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A New Look at Genre and Authenticity: Making Sense of Reading and Writing Science News in High School Classrooms

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Abstract

This qualitative study examined the importance of the genre and authenticity as teachers sought to bring science journalism to the high school science classroom. Undertaken as part of the National Science Foundation-funded grant "Science Literacy through Science Journalism (SciJourn)," this work was conducted as a series of smaller studies addressing the following issues: the definition of the genre from the point of view of professional journalists; teachers' motivation for joining the SciJourn project; qualities of science teachers compared to science journalists; science teachers' approach to writing and writing response; and the teachers' reflections on their own implementation strategies. Data collected included surveys, field notes from observations, in depth phenomenological interviews, focus groups, science news articles, and teacher/editor feedback. Qualitative textual analysis and critical discourse analysis were used to analyze the data.

Analysis showed that the genre of science news was especially promising for classroom adaptation for several reasons. Science journalism, as practiced by those with a strong background in science, occupies a space between the world of scientists and the world of non-scientists where new and highly technical information is contextualized and made relevant to the general public. As students and teachers engaged with science news both as consumers and producers, they came to appreciate the importance of science and to see science as an interesting, relevant field. Science teachers did not join the project because of a strong interest in the genre, but they did share several qualities with science journalists (including a broad understanding of science and a commitment to "translate" that understanding for a less-informed audience); these shared qualities may have helped teachers appreciate the genre and implement it authentically. The professional development proved particularly useful since teachers were able to draw on their own experiences writing science news during PD activities in order to work with their students. Access to a professional science editor and the possibility of student publication were also recognized as central to teacher development.

Acknowledgements

Because this study focused so much on the “pivotal moments” teachers could remember about their year in the classroom, pivotal moments are on my mind. And, as I come to the end of this project, I’ve been thinking about the pivotal moments that brought me to this point.

In one, my husband and I are in the car, driving west on highway 40, presumably to his parents’ house. The sun is setting and it must be spring because there are flowers in bloom. We’re talking about a crazy idea: Dr. Wendy Saul, one of my professors from my master’s studies, has been encouraging me to apply to the doctoral program. Should I do it? Andrew isn’t one to offer a quick opinion—as he likes to remind me when restarting a conversation from two days before, it takes him a while to figure out what he thinks—but he has something to say on this. “Most of the people I know who drop out of doctoral programs do it because they can’t write,” he says. “But you like to write. I bet you’d even think writing a dissertation is fun.” He doesn’t mean this as a compliment, but it’s enough to tip the scales. I decide to apply. For that bit of encouragement—and for the patience and understanding to live with all its consequences—I have to thank my husband, Andrew Driscoll.

Of course we wouldn’t have had that conversation if I hadn’t met Wendy Saul a few months before, on the first day of what I told everyone was to be my final fall semester of school. Prior to that course, I was simply slogging through the master’s degree with no intention of ever going any further, but Wendy changed my mind. In her class, I had the chance to combine two of my passions: teaching and writing. I had never heard the term “action research” before I met Wendy but by the end of that semester I was looking at my teaching in a whole new way. For taking me under her wing, and for pushing me to take on bigger and bigger challenges, I thank Wendy Saul.

Back in time just a little further, and I'm a twenty-eight year old waitress in the midst of a life crisis. I don't know what to do with myself. I'm tired of my job, but my English degree doesn't seem to be opening many other doors. As in all times of trouble, I call my dad. And, as in all other times of trouble, my dad helps me think through the situation and decide on a plan of action. This time, the plan is to get my high school teaching certificate. For seeing a future when I couldn't, I thank my father, Stephen Kohnen.

And now to my childhood and my mother, who brought me to the library and read me more books than either of us could ever count, who listened to the tales I invented and helped me write them down. For teaching me that you could make sense out of life by telling stories, I thank my mother, Jean Kohnen.

Beyond these four individuals, I am lucky to have been supported by many other wonderful teachers, mentors, family members, and friends over the past several years. I thank the members of my dissertation committee, Joe Polman, Nancy Singer, and Lisa Dorner, as well as professor emeritus Jane Zeni. I consider each of you a model of the teacher and scholar I hope to become. I am deeply grateful to the SciJourn teachers, especially Barbara, Tom, Jason, Mary and Shelley, for their willingness to share their time and insights with me. I also thank Alan Newman and Julie Miller for talking to me in such detail and with such patience about their fascinating careers. I thank Irving Seidman for his time and advice; I have never met a kinder man. I thank my fellow SciJourn team members, especially Cathy Farrar, Jennifer Hope, and Shannon Briner. I would have never made it through the series of catastrophes that my life briefly became had it not been for your humor and sympathy. I thank my extended family, especially Meghan, Nick, Jack, and Ginnie, for all of the times you rescued me during these overworked years. Finally, I thank my daughters, Cecilia and Adelina. Whenever I am discouraged or disillusioned, I picture your smiling faces and cannot help but smile myself.

Table of Contents

List of Tables

List of Figures

Preface: How did an English Teacher End up Hanging around these Science Folks?

It was very obvious to me from the get-go that they were bored, they wanted to hear how this stuff connected to them…also most of them were really into careers in science, so they wanted me to kind of show them that the rest of their life wasn't going to be boring, sitting and cleaning test tubes in a lab by themselves, you know. So, I thought that the SciJourn piece just really connected with them.

--Mary[1], high school chemistry teacher, SciJourn Cadre I

In the summer of 2009, I was one of 15 high school teachers enrolled in the professional development institute "Science Literacy through Science Journalism" or SciJourn. The institute, which was part of a four-year grant funded by the National Science Foundation (NSF) in conjunction with the University of Missouri-St. Louis, was in its pilot year. The goal of the professional development was to train teachers to incorporate science journalism activities into their high school classrooms, with the hypothesis that this would improve the science literacy[2] of their students. When we returned to our schools in the fall, most of us attempted to use the model but, as one of only two English teachers in the project, I had different goals than most of my colleagues. I was a writing teacher, always looking for new things to have my students write about;

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[1] All high school teacher names in this dissertation are pseudonyms.

[2] The definition of science literacy is a contested one. See Bybee, 1997; DeBoer, 2000; NRC, 1996; Roberts, 2007; Roth & Barton, 2004.

SciJourn was a way to give my students exposure to a new genre while also bringing some new content into the class. I didn't have a strong science background, but I felt comfortable asking questions and reading about science; it seemed worthwhile to have my students do the same. That was it. My expectations for the project ended there.

And that's about all that happened in my classroom. I assigned one science journalism article during the first semester and the unit went something like this: students chose science-related topics; we conducted research; I pushed them to make a first-person contact to interview; grant staff came to the classroom to observe and offer advice; students drafted articles; I responded; they revised; a few even sent their work off to Alan Newman, the science editor on the grant's newsmagazine *SciJourner*[3], for professional feedback and a chance at publication. And we moved on. Other than the presence of the researchers on a few occasions and the possibility of publication, which didn't seem to inspire too many of my students, it was not terribly different from any other assignment in my class. We all seemed to enjoy it—and it was something I would have done again had I stayed in the high school classroom—but it didn't dramatically change the dynamic of the student-teacher relationship or the trajectory of the course I was teaching. In fact, I may have never given the idea another thought if, a year later, I didn't find myself working as a research assistant on the grant's team.

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[3]*SciJourner* is published online (www.scijourner.org) and in print. Student articles are submitted by teachers; Newman and others provide feedback. Newman is the final gatekeeper for publication; all published articles meet standards of content, ethics, and style consistent with professional journalistic practice.

I don’t know the full story of how I got to be a SciJourn employee, but, from my perspective, it happened rather quickly. I had already decided to leave my high school job to work full-time on my dissertation—which, at the time, was about the possibilities multi-modal compositions offered high school literature students—when my advisor, one of the SciJourn grant principal investigators, approached me about changing my plans. The grant was looking for a researcher with a writing background to conduct some qualitative studies, was I interested? It was May. The financial reality of taking a year off of work was staring me in the face—and it looked a lot harsher than it had back in the fall when I’d committed to the idea. Sure, I’d have to put the multi-modal compositions aside for a while, but that seemed a small price to pay for stable job and a team to work with. Plus, it wasn’t going to be that hard. I knew how to teach writing; I knew the powerful impact writing could have on students’ lives. SciJourn was just about introducing science teachers to what we English teachers had known for years. And so I said yes.

The following pages are a testament to how wrong I was. The intersection of science, journalism, teenagers, authentic writing, impassioned teachers, professional editors and researchers, and a genre designed to build bridges is complicated in ways that I did not anticipate. What I learned about the project and all of the many connections and relationships it inspired profoundly changed my thinking about teaching, learning, and writing.

I. The Study

One of my girls talked about a disease where you pluck out your hair, and, you know, I said 'Well, where did this come from?' And she just kind of looks at me and I realized she was wearing fake eyelashes, you know. I suddenly took a closer look and it was just drawn on, her eyebrows, and I started realizing, I know where this comes from. And it's kind of like, okay, and then you look down and her arms are completely smooth and you're like okay, so this has a direct connection to her.

--Jason, high school chemistry teacher, SciJourn Pilot cadre

Data, Data Everywhere, and Not a Study in Sight

In the fall of 2010, I began working as a research assistant for the NSF-funded grant "Science Literacy through Science Journalism (SciJourn)." From the outset, I knew the grant would be ending in the summer of 2012 and, therefore, that the job came with an expiration date. This was fine with me; since I was planning to use my research as part of my dissertation, I thought I would be motivated to complete my degree in a timely manner, not languish in an ABD[4] state for years on end. I didn't have a clear dissertation question or a plan of action, but initially I wasn't concerned. I figured I would find my way.

After several years of the hectic pace of high school teaching, my work at SciJourn represented a change. My schedule was flexible; no one would be standing

[4] "All But Dissertation," a designation for doctoral students who have completed coursework and comprehensive exams but not a dissertation.

outside my door if I was a little later than usual. I rarely had to perform or be "on;" some days, no one came by my basement office except fellow research assistants. It was quiet, self-directed work, and I loved it. I could hardly believe my luck at having found a job where I was paid to read, write, think and talk about ideas. If I could have crafted my own dream job description, those would have been the key words.

My first research assignment seemed simple: analyze the editorial feedback provided by Alan Newman, the grant's professional science journalist and editor, on student articles. However, like many things that happened to me during my time with the SciJourn project, I was immediately surprised. As someone who spent a lot of time responding to student writing myself, I had a mental construct of what feedback should look like and Newman's just didn't match my expectations. He was direct in his comments, rarely prefacing them with compliments; he also rewrote large sections of text, something I never would have done. In terms of style, his discourse was far from a teacher's. As for substance, overwhelmingly his edits focused on content, particularly on articles that were not of high quality. As I sorted through his responses, I compared his edits with the then emerging SciJourn standards[5], which were designed to highlight the most important features of science journalism for a classroom focused on science

[5] The SciJourn standards have been developed over a period of years using an iterative process. The original version, developed in conversation with Alan Newman, Laura Pearce, Wendy Saul, Nancy Singer and Eric Turley, were first offered in 2010. Appendix A is the version of the standards used in most of this dissertation. An elaborated description of the current standards can be found in Saul, Kohnen, Newman, and Pearce (2012) or on teach4scijourn.org.

literacy. They were not *writing* standards and yet the concepts behind the standards appeared regularly in Newman's responses to student writing. They were the opposite of the Six Traits (Spandel & Stiggins, 1997) writing rubrics that are being used in many schools and districts. Not a "generic" template that could be used to guide responses to all kinds of writing, these were targeted, specific standards that only made sense in certain cases, to certain kinds of responders.

At the same time as I was looking at Newman's editing, several of the grant's researchers (including me) were conducting observations of teacher lessons. While what we saw varied widely from class to class—the project never promoted itself as a "one size fits all" approach—there were some recurring themes. Many teachers found the easiest way to begin using science news in their classes was through the read-aloud/think-aloud (RATA): teachers display an article on a science topic on a projector and read the text, stopping to think about the content at various intervals. The whole activity could be as short as 5-10 minutes; several teachers said that the small time investment made RATAs a low-risk way to start even though they weren't convinced that high school students would enjoy being read to. Again and again, though, they were shocked at how enthusiastic the student response was. Students stopped them before and after class to talk about science, they clamored for extra reading time, they asked questions and contributed to discussions in ways they hadn't before, some even brought in their own articles and asked to do a RATA themselves. This enthusiasm seemed the norm, not the exception—we saw it in honors and remedial classes, in high-performing and struggling schools, and in classes where the teacher invited a lively debate as well as in classes where the reading was teacher-dominated and nearly monotonous.

As the school year progressed, several teachers, inspired by their RATA success and encouraged by our continuing professional development activities, assigned written articles. The results were much more mixed, but many students chose to learn and write about topics of deep personal interest. Diseases—those suffered by parents, grandparents, siblings, and the writer him/herself—were a common topic choice, but so were quirky and unusual issues related to sports, hobbies, and the weather. Teachers tried to deal with the paper load in different ways; some sent all of their articles straight to Newman for editing, others worked one-on-one with students, still others basically gave a completion grade. Newman began describing the key characteristic of a published author as "tenacity," saying that he would continue working with any student who was willing to put in the time and effort to meet publication standards. In the winter and early spring, a number of high-achieving students in an honors class, inspired by their teacher to "show" the editor after receiving unexpectedly harsh feedback, revised and published their articles. A teacher in a struggling school worked with her students individually, determined to see some of them in print; many of their articles appeared in *SciJourner* near the end of the school year. As we gathered in May for our final SciJourn professional development meeting of the year, the one comment we heard over and over from the teachers was, "I wish I had started earlier." Despite the fact that this was designed as a one-year intervention, many teachers were eager to continue[6] and some even talked about making SciJourn a more central part of their classes.

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[6] At the end of the 2009-2010 school year, nine of the fifty-two teachers involved in the beta, pilot, and cadre 1 groups had dropped out even though they were still classroom teachers. An additional four

Anxious to capture what was going on, I asked for volunteers to participate in a series of phenomenological interviews (Seidman, 1998) with me about the project. Five teachers, all of them highly experienced and committed to the project, agreed; in the late spring and early summer of 2011 I conducted interviews aimed at understanding what the experience of writing and teaching science news meant to them. I also planned interviews with professional journalists in order to think about how their ideas of science news compared with the thoughts of teachers and students.

By mid-summer 2011, I found myself with the following interesting data sources: Newman's editing of student work; teacher responses to student work; student articles (often multiple drafts); field notes and videotapes from classroom observations (along with supplemental materials created by the teachers); field notes and videotapes from professional development sessions; interviews with teachers (along with the planned professional journalist interviews). It was enough to keep me very busy—and very overwhelmed.

Finding an Angle: What's the Question?

Editors and Teachers

As enjoyable as my work was, the whole reason I had taken the job was to finish my degree. As the first year of my position drew to a close, the issue of a dissertation question began haunting me. I knew that my question could evolve and change during the course of the study, but if there wasn't a question to evolve, the study couldn't get off the

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teachers were no longer involved because of retirement from the classroom or reassignment in the district.

ground. So I floundered. I wrote and rewrote the beginning of a dissertation proposal time and again. I free-wrote pages and pages of ideas. I called my advisor, I went to her office, I even went to her house; I took up hours of her time with my meandering ideas. And I felt like I was getting nowhere.

In the midst of all this, an article revision required me to look once again at my analysis of Newman's editing style as compared to one of our participating teachers, Mary Connor. As I thought about the differences between the styles of editing and the ways both Newman and Connor changed over time, an idea occurred to me. It wasn't just that Newman and Connor differed in their editing tone and emphasis; there was a fundamental difference in the way Newman and Connor each *saw* the student articles. Newman saw things that Connor didn't see; Connor, likewise, saw things that Newman didn't see. And the difference in their seeing, I thought, had to do with relationships.

For Newman, an article had to tell a story, and a story is all about relationships, connections, context. He did not often mark decontextualized problems in the text (misspelled words, factual errors), particularly on papers that were not close to publication. Instead, his editing focused on nesting the information that was being presented in a web of connections (or relationships). A story about a new video gaming system, for example, couldn't just give the technical specifications of the product; it had to also include some of the following: price; the overall number of gamers; how the new system compared to previous products; the thoughts of teens who tried it or wanted to try it; what experts reviewers might be saying; if there were any competitor products coming out soon. All of these kinds of details clarified the connections between this one new product (and this one news story) and its competition, and what came before, and what experts were saying, and the reader of the story (presumably teenagers), and its economic and social impact. These were the kinds of relationships and connections that Newman demanded of student articles.

Connor, though, seemed to see the articles through different eyes, those of a teacher. For her, the paramount relationships appeared to be between herself and the students, and the students and their knowledge of chemistry. Her comments were “nicer,” framed as questions or options for the author, perhaps written to maintain a supportive connection to her students. Her comments also emphasized the factual content of the article, but she often seemed to be asking for more factual information—more chemistry—not necessarily more information that helped establish the connections and relationships vital to telling the story.

Genre

As I thought about Newman’s and Connor’s differences through this lens, I began thinking about the role of the genre of science news in the project. It was the *genre* which demanded that Newman see the kinds of relationships and connections he saw; it was the genre that helped Connor gain a new way to connect to her students. This genre, one that was being used authentically[7] in these classrooms, was central to much of the excitement I saw in the project, I hypothesized, and here was an issue worth exploring. What I wanted to study, then, was what happens around the genre of science news in high school

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[7] More on this concept in chapter three.

science classrooms. My broad question was: Did the genre matter? More specifically, I wanted to understand more about the following thematic sets of questions:

- What are the essential characteristics of the professional genre of science news?
- Why do science teachers join SciJourn? Are they motivated by or thinking about genre? What do science teachers have in common with science journalists even before they join SciJourn?
- How do high school science teachers think about writing in their courses? Do they consider genre? What is the "high school science teachers' theory of writing and writing response"?
- From a teacher's perspective, what does SciJourn look like in classrooms? How do science teachers incorporate ideas about genre and authenticity? Does this look different in different classrooms? What characteristics appear across classrooms? What meaning do teachers make of this experience?
- What does SciJourn look like in a single class period? How does a teacher facilitate the creation of a hybrid community of practice, one that includes characteristics of a professional newsroom and of a high school science classroom?

In the chapters that follow, I will explore each of these questions in an effort to understand what happens in these classrooms at the intersection of authenticity and genre.

Theoretical Frame

My interest in SciJourn begins with an interest in the relationships and connections the project inspires. I see these relationships and connections as critical to the learning that happens in SciJourn classrooms and, therefore, situate this study within a sociocultural framework. I contend that the SciJourn project offers unique possibilities for creating learning environments that help resolve the seemingly inconsistent principles of theorists in this field.

Communities of Practice

My work with the SciJourn project in general and this study in particular is influenced by the concepts of "legitimate peripheral participation" (Lave & Wenger, 1991) and "communities of practice" (Wenger, 1998). Lave and Wenger's (1991) work starts from the premise that all learning is social and must occur in context. Individuals learn through social interactions with members of a community of practice; as they gain skills, knowledge and acceptance, they move from peripheral participation to full participation in that community. This perspective asserts that learning can never be completely externalized by the community nor fully internalized by particular members because learning is constantly being renegotiated through social interactions. Most importantly for educators, Lave and Wenger (1991) argued that instruction is not required for learning, nor does instruction in itself automatically lead to learning. What *is* required for learning is access to the full community of practice and opportunities to work with master practitioners on authentic tasks that gradually increase in complexity.[8] Schooling which limits this kind of access limits the possibilities for students to become full participants in a community of practice: "To the extent that the community of practice routinely sequesters newcomers, either very directly in the example of apprenticeship for the butchers, or in more subtle and pervasive ways at schools, these newcomers are prevented from peripheral participation" (Lave & Wenger, 1991, p. 104), and, consequently, from learning.

In a later work, Wenger (1998) explored in more detail how communities of practice come to be and the ways connections are forged between different communities of practice. As individuals negotiate meaning in communities, they rely on both participation—"the social experience of living in the world in terms of membership in social communities and active involvement in social enterprises" (p. 55)—and reification—"the process of giving form to our experience by producing objects that congeal this experience into 'thingness'" (p. 58). While communities of practice are the sites of learning, Wenger used the terms "broker" and "boundary object" to refer to the connections that are made between different communities of practice. A broker is a participant (a person) who is able to bring elements from one practice into another. A

[8] It is important to note that the tasks newcomers take on as they enter a community of practice are not structured *chronologically* but rather by difficulty. Lave and Wenger (1991) use the example of a tailor's apprentice to illustrate this point. The apprentice may first be asked to sew the final stitches on a garment because this is the simplest part of the process. Contrast this with schools where we nearly always proceed chronologically.

boundary object is a reification (a thing) that can be used by communities of practice to connect with one another. Sometimes these connections are simply to get jobs done, not to facilitate understanding or movement between the communities. However, in the field of education where the goal is “to open new dimensions for the negotiation of the self,” to be “transformative” for students and their identity (p. 263), boundary encounters ideally would provide students with enough understanding to explore possible futures.

The work of Lave and Wenger (1991) and Wenger (1998) obviously presents challenges for teachers working in isolated classrooms with students on specific, often decontextualized, learning objectives. Opportunities to expose students to authentic tasks and master practitioners are scarce. Gee (2011a) coined the phrase “mindless progressivism” to describe an additional problem: educators equating “participation and immersion in interest-driven activities” alone with sound practice. While participation is key to learning, Gee (2011a) identified production as being a critical component of the kind of learning that “leads to higher-order and meta-level thinking skills.” He went on to describe the role of a teacher as the designer of a learning environment, a place where students have many different avenues to explore high-interest topics and actively problem-solve en route to mastery of different skills. Like Lave and Wenger (1991) and Wenger (1998), Gee (2011a) presented expertise as distributed across individuals and objects and argues against school practices which create separate standards for students that are not true to “adult or professional norms.”

The theories of Lave and Wenger (1991) and Gee (2011a) are incompatible with the emphasis on test-taking and the standardization of the curriculum which characterize contemporary schooling. Lave and Wenger (1991) wrote, “Test taking then becomes a new parasitic practice, the goal of which is to increase the exchange value of learning independently of its use value" (p. 112). Authentic learning is motivated by a desire to participate in a community of practice, not by an external test. Gee (2011a) described ideal learning environments as places where "failure is used as a learning device" rather than a form of punishment. Furthermore, all three contended that expertise does not reside in a single individual but in the collective group; for them, the idea that all individuals should learn the exact same thing at the exact same time is anathema.

Third Space

In addition to the problems with the overall organization of schools identified in the work of Lave, Wenger, and Gee, several researchers argue that the language used in schools can be inaccessible to many students[9], particularly those from oppressed communities. They encourage teachers to create a "third space" in their classrooms, a space that is not fully embedded in the discourse of academia nor fully embedded in the language of everyday speech. Gutierrez, Rymes, and Larson (1995) described third space as a critical space where the language of power can be challenged and disrupted. Moje et al. (2004) expanded upon this notion and suggest that, in addition to being a critical space, third space can be a bridge between academic and home discourse or a "navigational" space whereby home discourse can be used to understand academic discourse.

[9] The special challenges posed by the language of science will be discussed in chapter four.

In a study of urban middle school girls, Calabrese Barton, Tan, and Rivet (2008) examined the emergence of third space in science classes. They identified three “merging practices” the girls used that enabled them to engage with science while still holding onto their out-of-school identities: creating of “science artifacts” not assigned for class; engaging in identity play; and participating in class in “strategic” ways that did not always conform to teacher directions. Calabrese Barton, Tan, and Rivet (2008) concluded: “First, these merging practices supported generative third spaces, transforming learning and participation over time. Second, merging practices support third spaces that have outcomes for both the authoring girls and the larger learning community” (p. 93).Through their actions, the girls changed the learning environment itself, legitimizing new ways of engagement for all students.

Yet the “merging practices” used in the third space described by Calabrese Barton, Tan, and Rivet (2008) may not fit into the ideal learning environment described by Lave and Wenger (1991). A key point of Lave and Wenger’s (1991) theory is that learning occurs when individuals engage in practices true to those used by full members of a community of practice; even the language used by peripheral members is the same as that of full members. A song created by a student in order to help her memorize the bones in the skeletal system (Calabrese Barton, Tan, & Rivet, 2008) may indeed help her learn the names of the bones, but it does not introduce her to practices used by a community of practice outside of school. The outcomes described by Calabrese Barton, Tan, and Rivet (2008) are certainly desirable for the classroom, but for the kind of learning advocated by Lave, Wenger, and Gee to occur, a key component is missing.

Science Journalism and the Issue of Translation

As I thought about the above ideas, it seemed to me that the apparent conflicts could be resolved by incorporating an activity into the science classroom that is authentic to a professional community of practice while still offering the advantages of third space. I began this study with the idea that science journalism could be one such activity, a genre that exists at the intersection of professional practice and third space; in the literature, I found some support for this hypothesis.

When McDermott and Hand (2010) reanalyzed student interviews from six different studies of writing-to-learn activities in science classes conducted over a ten year period, they found a recurring theme: “the issue of translation” (p. 536). The studies they examined included such writing activities as letters, textbook entries, lab reports, and posters written for audiences including the editor of the paper, peers, and younger students as well as the classroom teacher. Students contrasted this kind of writing to the writing they had traditionally done in science classes, writing that often involved using technical science terminology without really understanding the words. The authors conclude that “not only is the translation itself useful for communicating to the audience, it leads to the author’s emerging awareness of their own conceptual understanding, that is, they are able to construct richer understandings of the concept through the writing both in terms of everyday language and the official science language” (McDermott & Hand, 2010, p. 536).

If, as the McDermott and Hand (2010) analysis argues, “translating” science concepts is beneficial for students, asking students to write in genres that require translation would seem to be logical. All writing (aside from plagiarism or filling in the blanks) requires a degree of translation, even if that translation only takes the form of superficial paraphrase; however, translation is inherent to the genre of science journalism (Blum, Knudson, & Henig, 2006). As the head of the medical journalism program at the University of North Carolina said, a science journalist is “both a storyteller and a translator” (Dukes, 2008, p. 19).

Yet, despite the promise that teaching science journalism seems to offer, little research had been done on the effects of using the specific genre of science news on students or teachers prior to the SciJourn grant (see Jarman & McClune, 2007, for an exception). This was what I set out to study in more detail. The rest of this dissertation tells the story of how I did so and what I discovered along the way.

II. Methods

This dissertation study is qualitative, drawing on Seidman's phenomenological interview protocol (1998). The primary data sources were interviews with teachers and professional journalists. Additional data sources include student and teacher writing; teacher and professional editing; classroom and professional development observations (including field notes, audio and videotape); and surveys. This chapter will begin with an overview of phenomenological interviewing followed by a description of the population and sampling procedures for the interview portion of the study. Because this dissertation involved five separate research questions, the data sources and analysis section of this chapter is subdivided into four sections with separate descriptions for each question (a table of the data sources and chapter for each research question is included in the concluding section of this chapter).

Research Design: Overview

Phenomenological Interviewing

Phenomenological interviewing is an approach to interviewing outlined by Seidman (1998) in his book *Interviewing as Qualitative Research.* Seidman (1998) described the situations where this method would be most appropriate: "If the researcher is interested, however, in what it is like for students to be in the classroom, what their experience is, and what meaning they make out of their experience—if the interest is in what Schütz (1967) calls their 'subjective understanding'—then it seems to me that interviewing, in most cases, may be the best avenue of inquiry" (p. 5).

Seidman's (1998) phenomenological interview structure has its roots in life history (McAdams, 1993) and phenomenology (Schütz, 1967). The protocol involves three separate, 90-minute, open-ended interviews. The first asks participants to give a focused life history, a description of their lives up until the point of the experience under study. In the second interview, participants are asked to reconstruct the experience under study as completely as possible. The final interview asks for a reflection on the meaning of the experience. I will explain the content of these interviews in more detail later in this section (see Appendices B and C for interview protocol).

As with most methods, interviews as a research method are also subject to criticism. Among the critiques that Seidman (1998) addressed explicitly are the fact that the interviewer could be biased, that story-telling is not scientific, and that an interview can exploit the participants being interviewed. A contrasting view asserts that, for interview research, the humanity of the researcher can be something to celebrate rather than lament. As Seidman (1998) and Lincoln and Guba (1985) argued, a well-trained interviewer can respond to the participants in a way that a survey or questionnaire cannot. Furthermore, the criticism that storytelling is not scientific was refuted by Huron (1981) and Bruner (1992), who pointed out that story-telling is the most natural way that humans make sense of their experience. More explicitly, my study aims to understand the meaning participants make, not a picture of uncontested accuracy that has predictive power. Individuals act on their perceptions of a situation, not on the "reality" of what happened in a positivistic sense (Erickson, 1986). Finally, the criticism that interviews exploit the participants is one that Seidman (1998) found the most troubling since it is true that the research does depend on the experiences and cooperation of the participants. The phenomenological interview may be especially subject to the criticism of exploitation because it asks for such a time commitment from the participants and potentially involves sensitive discussions. To guard against this, I informed all participants that they could stop the interviews at any time and decline to answer any questions during the interviews. However, rather than feel exploited, my participants seemed to enjoy the experience. One journalist offered to connect me with other journalists to interview for future work; a teacher described the experience as “therapy;” two others asked me to explain the process so they could interview their students in a similar manner; and all of them referred back to the interviews in a positive way when I saw them later. For my part, through these interviews I came to admire and respect each of my participants in a way that I hope enhances my understanding of their experiences rather than clouding my vision.

Interview One: Focused Life History

The first interview is designed to put the phenomenon (science news) into context. Professional science journalists were asked to describe their life experiences involving science and writing up through their early science journalism career, going as far back as possible (see Appendix B for complete interview protocol). Teacher participants were asked to describe their life experiences involving science, education, professional development, and writing up until they became involved in the SciJourn program, going back as far as possible (see Appendix C for complete interview protocol).

Interview Two: Reconstructing the Experience

In the second interview, the participant is asked to focus on the details of the experience under study. Rather than asking for their opinions about this experience, I asked them to include as many concrete details as possible. Professional science journalists were asked to select a story or stories from their career to describe in detail.

Teachers were asked about writing their own articles as well as implementation of the program in their classes, focusing on pivotal moments from the year.

Interview Three: Reflection on Meaning

The final interview in this process asks the participants to make sense of their experience. Seidman (1998) stated that "the combination of exploring the past to clarify the events that led participants to where they are now, and describing the concrete details of their present experience, establishes conditions for reflecting upon what they are now doing in their lives. The third interview can be productive only if the foundation for it has been established in the first two" (p. 12).Without the first two interviews, the third interview will be incomplete or open to misinterpretation by the researcher. During this final interview[10], I asked the professional journalists the meaning they made of the particular articles discussed during the second interview as well as the overall role they saw themselves (as science journalists) playing in society. I asked teachers about their understanding of the role of science news in their classroom as well as their opinions on the role of the genre of science news in society.

Researcher's role

For this study, I conducted the phenomenological interviews myself. To prepare for this role, I attended a training workshop on interviewing run by Dr. Seidman; I also met with him to discuss my research design and questions. Because of this, I felt

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[10] For Newman, I conducted three interviews as recommended by Seidman (1998). Because of time constraints, I only conducted two interviews with Miller; the second began with conversations about specific articles and moved on to reflection.

qualified to conduct the interviews; however, I am a strong believer in the SciJourn program, which was a potential limitation on my ability to hear what participants said. On the other hand, my understanding of the program was also a strength since this knowledge helped me ask appropriate questions and make sense of the answers as the interviews occurred. I kept careful notes on my role during the interview and included relevant information about my thoughts in the analysis section of this dissertation.

Population and sample

The interview portion of this study included representatives of the populations of professional science journalists and of SciJourn teachers. Sampling procedures for each population are described below.

Professional Science Journalists

From the beginning of the SciJourn project, several science journalists and editors were involved. For this dissertation, I asked two of them, Alan Newman and Julie Miller, to participate in the interview research. Newman had earned a doctorate in chemistry and worked as a lab scientist before becoming a science journalist; he worked in the field, first as a journalist and later as an editor, for over twenty years before joining the SciJourn project as one of the principal investigators. Miller, too, was a PhD (her degree was in neuroscience) and had worked in science journalism as a writer and an editor; her career spanned thirty years. Because of similarities in their backgrounds and in their ages, I do not claim that they are representative of the entire population of science journalists; however, I was especially interested in their perspectives for a few specific reasons. As highly educated scientists-turned-journalists (rather than trained journalists who ended up working as science reporters), Newman and Miller deeply valued science content—and understood how the field of science works, even if they didn't always understand the specific area of science they were covering before they began working on a story. I also valued the fact that Newman and Miller had such long careers in journalism and that they had both worked as editors as well as reporters, something I thought would give them both a multidimensional perspective on the genre.

SciJourn Teachers

At the time this study began, twenty-two teachers were trained and participating in the program. Criteria for inclusion in the interview process included: (1) teachers had to be identified by the research team as actively implementing SciJourn activities in their classrooms, although they did not have to have assigned a written article to their students. This excluded SciJourn teachers who continued to attend professional development and collect data for the program but who had implemented few of the SciJourn activities. (2) Teachers had to be teaching high school science. This excluded one middle school teacher, two English/journalism teachers, and one psychology teacher. (3) Teachers had to agree to participate in the three interviews and sign consent.

To recruit participants, an email was sent out to all SciJourn teachers explaining the purpose of the interviews and the commitment involved. Five teachers who met the above criteria agreed to participate (see Table 2.1).

The sampling criteria were not specifically designed to identify teachers who represented the population of SciJourn teachers, but, as the chart indicates, the sample was fairly representative. In addition, the selected teachers were each interesting to me because of specific qualities. As the curriculum coordinator for her district, Barbara had recruited several other science teachers to join SciJourn and spoke of making it a district-wide initiative. Jason was someone who had difficulty writing but spoke often of the great power

Table 2.1: Teacher Interview Participants

Teacher	**Cadre**	**Yrs in tchng**	**SciJourn Classes (grade)**	**Undergrad. Degree**	**Graduate Degree**	**Other**
Barbara	Pilot	28	Advanced Biology (12), ABC (11-12) (Applied Biology and Chemistry)	B.S.(Biology; minor in Sec. Ed. and Chemistry)	MA, pursuing PhD	District curriculum coordinator
Jason	Pilot	6	Chemistry (10) Physical Science (9)	B.S. (Biology)	Pursuing M.Ed.	Interest in technology
Tom	Pilot	32	Physical Science (10)	B.S. Ed. (Biology)	M.S. Ed.	High performing school
Mary	Cadre I	35	Chemistry (9), Advanced Chemistry (11)	B.A. (Biology, Chemistry, Education)	M.Ed. (pursuing PhD)	Private school
Shelley	Cadre I	10	Chemistry (10)	B.S. (Chemistry)	M.Ed.	Low performing school
Teachers who met the criteria (n=15)	7 in Pilot 8 in Cadre I	15.7 (avg)			11 had Master's degrees, 1 had a PhD (an additional 3 were actively pursuing a PhD and 3 were pursuing a Master's)	

the project had for his students; he also was innovative, pioneering the project's expansion into graphics. Writing came naturally for Tom, but he had never included writing in his classroom, instead focusing exclusively on nearly daily read-aloud/think-alouds (RATAs). A private-school teacher, Mary had different expectations than the other involved teachers; she also taught in a one-to-one laptop environment. Finally, Shelley worked with students who read and wrote below grade level; in the beginning, she struggled to begin implementation but eventually her students published at a higher rate than nearly any other teachers'.

Data Sources and Analysis for Each Thematic Question Set

The goal of this study as a whole was to understand more about the genre of science news and to understand how it was used in high school science classrooms. Because the issue is such a complex one, I explored it from four different angles. Each of these had slightly different data sources and analysis procedures which are outlined below.

The Genre of Science News

Question Set 1: What are the essential characteristics of the genre of science news?

I felt it was important to begin this dissertation with a description of the genre of science news from the perspective of professional science journalists. Therefore, Chapter Four is based on an analysis of the phenomenological interviews with Newman and Miller, science news writers. During each interview, I took notes on the interesting points the journalists raised that I wanted to follow up on either within the interview or in a later interview; after each, I typed my notes and added a reflective memo. The audio recording of each interview was sent out for transcription by a third party; when transcripts were returned, I played the audio of the interview while reading the transcript in order to clean up any mistakes. Once the interview transcripts were accurate, I imported them into the qualitative research software NVivo[11] for analysis and attached my notes using the memo feature of the program.

Using the NVivo program, I began by open coding the interviews (Merriam, 2009), looking for emergent themes related to my question about the essential qualities of a science journalism article. As I coded, I noticed that both Newman and Miller referred as often to important qualities that they possessed personally, as writers of science news articles, as they did to important qualities of the articles themselves. During the process of axial coding (Corbin & Strauss, 2007; Merriam, 2009), I grouped codes together and realized each main category that emerged could be manifest both in the article and in the journalist; additionally, Newman and Miller referred to most of these categories as sources of pleasure or accomplishment, what I began calling “joys of the job.” My final codebook included five main themes: (1) accountability to the reader; (2) interesting science; (3) broad understanding of science; (4) who to talk to, what to ask, how to ask it; (5) a coherent story. This codebook is included in Chapter Four. By analyzing the transcripts of these interviews, I drew conclusions about the qualities practicing journalists emphasize in their work; I also compared these qualities with the SciJourn

[11] The NVivo program was used for most portions of the study.

standards (Appendix A) in order to think about the authenticity of the project as practiced by SciJourn teachers. This research question is discussed in detail in Chapter Four.

Science Journalists and Science Teachers

Question Set 2: Why do science teachers join SciJourn? Are they motivated by or thinking about genre? What do science teachers have in common with science journalists even before they join SciJourn?

This group of questions was not in my original dissertation proposal, but once I had ideas about the genre of science news as practiced by professional journalists with a strong science background, I wanted to know whether or not science teachers were thinking about genre when they joined the project. From my interviews with Newman and Miller, I also had a suspicion that science journalists and science teachers had a lot in common that I wanted to explore further.

