebrate species for viewing and touching. Most classes participate in a watershed model and water quality instruments demonstration—offered by Nina—at their school before visiting the lagoon in order to familiarize the students with the watershed and instruments they will be using.

The role of emotions in Nina's pedagogy is made apparent through her constant use of emotional language to refer to her actions. Nina articulates how emotions affect her way of doing public EE and she does that in many (interrelated) ways. In the following excerpt Nina comments on how she got started as an environmental educator and in doing so provides an account of the pedagogy underlying her program. She makes

available the place emotions occupy in the program and the inseparability of emotions from cognitive (mind) aspects.

> (i) Larry and I had this idea about how we were going to do it [the program] in the Lagoon and I was very, you know, I think what my approach is is to start with the head, you know, and think about it and do a very academic kind of style of education, which kind of surprises me looking back because I've evolved myself and that's not the general approach. (ii) My general approach is having them fall in love with the world that, with E*R* [the program] I was a little stiff because maybe it was a new environment and I thought all this great opportunities to do marine investigations and blah, blah, blah, scientific experiments, blah, blah, blah. (iii) And then we invited the teachers to come and then sit with us and give us their ideas and when it came to the wetland part one of the teachers said: "Well, this is all very fun and good, but this is the place where more quiet reflection might be required, this is a place where children can really actually sit and listen and look and watch and reflect on their experience." (iv) And my instant reaction was "Bahamong! What a bunch of crap! We only have these kids for a certain number of hours. What is this reflection business? What is this, you know, sitting down and touching-and-feeling?" (v) Pretty surprising in retrospect, because it is the heart of the program. We have the rowing part, kids are out doing the challenge, we are out doing the marine stuff, which I do, but the heart of the matter is in the wetlands and I am totally in love with it, and I've watched and listened to the kids and after they came out of that–nine times out of ten—even the most hyperactive kids have changed. (vi) And that's really changed my way of looking at environmental education. (vii) Include all parts, include the body, include the heart, include the soul, include the mind, and I think E*R* was a beautiful transformative experience for me around how I see environmental education.

Nina began the interview by recalling early stages in the designing process of the program. Nina draws on experience to introduce her perspective on her program and how it transformed her way of looking at environmental education: She talks about the construction of her identity as a public environmental education program designer. This particular narrative is relevant to my study as it makes available an evolving aspect of Nina's pedagogy, namely, the integration of emotions with the objectives and cognitive aspects of teaching and learning in out-of-school settings.

Nina started the program with the help of Larry (a public school teacher), when she had "this idea about how we [they] were going to do it [the program] in the Lagoon," an approach she claims to be both "very academic kind of style of education" and "with the head" (i). Looking back on her past experience Nina is surprised with herself (v). At

this point, Nina narrates how her interactions with the environment affected her representation of her own pedagogy: She has evolved to a different approach and her experience both as an environmental education program designer and public educator played an important role in this transformation.

When Nina first got involved with the environmental program, she was "a little stiff because maybe it was a new environment" to her and she saw "great opportunities to do marine investigations" and "scientific experiments" (ii). Noticeably, the recurrent use of "blah, blah, blah" in Nina's talk evokes the idea of criticism to this kind of approach. Indeed, Nina's current perspective (objective) is to have pupils "falling in love" with the environment, which represents an objective for doing environmental education. In her talk, Nina contrasts between academic/rational/scientific/stiff and non-academic/emotional/non-scientific recalling that the stiffness of her practice (traditional or rational approach) was associated with the insecurity of the new situation, hence justifying an appraisal of her past behavior.

According to Nina, teachers eventually became involved in the design of the program. At the time, one of the teachers suggested that time be allotted for "quiet reflection" (iii) at the wetlands station, a place where children could "sit and listen and look and watch and reflect on their experience"—a "bunch of crap" ([iii] and [iv]), as she recalls thinking of it. Nina also seemed overtly concerned with the time constraints that made the "reflection business" sound like an unaffordable luxury—"we only have this kids for a certain number of hours" (iv). She admits it is "pretty surprising" now that she considers this station the "heart of the program", one that she is "totally in love with" and

that has changed her way of "looking at environmental education" ([v] and [vi]), a "beautiful transformative experience."

After witnessing the changes students go through ("I have watched and listened to the kids"), Nina's approach is presently less "stiff". She is not exclusively considering cognitive aspects of environmental education, instead she includes "all parts" (vii)—body, heart, soul, and mind—in her pedagogy. Nina's standpoint ("to start with the head") has transformed to include the pedagogical notion that emotional and embodied ways of knowing about/within the environment are equally important. Within the pedagogy of public environmental education, this suggests that emotions are inseparable from its teaching and learning cognitive aspects and objectives.

The way Nina's feeling for the environment mediates her pedagogy is also articulated in terms of the motivational aspect of her actions. For instance, in another portion of the same interview she makes available why the emotional aspects of her pedagogy are relevant to the achievement of an environmental ethics: The prime goal for EE in general.

> (viii) I think it's the salvation of the world to have that connection because if you fall in love with something, you'll try your best not to harm it and more of a consciousness comes into your being in your relationship with it, in your relationship with the world.

Nina describes a sense of responsibility for the environment: a direct result of the process of falling in love with the world. According to her, this emotional bond involves a sense of caring that is important for conservation purposes, calling also for an environmental ethics. Falling "in love with something" is highly positive and describes an important aspect of a relationship, one in which people understand how they should behave with one another—"you'll try you best not to harm" (viii). This emotional approach to public environmental education pedagogy is the means to which "more of a

consciousness" (viii) comes into peoples' being in their relationship with the world, thus transforming it for the better. It is the "heart of environmental education" as Nina pointed out in another part of the interview. In this sense, humans and their environment can mutually affect each other, and ethical principles are necessary to guide this interconnection.

Nina's interactions with students in the program represent another example of the importance of emotions in the pedagogy of public EE. In this context, Nina fosters students' articulations of emotional expressions while they are engaged in field (on-site) activities. In the following excerpt from video, Nina is on the dock monitoring students' activities after offering them translucent plastic containers to collect plankton, invertebrate and fish samples with. A student, Juliana, approaches her[5]:

01	Juliana:	Check our giant fish
02	Nina:	Oh, it's beautiful. Isn't that lovely?
03	Juliana:	(2.0) I named it Rufus Bond=
04	Nina:	=That's a stickleback. (3.0) °A stickleback° (1.0) Rufus?
05	Juliana:	Yes. Rufus.

Juliana had collected a fish. In general, students are not required to check their samples with the instructor, although they frequently want to make sure they are performing the activities accordingly—i.e., that they are collecting not just dirty water, which is what zooplankton and phytoplankton look like most of the time to their untrained eyes. Juliana approaches Nina with a request, "Check our giant fish" (turn 01), demanding her attention to what Juliana has in her hands. She holds up a container filled with water, offering it for closer inspection. The introductory verb in Juliana's utterance is in the imperative form ("*Check*...") Juliana's demand is understood as such by Nina,

[5] Equal sign (=) indicates that there is no gap between the two lines; latching. Degree marks (°word°) indicate decreased volume of materials between them.

who responds positively to Juliana and elevates the container to eye level to observe the contents. Juliana's excitement is evident: (a) she uses the adjective "giant" to qualify the fish, when it actually measures only eight centimeters, (b) she constantly smiles during the conversation, and (c) if one accepts that an emotion is the outcome of a value judgment that we make to discern how and what we value (e.g., Artz, 1994)—a way of knowing—then the very fact that Juliana decides to hold on to the fish is evidence that she experiences emotions for it in the context of the goals of the activity. For example, she might feel proud of her catch as it indicates that she has accomplished one of the objectives of the task at hand, namely, to collect specimens for observation.

Nina also responds positively to what Juliana shows her by using an interjection of surprise ("Oh") followed by an adjective ("it's *beautiful*" [turn 02]). Next, Nina reinforces her initial statement by posing a tag question, an interrogative expression frequently used in spoken English to show agreement: "*Isn't* that lovely?" (turn 02). Only then, Juliana tells Nina that she has named the fish—"*I* named it Rufus Bond." Nina replies by immediately stating the animals' common name twice. The difference in intensity between both utterances of "stickleback" is noticeable and the pause in between functions to call the listener's attention to what she is saying. At the end of the fourth turn Nina repeats and questions "Rufus?" in order to clarify what Juliana said. Juliana follows with a validating statement, "Yes, Rufus" (turn 04), marking the end of the conversation. This, in turn, ends up validating Juliana's specific action of attributing a name to the fish. "Yes, Rufus", Juliana answered, marking the end of the conversation.