To investigate these questions, I distributed a survey to SciJourn teachers who attended a professional development meeting in February of 2012 (see Appendix D for complete survey). The survey included the open ended question: "Briefly, why did you originally sign up for SciJourn?" Twenty-three teachers responded (5 pilot teachers, 8 from Cadre I, and 10 from Cadre II); they provided a total of forty-eight reasons. When I coded their responses, I came up with eleven underlying explanations which I grouped into four larger categories: (1) word of mouth; (2) reasons related to anticipated SciJourn outcomes (but not main goals); (3) reasons directly related to SciJourn main goals; and (4) reasons not specific to SciJourn (the codebook is included in Chapter Five). However, I knew that asking teachers to think back and remember their original reasons for joining the program was not a perfect data source; however, this was the best data I could get if I wanted to hear from teachers across all three years of the project. In order to confirm the findings, I looked at field notes from the first day of the Cadre II professional development session when teachers were asked to introduce themselves and explain why they had signed up (similar field notes were not available for either the Pilot or Cadre I professional development sessions). The reasons the fifteen Cadre II teachers gave for joining the project on their first day of professional development were also coded and compared to the survey answers.

To further explore the idea that science journalists and science teachers have key qualities in common, I generated a list of statements based on my interviews with Newman and Miller that described how they seemed to see themselves as journalists. As part of the same survey given to teachers at the February 2012 professional development meeting, I asked teachers to rate their level of agreement with nine statements on a four-point Likert scale. The complete analysis of this research question is presented in Chapter Five.

Science Teacher Responses to Student Writing

Question Set 3: How do high school science teachers think about writing in their courses? Do they consider genre? What is the "high school science teachers' theory of writing and writing response"?

Whether or not the teachers had a lot in common with science journalists, I knew from other contexts that they probably did not think about student writing in the same way. In a previous study (Kohnen, in press), I had compared the way teachers (prior to SciJourn training) and Newman responded to student writing in the genre of science news and concluded that teachers were not emphasizing genre features in their responses. In a related study (Kohnen, in preparation), I also found that one SciJourn teacher changed her focus over time, learning to attend to specific genre features (although never in the same way as Newman, the professional, did). When I originally proposed this study, I planned to focus on this previous research; however, as I began writing I realized that I wanted a more complete picture of how teachers used writing overall in their classes prior to SciJourn. I therefore expanded my question to include “the high school science teachers’ theory of writing and writing response,” which encompassed the kinds and frequency of their writing assignments as well as their motives/goals for assigning writing; their perception of the assignments’ effectiveness; and their feelings about reading and responding to student work.

For this research question, I relied on two data sources, transcripts of focus groups and teacher responses to survey items. The focus groups took place in the fall of 2011, during a SciJourn professional development workshop with twenty-three teachers in attendance. The teachers were randomly divided into four groups and each group spent approximately 14 minutes with me[12] talking about the following questions: (1) prior to SciJourn, what experiences did you have talking about writing and responding to writing?; (2) Prior to SciJourn, how did you approach assessing the writing assignments that you gave? Where did you get your ideas about how to assess/respond to writing?; (3) How have your ideas about responding to writing changed since you got involved with SciJourn? These sessions were audiotaped; I transcribed each myself and coded the

[12] The focus groups took about an hour, with four different research topics being explored by four different researchers. This study only relies on data from the focus group about student writing.

transcripts in the NVivo program, beginning with open coding followed by axial coding (Merriam, 2009). The two main categories that emerged from the transcripts were (1) types of writing teachers assigned and (2) teacher responses to that writing. Because the focus groups were short and did not offer equal opportunity for all teachers to respond, I decided to follow up with survey questions related to writing and writing response and added writing/writing response questions to the February 2012 professional development survey discussed above. Within this survey, I asked more specific questions about the frequency and kinds of writing assignments as well as questions designed to understand teachers' feelings about these assignments (see Appendix D, questions 3-5). This research is discussed in Chapter Six.

SciJourn in Classrooms

Question Set 4: From a teacher's perspective, what does SciJourn look like in classrooms? How do science teachers incorporate ideas about genre and authenticity? Does this look different in different classrooms? What characteristics appear across classrooms? What meaning do teachers make of this experience?

In my dissertation proposal, I proposed these slightly different research questions: "How does a hybrid community of practice—one that includes characteristics of professional journalism as well as characteristics of high school science classrooms—evolve around the genre of science news? How do teachers talk about their involvement in this community of practice? How does their involvement affect the way teachers view their own jobs and their goals for their students?" In the end, my research focused on the way SciJourn looked in teacher classrooms more broadly than these original questions implied, although I still addressed the hybrid community of practice as well as teacher job perception as part of this question.

Five SciJourn cases. I explored the previous two questions of this study by looking at the SciJourn science teachers as a group, examining how they collectively compared to science journalists and how they collectively talked about writing and writing response. However, for the fourth question I wanted to learn something about how SciJourn looked in specific contexts and from the point of view of individual teachers. In order to do so, I first analyzed the transcripts from the five participating teachers' phenomenological interviews. I began by open coding (Merriam, 2009) all of the interview transcripts, looking for anything that seemed to stand out. In the beginning, I coded all five teacher participants one after another, adding codes to my list as appropriate and recoding previously coded interviews each time I did so. I initially generated a list of twenty-one codes (see Appendix E).

Because of my interest in understanding what SciJourn looked like in individual teacher's classrooms and what meaning each teacher made of this experience, my next step was to look at each teacher as an individual case. I began by focusing on the second interview, coding the "pivotal moments" each teacher described from the professional development and SciJourn implementation. I next coded each teacher's pivotal moments for emergent themes, especially in the metaphors a teacher used to describe the experience. Each teacher was treated as a unique example; initially, I did not attempt to look for themes and metaphors across cases.

After I finished coding metaphors and themes in a teacher's second interview, I proceeded to look at the third interview, first coding broadly for anything the teacher said about the “meaning of SciJourn” and then coding the metaphors and themes that emerged from within the “meaning of SciJourn” code. Once I had a picture of a teacher’s SciJourn experiences and the meaning s/he made of those experiences, I returned to the first interview (focused life history) and my long list of codes. I reanalyzed the first interview, focusing only on what issues from his/her life history that seemed most relevant to the way s/he implemented SciJourn. Chapters Seven through Eleven each present the story of one of my participating teachers, beginning with background and moving through meaning. Chapter Thirteen is a discussion of themes that emerged across all five teacher’s experiences.

Although I found NVivo to be a useful program in the previous sections of this dissertation, I struggled to use it effectively during this portion of the study. The teacher’s interview transcripts were extremely long (the transcripts from the complete set of interviews were between 33,000 and 50,000 words per teacher) and I had a hard time dealing with the small amount of text visible on a computer screen. I felt much more comfortable printing transcripts and marking on the hard copies (where I could flip back and forth at will) before transferring my codes to the computer program. In some cases, I did not ever code within NVivo but used my handwritten codes along with the “find” feature in Microsoft Word to locate quotes.

Question Set 5: What does SciJourn look like in a single class period? How does a teacher facilitate the creation of a hybrid community of practice, one that includes characteristics of a professional newsroom and of a high school science classroom?

In addition to looking at each participating teachers’ perspective on the SciJourn experience, I also had the opportunity to carefully analyze a short video clip from Mary’s classroom, one that provided insight into how Mary was negotiating the concepts of authenticity and genre with her junior chemistry students. Mary gave me a video recording of the class period where she returned professionally edited science news articles to the student authors; I analyzed the first 17 minutes of the recording, a period of time where Mary delivered a short PowerPoint lecture summarizing the editor's feedback.

In previous conversations, Mary described the students in this class as high achievers, those who are used to doing well in all classes but especially in science. They were also highly trained in the use of the five-paragraph essay, a traditional school genre that begins with an introduction (with a thesis statement as the final sentence), followed by three body paragraphs (each including a topic sentence and at least two supporting details), and ending with a concluding paragraph. Earlier in the school year, we observed these students chanting in unison the parts of a five-paragraph essay in response to a query by Mary about essay structure. The class in the video was the second of Mary's two honors chemistry classes; according to Mary, the return of papers did not go well in her earlier class.

To analyze this segment, I used Critical Discourse Analysis, particularly Gee's (2005) "seven building tasks"[13] and Gee's (2011b) "tools of inquiry"[14], along with Rogers' (2004) concepts of genre (ways of interacting), Discourse (ways of representing),

[13] Gee's "seven building tasks" are: significance, activities, identities, relationships, politics, connections, and sign systems and knowledge (see Gee, 2005, pp. 10-13 for full descriptions of each).

[14] Gee's (2011) outlines 27 different tools that can be used to illuminate a piece of discourse.

and style (ways of being). The complete description of the method of analysis and my interpretations is the subject of Chapter Thirteen.

Trustworthiness

In order to ensure internal validity in qualitative research, Merriam (2009) cites Denizen's (1978) four types of triangulation: "the use of multiple methods, multiple sources of data, multiple investigators, or multiple theories to confirm emerging findings" (p. 215). This study was primarily triangulated through multiple sources of data, including documents, field notes, interviews, and surveys. Furthermore, I spoke regularly with the other researchers on the grant to confirm or problematize findings; their thoughts helped me refine my interpretations. Although this study primarily relied on basic qualitative coding and analysis, the use of Critical Discourse Analysis added a second method.

In addition, Seidman (1998) also pointed out that the three-interview structure allows for triangulation both across interviews and across participants. Because of the three interviews, it is less likely that the data will be affected by the participant's mood or schedule. When certain issues came up in all three interviews, I was confident that these issues were "truth" for the participant. In a similar manner, I was able to look at the findings across participants to see what seemed to be a "pattern" and what was particular to only one or two participants. As I worked toward building theory, the number of data sources added to the trustworthiness of my findings.

Methods: Summary and Conclusions

Each of the research questions posed in this study was explored using different data sources. A summary of the questions and data sources is provided in Table 2.2, with the final column indicating the chapter of this dissertation where the interpretations are presented.

Table 2.2: Summary of Data Sources Used for each Research Question

Abbreviated Question	**Data Sources**	**Chapt.**
What are the essential characteristics of the professional genre of science news?	Phenomenological interviews with two practicing science journalists (Appendix B for protocol)	4
What were teachers' reasons for joining SciJourn?	Survey distributed at the February 2012 professional development meeting (Appendix D, question 1). Field notes from day one of Cadre II summer workshop	5
What are the similarities and differences between science teachers and science journalists?	Phenomenological interviews with practicing science journalists. Survey distributed at the February 2012 professional development workshop (Appendix D, question 6).	5
What is the "high school science teachers' theory of writing and writing response"?	Focus groups conducted at the fall 2011 professional development workshop. Survey distributed at the February 2012 professional development workshop (Appendix D, questions 3-5)	6
From a teacher's perspective, what does SciJourn look like in classrooms?	Phenomenological interviews with five implementing SciJourn teachers (Appendix C for protocol)	7-11
What does SciJourn look like in a specific lesson?	Video segment from a participating teacher's class period	12

The remainder of this dissertation is organized as follows:

- Section One examines genre, writing, and science news outside the SciJourn project. It is designed to provide context for the interview research that makes up Section Two.

    - Chapter III: My previous experiences with genre
    - Chapter IV: Professional science journalists' ideas about science news
    - Chapter V: Science Teachers' reasons for signing up; Science teachers compared with science journalists
    - Chapter VI: Science Teachers' theory of writing and writing response

This section ends with a short chapter (VII) outlining conclusions from Section One

- Section Two examines what happened in SciJourn classrooms.
    - Chapters VIII through XII: The story of an individual teacher's SciJourn experience
    - Chapter XIII: Discourse analysis of a single episode in a SciJourn classroom
    - Chapter XIV: The conclusion of Section Two, focused on themes that occurred across classrooms

Chapter XV concludes the dissertation by summarizing what was learned about genre and authenticity and offering recommendations for further research.

Section One: Before SciJourn

III. Flashback to my English Classroom

My thoughts about genre and education are strongly influenced by memories of my use of genre in the high school English classes I taught. Therefore, before moving forward to examine the genre of science news and its impact on high school teachers and classroom communities of practice, I would like to flash back in time to my own classroom and the genre projects I assigned.

Consider these two examples:

<u>The Crucible</u>, *Assessment Option 1. Write a letter to the editor of the Salem paper from the point of view of a concerned citizen, responding to the events depicted in the play. Use at least 3 direct quotes from the play for support.*

<u>Multigenre Research Paper</u>. *Choose a social justice topic to research (must be approved). Create a series of 5-7 different genres exploring that topic. Each genre must use information from your research; a minimum of seven sources is required.*

I say this with a bit of chagrin now, but I used to take pride in creating assignments like these. No five-paragraph essays in my class, thank you very much. My students were exploring the relationship between purpose, audience, and form; they were gaining experience working in authentic genres—genres that they might actually encounter outside of the classroom. And we were all having fun doing it. They preferred these assignments to something more traditional (they especially preferred the multigenre paper to a standard research paper); I preferred reading them. Students took me by surprise, occasionally even made me laugh out loud. Life was good.

However, as I looked back on my work in high schools, I started to think about my efforts as something akin to my mother putting cheese on top of my vegetables when

I was a child. The cheese didn't substantially change the vegetables—underneath, my broccoli was still broccoli—it just made the vegetables easier for me to eat. Likewise, non-traditional genre options didn't change the core purposes of these assignments, they just made those purposes more palatable to my students.

Take the above examples. At the end of *The Crucible* unit, I had a few goals for my assessment, goals that are the vegetables in this extended metaphor. I wanted to know that my students could take a position on the events of the play and support that position with specific details. I wanted to see them incorporate direct quotes into their writing. And, I'll admit, I wanted an idea of whether or not they had even read the play (or at least paid attention to class discussions). All of these goals could have been met in numerous ways: a five-paragraph essay, a series of test questions, a song, a public service announcement, and on and on. Some years, I gave my students several of these genres to choose from, that's how interchangeable I thought they were. The genre was just the cheese on top, there to disguise the unappealing taste of a literary analysis.

Because it was the subject of an entire writing unit, the multigenre paper was a little bit better than *The Crucible* example, but not much. In the years before I used this assignment, my students had written a standard research paper, and the multigenre paper was designed to meet the same core, vegetable-esque goals. Students needed to be able to effectively search for good information on a topic; they needed to be able to read and understand what they found; they needed to keep track of and cite their sources; they needed to synthesize information from different sources and communicate it clearly, without plagiarizing. Within the unit we did talk a bit about choosing an appropriate genre for different kinds of information, but class time was mostly taken up in the same way it had been before: exploring library databases, discussing website credibility, learning how to take notes and keep them organized, making an MLA Works Cited page, and discussing how to paraphrase and summarize.

I now believe that, although these assignments were engaging, they were also not as "authentic" as I thought they were. The problem comes down to the difference between what I've come to think of as "latent authenticity" and "functional authenticity," a distinction that seemed important to me the more I thought about the role of non-traditional genres in the classroom in general and the SciJourn project in particular.

Latent and Functional Authenticity

When teachers are called to use "authentic genres" in their courses, often the term "authentic" is defined as "work that is in some way meaningful beyond the context of school" (Whitney, 2011, p. 51). In that sense, genres that simply *exist* outside of schools are often considered authentic (e.g., articles about authentic writing by Kixmiller, 2004; Lindblom, 2004; Parsons & Ward, 2011)[15]. My "letter to the editor" assignment would have met this basic criterion, although, as Whitney (2011) pointed out, it was actually "as fake as any other" (p. 58). Whitney's (2011) argument was that we should consider the classroom a "real" space too and utilize it to help our students think critically about the kinds of reading and writing they do in and out of schools (p. 58). I agree with her, but I

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[15] In this chapter, I am specifically interested in the ways researchers have talked about authentic writing assignments. Other work (e.g., Shaffer & Resnick, 1999; Rahm, Miller, Hartley, & Moore, 2003) has looked at authenticity as a quality of the learning environment more broadly or of other kinds of activities beyond writing.

also think that there is a difference between authenticity as defined above—latent authenticity—and functional authenticity that needs to be taken into consideration.

As I see it, my English assignments did not require functional authenticity for several different reasons. First, I was almost always the audience. Even when I found outsiders to come visit my class (or contests to encourage my students to enter), my students and I all knew that my opinion was the one that mattered to their grade. This is a well-documented challenge for all teachers and not one that I want to spend a lot of time on here, other than to simply note it. More importantly, I always assessed these assignments according to the *real* goal of the assignment, not according to the successful execution of the genre—and my students were also well aware of this. My "letter to editor" writers might get a few extra points for especially clever "in character" moves, but in the end a well-written five-paragraph literary analysis and a well-written letter to the editor would be graded nearly identically. I paid even less attention to specific genres in the multigenre essay assignment because students could choose from virtually any genre they could conceive of—how could I possibly attend to the specifics of so many different writing forms? If a student wrote a song for her social justice paper, in the tradition of great socially conscious songwriters from Woody Guthrie to Gil Scott Heron, I never assessed the song on musicality. Songs were just one of many genres my students chose that I felt incompetent to judge, so I resorted to grading using a rubric based in part on Spandel and Stiggins' (1997) Six Traits. Genre-specific issues were nearly absent from my assessment. Perhaps sensing that the deeper qualities of the genres weren't all that important, some of my students did little beyond the superficial. I started calling this the "Publisher problem" after the Microsoft program that allowed students to enter text and believe they had created a newspaper. As much as I wanted to think of my assignments as "authentic" (or at least as "more" authentic than their school-specific counterparts), I now think that these assignments merely possessed "latent" authenticity—the possibility for functional authenticity existed because these were "real" genres, but that potential was not realized.

Why We Use Non-Traditional Genres

The obvious question at this point is "so what?" If my assignments were not functionally authentic after all, is that really a problem, particularly if my students enjoyed their work and met some of my (perfectly reasonable) goals for these assessments? To answer that, I'd like to consider the range of possible purposes genre writing can have in education, a topic that has been the subject of much research over the past several decades (e.g., Bawarshi & Reiff, 2010; Dean, 2008; Fleischer & Andrew-Vaughan, 2009; Lattimer, 2003; Romano, 2000).

Student Engagement

Although I may have claimed loftier goals, my primary purpose for using different genres was student engagement; as I said earlier, they liked these assignments better. I would still argue that this is a valid enough reason and I'm not alone in making that argument. In her article about the "schoolishness of school," Whitney (2011) described some of her more interesting assignments as the "artsy-craftsy" ones. When I talked about this topic with one of my professors, she could fondly remember many of the non-traditional genres her daughter had created for school even though some of these assignments happened twenty years ago. Outside of language arts classes, many teachers are encouraged to use non-traditional genres as a means of engaging students while learning content, an approach somewhat like my “cheese on the vegetables” use of genre (see Prain & Hand, 1996, for a discussion of these kinds of assignments in science classes).

Learning to Learn

Engagement is a compelling and popular purpose behind these assignments, but it’s not the only reason to incorporate non-traditional genres. A second purpose, one at the core of Fleischer and Andrew-Vaughan’s (2009) work, is that students can develop as writers through genre study. The primary goal of their “unfamiliar genre project” (which is described in detail in their book) is to learn *how* to learn about a new genre, a process they argue can help prepare students for the unfamiliar writing tasks they will face outside of school while using the school environment to support critical awareness of the connection between form and function. This, too, seems like a good reason to play with genre, particularly in writing classes. A related purpose is behind Romano’s (2000) multigenre research paper: the broad exploration of genres can help students think about the many ways of knowing and communicating knowledge that exist in the world beyond those traditionally taught in schools. In retrospect, my enactment of Romano’s (2000) project didn’t live up to this ideal, but it certainly seems like a worthwhile one.

What I never Considered

While all of these purposes make sense, another possible reason exists for engaging in genre writing, one that never occurred to me as a classroom teacher. In a 2009 article, Bazerman, who has written extensively on writing across the curriculum, offered a “view of how genre might interact with both learning and development, using a Vygotskian lens, considering genres as tools of cognition” (p. 130). Based on Vygotsky’s position that learning precedes development, Bazerman (2009) argued that new genres are first learned—often with difficulty—and only later, with repeated use, do the genres transform a person's way of thinking and seeing the world: "we then learn not just to talk but to learn the forms of attention and reasoning which the language points us toward. The words of the field become associated with practices and perceptions, changing our systems of operating within the world" (p. 135). His article included examples of this process drawn from his life, but I began thinking about it in terms of my own. I can distinctly remember when, as an undergraduate literature major, I was assigned a literary critique, an assignment where I was expected to include the thoughts of literary scholars alongside my own analysis. The first time I wrote this kind of paper, I struggled; my final product was little more than the summaries of articles I had read woven together with few of my own thoughts. But I received feedback, wrote another paper, then another, until, over time, I understood that this genre wasn't asking me merely to summarize what other people had done. Writing in this form was like putting together a sophisticated book club, sitting alongside other scholars at a table and engaging in conversation about certain aspects of a text we had all read thoughtfully. In this kind of paper, I had a voice; I could disagree with or add to the ideas of other scholars; I could have these scholars disagree with one another. Learning to write like this changed the way I read texts, it changed the way I read literary criticism, it changed the way I spoke about literature in classes and even (perhaps annoyingly) with friends.

What were the key components of this transformation? It seems to me that there were several. I had to work my way through the genre several times, not just once or twice (I know a similar transformation never occurred for me in disciplines where I only took an introductory course). By writing these kinds of papers again and again, I was learning the genre at a deep level, not just superficially. Although Bazerman (2009) did not explicitly discuss the role of feedback in this process, for me feedback was invaluable. I needed an expert to comment on my attempts, to show me where I had succeeded and where I had fallen short—with success and failure defined on the *genre's terms*, not by some external goal that the professor had[16]. In other words, success in the genre and success in the class were one and the same. I know consider this the key component of functional authenticity.

Functional Authenticity and High School Assignments: Possibilities

Much of Bazerman's work comes out of higher education where disciplinary genres are learned as a prerequisite for entering academic discourse, but I thought that the concept could be relevant in high school classes too. As I saw it, the key was to identify a genre where there is congruence between its authentic use outside the classroom (its functional authenticity) and the goals for its use in the classroom. This is not to say that there needs to be complete overlap between the two uses, but by finding genres where students are asked to aspire to an educationally relevant subset of the standards of professionals, perhaps we could respond to their attempts *authentically*—and the genre would become an essential ingredient in the learning experience, not just an afterthought.

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[16] Of course, professors and other academics help define and perpetuate these academic genres, both through their course assignments and through their own scholarship. Some scholars have argued that genre instruction should include a critical component; otherwise, students are led to believe certain forms are "correct" without critiquing the power dynamics embedded in the genre (e.g., Devitt, 2009).

And science journalism, I speculated, could be just such a genre.

IV. What is Science News?

Prior to my involvement with SciJourn, I had thought very little about science journalism as a genre. Yet I was an avid consumer of science journalism in its many forms: I listened to *Science Friday* on National Public Radio; I read the science section of newspapers and newsmagazines; I watched the science-related stories on the nightly news. I had few close friends with science degrees or careers, but those in my social circle all followed hot-button national topics like global warming and stem-cell research as well as local issues—air quality, for example—that had a scientific component.

I can't say that my interest in science was originally driven by curiosity or fascination. When I was younger, I was encouraged to go into engineering because I was good at science and math—and I briefly majored in chemical engineering as an undergraduate—but I can't remember ever really *liking* school science, not the way I liked literature or writing. However, I was someone who wanted to self-identify as "smart" and, for me, this equated to an awareness and understanding (however superficial) of science-related issues. As I grew older and the public discourse around science grew more heated, I sought to align myself with those who valued science, to distance myself from those who denigrated intellectualism in general and science in particular. For my friends and me, conversation about science became a political act. At the same time, I also began to enjoy science in a way I never had in school. Quite simply, the topics I encountered through science journalism were much more interesting than anything I had learned in my formal education.

This self-awareness about my history with science and science journalism has only come about recently, as part of my quest to understand the role of the genre of science news in the SciJourn project. But the more I read about the language of science and the relationship between science and society, the more my own story made sense to me. It turns out that for decades, theorists and writers have pointed out that the language of science is alienating to nonscientists. In his lecture “The Two Cultures,” Snow (1963) described the lack of communication between “literary intellectuals” and scientists as a crisis of the modern world, one that was of acute importance both to winning the Cold War and to the goal of ending poverty worldwide. As Snow (1963) saw it, literary intellectuals had an influential platform from which to speak, but they used this platform to depict science as dangerous and unnatural, leading the world away from the pastoral past and down a path toward apocalypse; their nonscientist readers were unfairly biased against science as a result. In his *On Knowing: Essays for the Left Hand*, Bruner (1979) described the problem as one of perception. People and ways of knowing aren’t either “left hands” or “right hands,” but the middle ground between the two is kept hidden. These ideas resonated with me, someone who had once viewed the world in this dichotomous way. I recalled when I switched my major from engineering to English—there had been literally no overlap between two fields, not in the kinds of conversations that went on in the classrooms, not in the assignments I was expected to complete, and certainly not in the content or style of the reading.

Frankly, my English classes felt like friendlier places to be. When I read Lemke’s (1990) *Talking Science*, I heard a possible explanation of why. In his study of language use in American high school science classes, Lemke (1990) argued that nothing is intrinsically more difficult about science than any other subject, but that the language used in science classes creates “mystique” around science that scares many students away. Lemke (1990) further contended that the American science curriculum is so abstract and decontextualized that students struggle to find relevance in their learning. Lemke (1990) presented this as a critical issue for a democratic society; when governments and corporations can hide their agendas behind the "mystique of science," public debate is stifled. Reading Lemke (1990), I became especially uncomfortable. In my experience, the "mystique of science" cut both ways. Part of the reason I even considered a career in science was that I believed this mystique—and I *wanted* others to be scared off while I, one of the smart few, became an insider in this secret world. However, by college, the alienating quality of the language of science was part of what pushed me away.

So what drew me into those science news stories? What was it about the genre of science journalism that captured my attention? In order to find out, I decided to talk to two science journalists, each with over 20 years of experience in the field, to learn more about how they defined the genre.

The Journalists and Our Conversations

Alan Newman, the science news editor working with the SciJourn grant, entered the field of science journalism reluctantly. He originally wanted to be a scientist; he earned a doctorate in chemistry and planned to spend his career working as a professor and researcher in a university. However, a series of circumstances—"things weren't going well," as he told me—caused him to look for a new career. A friend told him about an opening for a science writer with the Johns Hopkins Alumni magazine, and, although he said he "was not a very good writer," he got the position because he knew the science and "the editor prided herself on teaching people to write." After a few years working at

Johns Hopkins, where he learned the field of science reporting on the job, he moved on to the American Chemical Society's Publication Division and eventually became the managing editor. He stayed there for eighteen years.

Although Julie Miller's background was somewhat like Newman's—a lifelong desire to be a scientist culminating in a doctorate before a career change to science journalism—Miller described her transition in very different terms: "I felt like [becoming a journalist] was cheating because you got to do what to me was the fun part which was thinking about science and you didn't have to deal with…long, slow, tedious experiments." Miller discovered science journalism as she was completing her PhD in neuroscience; she moved straight from the doctoral program into a journalism program where she earned her Master's degree. Her first job was as the biology reporter for *Science News*; after ten years there, she became the editor of *Bioscience,* a magazine published by the American Institute of Biological Sciences, where she stayed for another ten years before returning to *Science News* as the editor, a position she held for eleven years.

Both Newman and Miller agreed to a series of in depth one-on-one interviews with me centered on their experiences as science journalists (see Appendix B for the interview protocol). As discussed in the methods chapter of this dissertation, I chose Newman and Miller as interview participants partly for reasons of convenience—both were affiliated with the SciJourn project and they were both willing to talk with me—but also because of their backgrounds. I was especially interested in the fact that they had been scientists—had been on the inside of the "mystique," so to speak—as I thought about the possibilities science journalism had for science classrooms where Lemke (1990) argued that the mystique was perpetuated.

Science News and Science Journalists

As noted above, Newman and Miller talked about their entry into science journalism very differently; however, they described their work and the field in strikingly similar terms. In particular, they seemed to value the following characteristics in themselves: a sense of accountability to the reader; the ability to identify what's interesting about a scientific topic; a broad understanding of science (and the ability to find out more when knowledge is lacking): knowledge of who to talk to, what to ask, and how to ask it; and the ability to tell a coherent "story." Each of these qualities of a journalist can be made manifest in a science news article, as detailed in Table 4.1. In addition, Miller and Newman also described similar aspects of their work as enjoyable; these can also be aligned with the qualities of the journalist and the article (see the third column of Table 4.1). As I will discuss below, the relationship between each of these categories is somewhat complicated; knowing what topics are interesting, for example, depends on a broad understanding of science *and* is part of being accountable to the reader. Yet each of the qualities in Table 4.1 illuminates something slightly different about science journalism and science journalists; only when taken all together, though, does a complete picture emerge.

Accountability to the Reader: Understandable, Useful, Accurate Information

Of all the qualities of science journalists and science journalism that Newman and Miller described, "accountability to the reader" was the one that I considered coding as an umbrella term under which everything else followed. Newman and Miller both portrayed “accountability to the reader” as the journalist’s first principle; they used all of their other skills in service to this. Because Newman and Miller described some of the other qualities as more important to them personally or as more fulfilling, I chose to weight all the characteristics evenly, but I believe “accountability to the reader” must be discussed first.

Table 4.1: Qualities Emphasized by Science Journalists in Interviews about their Work

Quality of the Journalist	**Quality of the Article**	**Joys of the Job**
A sense of accountability to the reader	Questions are answered, information is accurate, reading the article will be a satisfactory experience (not a waste of time), information will be understandable	
The ability to identify what’s interesting about a scientific topic	Interesting to the non-specialist reader (through the lede and elsewhere in the writing)	Opportunity to explore and learn about interesting, cutting-edge science
A broad understanding of science (and a willingness and ability to find out more about what s/he doesn’t know), recognition of what’s important and what’s not	Stories are put into context, new information is not overhyped, details that aren’t important are left out	Opportunity to learn about a wide range of contemporary science topics (in contrast to the deep but narrow knowledge of a research scientist)
A knowledge of who to talk to, what to ask, and how to ask it	Appropriate sources are consulted; direct quotes are included that clarify concepts without jargon; multiple perspectives are given voice when necessary; sources of information are respected and not stereotyped	Opportunity to talk to all kinds of people in various settings who do interesting work
The ability to tell a coherent story	Information is presented in a logical way; an appropriate level of detail is included; an organizational structure is used	Writing

For Newman and Miller, being “accountable” to the reader meant writing a story that, as Newman said, “people want to read.” In some ways, this overlaps with the second quality, “interesting,” although “accountability to the reader” is about more than just making an article interesting. According to Newman and Miller, “accountability” also requires delivering information that is accurate yet understandable while also being worthwhile to read. For trained scientists like Newman and Miller, this meant translating the complicated and technical world of science for a broader audience. Newman described the kinds of writing by lab scientists that appears in science journals: “they’re encouraged to write in this sort of tough way which makes it very difficult for non-scientists to read any of this stuff.” As he learned to work as a science journalist, Newman recalled, he had to learn that “even though you understand it [the science concepts] you need to put it in a way that will be acceptable to a general public so they walk away with that important piece of information and yet not violate that sort of scientist error bars.” Newman found walking the line between clarity and accuracy to be a challenging but important part of science journalism. Because accountability to the reader is so important, Miller found herself defending her loyalty in her first job interview: “at that time they felt that having a PhD was a disadvantage, that I wouldn’t make my stories accessible to ordinary readers or that I would favor the scientists or be protective of the scientists and not ask them the difficult questions.” She was able to convince her interviewers that she would be loyal and accountable to readers and eventually held her own writers to that standard when she worked as an editor. As editor, she called herself “the reader’s representative…you have to be sure that it’s [an article] going to be something that’ll interest the reader and that is the level the reader can understand." Describing his editing experience, Newman used almost the exact same words, calling himself the "proxy for the reader." In this role, Newman and Miller explained that they had to think like readers, making sure, as Miller put it, "that as the reader goes along any question that pops in their mind will get answered."

Being accountable to the readers also had to do with topic selection. One of the science journalist's skills was to translate technical information, but they also had to choose stories that the reader would find useful or otherwise worthwhile, something that Miller emphasized much more than Newman. At one point, Miller described the science journalist's role as providing a service to both the public and to the scientists whose research she covered. She said that science journalists were:

> helping the scientists in making their work more useful for the general public…the scientists are in general doing their work because they think it will be important so you're helping them get their messages out. And then the other side is that there are uses for this information and you're making it available for people to put to use when they make medical decisions, when they make business investments…you're helping them find out how to get answers and to understand what the caveats are so that people don't think that 'oh, this is for sure' when it isn't.

Being accountable, then, meant covering science topics that readers would find "useful" in their lives and covering them accurately and completely so that the limitations of the research would be clear. Although Newman did not describe the work of science journalists in this way during our interviews, I had seen him write comments on student papers and heard him talk to teachers about these same issues, emphasizing that the journalist's job was to choose a topic that readers would care about, to give enough contextual detail so that readers could understand the story in relation to the wider field or world, and to be clear about what parts of the story were well accepted and what information was more uncertain. In the interviews, Newman also described the "limited capabilities" of news organizations—limited resources, limited reporters, limited space to print—and said "you're always trying to come to the important story rather than to the stupid story," something he feared was being lost in the age of the 24-hour news cycle and the limitless space on the Internet.

However, being "accountable to the reader" wasn't always easy. As Miller pointed out in the quote above, journalists were also in a sense working for scientists by putting their research in the public eye. The relationship between science journalists and scientists—one of both mutual dependence but different purposes—could lead to difficult situations. Miller described a time when she worked on an article that exposed the fact that a researcher wasn't following rules around handling DNA; the scientists she called for comments "didn't want to talk to me, some of them yelled at me." When he worked for the Johns Hopkins magazine, Newman was "also doing PR stuff, so we never criticized necessarily people's work." The kinds of stories he wrote at Johns Hopkins wouldn't explicitly demand that he be critical of the work going on at the university, but in his later position conflicts of interest were more serious. When he was an editor, Newman said, one of his investigative reporters often ran into trouble by exposing problems with various chemical companies at the same time the American Chemical Society (the parent organization of the publication) was "busily courting" those same chemical companies. Newman said that news organizations avoid investigative journalism “because they’re basically peeing in their own sandbox.” Being accountable to the reader was complicated by obligations to editors, sources, and parent organizations, but it was still Newman and Miller’s main priority.

Interesting

As I said above, part of being “accountable” was to write stories that were interesting, but “interesting” was such a focus of my conversations with both Newman and Miller that I decided to make it its own code. Newman and Miller stressed that the journalist’s job was to find the most interesting topics to write about and both described meetings and conferences as a source of these topics. Newman said, “I used to go to technical meetings and I’d look for talks and listen for talks and see if I can hear something really great and so the first part is just probing for something excellent.” Likewise, Miller contrasted her experience attending conferences with that of a scientist:

> You didn’t have to stay for a whole lecture. If you were sitting there and it wasn’t interesting and you weren’t getting anything out of it you didn’t have to stay until the end to be polite you could just get up and leave…your job was to go find the most interesting stuff going on. Whereas the scientists…they couldn’t have left. Somebody in their field would think it was terrible if they saw them walking out in the middle of a lecture.

Newman and Miller emphasized that finding interesting topics was a matter of staying on top of the field by reading professional journals and attending meetings, but they also suggested that knowing what made a topic interesting was part of the journalist’s skill, something that couldn’t exactly be described. Miller tried to explain it this way:

> Sometimes you write a story where there's a topic that you know people are interested in and then you find the science behind it. And sometimes you choose something where you know the science is exciting and you're sharing that with the general public.

To me, this seemed like a useful distinction although it did little to illuminate how Miller knew the science was "exciting." Miller's conclusion—"I could assume that if I found something interesting if I did a good job they [the readers of *Science News*] would too"—further emphasized the journalist as a key in the process of making the science interesting to readers. When Newman was an editor, he worked with a journalist whom he called "one of those great intuitive writers…she spots things long before anybody else." Part of this journalist's skill, Newman said, was her solid science training (including a PhD from Oxford), but she was also able to "see" stories that other people might overlook. Newman's use of the word "intuitive" highlights the idea that the ability to find interesting science and make it interesting to readers is a talent, perhaps one that can't be taught.

The skill of a journalist to determine what was interesting must then be made manifest in the article itself, as Newman and Miller both explained. Newman particularly focused on the lede (the opening sentences or paragraph) of an article as important to capturing the reader's attention and getting them interested enough to read the science. One of Newman's most memorable articles was a piece he did for the Johns Hopkins magazine about genetic testing; the article began with a description of a woman preparing to receive the results of a genetic test for Huntington's Disease, an affliction that had killed her mother and haunted her entire life. Newman explained that taking this very human angle in the lede was designed to make the reader "go wow, this is something really dramatic and affects people in a fundamental way…that's really what technology is about in a real personal way." Although Miller did not emphasize the lede as much as Newman did, she also stressed that science journalism must be interesting. Miller's top priority as an editor was determining "whether they've [the writers] made it interesting to a reader…because if nobody reads it then it's a waste of time." She went on to elaborate that an article:

> better be good enough to grab somebody and give them value for the time they spend. And that is one of the things, the more time you're asking somebody to spend on a story, the more rewarding it needs to be either in being entertaining or providing useful information.

The idea that "interesting" is not necessarily synonymous with "entertaining" was something that Newman implied also. Both writers described writing short pieces, sometimes only 200 words, which simply gave a piece of news concisely. Neither journalist seemed to believe that these pieces would be "entertaining," but they had to be interesting to the reader; for a short article, the journalist might not use writing techniques to make the article interesting but the topic itself would be selected for its interest to the reader (not every science organization's press releases would be covered in *Science News*, for example). As Miller explained in the above quote, though, for longer pieces the writer would have to do more work to make sure the piece delivered value for the time a reader invested. Finally, both Miller and Newman emphasized that which topics might be "interesting"—and how much the writer might have to work to convey what was "interesting" about a topic—was a function of the audience; when each journalist worked for specialized publications, they could assume a certain level of innate interest on the part of the readership that might not be assumed when writing for a more general audience. The less the readers would be naturally interested in a topic, both journalists said, the more the journalist might use techniques familiar to fiction writers. Newman described his first editor teaching him to "put life into your articles…get that description, jot down what people look like, what they sound like, what the room smells like." Miller said that part of making something interesting was learning to do "things like putting in anecdotes, putting in quotes, using metaphors."

Finally, both Miller and Newman found that looking for the interesting science was part of what made the job of science journalism rewarding. Miller contrasted this with the work of scientists:

> You [a scientist] choose your topic and you get funding for it and you're sort of stuck with it. In each field, sometimes there are periods of real excitement and sometimes there are periods of sort of doldrums, like they have a question but the technology isn't available to answer it yet, and each field has some slow periods. But as a writer just you hit a few of the slow periods, it's like, okay I don't need to talk to these people, I'll check with them in five years, see if they're doing any better. You don't have to stick with it you can just hop around to wherever the excitement is.

Newman expressed much more ambivalence about his career switch, but he also believed that journalism gave him an opportunity to learn about the cutting-edge, interesting work that was going on across fields: "I realized after a while that I was doing some really interesting things. I was in places that even if I had been a professor I never probably would have gotten." Science journalists were obligated to cover the most interesting science, a fact that led them in directions that were interesting to them personally.

Broad Understanding of Science

The ability to find an interesting topic depends, in part, on an understanding of science, something Newman and Miller discussed. Although both said that a science journalist did not *have* to be a scientist by training (as they both were), they clearly found their own science background beneficial in their journalism careers. Newman and Miller both depended on their ability to read primary research, a skill not all reporters who tried to work in science journalism possessed. Newman described a journalist he had hired who "could never figure out what's important [in a research article]; she'd get lost in the details." Distinguishing what was important from all of the science information available was something that science journalists also developed over time as they work in particular fields. Newman called this "a skill set" and said that science journalists learned to figure out "what really is the important take home message" from a research article or a press release. Miller said that good science journalism was about giving readers a "sense of the scientific process" which meant situating new findings within the larger context of the research field. Good journalists needed this broad knowledge base to be able to do so.

Science journalists had a basic understanding of science and its processes, but good science journalists also had the desire and ability to find out more about unfamiliar topics. Miller described this as "a commitment to understanding what's going on. You really can't fake it." Similarly, Newman said that "not all science journalists have fancy degrees in science, but they sort of have the commitment and energy to stick with it and to understand this stuff." When he worked for the Johns Hopkins magazine and covered a range of science topics, Newman said he often had to "immerse myself" in reading background information in order to prepare to write stories.

The result of this reading and knowledge was that good science journalists could do the following things when covering a story: determine what information was new; decide whether or not to be skeptical of this new information (and whether or not it was an issue that had multiple "sides"); and ask appropriate questions about the ramifications of this information. Newman said that "what a good science reporter can do is to look at something and say I really have doubts…I need to be skeptical about this as I write it, or versus this thing may have legs" while Miller said that science articles needed to include whether "this supports the data that's already available or this is really different and there's a possibility it's flat out just wrong, but it's also a possibility that it's leading the field in a new direction." Both journalists described needing to know enough about the topic to decide whether or not they needed to gather quotes from people on the other "side" and pointed out that this meant understanding what the consensus of the scientific community was (both used the example that good science journalists do not feel obligated to get quotes from the few remaining scientists who disputed human involvement in global warming).

Finally, Newman and Miller said that the journalist's broad understanding of science was in stark contrast to the scientist's narrow focus on a particular area or question. Newman said, "when you're doing science you're focused very narrowly…doing more and more about less and less." He pointed out that this could lead to a rewarding career, but also said:

> the tradeoff in journalism is you get to go everywhere. It's like the old joke 'good girls go to heaven, bad girls get to go everywhere.' So, you do get entry into places that even if you were the best researcher you're not necessarily going to get entre to.

As elsewhere in the interviews, on this topic Newman made it clear that he would have also enjoyed working as a scientist; on the other hand, Miller was certain that she would have been less happy in the lab: "I like sampling things and getting a lot of variety and certainly being a writer gives you more variety than being a researcher because you aren't investing as much time in pursuing a particular idea."

Who to Talk To, What to Ask, How to Ask It

The broad understanding of science helped Newman and Miller with an essential aspect of journalism, conducting interviews. As discussed above, Newman and Miller relied on their ability to read primary research and to understand the context of new information, allowing them to determine what kinds of questions to ask. For Miller, interviews were about "asking questions until you really understand it and when you're writing it [the article] if you found you don't get something you need to call them back again." Newman also saw interviews as a time to deeply understand a topic, but he pointed out that his science background gave him the ability to avoid wasting time with basic questions the way a journalist with no science training might: "they're constantly asking people to translate and of course they're losing valuable time and information in the process." They both talked about various kinds of people whom science journalists needed to interview for stories. First, obviously scientists involved in the research would be interviewed. Secondly, scientists in the same field who were not involved in the research would be called for their reactions. Miller described doing this at conferences—“you would buttonhole anybody who you could at the meeting”—but also talked about how one source might refer you to another. Eventually, she said, reporters learned “who gives a good interview.” However, this could sometimes be a hindrance because journalists would only be interviewing the same sources or sources who had recommended one another, giving a one-sided story. Newman also said that over time a reporter develops a “rolodex,” but he also pointed out that a science reporter who regularly covered the same beat would learn the “nuance” of the field; as he put it, “even within the field of microbiology there’s people who do different things.” Newman also talked about using the primary research article for ideas about whom to interview, looking at whom the researchers had cited and finding individuals with the same expertise as the scientists who had peer reviewed the published piece.

Thirdly, Newman and Miller talked about certain articles needing to include interviews with non-scientists. Newman described a hypothetical scenario in which an environmental group released the results of a study saying there were elevated levels of arsenic in the drinking water: “as the writer, the first question is, ‘wow, should we take action?’” Newman went on to say that if the answer was “yeah, these are really frightening levels,” that a good science reporter would then ask questions of public health officials or members of the government. Miller also talked about the different kinds of non-scientists whom might be interviewed for different articles:

> Sometimes it’s industry, sometimes it’s people who will be using something. If you’re doing some sort of new genetic test, it might be good to talk to genetic counselors to find out whether they think it’s really going to be useful or not,

> whether there's a need for that, whether it's practical…sometimes they talk to patients when they're writing a story about a disease.

Bringing in these kinds of voices, Newman said, distinguished science journalists from the researchers. Scientists only reported results of the research; science journalists often wrote about the potential implications of these results.

At the heart of interviewing is the ability to ask questions and Newman and Miller felt quite differently about this job. Newman described conducting interviews with scientists as "awkward…most reporters, in order to get good quotes, play dumb…I knew way too much stuff and on one hand I didn't want to be dumb and on the other hand you needed it." However, Miller talked about the same issue in this way:

> When I was interviewing a scientist, I would never tell them that I had been trained as a scientist because then they would just switch into jargon and I would have to do all the hard work myself afterwards. But if I just asked questions as a reporter, then they had to do a lot of the translating…you want to encourage people to say things in an interesting manner. So I never felt like I was pretending not to be smart.

Both journalists recognized how important it was to talk to scientists and get good quotes, but, as with most issues involving the identity shift from scientist to reporter, Newman found the experience difficult while Miller did not. Newman seemed to want to keep his membership in the community of scientists—in part, he implied, because they were "smarter"—while Miller considered hiding her science background just part of this new job, a job she enjoyed. Ultimately, though, they both said that talking to scientists was one of the perks of being a journalist. Newman even said "at some points I had to pinch myself" and called it "cool hanging out with lots of famous scientists." Miller often dreaded making the first phone call but said that she "particularly liked that you could call up the most important people in the field and they would be happy to talk to you because they want to have their story published."

A Coherent Story

Once a topic had been selected, the research completed, and the interviews conducted, the science journalist still had to write an article. For Newman and Miller, writing the story meant putting all the pieces together in a coherent manner. Newman described the process of writing an article as one of crafting a story: "it's not a story in that the three little pigs went into the woods, it's a logic story." Miller also used the word "logical" to refer to a good article. According to Miller, the organizing principle of the article would depend on the information: "sometimes it works to do it chronologically…sometimes you group it by topics…the people working on birds discovered this and the people working on reptiles discovered something similar…[or] you could have sort of questions and answers." Newman called his approach to writing an article "a connect the dots type approach" and later said that he would always reread his articles, asking himself, "did I get from point A to B to C to D?" Similarly, Miller would check her own articles and those of her writers to be sure "that readers are going to understand why the story moves from this point to this point." Both journalists described sitting down to write an article only to discover that a key piece of the logic puzzle was missing and having to call someone back or hunt down additional information to fill in that gap. It was only in the act of writing that what was missing became clear.

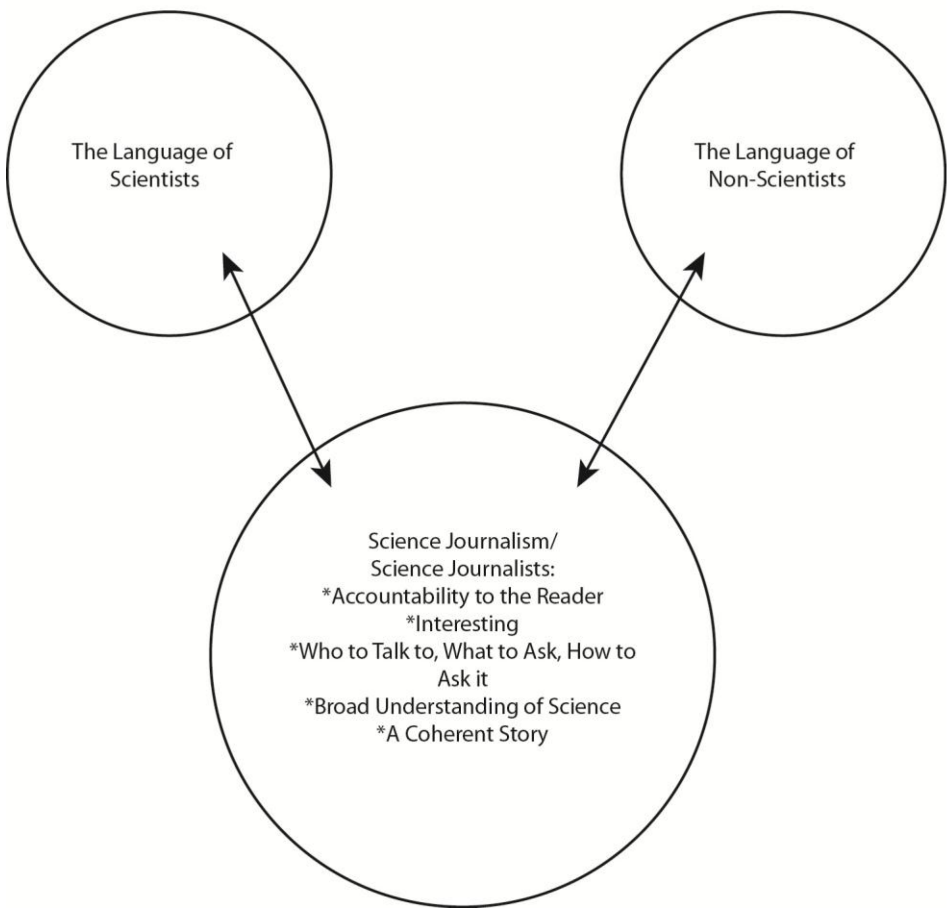
Although they agreed that a logical, coherent story was the goal, Miller and Newman differed in their approach to writing. Newman said that he would "prewrite articles in my head" where he would be asking himself "what am I going to write about and what's my angle?" As he gathered information he would say to himself, "Oh, that's really interesting, I need to make sure I have a couple of paragraphs on that…that stuff may be less interesting and maybe I can just forget about it." On some articles, the result of all this mental prewriting was that the article would "write itself," although others were much more of a struggle. Miller's process was much more systematic; she called herself "a big fan of outlines" and said that outlining helped her organize her articles and also determine if she had the appropriate level of detail for each subtopic.

One of the first things Miller told me when we began our first interview was that she was drawn to science journalism because she liked writing. As she was finishing her PhD, she said, she "looked around" and realized "other scientists didn't really like to write." Newman would have probably fallen into that group. He said that the writing he did in college and as a scientist wasn't particularly enjoyable and that he began his journalism career with a lot to learn about writing. However, as his first editor helped him with his stories, he said, the style of an article "really freed me up and was a revelation." For Newman, writing was not initially the most appealing part of the job, but he eventually came to enjoy it.

Science Journalism as Third Space

As I discussed in the opening chapter of this study, I began with the idea that science journalism might be effective in classrooms because it was, in itself, a third space activity. The analysis of Miller's and Newman's interview transcripts helped me to further my thinking on this idea. As indicated in Figure 4.1, science journalism can be envisioned as a third space, situated between the space where the language of science is spoken and the space where the language of non-scientists is spoken. All of the qualities described by Miller and Newman can be seen as contributing to the creation of that third space; the arrows indicate that science journalism and science journalists draw on *and* give back to both other spaces. Science journalism could be seen as the "navigational space" described by Moje et al. (2004), with science journalists serving as the navigational guides.

Figure 4.1: Science Journalism as Third Space



The Interviews and the SciJourn Standards

When I finished analyzing the interviews with Miller and Newman, I once again looked at the SciJourn standards (see Appendix A) in order to think about how the standards compared with what I heard from the journalists. The standards originally grew out of think-aloud protocols conducted with various people deemed to be scientifically literate (e.g., scientists, science teachers, science journalists). SciJourn researchers asked these scientifically literate individuals to read science news articles, stopping to think aloud about the article's content and their process of reading it as they went. This research, which centered on the product, a published science news article, was designed to reveal how scientifically literate people interacted with the genre of science news. The goal was to think about what scientifically literate people valued in science news articles (and in themselves as readers) in order to translate these ideas into tools that would help teachers work with their students. Ultimately, the idea was to create hybrid communities of practice within the SciJourn classrooms, communities of practice which incorporated the characteristics of professional science journalism while at the same time being educational environments (see Saul, Singer, & Kohnen, in preparation, for a full description of the process of writing the SciJourn standards).

My interest in functional authenticity led me to look at science journalism from the other end of the process, the creation of a science news article. My theory—that science journalism worked in classrooms in part because there was an overlap between the work of professionals and the goals of teachers—required that I understand the work of professionals from their perspective, but the interviews with Newman and Miller also served to confirm the SciJourn standards. Each of the first four qualities that Newman and Miller valued in themselves and their articles can be found in at least one of the SciJourn standards (e.g., “accountability to the reader” is addressed in SciJourn standards 1, 2, and 5); only “a coherent story” is not included in a SciJourn standard but this was deliberate (the relationship between SciJourn and writing will be discussed in more detail in Chapter Six). Therefore, at the end of this analysis, I felt comfortable considering the SciJourn standards representative of a subset of professional standards.

V. Science Journalism, Science Teachers, Science Curriculum

The more I thought about my conversations with Miller and Newman, the more I realized that the SciJourn program was challenging traditional school practices in two (potentially radical) ways. First, SciJourn treated “science” quite differently than the traditional school curriculum, something that was emphasized in previous publications based on the SciJourn project (e.g. Polman, Newman, Farrar, & Saul, 2012; Saul, Kohnen, Newman, & Pearce, 2012). At the same time, as I alluded to in Chapter Three, the SciJourn program approached “genre” very differently than most school assignments. And, although many of the science teachers who joined the project did not seem to anticipate these differences when they signed up, science journalism also seemed to make sense to the SciJourn science teachers in a fundamental way—perhaps, I thought, due to some underlying similarities between science journalists and science educators. The next questions I set out to answer, then, became these:

- Why do science teachers join the project? Are they motived by or thinking about genre?
- What, if anything, do science teachers and science journalists have in common?

Background: SciJourn and Traditional School Practices

SciJourn and School Science

At the time the SciJourn grant began, the National Science Education Standards (NRC, 1996) were the basis of most high school science curricular documents; these standards emphasized content. As I got to know more about the demands on high school science teachers through interviews with teachers and general involvement with the grant, I saw the impact these standards had on the classroom: teachers felt a tremendous amount of pressure to cover a lot of content and to do it quickly. In Missouri, biology teachers had an extra source of stress, the End of Course Exam (known as the EOC), a standardized test given to all biology students statewide as part of the testing mandates originally included in the No Child Left Behind legislation. Although the state's biology test had once included a "performance event" where students were expected to interpret graphical information and write out answers, by 2010 these questions were eliminated (Taylor et al., 2011). The test had become entirely multiple choice (and, therefore, able to be scored by machine).

In contrast to the content-driven standards emphasized in most high school science textbooks and classes, the SciJourn standards grew out of a different philosophy of science education (Polman et al., 2012). In the fall of 2010, Newman came up with a way of talking about the project's goal that seemed to resonate with teachers and researchers alike: we were in the business of preparing students for the science issues they would confront fifteen years after high school graduation. As this "fifteen years out" definition makes clear, issues in the areas of health, parenting, technology, politics, and consumer choices will be important, but we have no idea what the specific issues might be. Students will need a basic degree of content knowledge to understand any of these topics, but, even more importantly, they will need the skills and dispositions of a science journalist—the kinds of things articulated in the SciJourn standards—to make educated and responsible choices in a future we can't predict. Fifteen years after graduating high school, non-scientists will probably use little of the content information from a high school chemistry class; however, if in that class they learned to judge credibility, to put details into context, and to corroborate information from other sources, they will be prepared to investigate a science-related ballot initiative or a medical condition. The "fifteen years out" concept also distinguished SciJourn goals from the "inquiry" approach to science education, one that has generally focused on first-hand inquiry with the aim of helping all students become "little scientists" (Polman et al., 2012); after all, fifteen years after high school graduation our former students "will not head to the lab but rather to the Internet or the library" (p. 45).

The SciJourn project was not the only group talking about pushing science education in this direction. Competing "visions" of science literacy appeared in the literature; according to Roberts (2007), Vision I emphasized content knowledge; by this definition, to be scientifically literate was to possess a body of specific knowledge. Vision II, on the other hand, saw science literacy in terms of citizenship and focused on the ability to deal with scientific information; the SciJourn project could be situated within this tradition. And, like Polman et al. (2012), Feinstein (2011) emphasized making science education "useful": "the very specific notion that science education can help people solve personally meaningful problems in their lives, directly affect their material and social circumstances, shape their behavior, and inform their most significant practical and political decisions" (p. 169). However, Feinstein (2011) anticipated objections to the idea of using usefulness to shape instruction and pointed out that there are few initiatives working to make science more "useful" to students. Although not mentioned by Feinstein (2011), SciJourn would definitely be one of those few.

SciJourn and Genre

As I've said previously, as a former English teacher, my interest in the project is less about science curriculum and much more about the role of writing. In Chapter Two, I discussed my own approach to using non-traditional genres in my high school English classes and gave a very brief overview of current theories of genre and education. Here, in order to demonstrate how different the SciJourn approach is, I would like to take that topic up again, this time from the perspective of the science classroom.

As I read the literature on genre and science education, I saw the situation like this: there were those who thought specific genre features mattered to the learning process, but they tended to favor the experimental article and other "traditional" science genres (see Prain's review article, 2006, for a summary of this view). This position was similar to Bazerman's (2009) argument that through the struggle to learn discipline-specific genres, we can develop disciplinary ways of thinking and seeing the world. The high school science classroom manifestation of this idea went something like this: the experimental article functions as a representation of scientific thinking; as students learn to write it they are also learning to think like scientists and gaining access to the discourse of science (Prain, 2006). According to O'Neill (2001):

> One may ask whether it is necessary for students to use the genres of professional science to appreciate or understand science. Here, I argue that the imitation of

> professional practice is to some extent inescapable, because it is implicit in the very notion of teaching science. The more important questions for researchers and educators, I believe, are what purposes this imitation is intended to serve, how well it serves them, and how well it might serve them under different conditions. (p. 228).

O'Neill (2001) didn't contest the idea of using professional genres in high schools (although he also didn't suggest they were the only genres that had merit) but rather examined the manner in which they were being used.

On the other hand, there were those who believed a variety of genres were useful in science classes, but they tended to focus on content learning or on student engagement generally, without honing in on a specific genre. In a review article, Prain (2006) outlined the main tenets of the "nontraditional genre" position. First, the experimental article is not the only way actual working scientists think and communicate; only allowing students to work in this genre misrepresents the authentic work of scientists. Second, preparing students to operate in the discourse community of science is only one goal of high school education; educating students (even those who will not go on to pursue science careers) who are personally connected to and able to engage in civic discourse about scientific topics is another and writing in various genres may help meet this goal. Additionally, researchers such as Hildebrand (1998) approached the question from a feminist position, arguing that the experimental report is "masculine" (p. 348) and misrepresents the creative process of real science. Prain (2006) cited a long list of additional studies (e.g. Boscolo & Mason, 2001; Hand & Keys, 1999; Hanrahan, 1999; Hodson, 1998; Prain & Hand, 1996; Rivard & Straw, 2000) which "have asserted that students, in striving to clarify networks of concepts in science topics, should be encouraged to write in diverse forms for different purposes" (p. 184). Notably, the emphasis in this quote is on learning "networks of concepts in science topics," a goal in line with the content-focused science education standards.

It seemed to me that outside of publications that grew out of the SciJourn grant (e.g. Polman et al., 2012; Saul et al., 2012), very few people were writing about what I saw as the essential elements of the SciJourn project: an authentic (yet nontraditional) genre being used authentically to help students take on the dispositions and values of an authentic practitioner.

Science Teachers: Reasons for Signing Up

As potentially disruptive to school practices as SciJourn was, the teachers' goals for signing up were not quite as radical. As part of the survey given to the teachers at the professional development meeting in the spring of 2012, I asked the open-ended question: "Briefly, why did you originally sign up for SciJourn?" As I said in the methods section of this dissertation, twenty-three teachers responded (5 pilot teachers, 8 from Cadre I, and 10 from Cadre II) with forty-eight reasons. I grouped these forty-eight reasons into 11 different explanations which were further grouped into these four categories: (1) word of mouth; (2) reasons related to anticipated SciJourn outcomes (but not main goals); (3) reasons directly related to SciJourn main goals; and (4) reasons not specific to SciJourn (see Table 5.1).

The fact that word of mouth was the most frequently mentioned category did not surprise me. In interviews and casual conversations with teachers, I heard over and over again about how frustrating "bad" professional development could be. It made sense to me that teachers signing up for a voluntary summer professional development opportunity (as opposed to a professional development mandated by the school district during the academic year) would be looking for something they would consider worthwhile; basing the decision on friends, colleagues, or the program's own recruitment literature seemed reasonable to me, particularly since I had done the same thing as a pilot teacher.

However, the "word of mouth" explanation, though logical, did not give me much insight into what the teachers hoped to get out of the program in terms of pedagogical tools or future student learning. Neither did the reasons that were not specifically related to SciJourn. The remaining two categories were somewhat more useful. The responses that I coded as "reasons related to anticipated SciJourn outcomes (not main goals)" included "improve student literacy," "prepare to teach a specific course," and "improve student content knowledge." All of these would be favorable outcomes of the project—and, as I confirmed in conversations with the SciJourn team, all would even be *anticipated* outcomes for teachers who attended the professional development and regularly implemented science journalism activities in their classes. Yet none of these was a *main goal* of the SciJourn project. Notably, the overall top reason, given by nine different teachers, was in this category: "to improve student literacy." Many teachers anticipated using SciJourn activities to help their students with reading and writing skills in general, even though the language of the grant itself made clear that this was explicitly *not* a writing initiative. The teachers who gave reasons in this category were either not aware of the main goals of the project or saw within the project a way to meet additional goals.

Table 5.1: Reasons Teachers Gave for Joining SciJourn, 2012 Survey

Reason	**Example**	**Total times mentioned**
Word of mouth		**18**
Friend/Colleague involved	"I knew someone"	7
Reputation of the program or professors	"I had heard great things about Cathy, Dr. Saul and Dr. Polman"	6
SciJourn recruitment activity	"I went to the Science Leadership PD at WASHU"	5
Reasons Related to Anticipated SciJourn Outcomes (not main goals)		**13**
Improve student literacy	"Thought it would help me with literacy in my classroom"	9
To prepare to teach a specific course	"I wanted tools to help me with my biology students and standardized testing"	3
To improve student content knowledge	"something that would make a difference in students' ability to understand science"	1
Reasons Related to SciJourn Main Goals		**13**
Improve student science literacy	"I am very interested in science literacy"	5
To help students make connections with course content	"to connect science course content to everyday life"	4
To help students learn long-term skills	"help kids be productive citizens"	3
Genre	"I have always used the news in my classroom. I thought this sounded interesting and a new way to look at my teaching."[17]	1
Reasons not Specifically Related to SciJourn		**4**
Wanted to take a class/professional development	"needed a summer course to take to fill my program out"	3
Money	"Sounds like an easy way to make summer $$$"	1

Note. 5 Pilot teachers, 8 Cadre I teachers, and 10 Cadre II teachers responded.

[17] This was the hardest reason for me to categorize. Although the teacher was clearly referring to the specific genre of science news, he did not indicate whether or not he was looking at the authentic genre as integral to the learning process or if he saw the genre strictly in terms of engagement.

The explanations that I coded as “directly related to SciJourn main goals” were those that seemed to match the project’s stated mission. The teachers who mentioned helping students make connections between science content and their lives (4 teachers) and those who discussed long-term skills (3 teachers) seemed to be most aligned with SciJourn standards. Because of the debate around the terms “science literacy” and “scientific literacy,” I was less certain that the teachers who described joining the program in order to help improve “science literacy” (5 teachers) entered the program with the same definition of this concept as SciJourn. I did feel, though, that these teachers had enrolled in the professional development prepared to have conversations around the topic of “science literacy,” a main point of the program. As noted in the table’s footnote, I was even less confident that the teacher who mentioned science news specifically was thinking about genre in the same way as the project. Yet even including these responses, only ten different teachers[18] gave at least one reason that I coded as directly related to the main goals of the SciJourn project.

After I completed this analysis, I wanted to see if the retrospective reasons teachers gave for joining the project aligned with the reasons they provided on the first day of SciJourn professional development[19]. To do so, I examined the field notes from

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[18] Two teachers mentioned both “science literacy” and “connections;” one teacher mentioned both “connections” and “lifelong skills.”

[19] The reasons teachers gave on the first day was what I wanted to know, but I didn’t have any data from the Pilot or Cadre I summer workshops. My comparison of the reasons Cadre II teachers gave at the

the first day of Cadre II professional development, when teachers were asked to introduce themselves to the group and tell a bit about what they hoped to learn from the project. As might be expected, the reasons given by the fifteen Cadre II teachers prior to starting the course were even less likely to match SciJourn main goals than the survey results (see Table 5.2). This suggested that at least some teachers were thinking differently about their reasons for signing up as time passed or at least using more SciJourn-aligned terminology to describe these reasons in retrospect; both explanations seemed plausible to me.

Table 5.2: Reasons Cadre II Teachers Gave for Signing Up, 2011 Field Notes

Reason	**Times mentioned**
Word of mouth	**12**
Friend/Colleague involved	7
Reputation of the program or professors	2
SciJourn recruitment activity	3
Reasons Related to Anticipated SciJourn Outcomes (but not main goals)	**9**
Improve student literacy	9
To prepare to teach a specific course	0
To improve student content knowledge	0
Reasons Related to SciJourn Main Goals	**4**
To help students make connections with course content	3
Improve student science literacy	1
To help students learn long-term skills	0
Genre	0
Reasons not Specifically Related to SciJourn	**0**
Wanted to take a class/professional development	0
Money	0

Note. Fifteen teachers were present; most teachers gave two different reasons for joining.

beginning of training to the reasons all groups gave retrospectively gives me confidence in my claim that most SciJourn teachers were not considering genre or the grant’s main goals when they joined the project.

In this Cadre II data, the most frequently mentioned reason for joining the project was, once again, to improve student literacy skills in general. I knew from other conversations with teachers that “across the curriculum” literacy initiatives were common in many of their schools (this will be discussed in more detail in the following chapter). Some teachers, it seemed, were not initially joining the project in order to radically remake their classes or to challenge trends in their schools but, at least in part, to comply with them.

I was also interested in the fact that, in all of the responses I examined, only one teacher mentioned the genre of science news at all. Clearly, teachers were not thinking specifically about genre as they enrolled in the program. However, those who mentioned connecting students with science were thinking a lot like science journalists; as Newman and Miller made clear to me, science journalists consider it part of their job to make science interesting and accessible to readers.

What else did science teachers and science journalists have in common? This seemed like an important question. The teachers involved in the project did not join specifically to reinvent their work, and yet many ended up finding the experience of using science journalism with their students to be transformative (a point I will return to in later chapters). I speculated that this kind of change might have been possible because they found playing the role of a science journalist themselves to be a somewhat familiar one, a hypothesis that needed more investigation.

Science Teachers and Science Journalists

After my interviews with Newman and Miller, I created a list of statements that described how they seemed to see themselves as journalists. These statements eventually evolved into the characteristics of science journalists that I discussed in the previous chapter. I also used the statements to create survey items for the science teachers to include in the same survey described in the previous part of this chapter. I asked teachers to rate their level of agreement with nine statements on a four-point Likert scale. As I thought about the qualities that science teachers and science journalists share, the teachers' responses to five of the statements seemed particularly interesting (see Table 5.3 for a summary of notable results; see Appendix D for complete survey).

Although I found some of their responses to be confusing and even contradictory to what I had learned from other data sources, as a whole the science teachers' responses to these survey questions suggested that science teachers and science journalists have two key qualities in common: a solid understanding of science coupled with a mission to translate that knowledge for non-scientists. First, like science journalists, science teachers seemed to have a broad understanding of science. Newman and Miller contrasted their broad view of science with the narrow perspective a career as a bench scientist might have offered; they both described their ability to deal with a range of topics and fields not only as an important skill for journalists but also as a joy of the job. For the science teachers, I asked the question in terms of teaching ability: "I understand a broad range of scientific topics and concepts well enough to teach them." Ninety-one percent of the teachers either agreed or strongly agreed with that statement. Interestingly, a large majority of teachers (81%) also agreed or strongly agreed with the statement "I

Table 5.3: Science Teacher Responses to Key Survey Items

Likert-Scale Questions				
	Strongly Disagree	Disagree	Agree	Strongly Agree
Part of my job is to translate complicated or technical concepts into language my students can understand.	1	0	5	15
Prior to SciJourn, I found it easy to get my students excited about course content.	0	9	12	1
Prior to SciJourn, I found it easy to show my students how the content we learn in my class affects their everyday lives.	4	4	13	1
I understand a broad range of scientific topics and concepts well enough to teach them.	1	1	10	10
I am proud of my science knowledge.	0	0	10	12

Note: 23 teachers completed the survey. One journalism teacher's responses were removed from the results. For unknown reasons, not all teachers responded to all survey items.

understand a small set of scientific topics and concepts at an expert level," something that contradicted my expectations. Only one teacher explained this answer—describing extensive training and professional development activities in the area of environmental science. When I looked at the data more carefully, I found that two teachers who disagreed that they had an understanding of a broad range of topics *agreed* that they had an expert understanding of a small set of topics. These two both had undergraduate degrees in a science field rather than in education (although they were not the only teachers with science degrees). Many of the remaining teachers agreed with both statements, claiming both an understanding of a broad range of topics and an expert understanding of a smaller set of topics. Without follow-up questions, I can only guess either that the teachers and I were defining “expert level” differently or that I don’t know the extent of their training and knowledge[20]. Regardless, the science educators, like the science journalists, not only considered themselves knowledgeable about science, but they also took pride in that knowledge. Not one teacher disagreed or strongly disagreed with the statement “I am proud of my science knowledge.”

Secondly, both science teachers and science journalism seem to see “translation” as a key part of their work. For Newman and Miller, this was described in terms of accountability to the reader; they had to make things clear enough for their non-expert readers to understand. It also was part of the “coherent” story they prided themselves in telling; part of making a story coherent was putting it into context and making connections explicit that scientists might take for granted. The science teachers also valued “translation.” Seventy-one percent (15 out of 21) of the science teachers “strongly agreed” with the statement that “part of my job is to translate complicated or technical concepts into language my students can understand,” more than with any other statement on the survey; an additional five teachers “agreed” with the statement.

To me, the most confusing results of the survey had to do with these statements:

- Prior to SciJourn, I found it easy to get my students excited about course content.
- Prior to SciJourn, I found it easy to show my students how the content we learn in my class affects their everyday lives.

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[20] In a future survey, I would change the wording of the statements to include the phrase “compared to a research scientist.”

The teachers' responses to these items were more divided than their responses to the statements discussed in the previous paragraphs, yet the majority of teachers either agreed or strongly agreed with both of these statements (60% with the first statement, 64% with the second). This level of agreement seemed to run contrary to what I heard in interviews and in other conversations with teachers; in other settings, I often heard teachers expressing frustration about their inability to help students make connections between course content and life and to engage students with course topics. In retrospect, I wish I would have worded these questions differently, asking teachers to respond to statements about whether or not they considered it an important part of their job to (1) get students interested in course content and (2) demonstrate how content affects students' lives; these revisions would make the statements more closely mirror what the science journalists told me (neither Miller nor Newman described these aspects of their job as "easy" but they did describe them as important). Although I assume that the science teachers share these qualities with science journalists, I do not have the data to confirm these assumptions. I do know, however, that a majority of our science teachers felt that they *are* doing these things—getting students excited in course content and showing students how science affect their lives.

Despite the flawed nature of the survey and the somewhat confusing results, my analysis led me to believe that science teachers and science journalists share at least two important characteristics: a broad base of science knowledge (which they take pride in) and a mission to translate science concepts for a less knowledgeable audience. If part of SciJourn's success had to do with the teachers' ability to use an authentic genre in an authentic manner in the classroom, the fact that the teachers shared qualities with science journalists could be partially responsible for the teachers' openness to the project. However, I knew science teachers did not approach writing like science journalists, an important difference and potential roadblock to implementation. It is this subject that I will turn to in the next chapter.

VI. Science Teachers and Writing

Upon joining the SciJourn team, one of the first things I noticed was the conflicted stance the grant took toward writing. Part of this was due to the funding source, the National Science Foundation; the principal investigators told me that they regularly had to defend themselves against the charge that SciJourn was too much about writing and not enough about science. Not so, they argued. The goal of SciJourn wasn't to turn students into science journalists but to instill the *habits of mind* of science journalists in students for the purpose of improving science literacy. As a result, the SciJourn standards were all about skills that would help students deal with science-related questions, not about characteristics of written news articles. Even as they made this argument, though, many of the researchers thought that writing was extremely important to the project, that although the project wasn't primarily about writing, writing mattered to what the project *was* about. This hunch was confirmed by research into the scientific literacy of SciJourn students undertaken by Cathy Farrar. Students in classes where writing was required[21] had greater gains in their scientific literacy scores than those in classes where no writing took place with some of the greatest gains found in students of teachers who required revision with the emphasized goal of publication (Farrar, 2012).

When I spoke with science journalists about their work, I learned that writing was not only something that was important to their careers, it was something they found

[21] As noted earlier, not all SciJourn teachers had their students write articles, but every teacher who used the project in the classroom minimally read science news articles.

enjoyable. On the other hand, the science teachers did not seem to enjoy writing in general and assigning writing in particular. Although some claimed to feel competent about their own writing skills—particularly writing in academic or scientific genres—I had heard many of them talk about how awful their previous experiences using writing with students had been. The fact that many teachers signed up for SciJourn to help them improve student literacy also suggested that they did not feel comfortable in this area.

I expected that this would change, at least somewhat, through their involvement with the project. I especially expected that the teachers would come to understand something more about the genre of science news—and how the genre of science news could be used authentically in their classes to meet their goals for their students—even if they never referred to “genre” specifically. But in order for me to know that, I had to try to understand the science teachers’ perspective on writing and science news *before* SciJourn. Therefore, I set out to construct the “SciJourn science teachers’ theory of writing and writing response” as it existed prior to their involvement with the project.

Key Findings from My Previous Research

Professional Editing

As discussed in the opening chapter of this dissertation, in my position as a research assistant with the grant one of my assignments was to analyze the way Newman edited student articles. During my first study of Newman’s editing, using articles written by students during the first year of the project, I created a codebook of the types of edits Newman made on papers (see Appendix F for all codes and examples). I identified three main categories of edits: (1) content edits, those that addressed issues identified in the SciJourn standards[22]; (2) form edits, those that addressed writing concerns, including grammar, journalistic form, and style; and (3) coaching edits, those that seemed particular to the mentor-mentee relationship Newman was establishing with the student authors, including explanations, encouragement, and compliments. I also divided the student articles into those that were "publishable"[23] and those that were not. One of the most striking findings from this initial study was that Newman edited all of the articles extensively for "content;" the number of content edits was consistent whether or not the article was "publishable." However, the articles that he claimed to be interested in publishing received approximately twice as many "form" edits as the "non-publishable" articles ("publishable" articles also received more "coaching" edits, mostly in the form of compliments and encouragement to revise). Newman was clearly prioritizing content for all students—and looking at content in terms of more than just factual correctness (see Table 6.1)—and generally reserving issues of form for those students who had written articles that he was interested in publishing (these findings are discussed in more detail in Kohnen, in press).

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[22] At the time I began this work, the SciJourn standards were in a previous draft from the standards document discussed earlier and included as Appendix A. Codes for this study were based on the standards in Appendix G.

[23] Articles categorized as "publishable" included a specific reference to the possibility of publication by Newman in a holistic comment at the beginning of the article. I did not attempt to determine "publishability" myself.

Science Teachers

After looking at Newman's editing, I next analyzed a pre-test given to the Pilot and Cadre I SciJourn teachers on the first day of the SciJourn professional development

Table 6.1: Average Number of Edits by a Professional Science Editor

	"Non-Publishable" (33 papers)	"Publishable" (17 papers)
Content (SciJourn standards)		
searched for relevant/credible sources	1	1
multiple credible attributed	6	7
information is contextualized	2	1
information is made relevant to readers	1	1
factually accurate, important info fore fronted	9	10
Content Total	**20**	**20**
Form		
Lede	1	1
Conclusion	0	0
style (simplification and fluency)	6	13
conventions (typos, grammar, spelling)	2	5
Form Total	**9**	**19**
Coaching		
Compliments	1	4
references to assignment	1	0
Encouragement	0	0
explanation of change/modeling/clarifying comment	3	4
Plagiarism	0	0
Coaching Total	**5**	**8**
Cumulative Total	**34**	**47**

workshop. The teachers were asked to respond to two sample student papers as if the papers were written by a student in the teacher's class. We specifically told the teachers that the writing was in the genre of a science news article. Using the same codebook I developed for Newman's editing, I compared the teachers' responses to the editor's responses and found that, on average, the teachers emphasized very different concerns than the editor. They made fewer total edits (29 to 38 per paper), but more edits that focused on the form of the writing (14 to 12) rather than the content. They did not, however, seem to recognize that the writing was intended to be in the genre of science news; instead, their form comments were most often corrections of typographical or grammatical errors. Other comments about form treated the papers as if they were standard five-paragraph essays (e.g., asking for a thesis statement or a conclusion).When responding to content, the teachers focused almost exclusively on factual correctness, marking out “mistakes,” while the editor addressed such things as sources of information and contextual details. As I looked at the teacher pre-tests, I had the sense that some of the teachers approached the articles as if they were problem sets or test questions with a single correct answer, rather than science journalism articles with the potential to be revised in countless ways (see Kohnen, in press).