In the act of naming the animal Juliana demonstrates that her actions are not solely to collect organisms and information about the lagoon, but to also express emotion.

Her emotion is directed to Rufus Bond, indicating an object of her affection. The cause and nature of her emotions are not made available to my analysis. However, through her speech acts—naming the fish—is an emotional reaction to the presence of the fish, one in which she individualizes it and raises its anonymity.

Nina's constant positive reaction to what Juliana says acknowledges and contributes to the maintenance of Juliana's emotional expression. At the same time, it encourages Nina share the same emotional expression through her teaching, opening up the possibility for all the other students to do similarly. This analysis therefore offers another way of shedding light in the role emotions play in the pedagogy of public environmental education—that is, integral part of its motives, objectives and cognitive aspects.

Carolina: Caring for the environment

Carolina is the co-designer of a non-profit program that is intended to integrate marine education into students' academic and community lives by offering seawater aquaria and associated curricular materials to schools. After a daylong introductory classroom session in which students have the opportunity to observe and touch local marine organisms—several species of crabs, sea cucumbers, and starfish—they are tasked with the responsibility of looking after the aquarium and the organisms. The aquaria is usually placed "in a public part of the school where lots of people are wandering by," according to Carolina. Although she donates her time to maintain the function of the aquaria, it is up to the students to feed the organisms, monitor any changes in their behavior and collect and record water quality data—temperature, turbidity, and pH—on a regular basis. Carolina conducts follow-up activities, which

represent a chance to gather more detailed information about the animals, and includes a presentation for the school community and mentoring classroom activities where students mentor other classrooms from different grades on the same tasks. Carolina's program is now offered through Nina's organization.

As in the case of Nina, the role of emotions in Carolina's pedagogy is made clear through her constant use of an emotional language to refer to her actions. During her talk, Carolina articulates the intertwined nature of emotions, objectives, and cognitive aspects of her program. She considers the emergence of emotions to be a direct consequence of the activities students perform. According to her, it evolves out of their care for the animals, also bringing meaning to what students learn at the program. In that sense, emotions develop as a result of participants' engagement in activities. The following exemplifies this perspective:

> (i) So it's creating, at the same time you're creating a big increase in awareness people are realizing that these are living creatures and they, because they are taking care of it. (ii) And we also do projects where they learn about difficult (?) animals and then teach other kids about it, like coaching up their work, or writing out a book, and then leaving it to other kids, because they are doing all that they, they take it, they take it very personal, sort of emotional responsibility for it. (iii) and we think that's really important in creating, creating that, that link to learning that makes fit a part of their real world, you know?

Carolina explains that her program creates a "big increase in awareness" and people realize "that these [animals] are living creatures." According to her, encouraging students to take care of the animals and the aquarium, and to participate in mentoring activities "where they learn . . . and then teach other kids" (ii), elevates these tasks to an emotional level: "[B]ecause they are doing all that, they take it very personal, sort of emotional responsibility" (ii).

In her talk, Carolina articulates that the activities carried out by students in schools—"projects"—are a flip side of her pedagogy, one that builds a personal and emotional load that is "really important in creating that link to learning that makes fit a part of their [students'] real world" (iii). This, in turn, also accounts for the transferability of what she does as a public educator to situations outside the school setting. Emotions are depicted as commonalities underlying features of life in and out of the school. This notion was also demonstrated in a recent presentation Carolina gave to the academic community where she explained her program. Carolina spoke about emotions in the following way: "The means to improve environmental education is to develop tools to create emotional links to the local environment as the emotional tie stimulates learning both in and outside of school." This perspective on the integrality of emotions to the cognitive aspects and objectives of her programs was articulated in another part of her interview:

> (iv) They're [students] at the point where they understand a lot of those concepts much more than many adults that are living in the community. (v) And so you're sort of creating and build, slowly building on a, a, both, both sort of a lifelong learning and also an emotional attachment to what is around them. (vi) So that they part (?) understand how what they do on land can affect what's, what is in the environment around them.

Besides reproducing the association of emotional with cognitive aspects for an effective EE, the "emotional attachment" Carolina refers to as a focus of her program contributes to creating an understanding of "how what they [students] do on land can affect what's in the environment around them" (v). In conjunction with a "lifelong" type of learning, emotions help elevate the existing connection of humans and their environment to a conscious level, one in which ethics is fundamental for whatever comes after this realization.

In the context of Carolina's pedagogical practice, I have another example of how the expressions of emotions towards the environment are fostered among participants of activities (similarly to Nina). This, in turn, also contributes to the development of an *emotional practice*, that is, implicit emotional rules negotiated by the instructor and students that delineate what emotions are acceptable in certain situations (Zembylas, 2004). For instance, when Carolina brought marine organisms into a sixth-grade classroom she explained that, "They [marine organisms] are other living creatures just like you and I are living creatures so you wanna treat them like you would somebody else who's your friend," thus, integrating the notions of respect and environmental ethics. She instructed the class about how to gently handle the animals and the importance of this knowledge for their mentoring activity with the class next door (also sixth graders). The language Carolina uses is adequate for (intelligible to) the students.

Carolina's conversation with the class is emotionally loaded: She makes reference to the human capacity for friendship and how animals should be treated just like friends. Noticeably, she does not talk about humans in general, but specifically about those that we know and respect. In comparing those "other living creatures" to "you and I," Carolina expresses oneness with those creatures, thus emphasizing the organisms' connection to the students by elevating them to the same human condition. This, in turn, is also discursively performed by Carolina by imbuing the animals with emotions. For instance, she talks about crabs that are "shy" and "embarrassed" for having certain physical attributes. The use of this particular vocabulary and the emotions it evokes support the claim that the *affective domain* is nurtured in the pedagogy of public environmental education. Ultimately, this means that emotions play an important role in

their pedagogy specifically and in the pedagogy of public environmental education in general.

Discussion & analysis

As a direct result of our way of life, we humans face a serious ecological crisis—although some would argue about the magnitude and media presents the issue in diverse and often contradictory ways (Lomborg, 2001; Sanera & Shaw, 1999). Environmental education is advocated as an appropriate venue for increasing peoples' realization of the effects of their actions upon the environment and thus the possibility of reversing the ecological problems we have become so familiar with (e.g., climate change, loss of biodiversity, etc.). In this context, the role emotions play in the pedagogy—what is to be taught and how—of public initiatives in environmental education, designed to support formal education in schools, is yet to be better understood. Therefore, the purpose of this chapter was to describe and articulate how emotions are embedded in the pedagogy of public environmental education, as the topic emerged during interviews and the observations of the praxis of two public environmental educators and designers—Nina and Carolina.

My analyses show that emotions play a significant role in the learning and instruction processes that are performed in public environmental education programs: being associated with their cognitive aspects, objectives, and motives. This is to say that cognition is not the sole moment mediating the pedagogy of pubic environmental education and the way participants understand and represent their natural surroundings. Although the concepts of cognition and emotion are used distinctively, they are not mutually exclusive in relation to the pedagogy of public environmental education.

Moreover, emotions are the means through which an environmental ethics become attainable (Roth, 2007), representing an opportunity for people to re-connect with the environment. Emotions bring meaning to and sustain lifelong learning, contributing the transferability of what is learned in school. Although articulated differently by participants, these aspects are intertwined so that it is difficult to tease out each one without taking into consideration the others: They overlap in their pedagogical significance.

The emotional aspect present in the metaphor of the environment as a person brings to bear an embodied perspective of learning and instruction. For example, the interaction between Nina and Juliana would not have been possible had their bodies not been there to encounter with Rufus—according to Buck (1985) the attribution of feeling to an object is an effect of such an event. Likewise, the "real world" that Carolina talks about is related to the "emotional responsibility" she aims at fostering in the participants of her program, strengths the notion of emotions being the direct result of experience of participants' actions in the world and their interactions with teachers, students and the environment itself. These experiences affect and are affected by the way instruction is carried out and learned is thought of occurring. These observations run counter to the general lack of consideration for the embodied way people learn (O'Loughlin, 1997, 1998; Payne, 2006). They also reaffirm the fact that the process of perception is also a process of action in which we perceive the world as (and because) we act in it, making the acquisition of environmental knowledge inseparable from a productive practice (Ingold, 1992).