Based on this pre-test data, I concluded that the teachers did not seem to “see” genre in their responses to writing[24]. They also did not seem to approach writing as a learning opportunity for the students but rather as an assessment task—overall, the writing was largely “corrected,” not responded to.

Was this a fair picture, I wondered? Or did the very nature of the pre-test distort the view? I suspected that at least some of our SciJourn teachers felt pressure to do a

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[24] In a related study (Kohnen, in preparation), I found one SciJourn teacher did change her responses to student writing after involvement with SciJourn, commenting on a wider variety of content issues and decreasing her form edits.

"good" job responding to these papers. Might they have been more critical than they would have been with their own students? Were some worried that if they didn't "catch" everything that we, the researchers, might think they didn't notice all of the errors? Furthermore, the pre-test only looked at actual responses to student writing, but I wanted to understand the larger context of writing in these science teachers' classes. I clearly needed more data.

Another Study

Data Sources

Focus groups. In the fall of 2011, during one of the regular SciJourn professional development workshops, I held focus groups to talk with the teachers about some of these issues. After I presented the findings from the pre-tests and explained my wish to investigate these results further, the twenty-three teachers in attendance were randomly divided into four groups; for an hour, these groups rotated from researcher to researcher, participating in short (approximately 14 minutes) conversations on different research topics[25]. I acted as moderator of my sessions while a colleague took notes (sessions were also audiotaped). Teachers were asked to discuss the following questions:

- Prior to SciJourn, what experiences did you have talking about writing and responding to writing?

[25] In addition to my questions about writing, other research topics included: 1. Teacher use of the paper edition of *SciJourner*; 2. Inconsistencies in data collected on student engagement; and 3. Results of the Scientific Literacy Assessment.

- Prior to SciJourn, how did you approach assessing the writing assignments that you gave? Where did you get your ideas about how to assess/respond to writing?
- How have your ideas about responding to writing changed since you got involved with SciJourn?

A fourth question—what would you consider the values and priorities of SciJourn that can be emphasized through writing feedback?—was planned but very little time was spent on this issue. After the workshop, I transcribed the four sessions and imported the transcripts into NVivo for analysis.

Survey. After some preliminary analysis of the focus group responses, I decided to create a short survey to give to the teachers at the next professional development meeting to further explore a subset of topics related to writing and writing assessment. My questions about writing were added to the other survey questions discussed in the previous chapter (see Appendix D for complete survey questions) and administered electronically to the twenty-three teachers in attendance at the professional development meeting.

Data Analysis

Focus groups. When I began the process of open coding (Merriam, 2009) the focus group transcripts, I initially coded all statements as referring to either "pre SciJourn" or "post SciJourn." Because I was interested in understanding what general principles the SciJourn science teachers held about writing and responding to writing prior to SciJourn, I focused further analysis on the comments coded as "pre SciJourn." The teachers made two types of comments about writing which became the two main categories of my codes: (1) the types of writing used in their classes, and (2) their responses to that writing (see Table 6.2 for a list of all codes and example quotes).

Types of writing. As a group, the teachers talked about three distinct kinds of writing they used prior to their involvement with SciJourn; I created an additional "other" code to include kinds of writing mentioned by only one teacher. Writing assigned as part of a school mandate or initiative was the largest code, mentioned 13 separate times. Six times teachers described writing that had a single correct answer, and two of the teachers referred specifically to lab reports. Within the "other" category were such standard school genres as the research paper, learning logs, and the argumentative paper, as well as teacher-created projects like a resume for a famous scientist. The codes I used were not exclusive; school mandated writing might have been a lab report or might have been writing with a single correct answer.

Responses to writing. The most frequent comment teachers made about responding to writing was that they marked errors (13 instances). Within this code, I included both references to correcting/marking grammatical mistakes as well as comments about marking the factual correctness of a piece of writing; I did this because I saw both of these kinds of responses as focused on the final product, a final product that had a single correct answer and format. Many of the teachers also expressed dismay at the kinds of writing they used in their classes (12 instances). Eight times the teachers specifically claimed to have focused their responses on the "content" of the writing; in part, this seemed motivated by my earlier research presentation where I drew attention to their pre-test tendency to focus on grammar and form issues. When I looked at these more closely, two of the eight instances were double-coded with "single correct

Table 6.2: Writing Focus Group Codes

Types of Writing used before SciJourn

Code	**Quote**	**Times Mentioned**
Writing for a school initiative/mandate	"when I very first started in our district we had this power writing thing we would start class with, it was very much like large idea, detail detail, large idea, detail detail. That sort of thing."	13
Writing with one correct answer	"I just went through and said these are the pieces of information I'm looking for and boom, boom, boom, that was it"	8
Lab Report	"the only writing my kids did was for lab reports"	2
Other	"I had kids keeping learning logs."	7

Responding to Writing before SciJourn

Code	**Quote**	**Times Mentioned**
Marking errors (including grammar)	"I think before SciJourn I did a lot more of the grammar and that sort of thing and like, I had about five key points whether I put it in a rubric or I put it in a bulleted, just like these are the things I expect to see"	13
Disheartened/upset	"I would get so discouraged"	12
Content responses	"I just was more interested in content"	9
No training in what to do	"we haven't really been trained"	7
No revision required	"we didn't do rewrites"	2
Revision required	"My writing project did have a revision so based on the grammar edits that I was giving they would revise"	1
Peer review	"so what we do is a lot of peer editing"	1
Genre-specific	"it's going to be different for a lab report than it's going to be for a report, a topical report"	1
Non-specific feedback	"I was much more like, Oh, good, this is good, what does that mean, I had a lot of those little comments and that sort of thing instead of like specifically helping them to do, you know, what I wanted"	1

answer"—by "content," the teachers were referring to whether or not the student had arrived at the one answer. The other six references used "content" in a more general way (see the example in the chart). The final large code was "no training," instances where the teachers either explicitly or indirectly pointed out that they did not have training in how to respond to student writing. The two teachers who were indirect described seeking out support online and from their English department. Only one teacher mentioned varying his expectations based upon the genre of the assignment; notably, the genres mentioned were both school-specific types of writing. Once again, these codes were not exclusive.

Survey. As I looked at the transcripts, I realized that each of the short conversations had been dominated by a few voices and that the subject matter of each focus group had been determined by the first few responders. I also affected the conversations by limiting the topics; I came with a set of questions to explore, but the teachers talked about very interesting issues that hadn't been on my mind. While I believed that the data did give me information about the science teachers' main concerns and feelings about writing in their classes, the transcripts did not tell me much about the kinds of writing teachers had been assigning. For example, I knew that most of our teachers had assigned lab reports in the past, but lab reports came up only in passing during the focus group discussions. Coding the transcripts, I realized that I didn't ask any direct questions about kinds of writing assignments but, in light of the focus group transcripts, I wanted to know more.

One goal of the survey was to get much more information about the types of writing the teachers were assigning as well as the frequency of these assignments (see Table 6.3). I also used the "responding to student writing before SciJourn" codes from the focus groups to create a series of statements for the teachers to react to by answering "yes" or "no." These statements were designed to further investigate what I saw as the key points teachers had raised about responding to student writing in the focus groups by gathering input from all the teachers rather than just from those who chose to speak during the focus groups (see Table 6.4). Finally, because "writing for a school initiative/mandate" had been such a large part of several of the focus group discussions, I asked the teachers to answer the question: "Before SciJourn, the writing I assigned was based on (check all that apply): (1) school policies; (2) conversations with colleagues; (3) my own ideas." The teachers' responses to this question conflicted a bit with the focus groups: only six teachers said that writing assignments were based on school policies, while nine said they were based on conversations with colleagues and twenty-one of the twenty-two respondents said they based their writing assignments on their own ideas.

Interpretations

The amount and kinds of writing. In reviewing the literature on the state of writing in high schools, I encountered two descriptive studies that showed that high school students are not being asked to write very much. In 2002, "40% of twelfth graders report never or hardly ever being asked to write a paper of 3 pages or more" (Applebee & Langer, 2006). In a national survey of high school social studies, language arts, and science teachers, Kiuhara, Graham, and Hawken (2009) found that most of the writing done by high school students involved merely reporting information without analysis or interpretation. Furthermore, 36% of science teachers surveyed reported that they did not require a multi-paragraph piece of writing in a semester (Kiuhara, Graham, & Hawken, 2009).

Survey results. Based on their responses to the survey, the SciJourn teachers claimed to be assigning somewhat more writing than these studies suggest. All twenty-two teachers who responded to the survey said they assigned at least one type of writing once a month or more. However most of the types of writing included on the survey—a list I generated based on the focus groups and then revised with feedback from the SciJourn team—were not the kinds of assignments likely to provoke analysis or interpretation. The most popular assignment on the list—with 90% of the teachers assigning it at least once a month—was “vocabulary/key terms.” This item wasn’t even included in my original version of the survey since I didn’t consider writing out vocabulary words to be a true “writing assignment.” My colleague, a former high school science teacher, convinced me to add the item; in her experience, she said, most science teachers *do* consider this a writing assignment and they assign it regularly. The survey results support her contention, at least in the frequency of the assignment.

Other popular assignments that probably do not include a great deal of interpretation or analysis included “answers to the questions at the end of the chapter” and “summary of reading.” Like “vocabulary,” “answers to the questions at the end of the chapter” is not quite a “writing assignment” in my opinion, but it had the second highest number of teachers claiming to assign it at least once a month. As expected, more teachers claimed to assign “lab reports” on the survey than had mentioned them in the focus groups, with 12 saying they assigned “lab reports” once a month or more and only four claiming to never require lab reports. Based on my conversations with science teachers, I suspect many of these assignments did not require much analysis on the part of the students—lab reports are often based on “cookbook experiments” with one correct

Table 6.3: Writing Assignments given by SciJourn Science Teachers Prior to SciJourn

	~1 x/month or more	~ 1 x/quarter	~ 1 x/semester	~ 1 x/school year	Never
Lab Report	12	4	2	0	4
Answers to questions at the end of the chapter	14	1	0	1	6
Short essay (fewer than 5 pages)	9	5	2	3	3
Long essay (5 or more pages)	0	0	1	4	16
Learning logs	5	2	0	0	14
Summary of reading	13	3	2	0	4
Vocabulary/Key terms	20	1	0	0	1
Other (please explain in comment box)	2[a]	0	1[b]	1[c]	n/a

Note: 23 teachers completed the survey (10 Cadre II, 8 Cadre I, 5 Pilot). One journalism teacher's (Cadre I) responses were removed from the results. For unknown reasons, not all teachers responded to all survey items.

[a]Formal letters to businesses with the results of an analysis; written assessments of infographics

[b]Children's book to explain science concepts to younger audience

[c]Science fair report

Table 6.4: Teacher Attitudes toward Writing and Writing Response Prior to SciJourn

Before SciJourn…		**Yes**	**No**
1.	I could grade my writing assignments by looking for specific pieces of content information	21	1
2.	I required my students to revise their writing	10	11
3.	I found the writing I assigned to be useful for learning purposes	16	5
4.	I found the writing I assigned to be enjoyable to read	4	17
5.	I felt comfortable assigning and responding to writing	7	13
6.	I allowed my students to choose their own topics for their writing	8	13
7.	I had training in how to TEACH writing	1	20
8.	I had training in how to ASSESS/RESPOND TO writing (if yes, please explain below)	2	18
9.	I assigned creative writing (if yes, please explain below)	4	17

Note: 23 teachers completed the survey (10 Cadre II, 8 Cadre I, 5 Pilot). One journalism teacher's (Cadre I) responses were removed from the results. For unknown reasons, not all teachers responded to all survey items.

result and the related writing can be seen as an exercise in producing a “correct report” rather than an opportunity to think critically—but I can’t say that with certainty. A surprising number of teachers said they assigned “short essays” regularly, but without more information I can’t make any claims about the quality of these assignments. The two assignments on the list that had the greatest potential for pushing students to analyze or interpret material were “learning logs” and “long essay;” these were also the two assignments with the highest number of teachers reporting that they “never” assigned them (16 for long essays, 14 for learning logs).

The survey also included a “yes/no” item asking teachers about the way they graded their assignments: “I could grade my writing assignments by looking for specific pieces of content information” (see item 1 of Table 6.4) in order to corroborate the focus group finding that many of the teacher assignments sounded as if they had one correct answer (see focus group codes in Table 6.2). Nearly all the teachers responded “yes” to this item (twenty-one out of twenty-two, or 95%). This answer seems to confirm that these writing assignments did not involve interpretation or analysis but merely the reporting of information, information that could be assessed quickly for its accuracy. It also seems to confirm my hunch that when teachers claimed to look at “content” as they graded student work, they were looking at content in a different way than Newman did. However, despite my questions about the purposes of these assignments, the teachers seemed satisfied with them; sixteen out of twenty-one (76%) responded “yes” to the survey statement “I found the writing I assigned to be useful for learning purposes” (see item 3 of Table 6.4).

***School mandates and initiatives*.** Although in their survey responses only six teachers out of twenty-two (27%) claimed to base their writing assignments on school mandates or initiatives, this topic dominated several of the focus group discussions; I suspect school mandates and initiatives have more impact on the kinds of writing going on in science classrooms than the survey indicated. The survey could have underreported this result for a few reasons. First, many of the teachers who mentioned mandates in the focus groups characterized them as temporary, describing the mandates as things that came and went with administration changes or just with the passing of a school year. The teachers may have responded to the survey question with the more stable reasons behind their writing assignments. The tenor of the focus group discussions on this topic also suggested that teachers were often uncomfortable with school mandates or initiatives; on the survey they may have been hesitant to describe themselves as basing assignments on them. Finally, teachers may have been more likely to admit to following these mandates in the context of a sympathetic conversation than on a survey.

In the focus groups, ten out of the twenty-three teachers (43%) mentioned at least one school initiative involving writing and two teachers mentioned two such initiatives[26]. Of the eleven different initiatives, ten involved specific formulaic or pre-packaged approaches to writing. Five of the teachers explicitly connected the mandates with standardized testing pressures or school accreditation issues; in most other cases, the tie between standardized tests and the writing mandates was implicit. An additional three

[26] One initiative was mentioned by two different teachers.

teachers described the mandates as designed to address specific student deficits. Five of the mandates were no longer in effect at the time of the focus groups.

The literature on genre and high school science education reviewed in the previous chapter did not take into account the relationship between standardized testing, school mandates and initiatives, and writing in high school science. The theorists were more interested in thinking about what *should* happen in schools, with the debates revolving around a two main issues: the purpose of writing in science classes (and in science education more broadly) and the usefulness of different kinds of writing assignments in meeting those purposes. For the teachers, though, the kinds of writing they assigned were at least somewhat influenced by school mandates which, in turn, were influenced by standardized testing. The result was that the kinds of writing required by mandates tended either to teach students a “formula” they could use in all kinds of standardized testing environments (not just science testing), the five-paragraph essay being the most ubiquitous example, or to emphasize other general study skills, such as mandates requiring summaries or note taking.

Because these writing mandates were so closely tied to standardized testing, the teachers were also often required to create very explicit rubrics or scoring guides, something several found problematic. Mary, a chemistry teacher in a private school where policies were influenced by the ACT college entrance exam, said that her students wrote essays by following a “formula” and “there was nothing in the formula to take off for the joy of reading it” or “the pleasure in it or the excitement about it.” As a result, she found herself giving good grades to students whose writing was “boring as all get out, it’s so boring.” Stacey, a biology teacher, found the rubrics she used “incredibly formulaic” and struggled to "fit in my rubric…this big picture." She concluded "that's really hard to put into a rubric." In the focus groups, other teachers expressed this same frustration with rubrics, even when the specific rubric criteria was not mandated but had been created by the teacher her/himself. Several described revising their rubric even as they graded papers while others said they created a rubric because rubrics were required of them but that they mostly ignored their own rubrics during grading.

Teacher training and support. In the focus groups, several of the teachers said that they had no previous training in how to incorporate writing into their classes; when a teacher would make such a comment, the rest of the group seemed to be in agreement. To confirm this, I included two survey items asking teachers whether they had training in teaching writing and in assessing/responding to writing (see items 7 and 8 of Table 6.4). The teachers responded overwhelmingly in the negative: twenty out of twenty one (95%) said they had no training in how to teach writing while eighteen out of twenty (90%) said they had no training in how to assess or respond to student writing. The one teacher who had training in teaching writing came to SciJourn through a referral from a National Writing Project site; based on this information, I suspect that she had sought her own training and completed it on her own time (the National Writing Project conducts summer institutes for their teacher participants). One of the two who had training in assessing writing explained that she had attended mandatory district-wide training in Six Traits scoring (Spandel & Stiggins, 1997) in the past (although it was no longer in use); although she did not supply an explanation, the other teacher who responded "yes" to having been trained in assessing writing was from this same district so she could have been referring to the same training. I was somewhat surprised that fewer teachers reported some kind of training associated with the writing mandates they mentioned in the focus groups, although some of the teachers who mentioned mandates in the focus groups specifically said that the mandates included little to no training. Based on the focus group discussions, I tentatively conclude that many of these writing initiatives mandate *what* the teachers should do (or assign) but do not help teachers think through *how* or *why* to do (or teach) it.

The Kiurhara et al. (2009) survey also asked teachers about their training and found that nearly 60% of science teachers believed they were not prepared to teach writing. In addition to their responses about lack of training, the SciJourn teachers were similar to the Kiurhara et al. (2009) respondents in reporting a level of discomfort with writing (see question 5 of Table 6.4), with thirteen out of twenty (65%) responding “no” to the statement “I felt comfortable assigning and responding to writing.” This is particularly troubling in light of other research that has shown science teachers need support incorporating high quality writing assignments in their classes (e.g., Hand & Prain, 2002; Prain & Hand, 1996).

Responding to writing. A review of the literature found almost a complete absence of studies of content area teachers responding to writing. Instead, the majority of the research focused on English/language arts/composition classrooms (see the anthology edited by Straub, 2006, for influential works in this field). A few studies examined college professors’ responses to writing (e.g., Faigley & Hansen, 1985; Schwegler & Shamoon, 1991); additional literature out of the Writing Across the Curriculum (WAC) movement included recommendations for content-area teachers responding to writing, although, once again, this was primarily focused on college classrooms (see Bazerman et al., 2005 for a review of the WAC literature; see also Herrington, 1981; McLeod & Maimon, 2000). None of the existing studies seemed directly relevant to the high school science teachers involved in the SciJourn project.

In the focus groups, the most frequent comment teachers made about responding to writing was that they marked errors. In coding the focus groups, I included comments about marking grammar *and* content mistakes in the “errors” code; in the survey, I wanted to find out how many of the teachers only looked for specific content answers. As discussed above, 95% of the teacher respondents said they could grade their writing assignments by looking for specific pieces of content information, seeming to suggest that these writing assignments had one correct answer. The teachers were not all happy with this situation; many agreed with Lori, who said “what I have found really impeding everything in the last ten years has just been the pressure that the test, the content, they have to know this and this and this.” At the same time, others seemed to equate assignments with a single correct answer with assignments that emphasized “content,” a positive thing. Cynthia put it this way: “I just went through and said these are the pieces of information I’m looking for and boom, boom, boom, that was it. I didn’t do grammar.” By denying that she graded grammar, Cynthia may have been trying to distance herself from my research results which suggested the teachers looked at grammar at the expense of content; however, her definition of “content” and mine did not seem to be in agreement. Yet, as discussed previously, even when teachers tried assignments that seemed to call for more freedom (such as essays), many said they felt restricted by the rubrics that they had to use, rubrics which seemed to turn writing into a formula. Whether or not they assigned writing with a single correct answer, though, most teachers seemed to equate “responding to writing” with “assigning a grade;” the way they talked about writing response suggested that they looked to assess the specific piece of writing rather than to use the writing as an opportunity for the student to learn and grow. Ten out of twenty-one teachers did say they required students to revise their writing, but the nature of these revisions is not clear. In the focus groups, one teacher said he graded revisions mostly on whether or not students had fixed grammatical errors. Other teachers referred to “corrections” in the focus groups; the survey did not reveal whether or not teachers were equating “corrections” with “revisions” but this is a possibility.

After “marking errors,” the second most common comment the teachers made about responding to writing in the focus groups was that it was disheartening. Several of the teachers became quite upset when discussing their previous uses of student writing. Shelley was probably the most extreme, saying “I just junked writing because it was just torturous.” Luke and Denise both equated their personal feelings about writing with their attitudes toward incorporating writing in their classes. Luke called himself “a self-professed non-writer” and said, as a consequence, “I floundered, I struggled” to respond to student writing. Similarly, Denise called the prospect of teaching a class that involved a lot of writing “very daunting because I’m not, I don’t consider myself to be a writer.” In the related survey item, I asked teachers to respond to the statement “I found the writing I assigned to be enjoyable to read;” seventeen out of twenty-one teachers answered “no” (see item 4 in Table 6.4) despite the fact that a majority of teachers claimed the writing they assigned served learning purposes (item 3 in Table 6.4). Notably, the teachers’ attitude toward responding to student writing, something that was a roadblock for several of the SciJourn teachers, was not discussed in any of the responding to writing literature cited in this section.

Conclusions: the SciJourn Teachers Theory of Writing Prior to SciJourn

SciJourn teachers seemed to have entered the program considering any assignment where the students had to put pen to paper (or fingers to keyboard) a "writing assignment," rather than reserving that label for instances where students had to craft a paragraph or multi-paragraph document.[27] The survey, which was preloaded with examples of shorter assignments (like vocabulary or textbook questions), found that, whether or not individual teachers would have labeled these assignments "writing" themselves, less-than-a-paragraph assignments were the most common in science classrooms. Based on all the data sources examined in this chapter, I felt comfortable making the following generalizations about writing in our science teachers' classrooms prior to SciJourn:

Assignments were:

- Short
- Typical academic genres
- Influenced by standardized testing
- Often asking for specific "correct" answers
- Uninteresting to read

[27] The Kiuhara et al. (2009) survey also took a broad view of writing, while the Applebee and Langer (2006) study only included paragraph or longer types of assignments.

Assessment/responses:

- Were grade- and correction-oriented
- Often involved rubrics
- Were difficult for teachers

Not a single teacher mentioned striving to find authentic purposes for their writing assignments nor did they discuss using very many non-academic genres. Although the teachers shared many characteristics with science journalists, they did not enter the program with a great deal of training or confidence exploring non-traditional genres with their students. It was this aspect of the project, I thought, that would be the most challenging for teacher implementation, the subject of section two of this dissertation.

VII. Section One Conclusions

In this section of the dissertation, I set out to explore the following research questions:

- What are the essential characteristics of the professional genre of science news?
- Why do science teachers join SciJourn? Are they motivated by or thinking about genre? What do science teachers have in common with science journalists even before they join SciJourn?
- How do high school science teachers think about writing in their classrooms? Do they consider genre? What is the "high school science teachers' theory of writing and writing response"?

What I learned seemed to support the idea that the genre of science news might be especially useful to high school classrooms because it could be used authentically to support student learning (as opposed to the "cheese on the vegetables" approach to genre I had once subscribed to) and because science teachers and science journalists shared several key characteristics. These shared qualities had the potential of making the authentic adaptation of science journalism to the classroom an easier step than incorporating other genres had been.

However, the fact that teachers were not considering genre, their negative affect toward teaching and responding to writing in general, and their focus on writing as a means to assess specific pieces of content knowledge loomed large as likely barriers to SciJourn implementation. Another potential roadblock was that teachers were not joining SciJourn either to learn about genre or, more importantly, to radically rethink their ideas about science literacy or science instruction. Their reasons were much more conservative.

For the project to work in the ways that Bazerman's (2009) theory predicted—for students to learn the genre and then develop the ways of thinking and seeing the world that the genre requires—the teachers were going to have to use the genre authentically, to emphasis the important genre features in their RATAs, their instruction, their assignments, and their responses to student writing. They were going to have to think about writing and writing response differently, understanding that a publishable science news article will have many qualities (it will follow journalistic format, be grammatically correct, and adhere to ethical standards in addition to fulfilling the SciJourn standards), but that some of these qualities are much more important to the learning goals of the class. For some, they were going to have to rethink the learning goals of the class.

These were big challenges and the fact that many of the teachers overcame them seemed remarkable. How five SciJourn teachers did so is the subject of the next section.

Section Two: SciJourn Implementation

VIII. “Every Year it Gets a Little Better:” Barbara

Of the five teachers who participated in the phenomenological interview series (Seidman, 1998) with me, Barbara was the first to volunteer. A doctoral student herself, Barbara was happy to help a fellow dissertation-researcher, but her eagerness also seemed related to her general feelings about the program. Barbara was a vocal proponent of SciJourn, actively recruiting teachers to join and promoting her students’ efforts to the school administration and local media outlets. In one of our conversations, she spoke of her desire to make SciJourn a district-wide initiative. We met twice at my basement office at the university and once at a coffee shop. As she often admitted herself, Barbara also enjoyed talking, and the three ninety-minute interviews flew by with very little effort on my part. What follows is my interpretation of the story Barbara told, beginning with her background, followed by her SciJourn experience, and concluding with the meaning she derived from that experience.

“A Call from God”

At the time she joined the project in its pilot year, Barbara (a White female in her 60s) had 28 years of experience working as a science teacher. In our first interview, she described herself as a high school student who had always imagined a future career in nursing until, as a senior, she began teaching a Wednesday night children’s bible study class at her church. A very religious person, Barbara said that her decision to become a teacher “was a call from God…I was walking the halls with my friend and I just felt in my heart I’m supposed to be a teacher.” In college, she majored in biology and got a double minor in secondary education (which was not offered as a major) and chemistry; her first job was at the high school she attended. After taking ten years off, during which time she had five sons, she took a job at a small Christian school; here, she was the entire science department, teaching seventh through twelfth grade. When the school closed, she moved to an exurban public school[28] where she eventually became the department chair and the district coordinator for science.

Science was not considered a career path for girls at the time when and, perhaps more importantly, in the community where Barbara grew up; Barbara felt that nursing and teaching were her two options. Yet once she decided to become a teacher, the fact that she would teach science was never in doubt. She described her mother as someone who encouraged her to ask questions about anything and to explore the outdoors; Barbara credited her interest in science to her own innate curiosity and to her mother's responses to her questions. Her mother was a "farm girl" who was not afraid of any of the creatures Barbara brought back to the house, although she wasn't happy with the dog skeleton Barbara forgot about and left under the bed when she went off to college.

Barbara never regretted her decision to go into teaching, telling me that after all this time "I still love it." Talking to her, I was struck by how much of a *teacher* she really is; for her, the joy of the job was the connection with students and the opportunity to make a difference in their lives. Of course, she also valued her content area and was looking for ways to help students learn—the reason she signed up for a professional development opportunity at a time in her career when many teachers are just coasting towards retirement—but she became a teacher and continued to work on her teaching

[28] According to the state department of education, as of 2011 Barbara's school was almost 90% White, with 18% of students eligible for free or reduced price lunch. The enrollment was over 1300 students.

primarily because of the students, not because of her interest in the content. Their learning was her first concern and, in order to help them learn, she told me that she must care about them. When they don't do well, she said, "I take it personally…and I think the trouble today is too many teachers don't." Barbara was so interested in her students and teaching that in the first interview it was hard for me to get her to talk about her early life; she was eager to jump ahead to her teaching experiences.

In keeping with her "teacher" persona, Barbara's description of her involvement with SciJourn tended toward the practical. In our second interview, she spent a lot of time thinking aloud about the logistical problems she had in the past and possible solutions for the next year. She was convinced of the value of SciJourn, something that was very clear both in the interviews and in her behavior in professional development meetings as well as in her active recruitment efforts on behalf of the program, and she seemed to be concentrating on ways to make it work better in the future. She was certain this was possible, telling me "every year it gets a little better."

Barbara's SciJourn Experience

The Professional Development

For Barbara, the most important aspect of the SciJourn professional development was the fact that she had to write a science news article herself. She told me, "I still think that's [writing an article] the best thing for the teachers that go through the training to do because if we hadn't had to write and be edited, you know, so why are you struggling and what's the problem?" Ever the teacher, Barbara saw the writing experience as a way for her to have empathy for her students; she had struggled with her own article and could, therefore, relate to the challenges students would face. However, Barbara was very upset by the fact that the topic of her first science news article was limited; Newman had provided four broad topic areas and the teachers had to pitch a story idea based on one of them. Although Barbara couldn't remember the exact list of topics, field notes from the professional development listed them as flooding, highway construction, school lunches, and the state's renewable energy initiative. Barbara did clearly remember her reaction to this list: "To me that was a big negative…I just didn't like the choices so it wasn't interesting to me." She wrote an article about the lunches served in her school cafeteria, a topic she called "boring." She also struggled to write in the genre of science news: "I consider myself a pretty good writer, you know, as far as putting things together, but not this kind of thing." She did not see her skill at writing science reports and papers for graduate school transferring to writing a science news article. After she wrote a draft, she, like all the teachers, submitted it to Newman for editing. Receiving this feedback was difficult for her:

> we had to have 500 words and I was pretty close to right on the target and I think about five weren't a different color[29]; he had marked through and made comments and…it was humiliating in a way but not, I mean he wasn't ugly with it—it was honest, it was true, it all rang true, all of his comments.

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[29] The teachers received Newman's feedback electronically, using the Track Changes feature of Microsoft Word. Any comments, insertions, or deletions by Newman would have appeared in a different color (the default setting is red) when Barbara opened the file.

Despite her negative feelings about this article, it was one of the first to be published on *scijourner.org*. Barbara called getting her first article published "kind of cool, but I didn't like the story and I don't want anybody to see it because it's not a good story."

In the second year of the professional development workshop, the course was shortened to two five-day weeks (from three four-day weeks) and teachers were only asked to write one science news article (on a science topic of their own choosing, with topic selection assistance from Newman); Saul and Newman thought the first summer workshop was too long to sustain teacher intensity and that two articles were unnecessary. However, in part because she got to choose her own topic, Barbara described writing the second article as a key positive experience for her. She, along with two other teachers in the program, visited a local sewage treatment plant, toured the facilities, and interviewed the facility manager (who led the tour). At the conclusion of the tour, Barbara said that her colleague Stacey "was the best because she said 'Is there anything else you want to tell us?' And I always joke, I'll always remember that… and he [the manager] talked again a long time about stuff." This question—"is there anything else you want to tell us?"—was the way journalists always ended interviews, Newman had told the group, and it often yielded some of the best quotes. Barbara seemed to enjoy the role-playing that she and her colleagues were engaged in and to be pleased that the question actually worked as Newman said it would.

Although friends had joined her on the tour, Barbara was the sole author of this article. While her first topic had been "boring," Barbara repeatedly called her second article "interesting." Writing it "was easier because I had the experience; I had a better idea how to word things and how to organize things." Once again, she got feedback from

Newman, but this time "he said it was pretty good and I didn't have to make that many changes to the final one." Barbara was one of the only teachers in the group to have both of her articles published online. Of the second article's publication, Barbara said "I was much more excited…because I picked it [the topic]." She went on to call her second article "a good story. It was good to me, it was interesting to me, and I thought people would enjoy reading it which makes a difference." The issue of topic choice, something she saw as key to her own engagement with the article writing process, was something she would remember when she went back to the classroom. Of the whole experience writing articles, Barbara concluded:

> I think that it was pretty bad, the first one, but I think the fact that I didn't quit, that I fixed it, and then I did a second one that was much better, was a good learning experience for me. I feel a lot more confident helping the kids.

As was often the case in conversations with Barbara, the meaning of the experience was tied to its usefulness to her classroom.

In addition to writing science news articles, during the professional development the pilot year teachers were asked to create classroom activities and unit plans to share with one another as they prepared to use science journalism in the fall with their students. Although Barbara did not refer to creating these activities during her recollection of the professional development experience, she later told me that the activity planning definitely affected the way she implemented the SciJourn program the first time.

Year One

After she described the professional development workshop, Barbara primarily structured her responses to my questions about her classroom as a comparison between her first year working with SciJourn and her second (the interview was conducted in the spring of her second year, before the school year had ended). Her overall attitude was that she was constantly improving—the "every year it gets a little better" philosophy—and she described several things that she did in her first SciJourn year as unnecessary. In particular, she said, she felt constrained by the units and activities she had planned in the professional development; she went back to school with an implementation strategy of "step 1 do this, step 2 do that" but her students "just got sick of it." Describing her first year, she said "I had too much in my head and I didn't know what to pull out and what to use and they [the students] were overwhelmed."

During this school year, she implemented SciJourn activities with both Advanced Biology students and Applied Biology and Chemistry (ABC) students; the students in these classes represented the opposite ends of the spectrum of upper-level science students at her school. Advanced Biology students were those who were definitely college-bound, perhaps with visions of science careers, while ABC students were less likely to be interested in science and might not be planning to attend four-year college. When she thought about implementing SciJourn with these very different classes before the school year began, Barbara said:

> I didn't think my ABC kids would get very good articles. I didn't expect any of them to get published, quite frankly. I thought the Advanced Bio kids would probably come out with these great things and that they might get published.

However, her ABC students seemed to enjoy the project more and produce "better" articles; she speculated that this was "because it wasn't as threatening as a research paper, you know, it was easier because you could be more relaxed in your writing style."

Barbara also felt that SciJourn helped some of her ABC students connect to science content; she was so inspired by the impact article-writing had on a particular student with a learning disability that she presented a case study of the girl's experience in a public research forum.

For both Advanced Biology and ABC students, Barbara followed the following activity structure to write the articles: she began with a few read-aloud/think alouds (RATAs) to introduce the genre; students chose a topic (they were allowed to choose their own topics for one of their articles); did Internet research; created PowerPoint presentations of "just the facts" on their topics; shared PowerPoints with one another for feedback; wrote drafts; and peer edited. One revision was required, while additional revisions toward publication were optional, based on the student's own motivation. The PowerPoint activity was one Barbara and Stacey devised together and became a steppingstone assignment that many other SciJourn teachers were interested in trying. In her yearlong ABC class, Barbara was able to follow this schedule once in the first semester and again in the second semester; "the second semester…they did a better job," she said, perhaps because of "the second time around concept."

Throughout the interviews, Barbara positioned herself as in control of her classroom. She decided what activities to do and what to drop, not some outside authority or mandated curriculum; when things didn't go well, she described herself as the one responsible for figuring out why and making changes for the next time around. However, there were certain aspects of her implementation strategy that changed between year one and year two which were outside her control and which had a negative impact on her classroom. Most importantly, during the first year she and Stacey, her colleague and co-

SciJourn teacher, had both been doing SciJourn assignments with students in their sections of the same course, ABC, and had planned many of their activities together. Barbara described Stacey as:

> The one that comes up with cool ideas and neat things, and she used to come over last year and she'd say, "let's show them [the students] how to do it" and she'd pitch her ideas to me…I was the editor and she was telling me her ideas and, "well, what do you want to do that for? How do you want to find this? And why don't you?"…She's really good at that kind of stuff and the kids liked it when she came over and it helped them to understand what they needed to do.

With Stacey, Barbara had someone to role play with; Stacey could play the part of the reporter (the students' future role) while Barbara could be the editor (the role Newman filled during the professional development and would fill with the students once they began writing). Stacey and Barbara also created lesson ideas together and talked about the project. Unlike some schools where all courses with the same title must proceed at the same pace through the same activities, Barbara and Stacey's school did not require them to work in sync, but, Barbara said, "we like to stay together." In the second year, though, Stacey had a student teacher who kept her very busy and so she and Barbara were not implementing the SciJourn curriculum together, something Barbara clearly missed. Having Stacey to work with, along with having a familiar schedule of classes (in her second year, Barbara's schedule was changed, making some days 90-minute block classes and other days traditional, something that Barbara found difficult to adjust to), were the only two factors related to SciJourn implementation that Barbara described as better her first year compared to her second. Notably, both factors were entirely outside of her control.

Year Two

Based on the lessons she learned from her first year, Barbara approached SciJourn differently the second time through. She described herself as being much less "regimented" in her implementation style, using a less structured set of activities and lessons that the students had to complete before writing. She also talked about how the article assignment was in the back of her mind at all times, from the first day of the school year. She informed her students that they would be writing a news article at the very beginning of the course; throughout the year, before they actually started work on the article, she said that she would be listening for good article topics that came up naturally during class: "I was always throwing out ideas or pulling ideas out of what they said, which, then very few kids struggled [to come up with a topic]." To further help students decide on topics (and perhaps to save time), Barbara invented a new activity she called "speed pitching;" inspired by "speed dating," the idea was to have students interact with as many peers as possible in a short amount of time. Students would "pitch" topic ideas in pairs, giving one another feedback for a set amount of time before rotating to a new partner. "Speed pitching" was popular with both Barbara's students (who "thought it was fun," she said) and with other SciJourn teachers who heard about it at professional development meetings.

Barbara kept the "just the facts" PowerPoint activity for the second year. She compiled all of the students' slides into a single presentation and showed them one after another to the entire class, with the class commenting on each slide. She said the activity was popular because her students “liked seeing themselves up [on the overhead]” and that they were good at telling each other when a topic was “boring,” something she never told them herself. During this second year, these two activities—speed pitching and “just the facts”—were the only formal writing lessons Barbara did before asking her students to research and write. The most important thing she learned from year one, Barbara said, was to encourage students to “just get it down, get something down. We’ll worry about the grammar and the spelling [later].” For students who had problems writing (especially those with disabilities in written expression and communication, a percentage of Barbara’s ABC class), she told them “to get it down even if it’s just bullets of ideas.” This push to writing—at the expense of additional lessons and activities—was key to Barbara’s implementation strategy in year two.

However, even though Barbara wanted the students writing more quickly, she found it difficult to maintain the project’s momentum. In part, she blamed this on not having Stacey as a co-implementer: “this year hasn’t been a good year because I have that girl in there [teaching the other ABC section instead of Stacey] who doesn’t do SciJourn so I have to make it fit.” The “girl” (a younger teacher in the department) was teaching ABC for the first time and Barbara found her attitude toward the class frustrating. Barbara described her as “not really comfortable with the whole philosophy [behind the ABC course] because she doesn’t get in there and help do it.” Barbara emphasized that ABC was a hands-on course that required the teacher to do a lot of planning, but this teacher did not appear to want to put forth the effort:

> she didn’t know how to do it [the labs], she wouldn’t set it up, so I have to set it all up and tear it all down basically…and she wouldn’t try any of the SciJourner

> stuff. "I haven't been trained," and I'm thinking…some of this like the 'read aloud-think aloud,' there's not really that much training to use that.

In the beginning, Barbara tried to align her class with this teacher's as she had with Stacey in the past, hoping that she could convince the new teacher to do some SciJourn activities as the year went on, but eventually, Barbara gave up:

> I just said you guys are going to do what you want and I'm going to do this, and I'm not going to give the [end-of-unit] test, we're going to do SciJourn instead.
>
> And that's what I did. And they reviewed and gave a test and I didn't.

Barbara was able to have her students write an article, but by the time they did so it was already midway through the second semester. Unlike the first year, Barbara's second year students only produced one article even though they had chosen topics by the end of the first semester. Barbara regretted how drawn out the process had become—"I wish I would have just said, 'Okay, we're going to do this' and then just did it."—and planned to do things differently in the future, possibly blocking out several class periods in a row rather than spreading out the work over time. She was also hopeful that Stacey would work with her again on SciJourn the following year; Stacey's student teacher would be gone and Barbara knew Stacey was assigned to teach two sections of the ABC course while she (Barbara) had the other three sections.

Making Meaning

For Barbara, the SciJourn experience was clearly meaningful. Her continued involvement past her first year of implementation alone demonstrated that she valued SciJourn. *Why* she found the project worthwhile seemed to be a combination of the following factors, each of which will be discussed below:

- Her own experience in the professional development gave her a model of what SciJourn could be and do
- SciJourn affirmed what she thought about good educational practice
- SciJourn gave her a new way to make her classroom into a community
- The genre of science news drove student learning in a new and unexpected way

Teacher as Model

Barbara found the experience of writing her first science news article to be a challenge, and that challenge gave her a perspective from which to teach. In our final interview, Barbara once again said, “I didn’t like it [writing the article] at all…like I said, I’m pretty good at writing traditional and I can do a decent job on a traditional paper…but this was not fiction and it wasn’t your traditional research.” At the same time, Barbara thought writing the news article was valuable, telling me, “you don’t forget the pieces…that’s why it hooked me on this, is that process of seeing it and they clarifying it for people to read, you get the science.” She particularly found value in her second article, the one where she picked her own topic, describing a sense of ownership about the article from topic inception through to publication. Writing a news article, as much as she struggled, was essential to getting Barbara “hooked” on SciJourn, and she referred to the experience with her students as they wrote: “I talked to them about it and I brought it up multiple times since, when it fits the situation.” She recalled her own sense of discomfort as she worked with her students, recognizing ahead of time where they might struggle and sympathizing with their problems when they occurred. Conscious of her own role as a model for her students, Barbara had applied for and been accepted to the Summer Institute run by the local chapter of the National Writing Project, something she said “I would have never even considered…if it hadn’t been for SciJourn.” She described herself as needing more knowledge about how to teach writing and how to be a writer herself since this was an area where she had little prior training: “I took six hours of English in college and that was it.”

SciJourn as Affirmation

Barbara’s experience writing a news article, one that challenged her to think and write in new ways, was one example of how SciJourn affirmed her own ideas about good teaching and good education. Barbara repeatedly expressed the idea that teaching is not easy and that good teachers “put in the time required” to do the job well. Teaching, to Barbara, was about stretching herself and constantly looking to improve; because she saw the learning outcome as valuable, the fact that writing the article itself was a struggle may have even been a positive experience for Barbara since it matched her ideas about the importance of challenge and change.

SciJourn also affirmed Barbara’s ideas about science literacy and the role of science education, although she described herself as never explicitly defining science literacy before:

> I felt like when I started teaching the ABC, the applied class, I was preparing kids to be real people and to make science choices. So, I sort of thought, I didn’t know I was doing literacy, but I really think the applied classes, that’s their goal is to produce citizens that …know science, they know, can read it, and understand it and it’s practical science…it’s real, it’s something that I can use in my everyday life. So, I sort of was doing that with ABC and I’ve been doing that for 16-17

> years maybe, 16 years and that began to change my focus. When I heard about this [SciJourn], this crystallized…and I think it made it more in depth.

Unlike some SciJourn teachers, Barbara did not characterize herself as holding radically different values than her administration or overarching educational trends. As the district curriculum coordinator for science, Barbara had a lot more control on the curriculum she was asked to teach than many other SciJourn teachers; in her ABC class, she also had more flexibility than SciJourn teachers in other kinds of classes (e.g., those teaching core courses, AP or honors classes, or classes with state-mandated assessments). Whatever the combination of reasons, for Barbara SciJourn didn't represent an opportunity to be, as another SciJourn teacher put it, "subversive," but instead she called SciJourn "hand-in-glove with the way we do science," with SciJourn skills as "vital" to one of the state's former required strands of science learning.[30] The state had actually eliminated this standard (science and technology), but Barbara's comments suggested that she valued it; by using "we" in the phrase "the way we do science," Barbara emphasized her authority, her position as someone who determines how science is "done" in school district (although her other stories about fellow teachers suggested that not everyone "did science" the way Barbara would have liked). Furthermore, Barbara described herself as being a "hands on" teacher (which is related to her ideas that teaching requires effort), and said that SciJourn is "hands on in the English world." A rare science teacher who described herself as regularly using writing in her classes, Barbara didn't find the idea of

[30] During the pilot summer professional development, Barbara paired with one of the SciJourn researchers to map out how SciJourn activities aligned with national and state standards.

writing to be challenging, although the specific genre was something new. Finally, as Barbara's own reaction to writing an article on a pre-assigned topic demonstrated, Barbara valued choice and sought ways to connect student interests to the course content. In SciJourn, she found a way to help the students have some control over what they would learn, something she valued but hadn't been able to do as well prior to SciJourn.

Classroom as Community

When she talked about her classroom and her students, Barbara was at her most animated when describing individual students and relationships she forged. She rarely discussed a topic without referring to a specific student, some of whom she had taught thirty years ago. Barbara valued the relationships she had with her students, and SciJourn appeared to provide a way for her to expand those relationships and create a classroom-wide community.

Because Barbara emphasized personal connections and student interest in topics, she said that many students "wrote about things that they deal with," including issues like childhood depression, steroids, drug abuse, dropping weight for wrestling, and secondhand smoke. Although she described herself a teacher who was "accepting and I treat everybody equal," in the past the personal (sometimes serious) issues that her students were dealing with didn't always come up in class; "there wasn't an opportunity" in the curriculum, Barbara said. Through SciJourn, Barbara wasn't the only one who learned more about her students' lives and interests; the SciJourn lessons that she created herself made the process of writing articles into a community activity. Through "speed pitching," students shared their topic ideas with several peers. Barbara described this as a positive experience:

> they get a lot more personal…they're more open and sharing. But you know I think one of the things that's helped that this year is the speed pitching…But doing it around the room like that and then at the end summarizing it seemed to make it better.

Speed pitching helped her students open up about their own topics and listen to one another. Although she didn't discuss how she provided a safe atmosphere for this activity, Barbara clearly had created a place where her students felt comfortable talking about personal topics. Her second activity, the "just the facts" PowerPoint, was also a way for the students to learn from one another. Each student's slides were presented to the entire class; in this way, Barbara saw all her students being exposed to more relevant science: "it might not be in your traditional classroom curriculum but it's valid science and it's science kids are interested in, and by doing it this way…not only they but everyone in their class gets that piece of knowledge." Finally, Barbara had all of her students engaged in peer editing of their articles, a process that some teachers found difficult to implement but which Barbara saw as beneficial. She said her students were "really good and they don't do it nasty, and the kids respond well to each other for the most part."

At the center of this community was Barbara herself. Even if the peer editing went perfectly, Barbara said, her students would still require her feedback "because I'm me, I'm their teacher and they love me for whatever reason." Of her relationships with her students, Barbara said, "I treat kids as people and I respect them and I think it's my responsibility to make the environment so they'll learn," a responsibility she felt some teachers neglected. She recalled a student with a reading disability from her first SciJourn year telling her how much he enjoyed RATAs: “I want to know stuff but I can’t read it and I don’t understand it, but when you read it to me then I get it.” By giving over class time to activities like the RATA, Barbara was creating opportunities for her students to interact with interesting, relevant content, a fact they appreciated and which affirmed her desire to reach all of her students.

Genre as Driver

Finally, Barbara saw the genre of science news as essential to the learning and interest that was happening around SciJourn in her classroom. She hadn’t fully theorized why science news worked differently from other writing assignments that she had tried, but she had some thoughts:

> there’s something about that process and I’m not sure what it is yet, but there’s something about going from a research paper report to a news story that makes it more alive and more real and more, I don’t know, but it makes it more attainable for some reason. I don’t know what it’s doing but I know it does, and I don’t know, maybe it personalizes it more, I don’t know.

The idea that these news stories were more “personal” for the students was something that Barbara kept coming back to (as I discussed in the previous section). Barbara encouraged students to write about “personal” topics in part because she thought they would find those topics more interesting for their own learning, but she also suggested that “personal” topics were actually better news stories than the kinds of topics a student might choose for a traditional report; what was personal for the author would be interesting to the reader. She was convinced that the students benefited from the awareness of audience that SciJourn writing demanded. She speculated that “the writing of an article makes it theirs. They have taken these facts and turned it into something other teenagers want to read…why is this interesting to teens, how are you going to relate it to teens?" Thinking about audience—selecting a science topic that an audience would be interested in and then working to make that interest come through in the writing—was a key quality that Newman and Miller, the professional science journalists, valued in themselves and in their work. Barbara suggested that this genre feature was an important part of the project's success with her students. However, when she looked at student drafts, Barbara noticed that many of them put the most interesting—which, often, was the most personal—details at the very end.[31] She did not provide the level of editorial feedback that Newman gave during the professional development, but Barbara said she always looked for the lede in her students' stories; to get full credit for the assignment, her students had to have a good lede, credible sources, and grammatically clean work. Barbara believed that by writing a good lede, her students were "learning how to pick out the main point" of their topics. Students left their own stories to the end of the article because, Barbara hypothesized, "they don't think it's important. They're not used to being, my story means something, you know?" The genre allowed her to honor her students' own experiences and to require that her students forefront these experiences and connect them to serious science.

The genre, and the teenage audience, also required her students to really understand their story. As Barbara thought about her own writing and that of her students,

[31] In his capacity as editor of *SciJourner*, Newman has noticed the same thing with teenage writers across schools and teachers.

she said, “the fundamental key that makes SciJourn so important for science literacy is because people that write about it…they’re going to have a little piece of science that they really understand if they do a good job.” The act of writing, and in particular writing science news, forced the author to know the topic well. Newman and Miller said something similar when they talked about creating a coherent story as an important part of their work; Newman in particular emphasized the importance of seeing the logic, the “narrative thread,” in the information he was researching before he could write. Barbara’s quote also hints at the issue of “translation,” an important genre feature that has come up throughout this study.

Yet, although Barbara believed the genre was important to the experience, she did not place special emphasis on the opportunity for publishing that SciJourn offered. Barbara passed articles on to Newman for editing when she thought they were especially promising—and she had invited Newman into her classroom on several occasions—but she didn’t describe publication as particularly important. In general, she left the decision to pursue publication up to the students: “if they want to submit it, it’s up to them…that’s their choice.” She saw writing in the genre as valuable for all her students, but the possibility of publication was not an integral part of her implementation plan; the especially motivated students could work with Newman outside of class. For Barbara, the authentic use of genre did not extend to writing for an authentic publication outlet. Instead, the community she created in her class served as audience, and she even toyed with the idea of creating her own publication: “I may throw them in Publisher and publish my own and give it out to my classes or something.”

Barbara probably had many reasons for her reluctance to encourage all students to pursue publication. It was time consuming to go through so many drafts for both the teacher and the student, even when Newman was taking some of the burden of editing. Barbara had several other projects in her ABC class that she had created herself, including a murder-mystery for the students to solve; because she saw SciJourn as simply another “hands-on” activity, she may have been unwilling to bump something else. She also had class-specific goals for the article writing (creating a community, getting the students to connect to science content) that she saw as being met without the additional time and effort pursuing publication would require.

Because of her emphasis on relationships and student achievement, I also suspect that she was reluctant to set her students up for what she feared would be failure. She knew firsthand how harsh Newman’s editing could be and she also knew how much effort was required to publish an article. If she had required her students to all work with Newman on editing, she may have undermined one of the reasons she liked the genre so much; she described science news writing as “non-threatening,” particularly for her weaker writers. She pointed out that the “report,” or traditional school research paper, was inauthentic; as she put it, “people write research papers because they have to,” not for any real desire to know or for any desire to communicate to an interested audience. The rigid form of the report—Barbara called it “a formula: you want an introduction, you want a thesis statement, you want a this, you want a this, and they just plug them in”—was boring for some students and confusing for others. Properly citing sources according to an academic format was another challenge of research paper writing that wasn’t required in science news: “there’s no bibliography, you just write in the, it seems more natural; it's more like you're talking about it." The authentic genre of science news, designed to engage non-scientists in science material, demanded that the writing be accessible. For Barbara's students, this demand of the writing also was a relief to the writer. And, for a teacher like Barbara, anything that made the students more comfortable and at ease in her class was worthwhile.

IX. "A Glimmer at the End of the Tunnel": Jason

When I got an email from Jason offering to participate in my interview research, I was pleased but not surprised. Like Barbara, Jason enjoyed talking, describing himself as having been born with "the gift of gab." During the pilot year of the professional development, when Jason and I were both participating teachers, I had enjoyed working with him; we sat near one another in class and found ourselves partnered up for various activities. We had a similar sense of humor and similar perspectives on education and social justice issues, and I welcomed the opportunity to talk with someone I considered an old friend. Jason asked that we meet at a bookstore, explaining that the distractions of other conversations, the glossy book displays, the whir of the coffee bar blender, and the busy parking lot right outside the window would actually serve to keep him focused. He worried that he might not have enough to say to fill the time, but this was not a problem; we talked for nearly ninety minutes on each occasion. The story Jason told was as much about the effect of the SciJourn project on him as a teacher as it was about the effect of the project on his students.

A "Paranoid Planner"

Jason (a White male in his late 20s) joined SciJourn at the encouragement of a colleague who had been involved in the beta testing of the program. SciJourn came at a time in Jason's career when he was "getting tired of teaching…I wasn't seeing a lot of progress." Jason described himself as entering the profession reluctantly, saying that in college he "had tried to avoid education classes because that's what everyone does in the family." In all three of our interviews, Jason referred to other career paths he had considered or was considering; he expressed frustration with various aspects of teaching, including administrators, school culture, attitudes of other teachers, and pay. At the time he began the program, Jason had been a teacher for six years, four of them at his current suburban school[32] where he once attended.

Jason remembered being interested in science from the time he was a small child, although in the beginning, he said, he wasn't sure if the interest was in science itself or in the fact that science offered answers. He described himself as a child who was always "driving people crazy with questions every four and a half seconds." His parents encouraged his questioning, reading him books, letting him explore and play, and sending him to a summer enrichment program at a local private school where he enrolled in mostly science classes. He described his parents' parenting style as "the grass would grow back, that was their general policy on things." In school, his interest in science was fostered by a middle school German teacher with a background in biology, whose classroom he remembered in detail: "every single corner had some sort of specimen or jar or something cool…so even though he didn't teach science we still ended up doing a fair amount of science just because it was sitting in there, you know?" Jason recalled this teacher as "the reason I really thought that science was cool and education was kind of neat." Although he didn't speak as highly of several of his other middle school and early high school science teachers, Jason said he had good science teachers his junior and

[32] According to the state department of education, as of 2011 Jason's student population was primarily White (about 61%) and Black (about 30%); about a third of students qualified for free or reduced price lunch. The 2011 enrollment was over 1800 students.

senior years, including one who taught "probably the first in the Midwest forensics class you could take that wasn't switching the bait; it actually was, you know, CSI[33] stuff."

This class inspired Jason to enroll as a pre-med student in small private college about three hours from his home, with the plan of becoming a forensic pathologist. When the show CSI premiered his sophomore year, Jason said, forensic pathology "went from a quiet field to a big field" and, with diminished job prospects, he began looking for another career path. At first he considered remaining pre-med, but then, his junior year, he said he "looked around and realized I'm okay with my B's," a temperament he said was unsuited for medicine. A self-described "paranoid planner," he wanted a degree that would make him employable (not something like a "comm., no offense, degree[34]"). He enjoyed an education elective that he had enrolled in that same year and decided "let's run with this and see where it goes." He graduated with a double major in biology and education and, due to the strength of his transcripts and his performance on the teacher certification tests, entered the profession able to teach middle and high school biology, physics, chemistry, earth science, physical science, and general science.

Despite his solid preparation, Jason's career did not get off to a smooth start. He completed his student teaching at an inner city school but took his first job at a school that was predominantly White, "a complete reverse of what I was used to," in a city where he didn't know anyone. He described the administrators as misleading him—"they said, 'Oh, your classes will be small.' I was teaching an at-risk program at an alternative

[33] Crime Scene Investigation

[34] Communications. I didn't take offense.

school and I have 35 a class"—and his first classes as "insane." The teachers also went on strike both of his first two years teaching and he found himself picketing across the street from students who had been recruited to picket against the teachers; the result of the strike was a three thousand dollar pay cut. The environment was "toxic" and, when his father had a stroke during his second year teaching, he returned home and looked for a job near his family. He was offered a position at the school he had attended and was told he had to accept immediately or they would make an offer to the second choice candidate; although he had an interview opportunity with the orthotics and prosthetics company his father was working with during his recovery, Jason felt like he "needed to go to the sure thing." Yet, he said, "I still wonder about them because that would have been still education, still teaching people" but he would have made "significantly more than teaching."

Jason did not have an official diagnosis, but he repeatedly referred to himself as "ADD[35]" and said he and his mother shared a quality they called "the shiny thing syndrome, you know, 'oh, look something shiny,' you're off on a tangent." In addition to being easily distracted, Jason described himself as having a variety of difficulties related to writing. His handwriting was poor, he said, and he struggled to write quickly, making note taking during classes a challenge. Writing academic papers also did not come easily to him. Although he could write "informal" papers, including newsletters he created for the cross country and track teams he coached, he said that "formal writing for me has

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[35] Attention deficit disorder

never been a strong suit." He described paying people to edit his papers in college; the problem, according to Jason, was that he would write in fragments because "my mind works faster than my hands;" However, he felt like "the content was always there." He didn't consider his inability to write formal papers to be a reflection on his own knowledge; he just couldn't communicate his knowledge in formal academic prose, something he saw as entirely separate from the knowledge itself.

For someone like Jason who didn't enjoy writing and didn't consider himself a good writer, the SciJourn professional development program might not have seemed like a good fit. To explain his choice to enroll, Jason described signing up without a lot of knowledge as to what he was getting himself into. His colleague stopped by his classroom and said: "'Hey, we need something to do this summer.' I said, 'Sure.' He said, 'It pays.' I said, 'Even better.' So that was really it." Furthermore, Jason said, he wasn't aware that he would have to write his own science news article until the first day of class; upon learning about this assignment, he said, "anytime I hear I've got to write, I dread it." Yet Jason described the SciJourn program as having a profound impact on his teaching[36]; SciJourn, he said, "gave me a little glimmer at the end of the tunnel." And Jason, with his easily distracted nature, would have a profound impact on SciJourn as well.

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[36] When Jason read a draft of this chapter, he reminded me that prior to SciJourn he actively sought professional development opportunities and was considered an innovative teacher in his school, something I certainly believed true. If this chapter implies that SciJourn was Jason's first time rethinking his practice, the impression is unintentional.

Jason's SciJourn Experience

The Professional Development

Although Jason wasn't thrilled to have to write a science news article himself, he described his initial reaction to the professional development as cautiously interested:

> I was excited, but, see it sounds real pretentious, but I didn't want people to waste my time so I know I was a little leery at first because I'm excited but…I've done many things over the years and sat through too many things that I've gone, "Well, that was a complete waste of my time."

He was withholding judgment while, at the same time, feeling like the professional development was "something definitively new." When I asked him to explain how he suspected this "new" idea might be a good thing, he explained:

> it didn't involve a list of things to fix the school which is a plus because I said that last time I get tired of that. It's not coming down from an administrator which is also usually a sign that it's decent, and, you know, it was very open; it wasn't definitive we're going to do this, this, and this, exactly like this, there's no option for deviation, and I thought that was important too…that allows people to take ownership of what they do.

Jason's frustration with the current state of education—one that involved outsiders telling teachers how to run their classrooms and administrators implementing completely new "fixes" each year—was obvious in his description of why SciJourn initially seemed appealing. Jason was a teacher who was looking for new ideas but also wanted autonomy; he enjoyed involving expert outsiders in his classroom, but at his invitation and on his terms. From the beginning, he seemed to sense that SciJourn would meet his needs while also pushing him in unexpected directions.

Even the article writing process, one he was not predisposed to enjoy, was not too challenging for Jason. Unlike Barbara, Jason didn't remember that his topic choice was limited to a set of four broad areas, telling me that he had "not a clue" how he decided to write about infrared technology used for finding sinkholes for road construction or repair. He did not have much trouble researching the article, discovering after an Internet search that one of the leading companies in this field was located in our town. Jason, with his "gift of gab," called the company for more information:

> I was flying blind and I should have been far more prepared when I called. I figured I was going to leave a message; I didn't figure they'd say all right we'll switch you over to [the company president]…it was like a break between our class and I was like this is fantastic I'm totally not prepared to do this well; I haven't even talked to anybody really about what I needed to do as far as interviewing. So, I was unprepared but got enough out to get the article, but I probably ended up sounding like an idiot as I was talking to him.

Jason wasn't shy or afraid to call people on the phone, but once he began talking to the company president he realized that he was unprepared to play the part of a journalist and conduct an actual interview. One of his big regrets about the interview, Jason told me, was that he wasn't able to make a better connection with the company owner in order to invite him to speak to his chemistry class when the students were learning about the light spectrum. However, he had enough information to write the article, a process he described as "just following his [Newman's] general diagram[37] and look[ing] at some stuff online to see roughly how to write one." About Newman's feedback, Jason said, "I remember very distinctly getting an extremely red piece of paper" but that "I just took it as it was and figured he's smarter than I am and fixed it all." Jason perceived other teachers involved in the professional development as finding the editing process more upsetting than he did; he attributed the difference in their reactions to the fact that he was "used to kind of getting things back butchered." Jason also pointed out that "I've never written for an audience that wasn't paid to…read my work," echoing the language Newman used when talking to student writers, and that Newman was the authority on what the audience would like to read. Jason revised his article two times and eventually was published online[38].

While many teachers described the article writing experience as the most important part of the professional development, Jason left the summer course most affected by hearing Newman do a read-aloud/think-aloud (RATA). Jason said he "was profoundly hit when Alan [Newman] read to us," saying he "hadn't really seen that done before…yeah, I've been read to before…but it's another thing when you have someone who has a depth of knowledge that's obviously far beyond mine reading and giving their opinions." For Jason, the RATA also seemed like something he could implement easily

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[37] See Appendix H for the "inverted triangle" diagram the pilot teachers were given.

[38] Jason had no recollection of writing a second article and there was no record of his second article in the SciJourn database.

with his students at the beginning of the semester, without dedicating a lot of time or effort. Through RATAs, Jason hoped to inspire the same reaction in his students that he had upon hearing Newman read. As the SciJourn summer professional development ended, Jason said, he was “excited” and “thought it gave me some new avenues and things to do” during the upcoming school year.

Laying the Groundwork for Writing

Jason primarily implemented SciJourn activities with his sophomore chemistry students; these were “regular” students, as opposed to honors, described by Jason as being “very leery of their writing to begin with.” Unlike Barbara who emphasized getting students to write quickly, Jason said that he thought it was important “to have a decent amount of trust with these kids before you ask them to do something completely new.” He didn’t think he had time to establish this trust and move students to article writing during first semester, which was already packed with curricular requirements. Instead, he said, he saw first semester as a time to build relationships and “second semester, by then you’ve built up enough trust that they’re willing to pretty much follow you wherever you want to go.”

Although he didn’t believe in writing articles first semester, Jason did begin using RATAs right away. Their reaction was a lot like Jason’s reaction to Newman’s reading: “they became engaged quickly. They really connected to A) being read to, and B) just how…I looked at things versus how they did. [RATAs] opened their eyes that not everyone sees it exactly the same way.” Jason used RATAs as a way to end class several times a week and this became an important time for establishing connections with his students. After a few weeks, he said, students started bringing up topics they had heard about or seen on television themselves, with some even bringing in articles for him to read. At some point, as he read news articles, he "casually" mentioned that they would have an opportunity to write an article themselves, with the possibility of getting their article published.

In addition to the success of the RATA, Jason had two key SciJourn experiences that he described as moments where he thought "this is cool, this is different…I'm engaging these kids on a level that's not the level that I've engaged them before." One involved a group of students who were convinced a pseudo-documentary horror film was actually real, despite Jason's repeatedly telling them "it's bogus" and challenging them to "bring me evidence" that the film was a true story. Before class one day, three of his students approached his desk and said, "we spent all this time looking it up…it's crap." When Jason asked them how they knew the film was fiction, they said that they had looked up all of the references from the film's website and discovered none of them existed. Jason remembered thinking:

> that was really cool because A) it made a connection with them, and B) they were looking for credible sources, which is what the whole thing's [SciJourn] supposed to be in the first place, and I'm going, wow, this is pretty big, and the rest of the class was silent all listening to them discuss this.

A second key moment came the day Jason decided to show his students how he read an article online, as opposed to how he read print[39]. When reading an online article, he told

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[39] Even though he found all of his articles online, prior to this instance he typically approached a RATA as if he were reading a print article.

me, “my ADD makes me bounce around”; for his online RATA, Jason said, he “went through 17 different web pages” in about ten minutes time, clicking on hyperlinks and opening new webpages to fact check or ask questions that occurred to him on the spot. He described this RATA as demonstrating for the students “how my brain worked” and said the whole class was “astonished” and “exhausted” by the time he was finished. He knew the demonstration was a success when “the next two weeks straight I had them coming up, going, ‘hey, did you see this? Did you see?’…even some of them emailing me stuff because they wanted me to talk about it in class.” In both of these events, Jason described a high degree of student engagement coupled with a merging of student outside interests with classroom conversation; a “third space” was being forged.

Students Engaged in “Real” Work

In the years prior to SciJourn, Jason had assigned a ten-page research paper to his sophomore chemistry students: “the kids hated it, I mean absolutely just despised it.” The students chose a topic from a preselected list of five; Jason didn’t provide feedback but simply skimmed the papers to be sure students hadn’t plagiarized. It was an experience that no one—students or teacher—seemed to enjoy. During his first SciJourn year, after laying groundwork first semester through RATAs and other conversations, Jason told the students that they had a choice: they could write a ten-page research paper on a topic that Jason chose, or they could write a 500-word or less science news article on “anything that’s science, biochemistry/chemistry based as long as I clear it and I say it’s not inappropriate.” Because he had “loaded the question,” Jason said, and planted interest in science news articles all year, the students were “excited” to write stories for *SciJourner*.

Once students began article writing, Jason emphasized the “real” nature of the work they were doing. In the beginning, he said, several students approached the news article as if they were writing in a typical school genre, picking topics that “they think a teacher would want to hear” such as evolution, global warming, or abortion. Jason encouraged his students to “create something that you are actually interested in” which freed many of his students to look at more unusual topics, such as why tennis ball cans pop when you open them or what “titanium” bracelets actually contain. Although some students seemed stuck on “five paragraph essay” topics and format, Jason estimated that “95% of them, even more than that were really excited about what they worked on.”

When the students finished their first drafts, Jason sent them all to Newman for editing and invited Newman to come to his class to return the articles. In preparing students to face Newman’s edits, Jason told them “in real life he has a job where he’s paid to edit people’s stuff and he’s not paid to make you feel happy or sunshine about what to do.” He went on to emphasize the difference between the “real world” and what the students were used to:

> I said, guys, if I turned in a form that’s wrong they don’t say, “You know, you really tried well and you spelled your name right over here, and you got your birthday right, but you messed up on this part down here, could you fix this for us please? Smiley face, star.”…they may think that’s funny but I say no, that’s the truth. In reality they’ll come back to me and go, “Look, you did this wrong, what’s wrong with you? Fix it. You should have done this right in the first place.” I said, well, in the real world where these guys come from they’ve got to get these

> things [articles] in, which is if they don't have that article there's this big blank spot, so you have to have it done right or they just won't hire you again.

In emphasizing the fact that Newman represented the "real" world, Jason was also suggesting that normal school practices were "fake," with special emphasis on the "fakeness" of the kinds of feedback teachers typically provide students. Furthermore, Jason used the publication as the rationale behind Newman's editing; Newman needed articles to fill up space in the publication; without articles, *SciJourner* would have "big blank spot[s]." It wasn't just that Newman was an editor in some outside space—he wasn't just a guest speaker visiting to talk about things that took place outside of the class but had no direct bearing on classroom practice—or that Jason was asking his students to imitate journalistic practice; Newman was *currently* an editor and his students were *actually* writing articles for this publication. Jason said he went on to emphasize that his students could handle Newman's feedback and that he would be supportive of them except, he warned:

> if you plagiarized you're on your own…I said I'm not giving you a bit of help. And a couple of the kids did and pretty much he called them on it on their papers in no uncertain terms and let them know that…he'd fire their butts if they tried it and he was their boss, and they'd be discredited and not allowed to ever work in the industry again, which is an eye opener for some of them.

After Newman left, Jason said that he explained to his students that an editor publishing a plagiarized piece of writing was far different from a teacher catching a student turning in a plagiarized paper for class. It wasn't just a matter of the student getting a low grade or having to redo the work; the publication's reputation was on the line with potential legal consequences. Because the students were working with people from the "real world," they would have to measure up to real standards and face real consequences.

By the time his students turned in their articles, Jason said he found that many of them were incredibly excited about their topics. When they handed in a draft, Jason made it a habit of asking them, "What's new?" The responses of students to this simple question—"some of them are telling me about their entire paper and what they loved about it"—impressed Jason. He summed up their reaction to the whole SciJourn experience as "a big deal":

> Any time they want to stay after [class is over] and talk to you is a big deal, or any time when the bell rings and they go, "You're not done reading," is a big deal, and when they're asking, "Can I just get a pass to go to class? Can I stick around and hear the rest of this?" that's a big deal, or when they remind you the first second of class the next day, "Oh, you didn't finish telling us this," that's a big deal because that means that there's actual connection versus cattle moving from place to place.

The idea that students were actually connecting to something in school—as opposed to moving like "cattle" from class to class—was part of the reason Jason found SciJourn so meaningful, the subject of the next section.

Making Meaning

As I read through the transcripts from my interviews with Jason, it seemed to me that for Jason the meaning of the SciJourn project involved the following:

- It gave him a way to connect his classroom with the world.
- It provided an avenue for him to inspire "a sense of wonder" in his students.

- It renewed his energy for teaching by changing his classroom dynamic and pushing him to learn new facts and skills.

At the same time, Jason was not entirely convinced that the genre was essential to the project or these outcomes, something I will return to at the end of this chapter.

The Classroom and the World

In our conversations, Jason made it clear that he thought the current way science curriculum (and, actually, all school topics) was presented was alienating to most students. He described one problem as the way the science curriculum was "compartmentalized:"

> when we compartmentalize those things, it just ends up being they see no real connection between something that's at the cellular level, to something that's at the atomic level, to something that's, you know, structurally. They don't see any of the connections because in biology we do units; in chemistry we do units, so in physics we do units, so we never really connect the dots.

As students moved from grade level to grade level, encountering different science courses, Jason said they never were asked to understand how one course related to the others. According to Jason, the reason science courses were so disjointed was that to do it any other way "takes effort," a level of effort he said no one was willing to expend. In addition to being disconnected from one another, science courses were disconnected from his students' lives. He described having to answer the same question every year—"where am I ever going to use this again?"—and said that his students' frustration with their science classes was somewhat justified "because the way we teach it, and it being so compartmentalized, it doesn't have a big connection to their lives." Through SciJourn, Jason found “a different way to get my kids interested in science, and it gets them interested in real world examples a little differently.” As they researched topics that they were interested in, Jason saw his students better able to see “the big picture” of science; they were making connections both across science disciplines (their topics were not confined to chemistry) and between their own lives and science content.

SciJourn was also an avenue for Jason to bring the “real world” into his class. As discussed earlier in this chapter, Jason enjoyed inviting Newman into his classroom and promoting Newman as a representative of “the real world” to his students. Jason also knew that Newman “wants me to just do it [introduce concepts of science journalism] on my own now,” but said that he continued to invite Newman despite the fact that he was comfortable with the content of Newman’s presentation: “I could totally teach the section at this point, that’s not a problem, I could do it in my sleep probably.” He saw Newman’s visits as important because his students “find it really cool to hear it from someone other than me…I don’t think Alan [Newman] gets the fact that him coming in has more effect than he thinks it does.” The presence of an outsider in the classroom excited his students and made the experience that much more real. Jason described trying to get other experts to speak to his classes about different curricular topics, mostly through the technology Skype, but said that he’d had trouble coordinating anything yet. Newman’s visits represented the one outside expert he had available and he was reluctant to give them up.

A Sense of Wonder

One thing that I often heard when I talked to science teachers was the importance of questions. It seemed that most science teachers were thinking about ways to get their students to ask questions; some kept track of student questions in the room, while others worked to raise the level of questions their students asked. But for Jason, the inquisitive child who characterized himself as practically badgering the adults in his life, the word "question" didn't even capture what he wanted. Instead, he talked about "a wonder…not just a question." The difference, as he saw it, was that "wonder" came from a deep curiosity, not just a desire to find an answer. He described one of his jobs as "to make you ask questions you never even knew you wanted to know the day before," which meant that, as a teacher, he needed to create an environment where students encountered interesting information that they could connect to and be inspired by. Modeled after his elementary school German teacher's classroom, Jason's classroom was a place designed to spark this sense of wonder:

> that's just why I keep so many things around my room that they can look at and so many different infographics[40] and so many different posters and I change them from season to season so that things change, so that when they're looking around they'll go, "I never noticed before" and they'll ask me, "Well, what does that mean?" "Glad you asked," you know, and I can always go into something else; it just leads into conversations.

Jason believed that one of his skills as a teacher was the ability to have these conversations with students; beyond just providing a visually stimulating environment, he prided himself on listening to his students and keeping up with the music, television

[40] Jason was very interested in the genre of "infographics," or information graphics, the visual representations of data and/or information found in many news outlets. Jason's use of infographics in the classroom will be discussed in more detail later in this chapter.

shows, and movies they talked about, all in an effort to relate to them and connect science to their lives.

The teacher was responsible for creating a place where "wonder" could flourish, but Jason also suggested that students were waiting to be inspired in this way: "my students really want to learn, they just might not necessarily want to read that big blue book that I've got in my class." What SciJourn did, Jason said, was provide another opportunity for students to find their curiosity piqued. In his first year implementing SciJourn, he saw his students becoming interested in the news articles he was reading early in the year, describing the RATA as an activity that "opens up massive amounts of questions."

After laying the groundwork for writing through the RATA, when Jason assigned his students an article (or, in year two, an infographic), he said that many were inspired by the opportunity to learn about something they chose, rather than a teacher-determined topic. Unlike Barbara's classroom where very personal topics seemed to be the norm, Jason described his students as falling into four categories when it came to topic selection. First, he said, "you get the people that pick something because it's directly affected their lives." These were topics much like the ones Barbara discussed, especially diseases the student or a family member had dealt with. Interestingly, Jason felt that these students didn't necessarily write good news articles about their deeply personal topics, probably, he thought, because the material ended up being "a tough thing to talk about." At the same time, he described these students as "brave" and said that often they ended up learning things about their own lives or the lives of their family members that they never knew before: "they're asking their parents questions that they've never asked before, and their parents are answering questions that they've never had to answer before, and they're getting into some deep discussions because of this." A second group of students "have an interest in something that's a hobby or something like that and they end up trying to find something in that hobby area." These topics weren't as personal—they tended to be about sports or cars or other recreational activities—and Jason thought sometimes they became better news articles. Once again, the student was finding a science connection to something they were already interested in or knew about. Other students, Jason said, chose topics that were "just a cool idea." He described their topic selection as being:

> like they just threw a dart at the wall and it ends up, hey, that's where the idea landed. So, it might not even be an interest, it might just be this thought was flying through their brain and it just hit right at the right time when they were thinking about that topic and that's why they picked it.

He thought of his own experience selecting a topic (infrared technology for finding sinkholes) as falling into this category; student examples included a girl who wrote about why Scantron machines only recognize the marks of a number two pencil. While students in the first two categories connected science to an interest or experience that already existed in their lives, students in this group started seeing interesting science around them that they had not thought about before.

The final category of students was "the ones that don't care," a group that Jason acknowledged still existed despite his enthusiasm for SciJourn. However, he didn't see the presence of these students as a negative reflection on his teaching or on SciJourn. "There's nothing you're really going to do, as much as you try, to change that because they've got other things going on somewhere in their life," he said. Despite administrative and national mandates that all students must achieve, Jason and other teachers I spoke with said that in their classrooms there were always a few who were beyond reach. Jason suggested that this wasn't because of anything he did (or didn't do) and it wasn't because of anything the student did (or didn't do); it was because of outside factors that neither he nor the student was able to control. For the other three categories of topics, though, Jason saw SciJourn as providing an opportunity for students to be filled with "wonder" and then to go out and find information to satisfy this real curiosity.