Moreover, they bring about the otherness of the environment. For instance, Juliana was given the opportunity to see "Rufus" from a personal angle, therefore, rendering the fish known rather than amorphous and unknown. The fish becomes the Other that resides both outside and inside her humanness. The fish is a living creature different than herself but also not so different as it becomes part of the world she perceives and inhabits her immediate world: The fish can be cherished and named by her. Similarly, participants in Carolina's program are exposed to the same possibilities when animals are presented in familiar (humanly) emotional language—"friends" and "shame"—that tends to diminish the differences between nature and humans.

If the formal education system be considered an adequate venue for promoting the urgent task of shifting humans' relationship with nature (e.g., Weintraub, 1995), not only should it increase students' access to information (experiences) about ecological processes and issues, but also create room for an emotional relationship with the environment to take place. My study shows that public environmental education can fill this niche. Moreover, students that participate in these public programs are encouraged to learn about the environment through the interaction of all sense modalities that accompany and presuppose their emotional encounters. The public educators' practice attempts to dissipate the mind/body (feeling/reason) dichotomy that is pervasive in the formal education system (classroom practice, curriculum discussions and documents).

My study illuminates the need for teachers and students to understand their own environment-related emotions and build a more personal relationship with the environment, one that is more than merely cognitive. Encouraging and cultivating emotions for the environment is part of a *pedagogy of emotions* that is complimentary to

the classroom routine; after all, teachers are not the only force driving classroom dynamics, but their agenda can certainly influence students' experiences (e.g., Griffin, 2004). If we (as educators) decide to ignore emotions in our pedagogy for environmental education, learning, and instruction in particular and education in general, we are to be considered adopting a “head” perspective (to use Nina’s words)—an approach that has been proved to be pedagogically harmful for the present school generation and empirically damaging to our environment. Far from wishing to interfere with sentiments, the teacher may want to go out of his/her way to encourage them (Yarlott, 1972).

Eventually, the pedagogical emotional significance of events is defined socially, requiring the use of our senses. Attending to emotions might show us that what we do is shaped by the contact with others—not necessarily humans (Ahmed, 2004; Milton, 2005). As we move through the environment we come to know ourselves in relation to things around us, in a process of perception that emerges not only out of what we do with and towards objects in our environment, but also out of what they do to us (Bird-David, 1999). The respect for the otherness of nature implicit in such process might awaken new forms of solidarity with and respect for the environment (environmental ethics), ultimately contributing to the understanding of our own selves (Grün, 2005). To deny that would be to render a depthless prospect on the potentiality of EE initiatives in the current environmental debate and the possibilities for improvement. More importantly, the two cases described here show that, although such integral approach is plausible—and making it observable through research is a way of starting to deal with the issue.

CHAPTER 8

CONCLUSION?

I remember being asked numerous times about the importance of my research during "lab" conference presentation rehearsals or data analysis sessions, where we collectively try to bring sense to what we do as a research group. This chapter provides the reader with a comprehensive look at my contribution to science education, and the implications of the ethnographic research I have conducted over the last three years.

One way of investigating education initiatives is through the use of questionnaires and interviews. From this approach, researchers draw conclusions that are "verifiable" and taken as legitimate predictors of certain (future) behaviors resulting from specific experiences. The more a model resembles the phenomenon of interest, the higher the probability of a successful prediction. Moreover, depending on how the data collection instrument used, what a participant says is taken as a pathway to his or her attitudes and beliefs. Alternatively, one can look at the learning opportunities offered to participants and how they interact (or articulate their interactions) with other students and instructors as valuable indicators of the educational worthiness of educational practices. Over the course of my research I have learned and applied the latter approach.

I have documented a successful range of processes through the lenses of discourse analysis (DA), which is my first contribution to scholarship. By introducing the use of discursive psychology (DP) as an analytical tool for science (and environmental) education research purposes, I (i) describe how people negotiate their participation in interview settings when talking about their curriculum design decisions, (ii) study the ways interactions among participants take place, and (iii) articulate possible

consequences to science learning and instruction. Working in diverse learning environments and with varied audiences strengthened my research: it was oriented toward public educators and certified teachers in- and out-of- schools. Therefore, my analysis of activities in diverse settings contributed to my understanding of how people navigate between different activity systems.

During my research, I realized the real potential for out-of-schools initiatives to compliment and extend in-classroom work and vice versa from discursive analytical perspective. Indeed, one is not a substitute for the other (as noted elsewhere [e.g., Braund & Reiss, 2006]). Students are exposed to situations in one environment that the other simply cannot afford—and the instructors I have worked with have articulated their intention in seeking these complimentary routes (e.g., public environmental education initiatives) for the development of their teaching and the learning processes of their students. For example, how can we expect students to experience sound science (and the environment) if they cannot "feel" it through their own senses? In other words, how can people learn science if they do not do science? How can schools more closely simulate students' daily experiences and make sense of classroom situations?

By providing opportunities for students to leave the school ground or by bringing in the discussion of current activities originated outside the classroom students can grasp the usefulness of what they do in school and the hours of instruction they have to attend—science is build upon practice. Albeit, there are barriers to out-of-school programs for elementary and middle-schoolers in their regular routine: Funding scarcity, bad weather conditions, and availability of school personnel to meet the children to adult ratio to satisfy safety standards. Moreover, the actual design of curriculum for the

development of certain skills in preparation for and follow-up of fieldtrips requires in-classroom instruction. Under these constraints, using media as a curricular tool seems to be particularly favored over other practices.

Unexpectedly, in my research I have also found that these two settings are similar to one another in some ways. On the other hand, these similarities they can raise questions as to whether or not one should invest time and money on going on a fieldtrip or getting an aquarium for his/her school. The existing resemblance of the two environments form the familiar that is a necessary and inevitable starting point for participants for the unfolding of new activities—discipline and safety rules are important in determining the possibility of certain group actions. This, in turn, should not be used as an excuse for the immediate translation (reproduction) of the classroom environment on fieldtrips or vice versa—or else the complimentary component is partly lost. Rather, each setting offers different opportunities for the expansion of learning and the crossing of boundaries between school and other daily activities—the crossing of boundaries being an unavoidable task facing everyone attending schooling and fieldtrips at all levels.

In every chapter, readers find refined descriptions of situations in which real people negotiate their actions and move on with their business in ways considered acceptable—or else there would have been held accountable for their actions and argumentation would have followed (Locke, 2002). My approach was that of learning from the observed practices rather than being merely critical about them. My claims and discussions were aimed at offering opportunities (or has implications) for teachers and researchers interested in the study and development of programs that are similar to those I investigate here: I introduced frameworks for the analysis of curriculum actions and the

use of media in science classrooms, also serving as tolls to facilitate curriculum design (chapters 3 and 5). Likewise, I discussed the role of fun, uncertainty, and emotions in science (environmental) learning and instruction (chapters 4, 6, and 7, respectively). In the next, section, I offer suggestions for further research, which I will continue to doing during my academic career.

This dissertation represents the initial steps for my research to penetrate the mainstream discourse of science and environmental education in terms of the study and development of learning processes through which we make sense of the experiences that we (developers and teachers) create for children and adolescents in- and out-of our classrooms. The collection of chapters here indicates that learning is (or should be for that matter) meaning driven, socially situated and identity forming support a change hope and change in science and science education.

Finally, this thesis is an opening rather than a conclusion of my personal work—the question mark in the title of the chapter reflects that openness. That said, one may ask: What's next? That is exactly the objective of the next section, where I discuss the future direction I want to give to my research as a result of the work initiated with my PhD.

Next: Expanding learning possibilities

Each chapter represents the closing of specific moments in my research journey and the beginning of new ones. In other words, although this dissertation officially marks the end of my PhD program, it opens up endless possibilities for a lifelong research career. Metaphorically, my work is like the apical meristem of a plant—a tissue found in the buds and growing tips of root whose main function is to begin growth of new cells.

Put differently, what seems to be a dead-end is actually the beginning of something new, beyond the point that was once considered to be the highest (or better?). The aim of this last section is to pinpoint the growing tips of my investigations.

In chapter 3 (*Environmental Education in Action…*), the interpretive repertoires I identified in the discourses of environmental education program designers reveal the type of argumentation one may find in both explicit and implicit science curricula. The description and analysis of these taken-for-granted discursive strategies sheds light on some of the actions performed by educators who are either designers or are obliged to follow the Integrated Resource Packages (IRPs) provided by the British Columbia Ministry of Education. One question emerges from this study and that I have not addressed: To what extent those other participants (teachers and students) attending such activities (public environmental education programs) redesign these very same activities in the course of their engagement? This would be to recognize the possibility of people (students and teachers) to be competent to modify the activities they participate, thus changing their participation and expanding their learning possibilities—as opposed to being mere spectators. In other words, people do unexpected things, making education an unpredictable process. As pointed out by the interviewees themselves (curriculum designers), their actions are a combination of past experiences and their ability to put them to use for a specific environmental issue. What if students and teachers exercise similar capacities of modeling situations to fit their immediate instructional and learning needs (even on a micro level)? This would be also a chance to investigate how science curricula mediate practices as *boundary objects* (Star & Griesemer, 1989)—i.e., those objects that inhabit multiple social worlds of policy-making institutions (Ministry of

Education) and classrooms.

Although readers could get a glance at students' perspective on emotions when they talk about the *fun* component of their educational experiences (chapter 4, *When Fun is not Fun*), what are they (students) referring to when talking the way they do? Over the course of my research a high-school teacher mentioned that when he asked his students what the highlights of a fieldtrips were, they spoke about how fun certain activities were. The teacher confessed to being uncertain of the educational value (the significance) of fun in the context of his classroom. From an analytical perspective there existed a contradiction: Whereas the value of emotions in education is well established (Claxton, 1987)—the term *cold cognition* has long indicated the inadequacy of an exclusive focus on cognition (Pintrich, Marx, & Boyle, 1993)—the significance of certain emotions to science learning and instruction (e.g., fun) are yet to be better understood. Would students consider fun to be the ability to do whatever they want whenever they want? To what extent is fun associated with other motivational aspects already investigated in education (Hidi & Harackeiwicz, 2000)? How is fun associated with academic performances and scientific career choices? Should fun and learning be mutually exclusive in order for science learning to occur? If so, how do teachers and students resolve (negotiate) the dichotomy fun/classroom in the course of their school activities? Students have shown the pedagogical competency to inform the classroom routine in ways overlooked by traditional research—see, for example, research on cogenerative dialoguing that is based on the fundamental idea of human agency rather than any pre-conceived hierarchical categories of knowledge (Roth & Tobin, 2002). Research should more often investigate what students have to say.

The approach to the use of media I propose in chapter 5 (*Public Understanding of Science…*) illuminates the kinds of resources embedded in news report text to their own understanding, thus making explicit the discourse apparatus designed to sell a biased account of facts to their readership. In this scenario, the analysis of a case study of a high-school biology teacher reading a science-related newspaper article to her students provides an example of how teachers make use of news in their classrooms. Further to my study, how does the teacher's interpretation mediate students' own reading of science reports? How do students and teachers differ—or not—in their understanding of what they read? How do teachers negotiate the meaning of what they read for classroom purposes? These and other subordinate questions should be considered in future studies on the use of media in/for science education.

In chapter 6 (*Uncertainty as a Context and Resource…*), one could see how the unknown makes the businesses of learning and teaching uncontrolled. This does not, however, represent an inappropriate performance of participants (teachers and students). As my study shows, such circumstances are good venues for science to be experienced more authentically in the school setting. Likewise, it reinforces the idea that learning is situated (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991) and that what is known in one situation is not automatically transferred to another. Investigating how *not knowing* mediates the participants' view of the validity of such experiences would advance research in this area. For instance, there are certain expectations on the part of the community on how schools should work—e.g., the commonsense that teachers know what they teach and have to assess students accordingly. How do teachers allow room—or not—for instability in their teaching? Do these situations enhance students'

comprehension of science as an uncertain and collective process (i.e., their images of science)? How is the student-teacher relationship affected by the unknowability of interactions? In this scenario, how does one manage the inadequacy of traditional assessment tools to capture these nuances? Once again, these are empirical questions that demand observation and analyses of interactions at the classroom level.

The emotion language deployed by educators in the course of interviews and other interactions with students as discussed in chapter 7 (*A Feeling for the Environment…*) has important implications for the ways emotion in environmental education are incorporated into the cognitive aspects of school science content knowledge teaching and learning. The archetypal long-standing Newtonian–Cartesian tradition of separation of mind and body divorces reason from feeling and holds emotion as a countenance to truth and objectivity (Alsop & Watt, 2003). In this context, the discussion offered in chapter 7 contributes to the acceptance of our body as integral part of knowing science through the environment—an embodied knowledge (Varela, Thompson, & Rosch, 1993). However, what are the specific impacts of the use of such embodied emotional language to classroom interactions between students and teachers? Are they aware of their emotional discourse and how it mediates (and is mediated by) their practices? Even though research has suggested that it may be difficult to make teachers change their instructional behavior to foster student emotions (e.g., Pekrun, 2005), my own investigation indicates that they might not have to. If emotions are indeed an inherent part of what teachers do, then a descriptive and analytical look at how emotional teaching and learning processes unfold in real interactions will suffice to highlight ways of enhancing the enjoyment of learning. Nevertheless, there is still more

to learn on how students experience the transition between both in- and out-of school activities.

Ethical considerations

I have been always instructed by my supervisor to use descriptive title sections in my papers. Personally, I always understood this as a strategy that builds upon the fact that education research cannot be prescriptive. After all, there are no guarantees that any formulas for achieving distinct patterns of behavior and performance will work across situations, no matter how similar they seem to be. I have experienced unpredictability in my own teaching before—there is never an end.

The question mark (*Conclusions?*) in the title reflects that incompleteness that is the sociological stuff our lives are made of. As in all life's contradictions, this is also what drives people to do more and more. From this perspective, it is important to assure that I neither claim that the practices I observed are typical of all science educators, nor do I attempt to identify any universal mental archetypal states responsible for the ways teachers and public educators do what they do. Instead, the actions recorded in the course of my research activities are cultural possibilities. On the other hand, any portrayal of these educators' doings does offer important insights into the ways science can be enacted and might inspire the recognition of similar experiences in others.

In this dissertation I offer descriptions and analyses of situations common to science learning and instruction in general. My work is not about individual teachers and students, but about some of the processes that they may find themselves in and that I want to understand. It is true that different processes would have been observable under different conditions, but my interest remains in how real people cope (act and react) in

real instructional circumstances without being blamed for what they do and the way they do it. Ultimately, the situations I have described and analyzed are indicative of what others (students or teachers) do, so it is important to understand what is going on and how it is going on without laying blame on anyone. These situations are not a reflection of any individual's teaching or a reflection of what their students know about science, but the real processes real people like me in this field are trying to understand: It is my hope that my work illuminate this perspective.

This dissertation is a result of an ethnographic study conducted with teachers, students, and public educators in Victoria (British Columbia). Using discourse analysis (DA) as a method and theory to analyze participants' talk during interviews and other interactions in the course of their school-related naturally occurring activities, the present work describes and articulates curricular and instructional implications of the observed practices to science classrooms and environmental education initiatives more specifically. The fact that data collection took place both in- and out-of the school settings allowed a more refined understanding of the issues those crossing their boundaries might face, a point deserving of attention in the educational research arena. The conclusions amount to the potentiality of non-school activities for the improvement of learning and instruction in formal settings. Research of this type is important because they expand the understanding of not only the ways science education can be enacted, but also of how people take what they have learned in one place and make use of it in another, thus resulting in process-oriented and less contestable implications for education in general and science learning and instruction more specifically.

REFERENCES

Ahmed, S. (2004). *The cultural politics of emotion*. Edinburgh: Edinburgh University Press.

Alsop, S., & Watts, M. (2003). Science education and affect. *International Journal of Science Education*, 25(9), 1043-1047.

Anderson, A. (2002). In search of the Holy Grail: Media discourse and the new human genetics. *New Genetics and Society,* 21(3), 327-337.