The Blue Light

While Barbara described herself as a teacher to the core, Jason entered SciJourn unsure about his future in the profession. I could suggest many reasons behind the differences in these two teachers' attitudes toward their work—most obviously issues related to age and gender—but I would only be speculating. What I do know from talking to both teachers, though, is that Jason and Barbara had a lot in common, including a dedication to their students and a desire to improve their own practice. From what I knew about Jason, I don't think his frustration with teaching affected his performance in the classroom; in fact, it seemed to me that his high standards for himself fed into his frustration (rather the frustration lowering his standards). As Jason thought about the meaning he found in SciJourn, he talked as passionately about the way the project changed him as he did about the way the project affected his students, perhaps because he was in place where he was looking to be changed. Thinking about his state of mind when he entered the professional development, Jason said, "I don't know if I was bored or just fed up." While he admitted that even after two years of SciJourn implementation, "I'm not really ecstatic yet," he said that SciJourn created "a lot of excitement with my kids…and if you could have only seen that, that's what kind of builds on me."

As a person who was both curious and easily sidetracked, Jason found SciJourn to be a stimulating experience. It wasn't just that his *students* were learning new material, Jason was learning from SciJourn too. Perhaps most obviously, Jason was learning about the topics his students chose to research, something he didn't anticipate: "I really like it for the benefit that I didn't even know I was going to like it for, and that is I learn so much from the students." When they proposed new topics, he would go home and research those topics himself:

> they come in with an idea I've never heard anything about and the first thing I got to go do when I go home is type into Wiki or somewhere else, you know, what is this and figure out what it is, and half the time they're giving me mass amounts of knowledge.

Jason's description of his behavior was similar to how he described his students reacting to RATAs that sparked their interests: "maybe they'll go home and read about it themselves, and a lot of times they do after a while, once they realize that it's really that easy to go out, go find one of these good websites." Through SciJourn activities, Jason saw the entire class—students and teacher—inspired and interested in new science information.

He also found in SciJourn a place to learn more about another interest of his, the infographic. Prior to SciJourn, he had already come across the online magazine *Good* (www.good.is), which prominently featured visually dense information graphics that intrigued him. He began doing RATAs with infographics his first year with the SciJourn project. Teaming up with his school's educational technologist, during his second SciJourn year Jason allowed his students to choose either to write an article or create an infographic (which could be done in small groups). In order to make this project work, Jason had to do a lot of learning himself, including learning about technical programs—something he enjoyed doing—and learning how to evaluate a genre he was not expert in. He seemed to thrive in this situation, talking about a book he planned to write about infographics. Furthermore, when he explained his ideas to Newman, Newman became interested in the genre also[41] and was eager to work with Jason. The openness of the SciJourn project was one of the first things Jason liked about it and he was one of the teachers who pushed the SciJourn envelope the most. He also seemed to need a community of teachers and researchers who would support his creative ideas. Within his department and school, he said, he tried "to stay beneath the radar" and described other teachers as being critical of his "edutainment" approach to teaching. These criticisms caused Jason to get defensive—he described once telling another teacher, "it might be [edutainment] but I just outscored you by six points [on a common assessment]. So I still did all the edutainment and I kicked your butt."—and to try to avoid drawing attention to himself, although he was hopeful that a change in administration would translate into a change in school culture.

By far the most profound change Jason described in his classroom had to do with the energy teaching required. He told me that for SciJourn to be successful, his students

[41] During Jason's third year implementing SciJourn, several SciJourn researchers teamed up with him to propose a grant based on infographics to NSF.

had to be excited, which put extra demands on him: “I have to stay sharp on what’s going on currently, I have to stay up to date, I have to read, I have to have a wider knowledgebase than I would have had to have before.” He also said he had to be a better teacher during non-SciJourn activities because:

> they kind of expect more the rest of the time…if I’m going to do that [SciJourn] at the end of class I’ve got to keep them interested all the way through class or else they’re just going to flop when you get to that stuff.

However, all of this extra effort was worth it, Jason said, because SciJourn helped create an environment in his class where he wasn’t the only one giving. He told me about a philosophy he had read once centered on the concept of the “blue light,” a kind of positive energy that everyone had in limited quantity. According to the theory, people could pass their positive energy back and forth but relationships broke down when one person was taking too much of the other’s blue light. For Jason, this philosophy explained some of the challenges of teaching:

> I think that happens in a class a lot too, we give all day long…I literally give *will*, my will to the kids all day long. I am beyond just saying, “Hey you need to learn this,” I am actually willing them to learn and giving them part of me all day long, and that’s that blue light. I literally sometimes feel like I’m just like handing it out wholesale, and as teachers at the end of the day we’re usually down to that little sliver, and that’s why a lot of us have relationship problems, I think, at home is because we’ve given everything away and then our spouse wants us to give some more. “No, I’m done for today, I’ve given my amount for the day.” And the next day, we turn around and somehow we’ve built it back up overnight and we give

> everything away again the next day, and I think a lot of teachers get to the point they just don't give up as much.

What happened through SciJourn, Jason said, was that his students started returning some of that energy back to him so he didn't end the day so completely depleted:

> And I know that sounds very cliché and very, but it really is how I see it…it really is how I feel is that this project has allowed them to give some stuff back to me, and even if they're just asking questions, they're asking questions more than just "Where does this fall on the test?"…it turns from "do I have to?" to "I can" or "can I?"…There's days during SciJourn stuff that they walk in class and I feel ten years younger because they're all excited and they're just shoving energy back at me. You know, most days you're shoving as much energy as you can…most teachers walk in and if you want to be good, you have to shove so much energy into them. But with this stuff some days I'll walk in the door and I'm getting high fives and everything else and they're shoving tons of energy at me, and that's a change from what I had before.

The Importance of Genre?

For Jason, SciJourn was clearly a positive experience; however, as impressed as he was with the SciJourn project, he was not entirely convinced that actually writing a science news article was important. Underlying many of his comments throughout all of our conversations was a tension between the "real" quality of the experience as he emphasized it to his students and the idea that "nobody really cares about the article" but that what matters are the habits of mind that are manifest in an article. Although his expansion into infographics presented unique challenges—including how to find free use pictures and how to give feedback when neither Jason nor Newman were “experts” on the genre—Jason basically saw infographics as a different means to the same end:

> the format’s not as important as the sources and you getting your research done. Like, ideally nobody cares about the article, who cares about the infographic, if you can get them to go look up the information on their own time and get decent information and…more importantly decide whether it’s good information or bad information, that’s what this is all getting down to…if you’re looking at science literacy…that’s just an avenue to get them to do what you want them to do.

Although he didn’t explicitly refer to the idea of authenticity, I heard a lot of what I had been hypothesizing in Jason’s words, yet we seemed to draw different conclusions from the same evidence. As I saw it, authentically using the genre of science news writing or infographics *forced* students to “do what you want them to do;” for me, the genre was critical. Jason, though, seemed much less certain.

X. From “Red Headed Stepchild” to “Golden Child:” Tom

The third pilot teacher to volunteer to be interviewed, Tom (a White male in his 60s) had been teaching for thirty-two years when he joined the SciJourn project. During the two years Tom implemented SciJourn, he worked part-time at a suburban school[42], teaching two sections of tenth-grade physical science. After Tom’s second year with SciJourn, his district eliminated all part-time teachers and Tom reluctantly retired. When we spoke, the school year had just ended and all three of Tom’s interviews had a reflective tone to them as he looked over a career that had just ended. As a child, Tom never intended to become a teacher, dreaming of a future in music or sports instead, but, as he told me at the end of one of our talks, “To be honest with you, other than being the fifth Beatle or the centerfielder for the Cardinals, there’s not another job in the universe that I would have rather had.”

Like Barbara and Jason, Tom seemed happy to talk with me, although I did get the feeling that Tom was more conscious of the fact that he was participating in an “interview” than I did with the others. His answers felt a bit more scripted and less conversational. He told me early on that he had been a “teacher pleaser” from a young age, and I wondered if he saw himself speaking to the SciJourn professors through me. As I learned during the course of our interviews, Tom wanted to be liked and respected by the project’s principal investigators, namely Saul and Newman, which may have

[42] According to the state department of education, as of 2010 (Tom’s final year teaching), Tom’s school was 85% White and 12% Black; 19% of students were eligible for free or reduced price lunch. Nearly 1400 students were enrolled.

partly explained the tenor of our talks. Despite this, the experience of interviewing Tom was enjoyable; we met once at the university and twice at a café halfway between our two houses for each of the three interviews that easily filled the allotted time. Tom represented a third implementation strategy, one that was quite a bit more limited than Jason's and Barbara's, and I was interested to hear him talk about the meaning of this experience.

"I Didn't Like French"

Tom grew up in the 50's and 60's, with a father who was a carpenter and a mother who was a "homemaker." He described his childhood in idyllic terms:

> I think the late 50's, early 60's was the perfect time for a kid to grow up…In the summer we could leave the house in the morning on our bikes and not get home until dark and our parents never knew where we were, but they knew that we were safe.

Tom's parents expected him to respect his teachers—"I was always told the teacher is an important person and you do what they tell you to do"—and he developed into "teacher pleaser" at an early age. He spent his elementary years at a small school affiliated with his church and remembered most subjects, especially writing, being fairly easy for him. Tom published a few articles in the elementary school paper and brought these home for his parents to read (Tom said that just a few years before his mother had found a box of his childhood things, including copies of this newspaper); he also wrote short stories. Science was not emphasized at his elementary school; the science curriculum consisted of "once a week they would bring the TV out, we would watch Mr. Wizard or something like that on [PBS]."

After sixth grade, Tom moved from this small school—"probably a grand total of twelve kids in grades 5th and 6th combined"—to a large public junior high with over 1,000 students. The transition was hard for him; he described learning to use a locker combination and navigate the large building as "culture shock." He took traditional science courses (including life science, earth science, and physical science), but didn't remember any of them as being particularly interesting to him. As he moved on to public high school, he continued to enjoy sports and music, although he said he relied on natural talent and "never really developed a hard work ethic at that time toward things that didn't come easy." This was not true of school, where he characterized himself as a hard worker and a rule-follower. He took chemistry class his sophomore year rather than biology—"you know the kid that doesn't want to take biology because they might have to cut things up? I think that might have been me."—which gave him two science credits (the other being the physical science he took in ninth grade), double what was needed at the time for graduation. "That was it for me," Tom said. "I took no more science."

In his junior year of high school, when Tom realized that he probably wasn't going to have a career in baseball or rock and roll, he began to seriously consider other options. His girlfriend (and future wife) suggested that he become a doctor; he thought he could be an optometrist. He and his girlfriend both enrolled at an in-state public university about two hours from their home and married after their first semester. It was here, during a biology class the summer after his freshman year of college, that Tom first "got really turned onto science." He remembered very clearly "the exact moment":

> We were doing a lab on skin, like skin recognition, hot/cold, and we put our arms in, one arm in hot water one arm in cold water, left them in there for a couple of

> minutes, and then we pulled both arms out and put them both into temperature, or, room temperature water and the one that had been in hot felt cold, the one that had been in cold felt hot, and something about that just hit me.

From this class on, he was interested in science. This excitement continued even after he discovered he would have a hard time getting into one of the four optometry schools in the country and even after his wife got sick and he transferred schools so they could move closer to family. Transferring schools was a key event in his path toward teaching. He planned to be a biology major; as a requirement for the degree at his new university, he had to take three semesters of either French, German, or Russian but, after one semester, he realized, "I just absolutely hated French and I thought, if I have to take two more semesters of French I'm never going to get through college." Looking through the course catalogue, he discovered that he could major in biology through the college of education without having to take a foreign language and, therefore, "I became a science teacher because I didn't like French." It was a practical solution, one that caused him the least difficulty—a theme that would emerge later in his SciJourn implementation strategy.

Tom began his teaching career as a junior high school teacher and spent a total of fourteen years at that level, most of them teaching ninth grade. When his district moved the ninth graders to the high school, Tom went with them. There, he taught several different courses, including AP biology, but his primary assignment was physical science, the required ninth grade science course for a number of years. When the district changed the curriculum so that ninth graders took biology, Tom's "clientele" changed: "tenth graders who don't do well in biology are the ones that are taking physical science," he said. It was with this group of students that Tom eventually implemented SciJourn.

Tom's SciJourn Experience

The Professional Development

Tom described himself as someone who was constantly seeking out professional development opportunities: "I was always taking classes, taking workshops, taking summer institutes, anything that would either increase my skills in my curriculum or increase my skills as a teacher." He had completed his master's degree early in his career and had once been enrolled in a doctoral program but was discouraged by a professor who:

> kept talking about three D's and he said first you do your dissertation, then you get your doctorate, and then you get your divorce because you haven't seen your spouse for that year and a half while you were doing your dissertation.

Tom said a doctorate wouldn't have been particularly useful to him since he wanted to stay in the classroom (rather than moving to the university or going into administration or counseling). Instead of pursuing the PhD, he decided to take advanced courses that seemed directly useful to his teaching; as a result, "I have graduate hours from like 12 different colleges."

He joined the SciJourn program at the urging of a colleague who taught a research course at their high school; in the class, students spent three years designing, executing, and writing about their own science research. A student was interested in doing a project on student science literacy and had learned about the SciJourn program. She was hoping to research its impact and needed teachers from the school to implement the project and gather data for her. Tom said, “I thought, okay, why not, you know, I didn’t have anything to do that summer.” He had long been interested in science literacy and the stipend seemed “pretty good,” so he enrolled.

Tom’s experience in the professional development was quite different from Barbara’s and Jason’s. While Jason enjoyed the fact that SciJourn wasn’t a “definitive” program that had to be implemented exactly the same way by all teachers, Tom was disconcerted by what he saw as the professors “kind of feeling their way through about where we were going and what we were going to do.” Tom described himself as “an organized person” and said that the professional development wasn’t well organized, from the curriculum to the daily schedule. He “felt like the blind were leading the blind” and said that “there were several times that first week that I thought, man, why am I coming all the way out here to do this?” In particular, Tom didn’t enjoy being asked to create activities and write units, which he said had never been one of his strengths:

> I’m not a creative person. I’m very good at following rules…and so it takes me a long time to come up with an activity and it wasn’t what I wanted to do, I guess. In that situation, I wanted to learn to use science journalism to help kids’ scientific literacy, I did not want to write the curriculum and so that was very frustrating to me…I felt like we were being asked to write curriculum rather than being taught how to use a curriculum and I didn’t, I guess going into it I didn’t understand that’s what we were going to be asked to do.

In retrospect, Tom said he understood that the pilot group served as the “beta testers” for the program and, therefore, some uncertainty was to be expected, but he struggled with this uncertainty during the experience itself. Unlike most SciJourn teachers, Tom portrayed himself as a consumer, not a producer; he wanted to be given activities, not to make them himself.

Yet Tom found writing an article fairly easy. Someone who considered himself "not creative," Tom appreciated being given topics to choose from:

> When you just say okay, you can write about anything, oh my goodness, you know, you've got to start with all of these wild ideas and all of these big topics and then narrow it down. Well, if you're given the big topics then it helps. Okay, we've got that part done, we've got all the wild thinking and the crazy thinking done and now we can start narrowing down.

Tom chose to write about the state's renewable energy initiative, taking the angle of whether the utility company would be able to meet the target goal for renewable energy by the legislated deadline. Internet research went smoothly and he emailed sources on two sides of the issue with questions; both responded. Of the writing itself, Tom said, "of all the things we did those three weeks, the writing of that first article was the easiest for me." Using Newman's provided diagram (see Appendix H), Tom called writing an article a process of following rules: "I knew those rules and could follow those rules." Unlike Barbara and Jason, who clearly remembered getting Newman's feedback, Tom said, "I think the only feedback I got was 'It looks good.' I mean, I don't remember receiving much negative feedback at all." Tom's article was one of the first to be published online and came out in print in the fall.

Tom did write a second article, but didn't understand why he was required to: "the feedback I got on mine [his first article] was it was good and so I thought well, why do I have to write a second one? I didn't really want to go about doing that." In order to make the experience useful to him, Tom decided to write an article from the perspective of someone living in the 1800s when the periodic table was changed; he said he “intended to share it with my students” but that Newman and Saul “weren’t real crazy about…the fact that my attributions were all to people that are dead now because I was writing it as if I was living at that time.” This wasn’t the only time he felt that he was disappointing the professors: “that first three weeks I always felt like I was the red-headed stepchild. I don’t think Wendy [Saul] and Alan [Newman] were very happy with me because I said right, pretty early on I wasn’t going to have my kids write.” In both of these instances, Tom’s ideas about writing conflicted with Newman and Saul’s vision of writing in the project. Newman and Saul emphasized getting students to act as “real” science journalists, which meant that students would have to grapple with the ever-changing nature of scientific information and would have to consider the opinions of various experts and stakeholders. These goals couldn’t be met if the topics were historical and they certainly couldn’t be met if the students didn’t write at all. For his part, Tom explained his decision to not incorporate writing with his students this way:

> most of those kids were at the lower spectrum and I just didn’t feel like I would be able to teach them how to write, and get them to write…Also I didn’t feel like I wanted to teach them how to write. I guess that was the other part of it. I don’t mind teaching the science and I don’t mind having them do research on their own and pick a topic that they like, but I just didn’t want to teach the writing aspect of it, and then when you take into account that having taught physical science for as long as I have, and even as streamlined as I’ve made it, I’m still rushing at the end to get what I have to get done both semesters. I just didn’t see any way that I

> could take time out of my curriculum to get all the curriculum I wanted to teach, plus teach them a unit on how to write the thing

Tom articulated two obstacles to implementation that were echoed by many other SciJourn teachers: finding time and teaching writing. For someone like Tom—a teacher who didn't like to create his own curriculum, who had taught the same course for years, and who was nearing retirement—these obstacles were portrayed as insurmountable. Tom presented his students as incapable of writing an article without a great deal of help, help that he wasn't sure he wanted to—or could—give. Perhaps to justify his decision to avoid the writing, Tom concluded that writing an article was necessary to the underlying goal of improving student scientific literacy. Tom perceived the objective of SciJourn as:

> for a student to be able to understand what they're reading, to be able to understand what an attribution is and why we should care that person has an opinion on it, that there should be, that there's two sides to every argument and that those two, that the other side should really be presented as well, and to be able to see the difference between a quality source and a source who's just in it for the money.

According to Tom, it was possible to expose students to these ideas, which he agreed with, without requiring students to write. Like Jason, Tom thought the RATA was a powerful technique:

> I knew that [the RATA] was something I could do quickly, easily, and I could get them [students], with the exception of doing their own research, I could get them everything that I thought they were trying to accomplish in the class with the read-aloud by doing them daily.

Tom may have initially been drawn to the RATA because it was the most polished activity that had been presented to the pilot group; everything else the teachers were actively constructing, which Tom resisted. He also may have liked it because it left him at the center of the class, a position that he would tell me was most comfortable for him (this will be discussed in more detail later in the chapter). For whatever reason, at the end of the summer, Tom went back to the classroom armed with a single new activity and ready to help his colleague's student discover if that activity had an impact on his students' science literacy.

"A Closer Connection": The Power of the RATA

In order to help the research student with her project, Tom developed a quasi-experimental design for his SciJourn implementation. He was teaching two sections of physical science that fall and, by flipping a coin, chose one to be his "experimental group" and one to be his "control group." The classes would be taught in exactly the same way with the only difference being the daily RATA in the experimental class. Both classes took a pretest at the beginning of the school year and a post-test at the end of the first semester, tests Tom had developed himself using questions he found online that purported to test both science literacy and attitudes toward science (the test Tom gave had not been formally validated).

Tom began his experiment with the hypothesis that the RATA would improve the students' scores on his test. He explained, "if nothing else the kids were going to see that science is in the world, that it's not the case that we learn it in the classroom and then we never ever use it again." Starting in the second week of class, Tom read to the students in his experimental class each day that they didn't have a lab or a test. Based on his experience in the professional development, where journalistic form was heavily emphasized[43], Tom focused his initial RATAs on the lede of an article: “by the end of the [first] week, I would say, ‘Okay, guys, is this a good lede? Is this a bad lede? Does this make you want to read?’” The following week, he still discussed the lede but added comments about the “who, when, why, where, how.” As he continued doing RATAs, Tom said, he started to realize that these weren’t the important questions. “What’s more of a big deal is the attributions, the credible sources, are two sides listed, why is that a credible source,” he told me. Over time, he emphasized the lede and the five w’s less and began asking questions like “who is this person? Why should we listen to this person? Why should we care what their opinion is? Do they have a hidden agenda?” Tom thought that teaching his students to ask these kinds of questions would be an important step toward improving their scientific literacy.

As he thought back on that first semester, Tom said that it was about three weeks into the school year when he started noticing an impact. He sounded quite similar to Jason when he described the moment:

> really when I found I was making headway with the group was when kids were coming in to me and saying, “Hey, I saw on the news last night…are you going to read us an article about this, it’s scientific?” And so I thought, okay, I’m getting them.

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[43] During the Cadre I summer professional development, instructors placed much less emphasis on the format of the article, emphasizing the newly revised SciJourn standards instead.

After a few more weeks, Tom started to ask his students questions during the RATAs: “I was explaining to them how I thought and I was starting to ask them what they thought and how they thought.” Tom’s students, used to being lectured to or asked questions with right or wrong answers, did not initially respond to his questions but after “about another three weeks…they realized that when I ask questions I expected answers.”

Tom’s experiment had several results. First, the results of the quasi-experimental research did show a greater increase in the scientific literacy (as measured by Tom’s test) in the experimental group than in the control group. More importantly for Tom, he felt “a much greater connection” with the experimental class than he did with his other section “because they got to see how I thought and I got to see how they thought and they got to hear my opinions and I got to hear their opinions.” Tom also saw the RATAs influencing other parts of the class. Prior to SciJourn, Tom’s class typically consisted of a lecture where students would “sit and listen;” after SciJourn, Tom’s experimental class “would stop me and ask me questions if they didn’t understand something; they would offer their own opinions on things.” It was a subtle change, but one Tom noticed and valued. Once the first semester ended and the research student had collected all of her data, Tom began doing near-daily RATAs in both classes. Suddenly he was feeling that “kinship” with all of his students. Tom concluded, “it wasn’t me, it wasn’t them, it was the reading of the articles.” By the end of that first year, Tom said, “as long as I was teaching physical science, I knew that I was going to continue doing this.”

Tom also saw his experiment with RATAs as redeeming himself in the eyes of Newman and Saul. He described attending the follow up professional development meetings and seeing the professors’ interest in what he was doing:

> I think they saw that their SciJourn program had different ways it could go and still be successful, because I wanted, I don't know that Wendy and Alan really understood that not every teacher can take the time out of their curriculum to do this the way they originally wanted us to do it. So, I think I went from being red headed stepchild to a golden child.

Interestingly, Tom saw himself as doing something "different" with the program, while some on the research team characterized him as implementing in a more "limited" way. However, Tom saw his interpretation of events affirmed in the book the research team published about the project (Saul et al., 2012); he read a draft of the text with interest and was excited to see his own experiment discussed in an early chapter.

Making Meaning

In terms of "meaning," Tom's interview transcripts were probably the hardest for me to analyze. At times, it seemed that he was telling me what he thought I wanted to hear, rather than what really happened in his class. The fact that he was retiring—against his wishes—also complicated things. Often he talked about what he would do with SciJourn in the future, even though we both knew he wasn't going to be teaching in the near term. When Barbara was thinking ahead to the next year, her plans had a very practical (and often logistical) quality to them, but Tom's comments sounded to me like "if only" statements—he would have implemented SciJourn more "if only" certain things were different, an untestable proposition.

Yet, I believed that SciJourn did have meaning for Tom; it just might not have been the meaning that the research team was hoping to see. While six of the pilot teachers either never implemented at all or dropped out of the program after one year, Tom remained active in SciJourn for two years and claimed he would have continued had he not retired. Although he was not a "high" implementer in his classroom, he was highly involved as a teacher participant, attending all of the follow-up meetings (even those that were held at night, despite the fact that his drive into the university was nearly an hour each way) and contributing to conversations when he was there, collecting data for the various research initiatives the project involved, reading and commenting on drafts of the book written by members of the SciJourn research team, and (obviously) volunteering for my interview research. After talking with Tom for so many hours and reading and rereading the transcripts of these talks, I concluded that these two themes were important to his experience:

- SciJourn gave him a chance to interact with other teachers around issues that he believed in, even if he did not translate these beliefs into action.
- RATAs gave him an opportunity to implement SciJourn while maintaining a style of teaching and a classroom persona he felt comfortable with.

As always, I also analyzed Tom's transcripts for what he had to say about authenticity and genre, topics I will discuss at the end of this chapter.

"Belief," Action, and "a Chance to Socialize"

When Tom looked back over his career, he told me "science literacy has always been my thing" going back for several decades. He defined "science literacy" as "being able to use scientific knowledge to be able to make decisions that are scientific in nature." Acknowledging that this definition included the word "science" in it several times, Tom elaborated by explaining that scientifically literate people are those who recognize that many decisions have a scientific component, who can recall appropriate science content and apply it to the decision-making process, and who can research all sides of an issue in order to make a decision rather than relying on a single source. He initially became interested in the idea of science literacy when he was still a student teacher; he remembered his university professor asking the class, “What does a plumber care about a mitochondria?”, a question Tom interpreted as pushing the future science teachers to think about the applicability of the material they were presenting to their students. “Science literacy,” Tom said, was different from “science facts;” he described most administrators as being too worried about the latter at the expense of the former. Tom’s definition of “science literacy” was fairly similar to the “fifteen years out” definition advocated by SciJourn (see Chapter Five). He also claimed to find other parts of the SciJourn process valuable, telling me that SciJourn “gives them [students] the opportunity to write, it gives them to opportunity to speak to somebody face to face, and it gives them the opportunity to see that science is a viable part of their life every day.” (Interestingly, two of these three “opportunities” would only occur if a teacher assigned an article). At the end of our third interview, the last thing Tom told me was, “It [SciJourn] gave me another way of looking at science literacy, and I’m really glad there’s somebody out there that’s working at science literacy…and I think it’s a good way of going about it.”

Although he did not see assigning an article to his physical science students as a real possibility, Tom suggested several other contexts where article-writing would have been a good fit. One was a class called “General Science” which he had taught earlier in his career. Tom told me, “I wish I would have known about this program [SciJourn] eighteen years ago when I was teaching that General Science class;” it was a class with no mandatory curriculum, designed for students who “adamantly did not want to be in school.” Tom thought that without the pressure to prepare students for the next science class, a pressure he said he felt with his physical science class, he would have more time to ask students to write and revise an article; he also said that General Science was a course where he always tried to make the curriculum about what the students were interested in, and asking them each to choose a topic on their own to research and write about would have fallen right in line with what he tried to do. A second course where Tom suggested SciJourn may have worked was an elective he taught for the first time the year before he retired called “Project Lead the Way.” The course was based on a national curriculum and, in his first year, Tom said he didn’t know whether or not there was any flexibility; however, he told me, “to be honest with you if I would have taught that a second time I think I would have chosen to have them do an article in one of the subject matters.” Whether or not Tom would have actually asked students to write a news article in either of these contexts is impossible to say.

In the previous section, I described some of the reasons Tom gave for not requiring his physical science students to write an article. In our third interview, he elaborated on the lack of time and flexibility he felt in the physical science curriculum, a curriculum that was revised every six years at the district level and then approved by the school board. Tom’s school district, one of the best performing districts in the state, was not extremely rigid about the curriculum: “It’s not to the point where every physical science teacher is doing the same thing on the same day and has the same worksheets and the same tests,” he said. “But every physical science teacher is expected to cover these topics.” Tom considered it his duty to follow the curriculum, regardless of the fact that if he didn't "probably nobody would know." As he reminded me, he was a "teacher pleaser" who "firmly believe[d] that you have to do what you have to do." At the same time, Tom also was "a very strong advocate of the physical science curriculum" and had helped to write the curriculum during his career. When I asked Tom if he, as a curriculum writer, had ever tried to include his definition of "science literacy" into the mandated curriculum, he seemed surprised:

> I never tried to get, and thinking back on it now I should have, and maybe if I was writing a physical science curriculum today I would try to change some things so that we could work SciJourn into the curriculum so that maybe we would learn one of the things through a SciJourn project rather than another way. But no I did not and I, you're the first person that ever made me think about that and I feel bad that I didn't.

Tom appeared to honestly believe in the following things: the importance of science literacy, the value of SciJourn to some students in some contexts, the physical science curriculum at his school, and his inability to use writing in his physical science class. While his belief in all of these things seemed genuine, he also did not appear to make any attempt to reconcile the inconsistencies within these beliefs. Other SciJourn teachers working with students at (or below) the ability level of Tom's physical science students, under similar curricular constraints, had found a way to incorporate at least an extra credit writing assignment, something Tom had not tried. Tom's proximity to retirement probably played a role in his reluctance to take on anything too new or difficult, although other SciJourn teachers at a similar point in their careers had done much more. His level of implementation probably had as much to do with his classroom persona (discussed in the next section) as with his age.

Tom claimed that his interest in science literacy was the primary reason he stayed involved in SciJourn to the level that he did, but a second factor, he said, was social. Recalling his first impressions of the group of pilot teachers, Tom said he was impressed:

> It seemed like everybody had a passion for what they were there for. It didn't seem like your typical professional development where, oh, we have to be here, it seemed like everybody was there because they really honestly wanted to be there.

As the three weeks went by, Tom said he "learned a lot from" his fellow teachers, as much as he learned from the instructors. When the professional development was over, he said he felt like "we formed pretty strong bonds, that first group" and coming back to meetings was "a chance for me to socialize a little bit too." He may not have been a high implementing teacher, but Tom seemed to enjoy being a part of the group, identifying strongly with the main ideas behind SciJourn and participating in activities away from school, while at the same time limiting his classroom implementation to a minimum.

Teacher as Storyteller

When Tom explained his teaching style, he told me he was "an old fashioned teacher" who lectured most days of the week. However, he considered himself a "lecture storyteller," a role he saw as different from a more traditional "listen to some boring guy talk about some boring topic" style. Tom said that he tried to show his students how interesting science was by demonstrating how interested *he* was in science. Calling himself a "science nerd" who could "see the science in real life," he said he peppered his lectures with stories he drew from his own experience, using the following criteria for selection: “it’s got to be interesting, it’s got to relate to what I’m teaching, and it’s got to be…something that I can embellish a little bit.” Tom saw entertaining lectures as the way to reach students, telling me that “if you see your teacher actually enjoying the science that they’re teaching you, you’re going to do better, you’re going to be caught up in it” and that “the teacher is key to any class.” Tom saw his own role as critical to the success or failure of his class; furthermore, he consistently presented himself as a successful teacher. He appeared to have no doubts that his teaching method was effective.

Against this backdrop, Tom’s decision to only use RATAs with his students made a lot of sense. As he told me, “you can tell stories along with the read alouds;” RATAs did not demand that he alter his persona in the classroom much at all. He remained the central figure in the class, something he would have had trouble doing if all of his students were researching and writing different topics, especially if they were topics Tom didn’t know much about. Instead, by selecting and reading the articles himself, Tom preserved his control of the classroom and the power, something he seemed to believe was in his students’ best interests. The rationale behind this belief became even clearer to me when I looked at the way Tom described his role as a *physical science* teacher. Physical science students, he said, may or may not go on to take additional core science classes like physics and chemistry; consequently, his course might be the only time they encountered certain concepts in their high school careers. Tom believed that “if you have a high school education you’ve got to have been exposed to chemistry and physics,” making it his responsibility to “expose” the students to these ideas. I found the word “expose” to be a revealing one; Tom used it seven times when he talked about the physical science curriculum. In the RATA he could remain the sage on the stage, the role he found enjoyable and his raison d'etre for teaching.

As a teacher, Tom didn't portray himself as responsible for *teaching* these concepts or helping his students make active sense of them; he was responsible for showing ("exposing") them to his students. He was the actor and the students were in the passive, receptive role. Through the RATA, Tom could "expose" his students to more science, particularly more "real world" science. When he thought about the meaning he made of the RATAs, Tom said that they gave him an opportunity to point out that "a lot of the stuff we teach in our classes really is real world applicable," something he had always told his students but, through RATAs, could "show them." Once again, Tom was the one who was making these connections; the students were listening. Over time, Tom described the students as participating in the RATA (and more often in the rest of his class) by answering his questions, but he continued to depict himself as the one who asked the questions. As I said earlier, the role shift for Tom appeared to be a subtle one.

Genre and Authenticity

For Tom, writing a science news article was a fairly easy task, a fact that may have actually played a part in his decision *not* to have his students write. While other teachers described the writing experience as a difficult challenge that they overcame (and were publically honored for in the form of their published articles), Tom described the experience as enjoyable with no significant obstacles. His published article was an "ego boost," he said, but nothing more (other teachers referred to their articles almost as a badge of honor, an issue that will come up in the following two chapters). He also did not see writing in general as important to his thinking, telling me that "for me, writing is a tool. The researching is a learning process, but the writing itself to me is not a learning process." Ideas about genre did not factor into his comments at all; although he had never written a journalistic piece before, he saw writing in this format as simply following a different set of "rules," something he was capable of doing, rather than as something drastically outside of his experience. Once he had written the first article, he suggested that he had mastered this new genre and was annoyed that he was asked to do a second.

Tom also didn't seem to value the functional authenticity of the writing experience. His second article topic, written from the point of view of someone living in the 1800s, wasn't appreciated by Saul and Newman because it couldn't be written about with functional authenticity. Other pilot teachers had pitched similar story ideas—articles written from a historical perspective—and had also been discouraged by Saul and Newman, so Tom hadn't been alone in this thinking. However, I found it interesting that he still didn't seem to understand Saul and Newman's point, even years later. When reflecting back on that article, Tom said, "I did look up what people had to say about it at that time, so you know I tried to give everything in there that I could."

As I thought about Tom's ideas about this second article and about the project in general, I saw his approach to SciJourn as being much like my earlier ideas about genre in my English classroom (discussed in Chapter III). Tom seemed to see SciJourn as useful for entertaining his students around science topics, but not as an opportunity to empower them to find information for themselves or to research what *they* wanted to understand. He also described his 1800s article as "a good way of helping them [the students] to understand that that [the change in periodic table] would have been a very newsworthy event at the time." Notably, Tom also didn't seem to see science news as changing *his* relationship with content; he already knew that the periodic table change was significant and could use this “news” article to make this clear to his students. Furthermore, when he did RATAs he didn’t talk about wondering aloud about content with his students the way other teachers did. He focused more on credibility and other questions that he would have been very comfortable answering himself.

Even when Tom described hypothetically having his “Project Lead the Way” student write an article, he connected the article writing to an existing assignment that sounded to me like a classic “cheese-on-vegetable” project—the students were to propose an invention and present it to a group of teachers playing the part of “investors.” Tom thought that a good writing assignment would have been to have the students write a press release about the invention to go along with the presentation. While this would have probably been enjoyable, it would have been more like role playing than an authentic experience; writing a press release about a hypothetical invention wouldn’t have required the students to think more deeply or grapple with any more information than simply doing the presentation would have. The assignment would have had latent, not functional, authenticity.

Despite the fact that he never asked students to write, Tom did report changing one of his assignments in a way that reflected a new understanding of genre. For years, Tom said, he had required that his students read science news articles and report on what they had read. He called his assignment “just a generic ‘tell me what it was about and whether you liked it and why’” before he became involved with SciJourn. Once he joined SciJourn, he said he became “more specific” in his requirements: “now I’ve got ‘who are the attributions? Are they credible attributions? Who else would you have liked to seen?'" all questions that he had not considered prior to his involvement with SciJourn.

Of all the teachers I interviewed for this study, Tom appeared to change the least. For a man who had once dreamed of being a major league centerfielder or a member of rock band, SciJourn gave Tom a chance to continue to be the star in his classroom. It wasn't what the project was designed to do, but Tom seemed to get value out of it and to forge relationships with his students that had been impossible in the past. While not the intended outcome, it represented a certain kind of success.

XI. "Rollercoaster, Rollercoaster, Rollercoaster:" Shelley

A member of Cadre I, Shelley (an African American female in her 30s) was different from my other interview participants in a few important ways. She was the only teacher I interviewed to work in a school with a high concentration of poverty and where most of the student population read and wrote below grade level[44]. A former employee of the Food and Drug Administration (FDA), Shelley was the only teacher I interviewed who had experience working as a scientist. She also was the only teacher to begin teaching through a career transition program, where she started in the classroom with no formal training. At the time she joined SciJourn, she had been teaching for nine years.

I met Shelley (and the other Cadre I teachers) for the first time only after their professional development workshop ended. In the fall of Shelley's first implementation year, we on the SciJourn research team tried to visit each classroom at least two times to gather observational data (we were also available for support and assistance as often as the teachers requested); however, we struggled to get invited into Shelley's classroom. She was one of three SciJourn teachers in her building and every time researchers were there to observe or assist one of the other two, they dropped by Shelley's room to say hello. Shelley often looked sheepish during these quick visits, claiming that she would be contacting SciJourn soon. The team waited to see whether or not she would follow through. Although we couldn't observe her in her classroom, she did attend the SciJourn follow up meetings held during the school day and was an active participant at these

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[44] According to the state department of education, as of 2011 Shelley's school was 97% Black, with 70% of students eligible for free or reduced price lunch. The enrollment was approximately 1500 students.

sessions. My first impressions of Shelley were that she was a committed, professional teacher; she didn’t get overly involved in the socializing that happened during breaks but was attentive during the workshop activities, regularly asking questions about how the material presented might be adapted for her student population. She seemed like many other SciJourn teachers, sold on the ideas behind the project but finding it hard to get started.

And then she got started. By the end of her first year with SciJourn, Shelley had more students published in *SciJourner* or on scijourner.org than nearly any other teacher in the project. This was despite the fact that she was teaching “regular” (not pre-Advanced Placement) chemistry in a struggling school and hadn’t found her footing until nearly the semester break. Newman was impressed with Shelley’s students’ ability to tell “stories” drawn from their own lives, even though they had to be pushed to understand and write about the relevant science. Like Barbara’s students, Shelley’s students often wrote about very personal topics, including diseases and medical conditions of family members. As the school year wound down, Shelley had transformed from one of our most enigmatic teachers into one of our stars.

When Shelley responded to my request for interview volunteers, I was excited to hear the story of this transformation from her perspective. All three of our interviews took place in her school building after summer school had dismissed for the day (she was teaching credit recovery chemistry). Although Shelley was somewhat private about her personal life, she came alive when talking about her education, her students, and her work with SciJourn and I was swept up in the stories she told.