Artz, S. (1994). *Feeling as a way of knowing: A Practical guide for working with emotional experience*. Toronto: Trifolium Books.

Assor, A., Kaplan, H., Kanat-Maymon, Y., & Roth, G. (2005). Directly controlling teacher behaviors as predictors of poor motivation and engagement in girls and boys: The role of anger and anxiety. *Learning and Instruction*, 15(5), 397-413.

Austin, J. (1962). *How to do things with words*. Cambridge, MA: Harvard University Press.

Bach, R. (1977). *Illusions: The adventures of a reluctant messiah*. New York: Dell.

Baker, C., & Johnson, G. (1998). Interview talk as professional practice. *Language and Education*, 12(4), 229-242.

Baker, C.D. (1992). Description and analysis in classroom talk and interaction. *Journal of Classroom Interaction*, 27(2), 9-14.

Ball, S. J. (1993). Self-doubt and soft data: Social and technical trajectories in ethnographic fieldwork. In M. Hammersley (Ed.), *Educational research: Current issues* (pp. 32-48). London: Open University Press.

Bamberger, Y., & Tal, T. (2007). Learning in a personal context: Levels of choice in a free choice learning environment in science and natural history museums. *Science Education*, 91(1), 75-95.

Barnett, M., Lord, C., Strauss, E., Rosca, C., Langford, H., Chavez, D., & Deni, L. (2006). Using the urban environment to engage youths in urban ecology field studies. *Journal of Environmental Education*, 37(2), 3-11.

Battersby, J. (1999). Does environmental education have ‘street credibility’ and the potential to reduce pupil disaffection within and beyond their school curriculum? *Cambridge Journal of Education*, 29(3), 447-459.

BCME (British Columbia Ministry of Education). (1996). *Science 8 Integrated Resource Package*. Retrieved December 20, 2005, from http://www.bced.gov.bc.ca/irp/irp_sci.htm

BCME (British Columbia Ministry of Education). (2005). Science Integrated Resource Packages. Retrieved on August 15, 2005, from http://www.bced.gov.bc.ca/irp/irp_sci.htm

BCME (British Columbia Ministry of Education). (2006). *Biology 11 and 12 Integrated Resource Package*. Retrieved March 9, 2007, from http://www.bced.gov.bc.ca/irp/irp_sci.htm

Bennett, T., & Woollacott, J. (1987). *Bond and beyond: The political career of a popular hero*. Hampshire: Macmillian.

Bird-David, N. (1992). Beyond "the original affluent society": A culturalist reformulation. *Current Anthropology*, 33(11), 25-34.

Boyer, L., & Roth, W.-M. (2005). Individual|collective dialectic of free-choice learning in a community-based mapping project. *Environmental Education Research*, 11(3), 335-351.

Boyer, L., & Roth, W.-M. (2006). Learning and teaching as emergent features of informal settings: An ethnographic study in an environmental action group. *Science Education*, 90(6), 1028-1049.

Bransford, J., Brown, A., & Cocking, R. (Eds.). (1999). *How people learn: Brain, mind, experience and school*. Washington, DC: National Academy Press.

Brattstrom, B. H. (1999). Are students learning from their teachers or the media? *American Biology Teacher,* 61(6), 420-422.

Braund, M., & Reiss, M. (2006). Towards a more authentic science curriculum: The contribution of out-of-school learning. *International Journal of Science Education*, 28(12), 1373–1388.

Brown, J. S., Collins, A., & Duguid, S. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32-42.

Buck, R. (1985). *The communication of emotion*. New York: Guilford Press.

Canadian Cancer Society & National Cancer Institute of Canada. (2007). *Canadian cancer statistics 2007*. Retrieved January 23, 2007, from http://cancer.ca/vgn/images/portal/cit_86751114/36/15/1816216925cw_2007stats_en.pdf

Carlsen, W. (1991). Questioning in classroom: A sociolinguistic perspective. *Review of Educational Research*, 61(2), 157-178.

Carlston, D.E. (1987). Turning psychology on itself: The rethoric of psychology and the psychology of rethoric. In J.S. Nelson, A. Megill, & D.N. McCloskey (Eds.), *The rethoric of the human sciences* (pp. 145-162). Wisconsin:University of Wisconsin Press.

Christenson, M. A. (2004). Teaching multiple perspectives on environmental issues in elementary classrooms: A story of teacher inquiry. *Journal of Environmental Education*, 35(4), 3-16.

Clark, F., & Illman, D. L. (2006). A longitudinal study of the New York Times Science Times. *Science Communication,* 27(4), 496-513.

Claxton, G. (1987). Cognition doesn't matter if you're scared, depressed or bored. In P. Adey, J. Bliss, J. Head, & M. Shayer (Eds.), *Adolescent development and school science* (pp. 155-161). New York:Falmer.

Clore, G.L., & Ortony, A. (1988). The semantics of the effective lexicon. In V. Hamilton, G. H. Bower, & N. H. Frijda (Eds.), *Cognitive perspectives on emotion and motivation* (pp. 367-397). Boston: Kluwer Academic Publishers.

Conrad, P. (1999). Uses of expertise: Sources, quotes, and voice in the reporting of genetics in the news. *Public Understanding of Science,* 8(4), 285-302.

Corner, J. (2000). 'Influence': The contested core of media research. In J. Curran & M. Gurevitch (Eds.), *Mass media and society* (pp. 376-397). New York: Oxford University Press.

Coulthard, R. M. (1977/1985). *An introduction to discourse analysis*. London: Longman.

Davies, P. (1979). Taking the sigh out of science. *New Scientist*, 3, 351-355.

Deneroff, V., Sandoval, W. A., & Franke, M.L. (2002, April). *Learning the discourse of inquiry: How in-service high school science teachers come to understand themselves as listeners: Lessons from Samantha*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Denzin, N.K. (1984). *On understanding emotions.* Washington: Jossey-Bass Publishers.

Désautels, J., & Roth, W.-M. (1999). Demystifying epistemology. *Cybernetics & Human Knowing*, 6(1), 33–45.

DeWitt, J. (2006, April). *A tale of two contexts: Teacher-student talk on a school trip and in the classroom.* Paper presented at the annual meeting of the National Association for Research in Science Education, San Francisco, CA.

Dillon, J. (2003). On learners and learning in environmental education: Missing theories, ignored communities. *Environmental Education Research*, 9(2), 215-226.

Dimopoulos, K., & Koulaidis, V. (2003). Science and technology education for citizenship: The potential role of the press. *Science Education,* 87(2), 241-256.

Dog's sniffs alerted woman to cancerous mole on leg. (1989, April 3). *The Ottawa Citizen*, p. A2.

Doll, W. (1986). Prigogine: A new sense of order, a new curriculum. *Theory into Practice*, 25(1), 10-16.

Doll, W. (2002). Ghosts and the Curriculum. In W. Doll & N. Gough (Eds.), *Curriculum visions* (pp. 23-73). New York: Peter Lang.

Edwards, A. D., & Westgate, D. P. C. (1987). *Investigating classroom talk*. London: The Falmer Press.

Edwards, D., & Potter, J. (1992). *Discursive psychology*. London: Sage.

Einsiedel, E. F. (1992). Framing science and technology in the Canadian press. *Public Understanding of Science,* 1(1), 89-101.

Ekborg, M. (2005). Is heat generated from a crematorium an appropriate source for district heating? Student teachers' reasoning about a complex environmental issue. *Environmental Education Research*, 11(5), 557-573.

Elliott, P. (2006). Reviewing newspaper articles as a technique for enhancing the scientific literacy of student-teachers. *International Journal of Science Education,* 28(11), 1245-1265.

Engeström, Y. (1987). *Learning by expanding: An activity theoretical approach to developmental research*. Helsinki: Orienta-Konsultit.

Evans, B., & Priest, S. H. (1995). Science content and social context. *Public Understanding of Science,* 4(4), 327-340.

Fairbrother, R., Hackling, M., & Cowan, E. (1997). Is this the right answer? *International Journal of Science Education*, 19(8), 887-894.

Fairclough, N. (1995). *Media discourse*. London: Edward Arnold.

Farman, R., & McClune, B. (2002). A survey of the use of newspapers in science instruction by secondary teachers in Northern Ireland. *International Journal of Science Education,* 24(10): 997-1020.

Fleras, A., & Kunz J. L. (2001). *Media and minorities: Representing diversity in a multicultural Canada*. Toronto: Thompson.

Freire, P. (1987). *Pedagogy of the oppressed*. New York:Continuum.

Gall, M. D. (1970). The use of questions in teaching. *Review of Educational Research*, 40(5), 707-721.

Gary, T., & James, D. (2006). Reinventing grounded theory: Some questions about theory, ground and discovery. *British Educational Research Journal*, 32(6), 767-795.

Gayford, C. G. (1999). Environmental education and the secondary school curriculum. *Journal of Curriculum Studies*, 18(2), 147-157.

Gee, J. P. (2001). Reading as situated language: A socio-cognitive perspective. *Journal of Adolescent and Adult Literacy,* 44(8), 714-725.

Gigliotti, L. M. (1990). Environmental education: What went wrong? What can be done? *The Journal of Environmental Education*, 22(1), 9-12.

Gilbert, G. N., & Mulkay, M. (1984). *Opening Pandora's box: A sociological analysis of scientists' discourse*. London: Cambridge University Press.

Gläser- Zikuda, M., Fuss, S., Laukenmann, M., Metz, K., & Randler, C. (2005). Promoting students' emotions and achievement: Instructional design and evaluation of the ECOLE-Approach. *Learning and Instruction*, 15(5), 481-495.

Goff, K. E. (1998). Chaos, collaboration, and curriculum: A deliberative process. *Journal of Curriculum and Supervision*, 14(1), 29-42.

Gough, A. (2002). Mutualism: A different agenda for environmental and science education. *International Journal of Science Education*, 24(11), 1201-1215.

Gough, N. (1997). Weather incorporated: Environmental education, postmodern identities, and technocultural constructions of nature. *Canadian Journal of Environmental Education*, 2, 145-162.

Grace, M. M., & Ratcliffe, M. (2002). The science and values that young people draw upon to make decisions about biological conservation issues. *International Journal of Science Education*, 24(11), 1157-1169.

Gray, J. (2006). *Watching with the Simpsons: Television, parody, and intertextuality*. New York: Routledge.

Griffin, J. (1994). Learning to learn in informal settings. *Research in Science Education*, 24(24), 121-128.

Griffin, J. (2004). Research on students and museums: Looking more closely at the students in school groups. *Science Education*, 88 (Supl.1), S59-S70.

Gruenewald, D. A. (2004). A Foucauldian analysis of environmental education: Toward the sociological challenge of the earth charter. *Curriculum inquiry*, 34(1), 71-106.

Grün, M. (2005). Gadamer and the otherness of nature: Elements for an environmental education. *Human Studies*, 28(2), 157-171.

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. London: Sage.

Hagendijk, R., & Meeus, J. (1993). Blind faith: Fact, fiction and fraud in public controversy over science. *Public Understanding of Science,* 2(4), 391-415.

Halkia, K., & Mantzouridis, D. (2005). Students' views and attitudes towards the communication code used in press articles about science. *International Journal of Science Education*, 27(12), 1395-1411.

Hammersley, M. (1977). School learning: The cultural resources required by pupils to answer a teacher's question. In P. Woods & M. Hammersley (Eds.), *School experience: Explorations in the sociology of education* (pp. 57-86). London: Croom Helm.

Hammersley, M. (2003a). Conversation analysis and discourse analysis: Methods or paradigms? *Discourse & Society*, 14(6), 751-781.

Hammersley, M. (2003b). Doing the fine thing: A rejoinder to Jonathan Potter. *Discourse & Society*, 14(6), 795-798.

Hammersley, M. (2003c). The Impracticality of scepticism: A further response to Potter. *Discourse & Society*, 14(6), 803-804

Hansen, A. (1994). Journalistic practices and science reporting in the British press. *Public Understanding of Science,* 3(2), 111-134.

Harré, R.,& Gillet, G. (1994). *The discursive mind*. London: Sage.

Hepburn, A., & Wiggins, S. (2007). *Discursive research in practice: New approaches to psychology and interaction*. Cambridge: Cambridge University Press.

Heritage, J. (2005). Cognition in discourse. In H. te Molder & J. Potter (Eds.), *Conversation and cognition* (pp.184-202). Cambridge: Cambridge University Press.

Hidi, S., & Harackiewicz, J. M. (2002). Motivating the academically unmotivated: A critical issue for the 21st century. *Review of Educational Research*, 70(2), 151-179.

Ingold, T. (1992). Culture and the perception of the environment. In E. Croll & D. Parkin (Eds.), *Bush base, forest farm: Culture, environment, and development* (pp. 29-56). London: Routledge.

Iozzi, L. A. (1989a). What research says to the educator—Part one: Environmental education and the affective domain. *The Journal of Environmental Education*, 24(3), 3-14.

Iozzi, L. A. (1989b). What research says to the educator—Part two: Environmental education and the affective domain. *The Journal of Environmental Education*, 24(4), 6-13.

Irez, S. (2006). Are we prepared?: An assessment of pre-service science teacher educators' beliefs about nature of science. *Science Education*, 90(6), 1113–1143.

Jarman, R., & McClune, B. (2002). A survey of the use of newspapers in science instruction by secondary teachers in Northern Ireland. *International Journal of Science Education,* 24(10), 997-1020.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences*, 4(1), 39–103.

Kachan, M., Guilbert, S., & Bisanz, G. (2006). Do teachers ask students to read news in secondary science? Evidence from the Canadian context. *Science Education,* 90(3), 496-521.

Knight, J. (Ed.). (2005). *Animals in person*. Oxford: Berg.

Koosimile, A. T. (2004). Out-of-school experiences in science classes: Problems, issues and challenges in Botswana. *International Journal of Science Education*, 26(4), 483-496.

Korpan, C. A., Bisanz, G. L., Boehme, C., & Lynch, M. A. (1997). What did you learn outside of school today? Using structured interviews to document home and community activities related to science and technology. *Science Education,* 81(6), 651-662.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.

Lee, S., & Roth, W.-M. (2003a). Science and the "good citizen": Community based scientific literacy. *Science, Technology & Human Values*, 28 (3), 403-424.

Lee, S., & Roth, W.-M. (2003b). Re-mapping the land-scape: Science educators within a community action network. *Perspectives in Education*, 21 (2), 15-30.

Lee, Y-J. (2006). Working out work: learning, identity, and history from the perspective of cultural-historical activity theory. Unpublished doctoral dissertation, University of Victoria, British Columbia.

Lee, Y-J., & Roth, W.-M. (2004). Making a scientist: discursive "doing" of identity and self-presentation during research interviews. *Forum: Qualitative Social Research,*

5, Article 12. Retrieved April 23, 2004, from http://www.qualitative-research.net/fqs-texte/1-04/1-04leeroth-e.htm

Lemke, J. (1990). *Talking science: Language, learning, and values.* Norwood: Ablex .

Lévy-Leblond, J.-M. (1992). About misunderstandings about misunderstandings. *Public Understanding of Science,* 1(1), 17-21

Lind, L. (1998). Media education: Learning to reshape the world. *Educational Media International,* 35(1), 4-8.

Linn, M. C., Davis, E. A., & Bell, P. (Eds.). (2004). *Internet environments for science education.* New Jersey: Lawrence Erlbaum Associates.

Locke, S. (2002). The public understanding of science: A rhetorical invention. *Science, Technology & Human Values,* 27(1), 87-111.

Lomborg, B. (2001). *The skeptical environmentalist: Measuring the real state of the world*. Cambridge, UK: Cambridge University Press.

Long, M., Boiarsky, G., & Thayer, G. (2001). Gender and racial counter-stereotypes in science education television: A content analysis. *Public Understanding of Science*, 10(3), 255-269

Louv, R. (2005). *Last child in the woods: Saving our children from nature-deficit disorder*. Chapel Hill: Algonquin Books.

Lucas, A. M. (1983). Scientific literacy and informal learning. *Studies in Science Education,* 10, 1-36.

Luke, A. (1996). Text discourse in education: An introduction to critical discourse analysis. *Review of Research in Education,* 21, 3-48.

Lutz, C. (1988). Ethnographic perspectives on the emotion lexicon. In V. Hamilton, G. H. Bower & N. H. Frijda (Eds.), *Cognitive perspectives on emotion and motivation* (pp. 399-419). Boston: Kluwer Academic Publishers.