Learning to Love the Students

As a child, Shelley said, she was a "bookworm." The middle of three daughters raised by a single mother, Shelley said that reading was her family's main form of entertainment. Watching television was against their Pentecostal beliefs and her mother didn't allow the girls to play outside in their low income neighborhood. On each trip to the library, Shelley and her younger sister used to check out the maximum number of books allowed, "swapping" as they finished so they could each read twice as much. An early reader, Shelley skipped kindergarten and began first grade at a small church-affiliated school where the students sat "in a partition, you couldn't see each other." The curriculum consisted of "paces," or workbooks that the students completed individually; the workbooks were based on stories, with each subject taught through a religious lens ("religious science stories," "religious history"). Shelley said she "was flying through the curriculum because I enjoyed the stories and I just wanted to know what was going to happen next." Because the students were not allowed to talk to one another (even hand-raising was forbidden; students each had flags at their desks that were raised when they wanted the teacher's attention), Shelley said she "made up these little games and stuff to keep myself occupied," including challenging herself to complete each pace faster and more accurately than the one before.

When Shelley was in the fourth grade, her mother, concerned about the school's academic rigor, enrolled her daughters in the city's desegregation program and the girls began taking a two-hour bus ride to a suburban school south of the city. While Shelley called the academic transition to this new school fairly easy for her and her younger sister, it was socially difficult:

> we were on the bus with all the kids who were like, we called them "project kids," who were extremely bad, and so we were scared to death, and it was a long bus ride…It was a transition because the Christian school was all White and so they said I talked White, and I was used to having White friends, and then when I got to the other school it was mostly White but those Whites were taught that Black people, they called us names and all that, they were not for the deseg program, and they put that in their children. And so when I went to be with the White people because that's what I was used to, I was not accepted, but then I didn't know how to hang with the Black people because I had never been around them, and so it was hard for that reason.

Shelley said her quiet personality also made it difficult for her to make friends but that her experience at her first school taught her that "you can be by yourself and it's okay."

Shelley's mother was determined that her daughters graduate from college, a goal that Shelley shared from a young age. "My mom dropped out of college and she said the reason why we were poor is because she dropped out of college and had a baby. So, my goal was to go to college," Shelley said. When Shelley's older sister had trouble getting into a university after graduating from high school with good grades, Shelley's mother got the two younger girls into a different high school, this time in a western suburb. Shelley was a sophomore when she transferred schools; she said that the bus ride was longer, the science and math classes were harder, and the social scene was fairly similar.

Shelley traced her interest in science back to her junior year in high school and credited her "awesome chemistry teacher" with inspiring her. Based on her transcripts, when she transferred schools Shelley was given the option of enrolling in honors science or honors math classes: “I don’t remember what the logic was but I chose the science, and I don’t know why to this day because I don’t remember having such a positive science [experience].” She found the classes challenging and her classmates intimidating because “their parents were doctors and lawyers and they were asking questions that I had no clue what question they were asking,” yet she was very interested in the subjects. Too shy to speak in class, Shelley would skip breakfast and lunch in order to get extra help from her teachers. While her biology and physics teachers were also helpful, her chemistry teacher made the strongest impact on her. Shelley said “I just knew that out of all of them I felt like he cared the most.”

After high school graduation—where her fellow students from the desegregation program “cheered so hard for me,” with one yelling, “you represent us well” during the ceremony—Shelley enrolled at a university just far enough from her home that she would have to live on campus, an experience she had been craving. Only seventeen her freshmen year, Shelley found her roommates “wild” but otherwise “loved” the college experience. She started school with “no clue” about career plans, simply knowing she liked science and math. Her first science class in college was chemistry, which she found easy. While other students struggled, Shelley thought the material was “high school;” “I was knocking that stuff out of the park,” she recalled. Of her chemistry professor, Shelley had mixed feelings. He was a “great teacher,” she said, someone who was “down to earth” and made the material “so simple;” she even described herself as emulating some of his techniques in her own teaching. At the same time, though, he was “extremely prejudiced.” Shelley described a group of students going “to complain to the dean and everything. They already knew.” However, Shelley said that her background had prepared her to deal with racism. Because it was a lecture class, “the only way he could figure out people’s names was when they came to get their tests;” when her name was called, she “would sit for a while until he called other people’s names and then I would get up so that he wouldn’t figure out who I was.” Based only on her first and last names (which were not distinctly African American), Shelley said “there was no way he could know who I was.”

Shelley was convinced to major in chemistry by another professor, an African American man who invited high-achieving African American students into his office individually to invite them to join a program designed to increase the number of minorities in the sciences. When asked if she wanted to be a chemist, Shelley remembered answering, “I don’t know what a chemist is.” As part of the program, Shelley and other students attended regular meetings and were paid a bimonthly stipend for keeping high GPAs. Although the program ran out of funding her senior year, she and her classmates “weren’t changing [majors] then;” however, Shelley was looking for another income source. A neighbor happened to be a chemist working for the FDA and encouraged Shelley to apply for a part-time job; she handed the neighbor her resume the next day. Others applied, but Shelley was the only one with lab experience, having worked under various professors at the university (where she won an outstanding research award), so she got the position.

Once she finished college, Shelley briefly attended graduate school out of state on a full scholarship but found the adjustment too difficult and returned home, joining the FDA as a full-time employee. It was in graduate school, though, that Shelley first discovered that she could teach. Working as a teaching assistant, Shelley gained a reputation for her skills, even being called to the department chair's office where she was told, "Your name is all around the school…they say you can really teach." At the FDA, Shelley volunteered to go into schools to give presentations on science, something none of the other employees enjoyed. She also liked other aspects of her job, calling it the "right amount of research." Unlike her laboratory experience in college, which she described as "boring to me," the research she did at the FDA "had everything to do with people;" among other things, she researched the effect of tobacco on the body. However, when the rumor spread that her office was going to be closed, Shelley decided to look for other work rather than relocate to Washington DC. She discovered a program in the city public school system that would allow her to immediately start teaching and would pay for her to get her teaching certificate and master's degree.

The transition was not a smooth one. Shelley started at a school "known to be the worst school in the [district]" and said she "cried every night." She described the students as taking pride in "getting rid of teachers" and said that she was most surprised by their attitudes: "the whole atmosphere is like to ask someone to sit in their seat and not talk was like criminal." She refused to quit mid-semester, but at the end of the school year she decided to look for a new position. After calling around the district, she moved to another school and found the experience completely different; "when you experience horrible, bad is not bad," she told me. She also had adjusted her expectations and had begun taking classes toward teacher certification. The coursework was designed for others in her situation, those with math and science degrees who were now teaching in the urban school district, and was taught by "this wonderful professor who gave us books to read on how to work with students of that nature." In this program, Shelley said, "I started not becoming the traditional teacher but an untraditional teacher and learning how to reach kids who wouldn't normally be reached in a regular academic setting." After four years in this school, Shelley taught for one year in a more affluent district, where she realized that she preferred working with students who "need me," before moving to a school closer to her home. Although technically "suburban," her current school was similar to her original urban district, with a high-poverty, predominantly African American population and a history of low test scores.

Throughout her years teaching, Shelley said she looked for professional development opportunities to help her reach her students. As she learned more about their lives, Shelley realized that she had to start by getting them to like her, something she didn't understand at the beginning of her career:

> And I realized that was their psyche, that if I care about you I'll do your work and if I don't care about you I won't. So, in order for us all to succeed I had to get them to care about me, I had to care about them so they could care about the work. And in the beginning I thought that was so stupid, you know, who cares? What job are you going to go to like that? And then it became one of those things that at first I hated the kids…I used to say this: how do you teach somebody you hate? I just hate them. And then it came to an appreciation, a respect, a love, a understanding that they really are in some ways fighters and champions because if you can go through all that and just show up at school that takes a lot of strength and courage, where I didn't have to go through any of that, and so I learned how to teach them in a way that they would get it, and a way that they would understand, and a way that they could appreciate the science, and bring the humor

> in…You know, they've been dropped, for lack of a better word they've been dropped, and you can't learn the same way if you've never been dropped versus if you get dropped, and so I teach from that perspective and not the other perspective, and I don't know, they're just great. I love them and I appreciate them, and at first I didn't have that, it was like a horror movie in the beginning to me and now I just have a different perspective of it all.

As much as she learned to care about her students, Shelley had not found a good way to incorporate writing into her curriculum. The students' writing skills were "horrid" and all her attempts to require more writing failed. She started out strongly believing that students needed to write lab reports, something that she had found beneficial as a student, but the assignments didn't go well: "they were aggravated and I was aggravated, and I did it because I thought it was the right thing to do every year but every year we all hated it." When the school district launched a "content literacy" initiative, Shelley tried again to use more reading and writing with her students but "felt like somebody had put something else on my full plate that I'm trying and struggling and it's not fitting." When she heard Newman speak at her school about the SciJourn professional development, Shelley said, "It was like, well let me try it," and so she, along with two of her colleagues, decided to sign up.

Shelley's SciJourn Experience

The Professional Development

Like many SciJourn teachers, Shelley entered the program with the idea that it would help her improve student reading and writing skills. From the first day of the Cadre I professional development, though, she found the experience "so outside of my box.” Instead of working strictly on reading and writing, the program was about science literacy, something Shelley said she had “never thought of” before. She listened to the other teachers in her group “talk science literacy” and felt like “the little person on the pole,” a feeling she described as disconcerting but beneficial because it showed her “a part that I need to grow in.” As a teacher, Shelley said she was:

> so busy trying to figure out how to implement the content to students who don’t study and don’t do homework, and the PD for me was a refreshing way to remind myself…that sometimes you have to step away and really talk about how it’s relevant or give them the opportunity to investigate how it’s relevant.

From the beginning, Shelley said she thought science journalism could be a way to help her students see the relationship between science and their lives; furthermore, she “just felt like it was something that my kids would do, would enjoy,” unlike some of her previous writing assignments.

Even as she saw the potential of SciJourn for her students, Shelley was nervously playing the role of the student herself, a position she found “very overwhelming” but “very positive” because it would help her implement the program later. In particular, Shelley found the entire process of writing her science news article a challenge, starting with finding a topic: “I’m like, okay, what am I going to do mine on? Okay, mine doesn’t sound as good as everyone else’s.” Shelley decided to write about tattoos because she wanted to write an article her students would read; getting a tattoo “was like the major thing that my students loved to do,” with some students claiming that tattooing was addictive. On the day she pitched the idea to Newman, Shelley recalled getting “the look I give my students, like you need another idea;” she found herself redeemed when

Newman turned to the rest of the group and "said, 'Okay, who will read that article?' and it made me feel good when they raised their hands." In that moment, she "felt like the kid when all the other kids agree with the kid instead of the teacher," one of the many role-reversal incidents she described.

Once her topic had been approved, Shelley immediately began researching and writing her first draft. Like Barbara and Mary, Shelley considered herself an adequate writer but found shifting genres to be a challenge. "I'm one of those typical students," she said, "that once I'm taught one way [to write] it's hard for me to retrain my brain to go another way." Writing was so hard, she "wanted to quit" and had moments where she thought "now what can I do to just get a D?" By giving herself "the little pep talk" she finished her draft and sent it into Newman for feedback, an experience she remembered very clearly: "Alan told me I had to find another story," she said. "I was devastated." Shelley had been prepared for feedback and another revision—"I'm not upset if someone says do it over"—but she wanted direction. "I'm not lazy," she told me, "I just gave you my best, I have nothing else to give without you telling me what else I can do." This specificity was what she felt was missing from Newman's feedback and, in response, Shelley "turned into the kids," saying things like "I'm not doing this over, I'm not starting over." For help, she emailed David, a classmate who had a journalism background, and asked him to look at the article. David "just rearranged everything that I had and…it sounded so good," a technique that would have a major impact on what Shelley later did in the classroom. Shelley spent the weekend gathering additional interviews for the article, visiting a tattoo parlor where she "had to beg for an interview because I think they thought I was with the health organization" and talking to a former student's mother who "had like a zillion tattoos," and arrived for the second week of the professional development with another draft. At this point, Newman told her "I really do think you have a story," and, after she worked with Newman to incorporate the interviews, the article was published online, a moment that Shelley described as "a very big thing for me."

Of the whole professional development Shelley said "it was just the best thing ever, it was one of the best PDs ever." She described leaving each day filled with useful and interesting ideas. At the end of the two weeks, she said was "so excited about…how easy it was to implement," a feeling that would be tested when she got back to school in August.

Changes

The summer ended with Shelley feeling like she was "ready to roll" with SciJourn. "In my mind, there were no questions," she said. However, when she returned to school, several things had changed. The administration had been entirely replaced, something Shelley hadn't seen coming. Rather than teaching pre-AP chemistry, a class that was comprised of the best science students, Shelley had been assigned to the regular level of chemistry. She also found out that she had additional, unanticipated requirements for a Culturally Responsive Teaching (CRT) program she had volunteered to pilot. These changes, coupled with some new concerns outside of school, quickly turned SciJourn into "one of those distant memories."

The change in student population became the most difficult challenge. Shelley described struggling to reach students who had learning disabilities, behavior problems, and negative attitudes. During the early weeks of the semester, she said "I couldn't seem to get my bearings…I was just trying to survive.” Even asking her students to complete the pre-test surveys for the SciJourn research was a challenge: “they [the students] were just so negative.” The students did respond positively to her own article, which she showed them at the beginning of the year, but all of the other SciJourn activities she tried fell flat. She ran into technology issues and had trouble remembering “the small things to make it work,” things that had seemed so clear at the end of the summer. Students didn’t understand any of the research they were reading, reminding Shelley of “why I stopped doing research reports.” The students seemed “too needy and then it became overwhelming.” If it weren’t for the SciJourn follow up meetings, which occurred four times during the school year, Shelley may have given up, but “every time I would say, ‘okay, it’s [SciJourn] not going to happen, I would go to a [SciJourn follow up] PD and I would get excited all over again, and then I’d come in and I would try something else, something else.” She remained convinced that SciJourn “would be best for my students,” but she just couldn’t seem to find a way to make it work in this unfamiliar situation. The turning point came when she reached out to the SciJourn team and invited researchers into the classroom. She remembered being encouraged to “just junk all that other stuff and get them to write,” a lesson the researchers had actually learned from Barbara and other pilot teachers.

“The Magic Thing”

When Shelley decided she was just going to assign the article without trying any more preparatory lessons, the student response wasn’t overwhelming. She remembered, “I had maybe two students out of the whole 100-something who knew what they wanted to do…who wrote, and I became inspired just because they had something." Other teachers might have been discouraged, but Shelley said:

> I never believe I'm going to get 100% so that doesn't bother me. But if I can get a few to buy in to what I'm doing, then I'm like, "it's good as golden." And so once I had, like I said, the two to four students to buy into it, we were going to do it. Whether everyone was going with that train or not, it was taking off, and so that's what I did.

Shelley required all of her students to write an article, but the majority of these articles she just skimmed and set aside (she described having a desk drawer dedicated to this purpose); most of the writing was so bad, she said, "my head hurt." When she came across an A student's article about a sibling with Downs Syndrome, Shelley said, she had found someone "I was able to help." This girl and another A student had both written understandable papers; they just weren't journalistic articles. Based on her own experience with David, Shelley first "did the magic thing, I moved their stuff around." Working one-on-one with these students at the end of class while the others finished their regular assignments, Shelley would ask "How does this sound to you? Because I do not believe in moving things around that they don't agree with," transforming the student's research paper into a news article. Once they seemed to understand the genre, Shelley asked them directed questions to research. In the course of asking these questions, Shelley discovered how little all of her students knew about sources of information:

> They were like, "What's the Mayo Clinic?" And I'm like, oh my gosh. "What's the CDC?" Oh my gosh. So then I was inspired to, "Okay, you guys, all right. Now, this is the Mayo Clinic and this is where it is and this is what they do. And I

> worked for the Food and Drug Administration." And so it just allowed us to have those type of conversations as a whole, even though everyone else wasn't doing it [working on an article], we were able to have those type of conversations.

The two girls Shelley focused on seemed to be excited about the prospect of getting published; Shelley encouraged this excitement by saying things like, "Oh, girl, this has potential. I could send this to the publisher, but I think he's going to send it back if we don't have these types of things." Perhaps because she had been so devastated by Newman's initial feedback to her own article, Shelley was very particular about what she forwarded on to Newman: "I wouldn't even submit it to the publisher until I felt like he could give feedback…that was really something that would make it an article." Unlike many teachers, Shelley was not worried about moving every student through the article-writing process at the same rate (where they all turned in a rough draft on the same date, followed by a second draft, followed by peer editing, etc.); the assignment was highly individualized at every stage with students moving forward only when Shelley deemed them ready.

Midway through second semester, Shelley found out that one of her colleague's students had written an article that was accepted for publication in *SciJourner*. When she read his article, Shelley said, "I felt like he did something that my kids could do." This was one of many moments that reenergized Shelley and the students during the course of the year: "the flames kept dying out and then something would spark it and it would go on again." The students also seemed excited about reading and commenting on articles on scijourner.org, an assignment Shelley would give when she had to miss a day of school to attend a professional development meeting. Inspired by her success with her two A students, Shelley began encouraging all of her students to “just write it…it doesn’t have to make sense, I know how to move things around.” She was able to work one-on-one with many of the students, helping them rearrange their articles and giving them specific advice on what to research next, but she was also getting overwhelmed with the number of articles that had been turned in, many of them very poorly written. Once again, she asked for help from the SciJourn team, and Saul, Newman, and Laura Pearce (the project’s classroom implementation coach) all arrived to do one-on-one student conferences which Shelley listened to “so that I knew what to say when they came to me.” From these conferences, Shelley decided to require far less from some of her students—“just give me four sentences”—and to ask others to go interview other teachers, which “helped them because they had to listen to someone talk about their topic.”

Eventually, Shelley discovered how to help even her weakest writers. When she first read many of these papers, Shelley thought the students hadn’t done any research or put any effort into the assignment. However, when she sat down to talk with them one-on-one about their topics, she realized “they did [do research], they just didn’t know how to report it. Either they’d copy and paste or they talked in such fragmented sentences that it just seemed like they didn’t get it.” Shelley’s solution was to “be their secretary,” asking them to tell her about the topic and then typing what they said. If they “started talking fragmented,” Shelley would type the fragment and then ask, “Is there a way we can say this better?” at which point the student would restate the thought more clearly. Although this was time consuming, Shelley said she didn’t have to do it for the entire article; after a paragraph or two, “they had the direction…they had the model, they knew what to do." Shelley had even more help when a few of her students got their articles published on scijourner.org: "of course they thought they were the stuff and the kids thought they were the stuff." These published students became "mini me's:" "they didn't have the gift of moving things around…but they were at least able to tell them, 'okay, this doesn't make sense'…or 'where's your source?' and 'how do you know that's credible?'" Becoming a "mini me," a peer editor, was something to be earned, rather than a class-wide activity.

SciJourn teachers all had different attitudes about their students publishing in *SciJourner*. For many, including Barbara and Jason, all of the students were required to write and revise their articles once for a class grade, but whether or not they revised any further was completely up to the student. But for Shelley, the *assignment* was to get published. Many of her students didn't seem to understand this:

> they kept saying, "when is the final draft due?" And I'm like, "there is no final draft—it's drafts, publication, there is no in-between." "No, I'm just waiting until it's due," because they wanted to just do one paper and then me to give it back, and they really didn't understand that I really didn't have a final draft, that "final" meant it got published, that was my definition of "final," and until then you get no points.

Shelley's students went through numerous drafts before she even sent their work to Newman; for students who resisted, Shelley would enter "0"s in the grade book and try to get parents or guardians involved. The revisions paid off: "by the time it got to Alan, they were willing to do what he said because he always started with 'This is a possible *SciJourn* story.'"

Of her year working with SciJourn, Shelley said, “It was rollercoaster, rollercoaster, rollercoaster. I was holding on the bars in the beginning, gritting my teeth, and then there were moments where I was like, oh, I have my hands up.” As much effort as she put in, Shelley said, “I wouldn’t take anything back” because it had been a positive experience for all of them, one that she believed the students would never forget. “I only have to do that once,” she said. In the future, “They’ll be able to do it on their own.”

Making Meaning

The meaning Shelley drew from the SciJourn experience seemed to have three components, the last of which was related to the themes of genre and authenticity that have been running through this dissertation:

- Modeling is a powerful teaching tool that can be used to empower students.
- The majority of chemistry students will not go on to be chemists, but they need to deal with science information in their lives now and in the future.
- Writing for publication is different than writing for school.

Empowerment through Modeling

By far the most prominent theme in Shelley’s interviews had to do with the power of modeling, particularly modeling success. She described the modeling technique as something she had used in her classroom for years, even prior to her involvement with SciJourn, because “that’s the way they [her students] learn.” She speculated that she first tried modeling with her students because it was the way she learned herself: “if you ask me to do a task and it’s something that I’ve never seen before I can almost mimic anything.” This was evident in the professional development when she relied on her classmate’s help to improve her article—Newman’s feedback was too general (and negative), but once David had rearranged her text for her, she understood more about what an article should look like; this experience became a model of “the magic thing” that she used with her students. Shelley also emphasized her feeling of being in the “student role” during the professional development, which gave her a clear model of her students’ perspective.

Back in the classroom, Shelley drew extensively on this experience. While many SciJourn teachers held themselves up as an example for students (often talking about their own writing experiences and displaying drafts of their own science news articles), Shelley’s technique seemed different and I struggled at first to articulate why. Eventually I concluded that other teachers seemed to share their experiences writing and revising science news with students primarily to project empathy with the students (i.e., “I went through this too so I understand how you feel.”[45]). While Shelley talked a lot about empathizing with her students in other ways, she seemed to use modeling not to show her students that she knew how they *felt*; she modeled in order to show her students how to *act* so that they, in turn, could act themselves. Empowerment was central to what she was doing in a way I didn’t hear from other teachers.

The idea of empowerment came up again and again in Shelley’s description of her SciJourn experience. First, Shelley had been empowered by her work in the professional development to teach the students based on the model she had experienced; later, she picked up new techniques by “listening to the feedback that they [Saul, Pearce, and

[45] A discourse analysis of an episode of modeling as empathy is the subject of chapter 13.

Newman] gave" her students when Shelley asked for a classroom support visit. Having been empowered herself, Shelley empowered her students. Although they were poor writers, Shelley said she rarely needed to help them with their entire article; once she had worked with a student one-on-one for a few paragraphs, she would ask, "Okay, now can you do that for these other paragraphs?...because they had the model, they knew what to do." With so many students, this was still an overwhelming process, but as students became published *SciJourner* authors, Shelley empowered them to work with their peers. Other teachers used peer editing as a whole class activity where all students would exchange rough drafts prior to turning a paper into the teacher (which is what I used to do with my English students); for many students this kind of peer editing was just a hoop to jump through to get all the points on a writing assignment, with the teacher's comments clearly the more valuable feedback. But Shelley characterized the peer feedback her students were getting as the same as the feedback she would have given herself:

> they were mimicking. It all became a modeling thing because everything that I had said to them about their paper they had said to the other kids about their paper…it just became one of those things that they just simply did what I did.

Her students were never able to rearrange text as she could, but she described them as able to ask questions and challenge classmates just as well as she could. Once Shelley deemed the articles ready to send to Newman, she saw the students as capable of handling his feedback on their own even without being in her classroom, a fact she described as "the most amazing thing ever…Because it went from I can't write a paragraph to I can straight up go to another teacher's classroom and do it all by myself."

I can't entirely explain why Shelley saw modeling as a path to empowerment, but it seemed to have something to do with the way she characterized her students. She did not consider her students incapable of writing publishable stories, despite their poor writing skills and placement in a lower-level science class. She did, however, view them as naïve (or unsophisticated), much as she once was. She said "they didn't grow up in a house where science had a lot of relevance," which meant they didn't know certain things that other students, raised in a science-rich environment, might consider obvious. Her students didn't know credible sources of information like the EPA or the Mayo Clinic; they didn't immediately understand that science topics like the sudden disappearance of honeybees had an impact on their lives. She had been the same way when she was a high school science student, afraid to ask questions in front of her more affluent and worldly peers. Neither she nor her students were unintelligent, but they needed someone to guide them. Once she had done this work with a student, she expected the student to be able to do the same thing with peers.

For the students who published an article—a large percentage of Shelley's class—she described them as "owning" the experience. She called herself "a firm believer of when you have one experience it triggers something for everything thereafter and you don't have to re-teach that particular moment again; they will own that." She saw evidence of this in her classroom when her students challenged one another about sources of information on non-SciJourn topics. They "owned" ideas about credibility.

From "Pipeline Science" to Science Literacy

Shelley also described the SciJourn experience as having changed her ideas about her own job. Perhaps because she had been a chemist herself—and had been inspired by her own high school chemistry teacher—Shelley had seen her role as covering curriculum and preparing her students for a possible future in chemistry. She described it as difficult to do, particularly because the curriculum was basically "formulas, formulas, formulas" with little to interest or inspire the students. As I learned through my involvement with SciJourn, Shelley's attitude was not uncommon in the science education world, where teachers feel pressure to prepare students for the "science pipeline," the path that leads to a science career. However, Shelley said, "At the end of the day I haven't got a chemist yet. It's been 10 years, no one has majored in chemistry that I know of yet, and for the type of students that I'm teaching it's probably slim." They would all need to engage with science material, though, and this was where she found SciJourn was meaningful.

While the research team was busy thinking about the "fifteen years out" concept, Shelley saw the SciJourn project as immediately useful in ways she hadn't expected. Several of her students wrote about personal topics involving serious medical conditions; what Shelley quickly discovered was that these topics were basically taboo in the family, a fact that caught her by surprise: "I could see if it was like an STD or AIDS or something like that that has a stigma with it, but these things that they were reporting on, there's no stigma attached, and so it's just amazing. I guess maybe the hurt is so deep that it's not discussed in the home." And it wasn't just that the families weren't talking about these topics, the students didn't seem to *want* to know. She thought this was just a desire "to get it done" and get a grade, something she refused to allow them to do. Shelley described sending students back for more information again and again, something that eventually paid off: "Constantly I had to keep sending them back. Now…once I asked a question and they had to find out my answer they seemed to be surprised and like 'Oh wow, check this out,' but if I didn't ask the question, if I could have gave them a passing grade on it they would have been done." In the same way, Shelley would help students write down questions to ask their relatives and tell the students to blame her if the family member didn't want to answer. One student, Shelley said, had to say "my teacher really wants to know for this paper and I really need it for a grade" after nearly every question to get basic information about a cancer death in the family. Shelley found these situations disturbing (as did the research team) and wondered about a future research project herself to explore "what makes a group of people not want to talk about certain things?" a question she saw as critical to science literacy in her student population.

Publication and Functional Authenticity

By setting up "publication" as the actual assignment in her class, Shelley used genre in a more authentic way than nearly any other teacher in the project. As I've noted before, most SciJourn teachers who assigned writing created a classroom standard that students had to meet for a grade, leaving pursuit of publication up to the student; these classroom standards invariably placed less emphasis on authentic science journalism than did Newman's standards for publication. At the same time, by providing the level of support she gave, Shelley was also offering more scaffolding than nearly every other teacher in the project. In terms of a "hybrid environment," one that adapted the authentic standards of science journalism for classroom use, Shelley was the exemplar.

Perhaps because Shelley's standard was so unusual (for the students as well as within SciJourn), many of her students found it incomprehensible. "In school," Shelley told me, "everything has a due date." Even though her students were expected to produce multiple drafts in their English classes, these drafts were not limitless. Shelley described the students' attitude toward writing drafts as "I wrote my first draft, I wrote my second draft, this is the final draft, I'm done." In all of their other classes, the criteria for completion was numerical (three drafts) and temporal (specific deadline)[46]; at the end of the three drafts and once the deadline passed, the student would get a grade based on the quality, but that was the end of the assignment. As they went through cycles of revision in her class, she reported them asking her, "when it's over and we finish all these track changes am I going to be done?" Her response was, "I don't know yet, I'll have to read it again and see if there's something else." She would neither quantify drafts nor give a strict deadline; the students were all expected to meet the standard of publication before the assignment was complete, however long it took and however many drafts they wrote. Some never did publish their articles, a fact Shelley attributed not to their intelligence or skill (or to her own teaching) but to a lack of effort. "The rest of them just refused to do what I asked them to do," she told me, meaning that she didn't forward their articles on to Newman for consideration.

While from a research perspective, Shelley was creating an "authentic" standard for her students, she never brought up genre or authenticity herself. Instead, the one

[46] In Shelley's school (and in many others), deadlines in many classes have become flexible, with student work accepted at any time, even weeks after the "due date." Shelley also described her students as bypassing the drafting requirement in their English classes, simply waiting until the "final draft" to turn anything in. Regardless, Shelley's standards were quite different from what was happening in their other classes.

motivator she mentioned more than any other was competition. She described the publication of her own article in these terms:

> I'm very competitive and so if I set a goal and accomplish it, it's like fireworks for me, so it was the fact that I didn't think I could write the article, I was just so overwhelmed, so when I actually wrote it and it got published for me I was like, "oh I did it!"

She was also reinvigorated when her colleague's student was published; although she didn't say it directly, her competitive nature seemed to take over and inspire her to push her students further. Within her classroom, competition seemed to arise around publication, with published students enjoying an elevated role and others aspiring to reach that plateau. At the same time, Shelley's classroom was a community, a place where the published students became "mini-me's" in order to help classmates.

While the students were becoming more like Shelley, Shelley said that she was also becoming more like them over time. When Shelley described her classroom, she evoked the concept of "third space," if not the actual terminology:

> I can talk their [the students'] talk so much, I'm wondering if I'm ever going to get my professional language back…it's because the more I'm around them, we're rubbing off on each other and I have to make sure that I can be on their level so that they can learn from me, and that I have to be on their level so I can learn from them, and so I can be effective in teaching them…and like I said I have the one kid who I finished his article first and he did what I said, and I needed to do some more, and I'm like "oh just go help some other people," and I just overheard him and he's like "oh you didn't cite your source, where'd you get the

information," you know. So, it's the same thing I said to him and then he came back to me. He seemed to be excited about peer editing. He's like "okay, I saw that comment you made about such and such, now what is the clarity on this?" and yada, yada, yada, "okay, I know where to go," and then he went…So, they are, you know, they are mini-me's and I'm them and it's just a good relationship.

XII. “A Change in my Personality as a Teacher:” Mary

The fact that Mary (a White female in her 50s) volunteered to participate in my interview research came as no surprise to either me or anyone else on the SciJourn team. Once she joined SciJourn as a member of Cadre I, Mary was as agreeable a research participant as could be imagined. She provided the team with countless data sources, always neatly organized on a flash drive; she invited us in for research and support visits; she allowed the grant’s external evaluator into her classroom whenever he was in town; she used the grant-provided video camera to record lessons; and she became a case study teacher for another SciJourn dissertation (Hope, 2012). During SciJourn team meetings, we sometimes had to remind ourselves not to abuse Mary’s goodwill by calling on her too often. As I learned during the course of our conversations, Mary was very nervous about what implementing SciJourn would require of her personally, making her willingness to share her experiences from the beginning of the school year quite brave.

Mary and I met twice at the university and once at a coffee shop near my house (also near her mother’s house). Despite her willingness to participate in research, Mary appeared reserved and I was worried that I would have trouble facilitating the conversation. However, talking to Mary was easy and enjoyable; I found her life story fascinating and her comments about the SciJourn experience forthright. Although we knew a great deal about Mary’s SciJourn year before I interviewed her, I was interested to hear what the program meant to her, from her own perspective.

“I didn’t feel like I had an option”

Very early in our talks, Mary expressed concern about her age, a theme that would come up throughout the three interviews. I remember being surprised to find out that when she joined SciJourn, she had been teaching for thirty-five years, over thirty of them at her current private school[47]; she simply didn't strike me as old enough. Mary was one of ten children, nine of whom had science-related careers. During our first interview, I became captivated with her description of her mother, a woman who had a master's degree in biology, a second master's degree in chemistry, and had spent time in the 1950s working at the Oak Ridge National Laboratory in Tennessee. Upon marrying Mary's father, a man who "didn't want his wife working outside the home," she became a stay-at-home mother until their Catholic parish grade school needed substitute teachers. Once her mother started substitute teaching, Mary said, "it became obvious that she needed to be something more than taking care of children, so she went back to work full-time." Due to her strong science background, a rarity among elementary teachers, Mary's mother became "the science teacher of this grade school and taught basically all eight grades of science." At this school, Mary was taught by her mother several different years; later, her mother moved on to teach at the all-girls' Catholic high school Mary attended. As a teacher, Mary said that her mother was "a real character. She would tell all the stories, she was a storyteller, that kind of a teacher, and she was also a 'bring it in and show you'

[47] When she joined SciJourn, Mary was teaching at a private Catholic all-girls' high school in an affluent suburb. It was one of twenty-five Catholic high schools in the area; ten were directly run by the archdiocese and fifteen were affiliated with the church but under private leadership. Seventeen of these schools were single sex (10 all girls, 7 all boys). According to the school website, Mary's school had an annual tuition of $11,000 and an enrollment of approximately 600 students who resided in 50 different zip codes. Nearly all of the students were White and almost all go on to four-year college.

[teacher].” Outside of school, Mary recalled that she and her siblings were “always doing science activities” with their mother.

Mary was also exposed to science by her father, an English professor who took a position that was part teaching and part administration—she described him as someone who was good at “scheduling classrooms and keeping records”—at the aeronautics and engineering college of his university; later he became the assistant dean of the university’s medical school. As a child, she and her siblings toured the university wind tunnel and visited medical students doing cadaver dissections. Of her own interest in science, she said:

> the culture in our home was that science is where it’s at, and if you wanted to move forward in your life, science is probably a good thing to get involved with, and plus it was the 60s and the space launches and Sputnik.

Although at one time he didn’t want his wife to work, Mary’s father encouraged all of his children, sons and daughters, to pursue science careers. He dreamed of his sons becoming engineers (five of the six did) and his daughters becoming doctors (none did).

Mary herself wanted to get her PhD in plant physiology. As a high school student, she “had it totally all mapped out.” Her plan was “to create a backpack that was solar powered and it had plants in it and it was hooked into your body and it pumped nutrients from the plant directly into your body…remember, I grew up in the space age.” Her high school was what she called “a packet school;” rather than attend classes, students were given “packets” of material to complete at their own pace. Courses consisted of approximately twelve packets; science classes also had a mandatory weekly lab. By the end of her sophomore year in high school, she had completed all of the core courses her school offered and "was taking sewing and art and my dad was, like, freaking out." Along with a few classmates, she began taking upper level math and science classes at the boys' high school; here, she attended her first lectures, an experience she described as enjoyable: "It was the first time I'd ever really had a teacher at the high school level. Most of my other teachers didn't ever teach." Eventually, though, she ran out of classes at the boys' school as well. Second semester of her senior year in high school, having secured a full scholarship to a prestigious out-of-state university, she enrolled in courses at her father's university, "just a bunch of the first year classes" such as calculus and biology. The consequence of this decision was life-changing; when the other university discovered what she had done, "they said I was no longer an entering freshman and so they dropped my scholarship." Already enrolled where her father taught, a university that did not offer a degree in botany, she decided to stay and complete a pre-med degree in biology, still with the plan of attending graduate school.

Plans changed when she "fell in love" with a fellow student who wanted to go to dental school. The couple decided on a course of action: Mary would finish her degree but also get a teaching certificate and find a job in order to put him through dental school. Once he finished, he would work to put her through graduate school. She described her education coursework as minimal; "I hardly took any education at all," she said, testing out of some of the requirements and completing the others in a single semester. However, her student teaching experience was "horrible." Her supervising teacher became ill and the school simply turned all the classes over to Mary without providing supervision or pay. Classroom management was difficult; fellow teachers were unhelpful; and she was expected to follow the same lesson plans and schedules as the other eight biology teachers with no room to develop the decision-making abilities her education professors emphasized. All of her concerns were met with indifference and even hostility by the administration: “It was kind of like, well, who are you? I mean, why are you even talking to me, are you even an employee?” Despite this experience, she felt like she “had to” look for a teaching job once she graduated with a biology major and a minors in chemistry and education; it was the deal she had made with her fiancé (they married the August after she graduated college) and she “didn’t feel like I had an option.”

Once she began teaching, though, she had only good experiences. She taught at a total of three high schools and said that each school “had that configuration of a[n] administration that expects the students to cooperate with the teachers and expects the teachers to stimulate the students, and as long as everybody’s doing that there’s a lot of progress that gets made.” However, her personal life did not proceed as smoothly. When her husband finished dental school, “he found a young, sweet trophy wife and said goodbye to me.” Mary was supposed to be enrolling in graduate school and had even been looking into different programs. Her father, who had always disapproved of the marriage and of Mary’s career, encouraged her to go back to school, perhaps even medical school, but she decided to stay in teaching. She was working at the school where she continues to teach, and she thought to herself, “Okay, well, I’ve got this job and I’ve been supporting him and now I can support myself, let’s see how it works.” She also realized that she enjoyed teaching: “something inside of me started saying I’m good at this, these kids love to come to class.” As she told her father, “maybe I didn’t go to med school but a lot of my students did.”

Mary eventually earned a master's degree in education and was pursuing her doctorate at the time of our interviews. In addition to formal degrees, she described a long list of other professional development classes and opportunities she had been involved in, saying she liked "to stay fresh" by keeping up with the field. She has also presented several times at national and international conferences. When she heard about SciJourn, she saw the program as "something else I can maybe add in to my toolbox to help my students" and decided to enroll.

Mary's SciJourn Experience

The Professional Development

Mary first learned of SciJourn when Saul came to speak to her graduate seminar. Prior to this, Mary said that she had never thought of "science literacy" as applying to her situation: "I always thought that all the talk about literacy was really talking about kids being able to read and write, and my clientele can read and write very well." During the graduate seminar, she said, "I started to see that it's like you could read science, you can write science, but you just will not understand a thing," a problem she said was common in even her A students. She also knew that her students struggled with the science portion of the ACT, which most teachers at her school considered "a reading test;" she speculated that SciJourn might help student scores. After hearing Saul talk about SciJourn, Mary was required to write a journal reflection, a portion of which she shared with me: "I really thought that the activities she described her students doing in classes would be beneficial to my students and get us away from lecture-lab, lecture-lab, lecture-lab. I would like to learn more about her techniques." Another motive for enrolling in SciJourn had to do with her age and salary level. As a private school teacher who did not have the benefit of tenure, she said, “they could get rid of me and hire two or three other teachers, and I need to keep stepping it up.” When she spoke to her principal about SciJourn and the possibility of participating in university research, the principal was quite enthusiastic, particularly in light of a school-wide writing across the curriculum initiative. The principal’s enthusiasm convinced Mary to apply for SciJourn Cadre I.