Lyon, M. L. (1995). Missing emotion: The limitations of cultural constructionism in the study of emotion. *Cultural Anthropology*, 10(2), 244-263.

MacPherson, E. D. (1995). Chaos in the curriculum. *Journal of Curriculum Studies*, 27(3), 263–279.

May, T. S. (2000). Elements of success in environmental education through practitioner eyes. *Journal of Environmental Education*, 31(3), 4-11.

McCullagh, C. (2002). *Media power: A sociological introduction*. New York: Palgrave.

McHoul, A. (1979). The organization of turns at formal talk in the classroom. *Language in Society*, 7(2), 183–213.

Mehan, H. (1979). "What time is it, Denise?": Asking known information questions in classroom discourse. *Theory into Practice*, 18(4), 285–294.

Mehan, H. (1980). The competent student. *Anthropology and Education Quarterly*, 11(3), 131-152.

Miettinen, R. (2000). The concept of experiential learning and John Dewey's theory of reflective thought and action. *International Journal of Lifelong Education*, 19(1), 54-72.

Millar, R., & Osborne, J. (1998). *Beyond 2000: Science education for the future*. London: King's College London/Nuffield Foundation.

Milton, K. (2005). Meanings, feelings, and human ecology. In K. Milton and M. Svašek (Eds.), *Mixed emotions: Anthropological studies of feeling* (pp. 25-41). Oxford: Berg.

NAAEE (The North American Association for Environmental Education) & NEETF (The National Environmental Education & Training Foundation). (2001). *Using Environment-based Education to Advance Learning Skills and Character Development*. Washington, DC.

Newhouse, N. (1990). Implications of attitude and behavior research for environmental conservation. *Journal of Environmental Education*, 22(1), 26-32.

Ninnes, P. (2001). Representations of ways of knowing in junior high school science texts used in Australia. *Discourse: Studies in the Cultural Politics of Education*, 22(1), 81-94.

Norris, S. P., Phillips, L. M., & Korpan, C. (2003). University students' interpretation of media reports of science and its relationship to background knowledge, interest, and reading difficulty. *Public Understanding of Science,* 12(2), 123-145.

O'Loughlin, M. (1997). Reinstating emotion in educational thinking. In S. Tozer (Ed.), *Philosophy of education* (Yearbook). Urbana-Champaign, IL: Philosophy of Education Society. Retrieved August 15, 2006, from http://www.ed.uiuc.edu/EPS/PES-Yearbook/97_docs/oloughlin.html.

O'Loughlin, M. (1998). Paying attention to bodies in education: Theoretical resources and practical suggestions. *Educational Philosophy and Theory*, 30(3), 275-297.

Palmberg, I. E., & Kuru, J. (2000). Outdoor activities as a basis for environmental responsibility. *The Journal of Environmental Education*, 31(4), 32-36.

Payne, P. G. (2006). Environmental education and curriculum theory. *The Journal of Environmental Education*, 37(2), 25-35.

Pekrun, R. (2005). Progress and open problems in educational emotion research. *Learning and Instruction*, 15(5), 497-506.

Pellechia, M. G. (1997). Trends in science coverage: A content analysis of three US newspapers. *Public Understanding of Science,* 6(1), 49–68.

Phillips, L. M., & Norris, S. P. (1999). Interpreting popular reports of science: What happens when the reader's world meets the world on paper? *International Journal of Science Education,* 21(3), 317– 327.

Pinch, T. (1990). The culture of scientists and disciplinary rhetoric. *European Journal of Education*, 25(3), 295-304.

Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research*, 63(2), 167–199.

Pollard, A. (1996). Playing the system? Pupil perspectives on curriculum, pedagogy and assessment in primary schools. In P. Croll (Ed.), *Teachers, pupils and primary schooling: Continuity and change* (pp. 119-133). London: Cassell.

Poole, D. (1994). Routine testing practices and the linguistic construction of knowledge. *Cognition and Instruction*, 12(2), 125-150.

Potter, J. (1996a). Discourse analysis and constructionist approaches: Theoretical background. In J. T. E. Richardson (Ed.), *Handbook of qualitative research methods for psychology and the social sciences* (pp. 125-140). Leicester: BPS.

Potter, J. (1996b). *Representing reality: Discourse, rhetoric and social construction*. Thousand Oaks: Sage.

Potter, J. (2000). Post-cognitive psychology. *Theory & Psychology*, 10(1), 31-37.

Potter, J. (2003a). Discourse analysis and discursive psychology. In P. M. Camic, J. E. Rhodes, & L. Yardley (Eds.), *Qualitative research in psychology: Expanding perspectives in methodology and design* (pp. 73-94). Washington: American Psychological Association.

Potter, J. (2003b). Discursive psychology: Between method and paradigm. *Discourse & Society*, 14(6), 783-794.

Potter, J. (2003c). Practical Scepticism. *Discourse & Society*, 14(6), 799-801.

Potter, J. (2005). Making psychology relevant. *Discourse & Society*, 16(5), 739-747.

Potter, W. (2004). *Theory of media literacy: A cognitive approach*. London: Sage.

Pruneau, D., Doyon, A., Vasseur, L., Langis, J., Ouellet, E., McLaughlin, E., Martin, G., & Boudreau, G. (2006). When teachers adopt environmental behaviors in the aim of protecting the climate. *Journal of Environmental Education*, 37(3), 3-12.

Ramey-Gassert, L. (1997). Learning science beyond the classroom. *The Elementary School Journal*, 97(4), 433-450.

Ratcliffe, M. (1999). Evaluation of abilities in interpreting media reports of scientific research. *International Journal of Science Education,* 21(10), 1085-1099.

Redfield, D. L., & Rousseau, E. W. (1981). Meta-analysis of experimental research on teacher questioning behavior. *Review of Educational Research*, 51(2), 237-245.

Rennie, L. J., Feher, E., Dierking, L. D., & Falk, J. H. (2003). Toward an agenda for advancing research on science learning in out-of-school settings. *Journal of Research in Science Teaching*, 40(2), 112–120.

Rickinson, M. (2001). Learners and learning in environmental education: A critical review of the evidence. *Environmental Education Research*, 7(3), 207-317.

Roth, W.-M. (1995). *Authentic school science: Knowing and learning in open-inquiry science laboratories*. Dordrecht, The Netherlands: Kluwer Academic Publishing.

Roth, W.-M. (1996). Teacher questioning in an open-inquiry learning environment: Interactions of context, content, and student responses. *Journal of Research in Science Teaching*, 33(7), 709-736.

Roth, W.-M. (2004a). A phenomenological anthropology of texts and literacy. In A. Peacock & A. Cleghorn (Eds.), *Missing the meaning* (pp. 253-266). New York: Palgrave Mcmillan.

Roth, W.-M. (2004b). "Tappen Im Dunkeln". Der Umgang mit Unsicherheiten und Unwägbarkeiten während des Forschungsprozesses. *Zeitschrift für Qualitative Bildungs-, Beratungs-, und Sozialforschung*, 5 (2), 155-178.

Roth, W.-M. (2005a). *Auto/biography and auto/ethnography: Practice of research methods*. Rotterdam: Sense Publishers.

Roth, W.-M. (2005b). *Doing qualitative research: Praxis of methods*. Rotterdam: Sense Publishers.

Roth, W.-M. (2007). Identity in scientific literacy: Emotional-volitional and ethico-moral dimensions. In W.-M. Roth & K. Tobin (Eds.), *Science, learning, and identity: Sociocultural and cultural historical perspectives* (pp. 153–184). Rotterdam: SensePublishers.

Roth, W.-M., & Alexander, T. (1997). The interaction of students' scientific and religious discourses: Two case studies. *International Journal of Science Education*, 19(2), 125-146.

Roth, W.-M., & Barton, A. C. (2004). *Rethinking scientific literacy*. New York: Routledge.

Roth, W.-M., & Lee, S. (2002). Scientific literacy as collective praxis. *Public Understanding of Science*, 11(1), 33–56.

Roth, W.-M., & Lee, S. (2004). Science education as/for participation in the community. *Science Education*, 88(2), 263-291.

Roth, W.-M., & Lucas, K. B. (1997). From "truth" to "invented reality": A discourse analysis of high school physics students' talk about scientific knowledge. *Journal of Research in Science Teaching*, 34(2), 145-179.

Roth, W.-M., & Middleton, D. (2006). The making of asymmetries of knowing, identity, and accountability in the sequential organization of graph interpretation. *Cultural Studies of Science Education,* 1, 11–81.

Roth, W.-M., & Tobin, K. (2002). *At the elbow of another: Learning to teach by coteaching*. New York: Peter Lang.

Roth, W.-M., Pozzer-Ardenghi, L., & Han, J. Y. (2005). *Critical graphicacy: Understanding visual representation practices in school science*. Dordrecht, The Netherlands: Springer-Kluwer.

Roth, W.-M., Riecken, J., Pozzer, L. L., McMillan, R., Storr, B., Tait, D., Bradshaw, G. &, Pauluth Penner, T. (2004). Those who get hurt aren't always being heard: Scientist-resident interactions over community water. *Science, Technology, & Human Values*, 29(2), 153-183.

Sanders, R.E. (2005). Validating 'observations' in discourse studies: A methodological reason for attention to cognition. In H. te Molder & J. Potter (Eds.), *Conversation and cognition*, (pp. 57-78). New York: Cambridge University Press.

Sanera, M., & Shaw, J. S. (1999). Facts, not fear: A *parent's guide to teaching children about the environment*. Washington, DC: Regnery.

Sansone, C., & Thoman, D. B. (2005). Does what we feel affect what we learn? Some answers and new questions. *Learning and Instruction*, 15(5), 507-515.

Scherer, K. R., & Ekman, P. (1984). *Approaches to emotion*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Schnabel, U. (2003). God's formula and devil's contribution: Science in the press. *Public Understanding of Science,* 12(3), 255-259.

Schoenfeld, A. (1985). *Mathematical problem solving*. New York: Academic Press.

Schudson, M. (2003). *The sociology of news*. New York: W.W. Norton.

Schwartz, B., & Asterhan, C.S.C. (in press). Argumentation among peers, dialogue characteristics, and conceptual change in evolutionary theory. In M. Chi (Ed.), *Talk, dialogue, and learning*. Mahwah, NJ: Lawrence Erlbaum Associates.

Scott, P. (1998). Teacher talk and meaning making in science classrooms: A Vygotskian analysis and review. *Studies in Science Education*, 32, 45-80.

SEE (State Education and Environment Roundtable). Retrieved July 15, 2005, from http://www.seer.org/

Sherman, W. (2004). Science studies, situatedness, and instructional design in science education: A summary and critique of the promise. *Canadian Journal of Science, Mathematics and Technology Education*, 4(4), 443-465.

Sherman, W. (2005). A reply to Roth. *Canadian Journal of Science, Mathematics and Technology Education*, 5(2), 199-207.

Spears, T. (2006, January 12). Dogs show ability to sniff out cancer. *Times Colonist*, p. A2.

Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's museum of vertebrate zoology. *Social Studies of Science*, 19(3), 387-420.

Statistics Canada. (2005). *Canadian Internet Use Survey*. Retrieved January 13, 2007, from http://www.statcan.ca/Daily/English/060815/d060815b.htm

Steinke, J. (2005). Cultural representations of gender and science: Portrayals of female scientists and engineers in popular films. *Science Communication,* 27(1), 27-63.

Strauss, A. L. (1987). *Qualitative analysis for social scientists*. New York: Cambridge University Press.

Strelitz, L. N. (2002). Media consumption and identity formation: The case of the 'Homeland' viewers. *Media, Culture & Society,* 24(4), 459-482.

The nose knows. (2006, January 12). *Times Colonist*, p. A1.

Thomas, G., & James, D. (2006). Reinventing grounded theory: Some questions about theory, ground and discovery. *British Educational Research Journal*, 32(6), 767-795.

Van Aalsvoort, J. (2004) Activity theory as a tool to address the problem of chemistry's lack of relevance in secondary school chemical education. *International Journal of Science Education*, 26(13), 1635–1651.

van Dijk, T. (1988). *News analysis.* Hillsdale: Erlbaum.

van Dijk, T. (1991). *Racism and the press*. London: Routledge.

Varela, F. J., Thompson, E., & Rosch, E. (1993). *The embodied mind: Cognitive science human experience*. Cambridge, MA: MIT Press.

Veel, R. (1998). The greening of school science: Ecogenesis in secondary classrooms. In J. R. Martin & R. Veel (Eds.), *Reading science: Critical and functional perspectives on discourses of science* (pp. 114-151). London: Routledge.

Wade, S., & Schram, W. (1969). The mass media sources of public affairs, science and health knowledge. *Public Opinion Quartely,* 33(2), 197-209

Wallace, C. (2004). Framing new research in science literacy and language use: Authenticity, multiple discourses, and the 'Third Space'. *Science Education,* 88(6), 901-914.

Watts, M., & de Jesus, H. P. (2005). The cause and effect of asking questions: Reflective case studies from undergraduate sciences. *Canadian Journal of Sciences, Mathematics, and Technology Education*, 5(4), 437-452.

Weintraub, B. A. (1995). Defining a fulfilling and relevant environmental education. *Urban Education*, 30(3), 337-366.

Wellington, J. (1991). Newspaper science, school science: Friends or enemies? *International Journal of Science Education,* 13(4), 363-372.

Wellington, J. J. (1993). Using newspapers in science education. *School Science Review,* 74(268), 47–52.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Wetherell, M., & Potter, J. (1993). *Mapping the language of racism: Discourse and the legitimation of exploitation*. New York: Columbia University Press.

Wilkie, T. (1991). Does science get the press it deserves? *International Journal of Science Education,* 13(5), 575-581.

Wong, D., & Pugh, K. (2001). Learning Science: A Deweyan perspective. *Journal of Research in Science Teaching*, 38(3), 317-336.

World Association of Newspapers (2007, February). *Newspaper growth defies conventional wisdom*. Retrieved January 13, 2007, from http://www.wan-press.org/article12949.html

Wright, N., & Nerlich, B. (2006). Use of the deficit model in a shared culture of argumentation: The case of foot and mouth science. *Public Understanding of Science,* 15(3), 331–342.

Wymer, P. (1991). Never mind the science, feel the experience. *New Scientist*, 5, 49.

Yarlott, G. (1972). *Education and children's emotions: An introduction*. London: Willmer Brothers.

Zembylas, M. (2004). Young children's emotional practices while engaged in long-term science investigation. *Journal of Research in Science Teaching*, 41(7), 693–719.

Zembylas, M. (2005). Beyond teacher cognition and teacher beliefs: The value of ethnography of emotions in teaching. *International Journal of Qualitative Studies in Education*, 18(4), 465-487.

Zembylas, M. (2007). Theory and methodology in researching emotions in education. *International Journal of Research & Method in Education*, 30(1), 57–72.

APPENDIX

Ethics Approval From

University of Victoria

Human Research Ethics Board
Office of Research Services
University of Victoria
Room A240 University Centre
Tel (250) 472-4545 Fax (250) 721-8960
Email ovprhe@uvic.ca Web www.research.uvic.ca

Human Research Ethics Board
Certificate of Approval

Principal Investigator	Department/School	Supervisor
Wolff-Michael Roth **Faculty**	**EDCD**	

Co-Investigator(s):

Giuliano dos Reis, Grad Student, EDCI, UVic
Diego Ardenghi, Grad Student, EDCI, UVic
SungWon Hwang, Post-Doctoral, EDCI, UVic
Jin Yoon, Post-Doctoral, EDCI, UVic
Leanna Boyer, Grad Student, EDCI, UVic
Gholamreza Emad, Grad Student, EDCI, UVic
Yew Jin Lee, Grad Student, EDCI, UVic

Project Title: **Navigating Knowledge Boundaries between Formal Education and Workplace**

Protocol No.	Approval Date	Start Date	End Date
208-04	**25-Jun-04**	**16-Jan-02**	**24-Jun-05**

Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concludes that, in all respects, the proposed research meets appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Subjects.

Dr. Richard Keeler
Associate Vice-President, Research

This Certificate of Approval is valid for the above term provided there is no change in the procedures. Extensions or minor amendments may be granted upon receipt of a "Research Status" form.

208-04 Roth, Wolff-Michael