However, her initial reaction to the professional development was somewhat like Tom’s. She described her expectations for the course as:

> I thought, I’m going to learn how to do this new way of doing some of my existing lessons and I’m going to hear how to do it, how to work it, maybe get some like schedule or timeline, and then at the end I’m going to decide whether I think I can pull this off in my classroom or not.

Even though the professional development was more organized the second year than it had been the first, it was not designed to meet goals like Mary’s. Teachers were much more actively involved in creating the professional development curriculum than she expected. As she met the other teachers in her cadre, she said, she looked for someone in “the same kind of school that I’m from, or in the same situation I’m in, and I didn’t feel like there was.” She described the course instructors, particularly Newman and Pearce, as being different from her other professors and difficult for her to relate to. Underlying all of this was an ongoing concern about her age—“I didn’t want to be viewed as a dinosaur”—and a worry that the whole SciJourn concept would entail too much of a “personality shift” for her in the classroom.

Mary started the course unaware that she would have to write her own science news article—“I really did not have a clue,” she told me—and she found the assignment:

> very stressful, it was very stressful, and I think, well, also because it was out of my area of expertise; I'm not a writer and, well, let me just say this, I'm really good at writing stuff for my night school classes, I can really write a thought following all the format. I'm good at that, but writing to catch and hold interest, it was like I never had to do it and it was a little scary.

During the Cadre I professional development, the teachers were encouraged to choose their own article topics and Mary remembered Newman telling them to think about "what's important in your life right now." Inspired by her sister's recent car accident (no one was hurt), Mary decided to write about the dangers of automobile airbags, a topic that involved chemistry ("I was thinking chemistry not science," she said). She researched the article online, found several sources on the topic, eliminated those that were not credible, and then wrote her first draft. Even though she described journalistic format as being unfamiliar, she said that writing the first draft wasn't too difficult because we "had the formula, right, we had the inverted triangle" (see Appendix H). Like Jason, Barbara, and Shelley, Mary remembered Newman's editorial feedback very clearly, telling me he "just like ripped it apart." After she read through his suggestions, some made sense to her—"there were some things that…I went, 'Oh yeah, that's, duh, I needed that.'"—but she didn't agree with all them. In particular, she questioned his request that she add even more chemistry to the article:

> I thought I did a pretty good job of walking that fine line of keeping the students' attention and not being too heavy into the chemistry but still getting the chemistry…he felt like I needed to go more into the chemistry and even now I don't know if that was a good decision.

Mary had been imagining her own students as the article audience and believed that she had included as much chemistry in the article as they would be willing to read. However, she adopted the attitude that Newman was the editor and he understood the audience better than she did (echoing Newman's concept of the editor as "proxy for the reader") and therefore she made the changes, telling me "it's possible I didn't understand the audience I was writing to." After two revisions, her article was accepted for publication and appeared online.

Once the stressful experience of writing the article was behind her, she turned her attention to thinking about how to teach science journalism, something she said she hadn't considered while she was focused on writing and revising. Unlike Jason and Tom, Mary found the idea of doing a RATA in front of her students intimidating. Mary's descriptions of her own teaching style emphasized the "role" she had fashioned for herself in the school; she described herself as the "sage on the stage," a "content expert," and the "mom in the classroom." She saw her role as very important to her ability to teach: "you've got to be accepted by them [the students] in the role that you're playing or…they'll sit there and go through the motions but you never will get through to them." In order to do a RATA, she feared, "you really had to put your personality out there," something she wasn't sure she could do. Practicing a RATA in front of the professional development group did little to alleviate her nerves: "I felt it came across as very wooden and so I got even a little more concerned that, okay, I'm not dynamic enough to pull this off." She also was worried that the lessons Pearce was demonstrating were "grade school ideas" that wouldn't work easily with her students. However, she was impressed by the demonstration of the online bookmarking tool Diigo (www.diigo.com), which she said appealed to the “techie” side of her and would be useful in her school where each student had her own laptop. She also was somewhat relieved by the lesson plan binder that was distributed near the end of the course; the binder seemed to meet her earlier expectations for a professional development course. When she looked at the lessons, she said:

> I realized they have these lessons that I can fall back on…even if my personality issues might take a couple years to work up there, at least this is so exciting of a lesson that the kids will get into the lesson and stop thinking about how it’s being presented.

This binder gave Mary the confidence to make plans for the fall.

As she looked toward the school year, she wasn’t sure if she should implement SciJourn with her freshmen students (in a semester-long physical science course) or with her juniors (in a year-long honors chemistry course). She described meeting with Farrar, who was also a doctoral student at the time, and talking through her options. Mary recalled Farrar telling her, “why don’t you just do it with all of them and if it doesn’t work with one…don’t worry about it…if it’s failing miserably, you just stop.” Based on this conversation, which partially seemed to fill Mary’s desire for “connection” with the instructors, she said she decided, “Okay, I’ll do what I can do.”

A Surprising Reaction

Even though Mary worried that the RATAs would be hard for her to do, she spent time over the summer preparing articles that went along with her curriculum. Unlike some SciJourn teachers who saw the RATA as an opportunity to look at any current science they thought their students would find interesting, Mary thought it was important to tie the RATA to her course content. Her plan was to try a RATA around once a week, although she continued to worry that "it'll be a miserable failure because they are going to go, 'oh, this is kindergarten, get us out of here.'" She described the reaction of her honors juniors to RATAs as being "earth shattering"; she couldn't believe how much they enjoyed being read to. Like the students of Tom and Jason, Mary's students "started asking for more read alouds, they started bringing in read alouds unasked; I didn't even ask them and they would bring them in." The teachers had been taught to think of RATAs as short activities, the kind that could be done in five to ten minutes at the beginning or end of class, but Mary found it impossible to keep to that time limit:

> they would get so into that article that they couldn't make the transition to classroom work. So then after a while I started to realize that maybe what was really happening was they were learning more from the read-aloud than they were from the classroom stuff…so the actual classroom activity become the read-aloud.

As she read the articles, she would ask her students for their opinions and "all the hands would shoot up." She described them as talking about content (her articles continued to be tied closely to the chemistry curriculum) and the SciJourn standards, particularly issues about credible sources and whether or not the topic was made interesting.

Mary did RATAs with both her freshmen and her juniors, but her expectations for article writing were different in the two courses. In her one-semester freshmen course, the project was connected to their learning about the periodic table. Initially, she assigned each freshman an element and asked them to create a movie about that element. These movies were "very disappointing and boring," Mary said, and so she decided to require her students to each write a SciJourn article about their element, focusing on "how they [the elements] actually really did fit into their own lives." On the day that the freshmen were brainstorming topics for their articles, Pearce visited Mary's classroom: "I felt like I was kind of under some pressure, but, and I could just tell that Laura [Pearce] didn't think that this would work…she just thought you need to let them have their own ideas, totally open." By the end of the class, though, Mary felt that she had finally "made the connection with Laura." As Pearce and Mary talked with groups of students about topic ideas, Mary said, the energy level in the room went up; "the way she [Pearce] was so enthusiastic with those kids, it just really, I don't know, it just did something to me and to the kids that I'd love to bottle it." This activity made Mary think about how SciJourn could be part of the regular curriculum, not a separate piece, and in the future she planned to skip the movies entirely and just assign the articles.

SciJourn became a much bigger part of Mary's year-long honors chemistry course, where she first decided to tie the article to the students' science fair project. While the freshmen course was a requirement for all students, Mary described the honors chemistry course as attracting only the most serious science students: "honors chemistry is considered one of the most difficult courses at the school; it is. I'm considered very demanding of my honors chem students… the kids that get A's from me deserve the A's." She informed her students that they would be writing an article during the first week of school; the article was part of the students' background research for their science fair projects. They worked on writing first semester; the process involved students researching (using Diigo), writing a draft, peer editing, revising, and finally turning the articles into Mary. Mary forwarded all of her students' articles to Newman for additional feedback.

Mary originally thought that the actual writing would be fairly easy for her students whom she felt were very good writers. However, these students had been rigorously trained in the five-paragraph essay format and "it was much harder than they had anticipated to change that format of writing, and some of them never did; some of them could never do it, they just never could make that change."[48] When they received Newman's edits, Mary saw her students reacting much like she did (how Mary dealt with this reaction is the subject of the next chapter). "They thought he was harsh," she told me, "…but, as I said, at our school we don't ever really criticize each other bluntly and directly. And he's also male…we have one or two male teachers and they're usually considered harsh also." Mary remembered nearly every student in the class coming to see her outside of class time so that she could "translate what I thought he [Newman] meant," although Mary said that "they didn't actually need me to do that, but they needed somebody to tell them they weren't so off base." With Mary's encouragement and help, many of her students revised their articles.

From the beginning, Mary hoped her honors students would publish their articles in *SciJourner.* As one by one students got word their articles were accepted, she said, "I would make a big deal out of it in class…I had an announcement on the PA, it was in the school newspaper, I mean it was a huge thing." The principal also recognized the students who had been published, sending them personal e-mails and seeking them out to talk about the article topic. Second semester, Mary gave her students the opportunity to write

[48] Mary's students' tendency to write five-paragraph essays was also noted by Newman who found the whole genre perplexing.

a second SciJourn article or create a SciJourn infographic about their science fair results (in addition she offered two other, non-SciJourn options). Many of her students' infographics were also published on scijourner.org.

As she thought about her year with SciJourn, Mary recalled particular students who seemed inspired by the project. At the beginning of the year, she had worried one student "wasn't even going to make it through the course," but this girl published an infographic and won the division at the science fair; Mary said, "I actually think the SciJourn is how come she made it and she connected." Another group of students Mary described as "so blasé about, oh, I'm going to get an A in this class, this is going to be a lot of work but I can do it," but SciJourn "challenged them to think and learn and understand in a different way that I really think resonated with them." Mary said these students "were like, finally, somebody who's making us apply what we're learning to our life."

Of her SciJourn experience, Mary said, "it wasn't just the change in pedagogy; it was also a change in my personality as a teacher, and that's the part that, I'm still working on that." She was enthusiastic enough about her first year, though, that she was determined to continue that work.

Making Meaning

As Mary spoke about SciJourn, these themes seemed to be the most important to her:

- Role playing and role shifting
- Personal excellence in the job

Perhaps more than any other teacher, Mary also spoke about genre and functional authenticity, although never in those exact words, which I will discuss at the end of this chapter.

Teacher and Student Roles

From the beginning, Mary was concerned that implementing SciJourn as it was presented at the professional development would be too much of a role shift for her to manage, something she claimed to still be grappling with at the end of her first implementation year. Perhaps because her own identity as a "scientist" was so strong (with teaching originally viewed simply as a source of income), she had created a role for herself in the classroom as the expert, rarely talking with the students about her personal connections with science or about unfamiliar science topics. In this role, she was the lecturer and students participated mostly to "show off or show what they knew." Changing this dynamic was a frightening proposition for Mary, especially in the current political climate at her school where it was "hard to feel safe" either for the teachers (who feared for their jobs in the wake of administrative turnover) or for the students (who were teenage girls worried about impressing one another). Lacking the "drama queen" personality Mary saw in other SciJourn teachers, she worried that even the RATA wouldn't work. Her students might perceive a RATA as an attempt to push them into the role of kindergarteners, which Mary was certain they would reject.

Instead of rejecting SciJourn, though, Mary's students embraced the new roles the project opened for them in the classroom. In an episode from the beginning of the school year, Mary recalled showing her juniors the list of possible SciJourn article topics generated by Pearce; the "chemistry" section was empty. Her students had just finished reading the first chapter of their textbook—a chapter on “what is chemistry” and “why is chemistry important,” which Mary hadn’t lingered over in past years—and wanted to generate a list of topics themselves. Both sections of honors chemistry brainstormed lengthy lists that Mary posted in the classroom and sent to Pearce, an activity which “transformed them from the students to the experts.”

Roles were also shifted during RATAs. Rather than talking about what they already knew, Mary and the students “were talking about actually most of the time what we didn’t know and how we could learn it.” Sometimes students knew more than Mary did about RATA article topics, an experience they enjoyed. Personal stories became legitimate classroom contributions, with Mary “giving them a perspective of in my life” and students “telling me what they’ve done” around issues raised by RATA articles. These kinds of stories were “never” raised in class prior to SciJourn.

Article writing offered more opportunities for roles to shift in the classroom. Mary required all of her students to write and strongly encouraged her juniors to pursue publication. For her junior students who saw themselves as future scientists, SciJourn became an opportunity to take “these steps towards being expert science writers,” with publication seen as a valuable line on a resume. Peer editing gave students a chance to work with one another in a supportive, community environment, sharing topics with one another and offering feedback. Although she said she needed to work with her students on ways to offer more constructive feedback (rather than only positive remarks), Mary saw peer editing as a valuable classroom exercise. Near the end of the year, Mary asked her students for feedback on a piece of her own writing that she was going to submit as part of a contest. Before SciJourn, she told me, “I would never have brought a piece that I was writing and shown it to my students and said what do you think?" This was just one more example of how Mary's "repertoire with the students evolved" as a result of the SciJourn experience (a close analysis of Mary negotiating these role shifts in the topic of the next chapter).

Excellence

Although she never used the word "competitive" to describe herself, Mary portrayed herself as someone who wanted to be the "best." Worries about her age seemed to stem from a fear of being seen as out-of-touch or expendable, and she described working hard to combat this image. "I not only want to keep my job, I want to be the best teacher. I mean that's what I want to be. I feel like if it's worth doing it's worth doing well," she told me. SciJourn interacted with Mary's desire to be the "best" in a few ways: through SciJourn, she found opportunities to re-conceptualize what it meant for her to do her job well; to publically draw attention to her students' success; and to demonstrate her commitment to the school improvement plans.

As someone who wanted to be the "best teacher," Mary needed a clear idea of what her students should learn in her class. Prior to SciJourn, Mary saw her job as preparing students for science careers, despite knowing that many would not follow that path:

> I've been teaching science class so everybody in the class is going to go on and get a master's in science and be a little professor, a little scientist, and, I mean, I realize that the majority of them weren't going to, but I still expected them to know the science as though they were going to be

However, once she became involved in SciJourn, she was convinced that educating "little citizens" was just as important. With this new mindset, she began asking herself "What do they need to know to survive life on our planet and in the United States in the 21st century?" Among the skills she thought students would need were "being able to read critically, write critically, being able to question credibility, question expertise, question meaning," all skills emphasized by the SciJourn project. The SciJourn goals resonated with Mary; Mary wanted to view herself as a master teacher; therefore, participating enthusiastically in SciJourn became an obvious step.

With this new goal in mind, it seemed important for Mary to publically draw attention to the successes she and her students were having with the project. In addition to announcing the publication of student articles as part of the school announcements, Mary would send the entire school community "an email blast from me who they were, what their article was, and the link to their article online." In part, she described the publicity as an opportunity to push other teachers in her building to begin thinking about education in the new way she had. In her email to teachers, she "basically said that it was first of all emphasizing the connection of science to the student's everyday life and to the student as an informed citizen" which was her own "biggest takeaway" from the project.

The publicity was also a chance for Mary to show that she was onboard with the school's two improvement initiatives: writing across the curriculum and educational technology. As part of the private school's accreditation process, these two goals had been identified by the administration; teachers were expected to develop plans related to them and to meet with the principal three times during the course of the year to discuss their plans and their successes and failures. Although she described these goals as being top-down mandates with little input from the faculty, she also saw it as a part of her job to improve on these fronts: “So, okay, this is what my boss is telling me we are doing, I’m going to jump in there and I’m going to do the best I possibly can.” SciJourn, Mary said, was a natural fit with both goals. Before her first implementation year even began, she was already sharing what she had learned about Diigo (technology integration) with the entire faculty at a professional development workshop, following up her demonstrating with an email which included her PowerPoint slides. Later in the year, Mary seemed pleased that her students were so excited about Track Changes (another technology component) that they were encouraging other teachers to use them too. SciJourn obviously dovetailed with the writing across the curriculum initiative; prior to students being published in *SciJourner*, Mary had also shared their work with the school newspaper moderator and articles appeared there throughout the year as well.

Functional Authenticity

Unlike many other SciJourn teachers, Mary’s students were generally adequate readers and writers, with several expressing a desire to pursue science careers. Yet even in this environment, science was not viewed as a vibrant, exciting field and student writing about science was not engaging or interesting either. In focus groups Mary called her students’ writing prior to SciJourn “boring, boring, boring;” she also saw her students “thirsting for this connection” between science and their lives. In particular, she thought that her future scientists “wanted me to kind of show them that the rest of their life wasn’t going to be boring, sitting and cleaning test tubes in a lab by themselves.” The genre of science news, with its emphasis on piquing the readers’ interest, seemed essential to the transformation of Mary’s classroom and of the roles she and her students took on.

SciJourn wasn't the first time Mary had played with genre in her class before, but as I looked at her other examples it was clear to me that her earlier attempts had lacked SciJourn's functional authenticity. Years before she had taught a class called ChemCom (Chemistry in the Community)[49]; the course was designed for students who did not plan on pursuing science careers and had goals that sounded similar to SciJourn. Within this class, her students did various genre projects like making movies, giving talks before the "town council," and writing letters to the "editor," but these projects didn't have authentic audiences (nor, I assumed, did Mary grade them according to the authentic attributes of the genre); "we just did it ourselves within the school," Mary said, although she did invite the principal to come in and observe the town council. In the freshmen physical science class that she continues to teach, Mary had previously asked students to make a slideshow as part of the lab safety unit; these slideshows were not actually used to inform anyone about lab safety nor did they include any new information about lab safety that the students didn't know from their textbook. Mary described them as "a lot of pictures of people's eyeballs and, you know, stuff that probably never really would happen." During her SciJourn implementation year, Mary also assigned her freshmen the element movie project (described earlier in this chapter), hoping that by asking her students to describe "the chemical and physical properties of the element, the atom arrangements, everything we've been learning in chemistry" in a movie would be more interesting than the posters she had assigned in years past. The results were "very dead

[49] Mary described the course as a wonderful one that she loved teaching; according to Mary, her school had cut the course when administration changed because it sounded "too fun" and the name was "little kid."

and boring, and I'm telling you they were the most dead and boring. It was just pathetic." After watching them, Mary said she asked the class "I mean would you want to watch these movies if you didn't have to?" Yet it sounded like the students were trying to meet her assignment requirements (to include the chemistry content) rather than trying to make an authentically interesting movie. Without the emphasis on authentic qualities of the genre, the students were simply dressing up dull content in a new form; the authenticity was latent.

However, when Mary worked with her students on science news articles, the first thing she emphasized was that the articles had to be interesting. She described herself as reminding the students again and again, "who's your audience, who's your audience? Your audience is high school students, that's what you need to keep in mind." By making the audience central to her instruction, Mary was pushing her students to see science as relevant and interesting; the same thing may have happened with the movie genre had she similarly emphasized creating movies that teens would want to view (through the SciJourner website or elsewhere), although the topics and content requirements probably would have needed some adjustment.

Even as she highlighted the importance of audience (and, by extension, the authenticity of the genre), Mary put constraints on her students' topics that may have interfered with the project in her classroom. Unlike most other SciJourn teachers who assigned articles, Mary required that her students choose curricular topics (the freshmen had to write about elements; the juniors had to write about their science fair topics), making the requirement that articles be "interesting" a challenge for students who didn't like their topics (or who liked their topics for a science fair project but not for a news article). As much as Mary wanted to connect students with content and prepare “little citizens,” she also highly valued the chemistry content and seemed comfortable with the fact that the functional authenticity of the articles would be subordinate to the chemistry content of the class.

XIII. A Closer Look

As I said in the previous chapter, Mary provided the research team with many more data sources than just the interviews, including videotape of her classes. Early in the second semester of her first SciJourn year, she bought her grant-issued camera with her to a professional development meeting. As a SciJourn researcher was transferring the footage, Mary mentioned a particularly interesting class period she had recorded, one we might want to take a careful look at. At the time, I was in the middle of analyzing Mary's responses to her students' writing compared with Newman's responses. When I heard that the class period was one where Mary was preparing her students to receive their edited papers back from Newman, I was excited to watch it. Even though I hadn't yet interviewed Mary, from previous professional development workshops I knew that she wanted her students to publish; I also knew that she was struggling to figure out how to work with Newman and maintain her own position in the classroom. I hoped that the video would give me some firsthand insight as to how she was managing to create this hybrid community, one that was her classroom while at the same time taking on authentic characteristics of a science newsroom.

The video clip did not disappoint. In fact, I became so intrigued by what I saw during the first 17 minutes of a class period that I spent several weeks immersed in the data. What follows is my analysis of this episode.

Opening Act

Mary stood in front of the room, addressing her Honors Chemistry class. Each student in her advantaged private school had a laptop computer closed in front of her; each looked attentively at Mary as she spoke. It was January. These students had spent a significant part of the first semester writing science news articles, and now they were about to receive their articles back from Newman, the professional editor. Mary had already looked at Newman's feedback. She knew that her students were likely to be disappointed. At a school where teachers were trained to sandwich all critical comments between two compliments, Mary was afraid that Newman's comments, straightforward and direct, would devastate them. Before she allowed her students to see their articles, she prepared a mini-lecture, a PowerPoint, and a handout detailing the kinds of problems they could expect to see identified in their work. After introducing the process she planned to use in returning the articles, she took a breath and said:

> There's just some things that I wouldn't have said the way he said. But he did, and that's, that's his prerogative…He's the editor, he's our boss, so we've got to keep that in mind. We got to give our boss what our boss wants. So our job this weekend is going to be to make improvements to our articles. We're all going to make improvements, we're going to do the best we can to make our article the best we possibly can.

With that bit of encouragement, she launched into her PowerPoint slideshow, titled "Improvements to the Articles."

Background

For most students and teachers involved in SciJourn, the genre of science journalism is unfamiliar. Mary's students, having been drilled so extensively in five-paragraph essay format that they eagerly chanted it for teachers and researchers alike, seemed to struggle even more than most. Perhaps because of her own difficulty writing a science news article during the SciJourn professional development (described in the previous chapter), Mary drew heavily on her writing experiences as she worked with her students. As she did so, she became what Wenger (1998) called a “broker,” bringing elements of the community of science journalists to her classroom community of practice. When I looked at the tape of Mary’s class, I realized I had the opportunity to closely analyze how a teacher enacts being a broker. Using discourse analysis (Gee, 2005, 2011b; Rogers, 2004), this chapter looks at how Mary constructed her own identity and created a position for herself in the editor-student interaction.

Mary’s efforts were designed to lead to the creation of a hybrid or third space. Most educational research into “hybrid” or “third space” refers to classrooms where students’ home discourses are used to gain access to (or critique) academic discourse(e.g. Benson, 2010; Calabrese Barton, Tan, & Rivet, 2008; Gutierrez, Rymes, & Larson, 1995; Moje et al., 2004). However, in the SciJourn project the hybrid space existed between a traditional academic classroom and a professional newsroom; this was a space where neither the teacher nor the students felt fully comfortable. Because science journalism asks writers to “translate” complicated topics for a general audience (Blum, Knudson, & Henig, 2006), it also demands that students and teachers talk about science topics in a way not normally used in science classrooms. According to Lemke (1990), students become accustomed to the “mystique of science,” which is created by the abstract and technical curriculum and perpetuated by teachers and textbooks, and actively resist attempts by the teacher to make science more accessible. For these reasons, brokering a connection to the hybrid space of a SciJourn classroom was often a challenging prospect for participating teachers.

As discussed in the previous chapter, Mary often referred to her work in the classroom as “role playing.” By watching this video, I was able to see Mary’s role playing for myself. In this class period, her performance involved several different (sometimes conflicting) roles; it was a complicated and graceful one. It was also ultimately successful: many of her students went on to revise their articles for publication. Understanding how she managed this was the goal of this analysis.

Data Analysis

For this study, I analyzed the first 17 minutes[50] of a junior honors chemistry class, a period of time where Mary prepared the students to receive their edited articles back. Mary told me the honors chemistry course was considered one of the hardest classes in the school, with the students seen as the most capable science students. Mary had decided to videotape this class period after the return of papers in her first honors chemistry section did not go well, a fact that had spread around the school. At the beginning of the clip, one of the students asked Mary why she was setting up the video camera. When she said she wanted to share the video with the SciJourn researchers, a student laughed, “Oh, God, like our reactions?” and Mary replied, “This is a good one for them [SciJourn] to see.” Another student chimed in, “People were in upheaval about it.” Apparently Mary had some reason to feel nervous about the upcoming class.

After receiving the video from Mary, I transcribed the opening 17 minutes; my goal was to create a “broad” transcription (Gee, 2005), an accurate recording of the words

[50] Once the teacher concluded her PowerPoint, students were given work time to revise their articles while the teacher provided one-on-one or small group assistance.

and large gestures but not details such as length of pauses. I next broke the transcript into idealized lines, lines with one new salient piece of information each, and then divided these lines into stanzas (Gee, 2005). The transcript was 310 lines long, with 17 of these lines spoken by students[51] in 9 different turns and the remaining 293 lines spoken by the teacher. I organized these lines into 14 stanzas which could be further grouped into 3 different sections corresponding to the macrostructure (Gee, 2005) of a teacher-centered lesson plan (see Table 13.1).

Table 13.1. Organization of the Transcript

Section 1: Opening of class, review of where they've been and where they're going		
Stanza I	Recap of what they've done on papers	Lines 1-29
Stanza II	Who the editor is	Lines 30-53
Stanza III	Teacher's experience being edited	Lines 54-94
Stanza IV	Differences between the editor and the teacher	Lines 96-109
Stanza V	Editor as "boss," writing as a "job"	Lines 110-124
Section 2: Lecture, including handout and PowerPoint		
Stanza VI	Transition to the handout/PowerPoint	Lines 125-131
Stanza VII	Topic 1: "the best sources"	Lines 132-165
Stanza VIII	Topic 2: "attributions"	Lines 166-206
Stanza IX	Topic 3: "context: relevance"	Lines 207-235
Stanza X	Topic 4: "factually accurate"	Lines 236-251
Section 3: Papers returned, moving into individual work time		
Stanza XI	Where to find the papers	Lines 252-265
Stanza XII	Encouragement	Lines 266-283
Stanza XIII	Reject the edits if you must	Lines 284-306
Stanza IX	Begin working	Lines 307-310

Gee (2005) asserted that in any situation, language is used to "simultaneously construct or build seven things or seven areas of 'reality'" (p. 11); a discourse analyst can

[51] Because of the position of the camera, I could not determine how many different students spoke.

analyze these “seven building tasks”[52] through various lenses. Because of my interest in Mary as a broker in a hybrid community of practice, I chose to use Gee’s (2005, 2011b) framework to look at the way Mary used language to construct identity, relationships, and connections. After focusing on these three building tasks, I turned to three of Gee’s (2011b) tools of inquiry[53] to further examine the transcript, particularly using his identities, relationships, and “D”iscourses[54] tools.

Although I conducted this analysis primarily from a perspective influenced by Gee (2005, 2011b), I also found Rogers’ (2004) concepts of genre (ways of interacting), Discourse (ways of representing), and style (ways of being) informative. Rogers (2004) suggests that Discourses can be understood in part by examining pronoun use. Mary’s pronoun use was so interesting that I created a chart to catalog her use of “he,” “I,” “we,” and “you” (although Mary used the pronoun “they” on a few occasions, it was not as informative to the analysis). Part of that table is reproduced as Appendix I. For style, Rogers’ (2004) method draws attention to verb usage and verb tense; I found Mary’s portrayal of time also to be of interest and created a second table to organize what she described as having happened in the distant past, the more recent past, the collective past of the class, the present, and the future. I also added a column for stable characteristics,

[52] Gee’s “seven building tasks” are: significance, activities, identities, relationships, politics, connections, and sign systems and knowledge (see Gee, 2005, pp. 10-13 for full descriptions of each).

[53] Gee’s (2011b) outlines 27 different tools that can be used to illuminate a piece of discourse.

[54] Gee (2005, 2011b) uses the term “D”iscourses with a capital “D” to refer to all that goes into being recognized as a “certain kind of person,” including language (discourse), clothes, gestures, values, etc.

those expressed through the use of present tense which implies these are qualities that simply “are” (see Appendix J).

At this point, my work with Gee’s (2005, 2011b) building tasks and tools of inquiry as well as Rogers’ (2004) concepts of Discourse and style led me to return to the transcript a final time to code for the following: (1) moments where the teacher is acting in a traditional “teacher” role; (2) moments where the teacher establishes the editor’s credibility; (3) moments where the teacher aligns herself with the students; (4) moments where the teacher contrasts herself with the editor; and (5) moments where the teacher aligns herself with the editor (see Appendix K for codebook).

Finally, as I formed initial interpretations, I shared my findings with fellow researchers and with Mary herself for feedback. I also looked at other data sources (including interviews with Mary) for additional contextual information and triangulation. My goal in this analysis was to understand how Mary functioned in this hybrid space, one where she and her students found themselves in the unfamiliar territory of a writing-to-learn classroom with a consulting outside expert.

Interpretations

In preparing for this class period, Mary seemed to have two concerns born from the fact that an outside professional had a voice in her classroom. First, she was worried the students would be hurt by the editor’s comments. This worry came through directly in statements like “I try to say things in a way that, that, that’s more roundabout or gentle, um, Alan is not like that" (42-43)[55] and indirectly by the fact that she did not allow the students to immediately see their edited articles. Although she never said so explicitly in this video, she also expressed to us a concern that she wasn't meeting the editor's expectations herself. Because Newman identified so many more problems with the student articles than she had, her authority, her status as the "science expert," was at risk. In the face of these concerns, it appeared that Mary had a specific goal for this class period: she wanted to give her students a sense of confidence in their ability while at the same time encouraging them to improve the quality of their work. In order to accomplish this, Mary positioned herself in the following ways at different (sometimes overlapping) points and in different ways: teacher as kindly authority/master of the class; teacher as insider (not like the editor); teacher as model/advanced peer; and teacher as broker/translator.

Teacher as Kindly Authority/Master of the Class

In his description of "the Big 'D' Discourse tool," Gee (2011b) includes "ways of acting, interacting, believing, valuing, dressing, and using various objects, tools, and technologies in certain sorts of environments" (p. 201). Despite the complicated and unusual nature of what was happening in Mary's classroom, at the most basic level the Discourse of this transcript is that of a teacher acting as a traditional teacher, the authority and master figure in the classroom. Mary enacted this identity in a variety of ways, most obviously in her non-verbal Discourse. In this Catholic school classroom, all of the

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[55] Line numbers. See Table 13.1 to locate line numbers within the overall structure of transcript.

students were wearing uniforms and sitting at tables arranged in a semicircle facing a whiteboard where Mary, dressed conservatively and wearing glasses, stood. Although the students had laptop computers, Mary directed the use of technology, instructing students to “turn off their computers” (1) and controlling the PowerPoint slideshow. Her talk dominated this portion of the class period and topics for discussion had been organized by her through both the PowerPoint and the accompanying handout. She occasionally drew attention to her control of time and topic (e.g.“that’s what I want to talk a little bit about” (129-130); “and here’s one last thing before I let you, each one, read yours over and work on it” (284-287)), but mostly her “teacher as master of the class” identity was constructed not through explicit language but through her Discourse as a whole. Although she clearly controlled the situation, she also constructed an identity that was caring and supportive. She reminded the students, “I know you guys very well, okay, so, and I know the students at our school very well” (103-104), and told them that “I try maybe not to hurt your feelings” (38-39).

The students did not resist, and even co-constructed, Mary’s “teacher as master of the class” role. There was only one instance of teacher discipline within the tape and it involved the teacher simply stating a student’s name in the middle of the lecture when the student appeared to be whispering to a classmate. Students closed their laptops, distributed papers, and faced the front of the room without being prodded. They also affirmed Mary’s supportive identity. Prior to the transcribed portion of the tape, before class began, the atmosphere appeared relaxed as students chatted with one another and with Mary; during the tape, they laughed at various points. One responded to Mary’s claim that she tries not to hurt their feelings with “we appreciate that” (41). To use an educational cliché, the teacher appeared to have authority without being perceived as authoritarian.

Yet by exerting her authority in this way—delaying the return of the papers in order to deliver a PowerPoint and a handout summarizing the editor's main concerns—Mary created a buffer between the students and the editor (or the editor's persona as realized in his comments). In this space, she interpreted Newman's comments for the students and, therefore, ensured that the students' reading of the editor's comments would be influenced by *her* reading of the editor's comments. Although this is certainly a scaffolding move, it is also a move that works to preserve her authority and power in the classroom as well as her caring/supportive role. I do not mean to imply that Mary had nefarious intentions, only that she (either consciously or subconsciously) reacted to Newman's comments as a potential threat (which they may well have been). Whether the threat was to her authority or to her students' self-esteem, the loss of either could be potentially harmful to the immediate goal of improving these articles and to the long-term goal maintaining a productive classroom atmosphere. In part, Mary seemed to use her "authority" identity to diffuse this threat.

Teacher as Insider (not like the Editor)

A closely related identity Mary took on is that of an insider, "not the editor." According to Gee (2011b), "One way we enact an identity in language is to portray other people and their identities in certain ways that compare or contrast with the identity we wish to enact" (p. 109). The most obvious contrast Mary drew between herself and Newman had to do with the tone of Newman's comments. In five different instances, Mary called attention to the fact that she did not respond to students in the same manner as Newman did: “he’s a very different person than me, right? And, uh, with me I try maybe not to hurt your feelings” (37-39); “I try to say things in a way that, that, that’s more roundabout or gentle, um, Alan is not like that. Alan, Alan, Alan is, is very blunt” (42-44); “I do feel that, uh, he’s, he’s very blunt, uh, much more blunt than I would be” (99-102); “there’s just some things that I wouldn’t have said the way he said” (105-107); “the way they were said would not have been the way I would have said ’em” (203-206). The first four times she made this distinction occurred early in the lesson, prior to her main PowerPoint-aided lecture. She appeared uncomfortable referring to Newman’s comments in these lines; her use of “uh”s, “um”s and repeated words was much more pronounced than elsewhere in the transcript. It seems that she wanted to firmly establish her disagreement with the editor’s tone early in the class period, yet she also struggled to speak about his comments. Clearly she was worried about her students’ confidence, but she also may have been worried about walking the line between disagreeing with the editor’s tone while also encouraging her students to revise to meet the editor’s approval.

Also early in the class period, Mary contrasted herself with the editor in terms of expertise, particularly expertise in journalism. When she first introduced the editor, she established his credentials: “he has a PhD in chemistry, he’s, he’s been a research scientist. He’s also been an editor of a science journal for about 20 years. So he, he really knows his stuff” (33-36). A few lines later, she said: “I believe that’s how editors on papers probably really are, although I’ve never really gone into the writing business myself” (46-50). Later, in the lines quoted in the opening of this paper, Mary began referring to Newman as the “boss” of the students, who were filling the role of “writers for the paper” (110-111). Through these lines, Mary provided some justification for the differences between her own comments and Newman's comments on the students' articles. Mary and Newman have different backgrounds and different areas of expertise; these differences led to them filling different roles in this classroom environment. Mary was *not* the editor, not in terms of tone but also not in terms of journalistic experience. Newman had expertise that Mary did not have; in this specific situation, where the students are attempting to publish their writing, Mary's words suggested that Newman had *more* relevant experience and therefore more power (he's the "boss") than Mary herself.

Once again, though, Mary's positioning also served to preserve her own authority in the classroom. In separate conversations with us, Mary talked about how "emotional" her all-female students could be; making sure these students stayed motivated (even in the face of "blunt" feedback) was a priority of hers. By contrasting her own approach to student writing with Newman's, Mary was creating a role for herself: she was the one who knew the students well and wouldn't hurt their feelings. Although this might not sound like a position of authority, Mary's interpretation of her own students' needs implied that it was. Furthermore, by pointing out Newman's journalistic experience (and her lack thereof), Mary was implicitly providing a rationale for why she didn't identify as many problems with these student articles as Newman did: she couldn't have been expected to do the same job as Newman did because she wasn't similarly qualified. However, it is important to note that Mary highlighted Newman's credentials mostly in journalistic terms, not in terms of his science knowledge. Although she did point out that he had a PhD in Chemistry and a background as a bench scientist, the expertise she returned to again and again throughout the lesson was his editorial expertise. Newman actually also had more *science* expertise (at least in terms of his educational background) than Mary, but she did not dwell on that fact perhaps because her identity as "science expert" in the class was much more central to her own self-image, something she alluded to in other interviews.

In her role as "insider," Mary's words and actions suggested that she was qualified to interpret Newman's comments for the students in part because she knew them better than Newman did. She was also qualified to interpret Newman's comments because of her own recent experience as a writer of science news, an experience she drew on to position herself in a third way: teacher as model or advanced peer.

Teacher as Model/Advanced Peer

Once Mary began the class period, her opening lines immediately established her as "like" the students through the use of the pronouns "we" and "our":

> we have been through a lot with these SciJourn articles, haven't we?...We wrote the articles, we did a lot of research using diigo, we wrote our articles, we peer edited each other's articles, I edited your articles, you rewrote them a second time after those edits, and so now we're at the stage where, um, we also went through this evaluation sheet with each other, um, what, with each other's articles, right? So now we're at the stage where we submitted it to our editor and our editor's coming back to us that it's either acceptable but it needs some edits or it's in pretty bad shape and it needs a lot of edits. (9-10, 15-28)

Only twice in this description did Mary's pronoun use acknowledge the fact that she and the students had different roles in the classroom ("I edited your articles, you rewrote them a second time"); otherwise, Mary's use of "we" and "our" suggested that she was actively completing all the stages of this writing process alongside the students when, in fact, she was not. Later, before beginning her PowerPoint, Mary once again affiliated herself with the students:

> our job this weekend is going to be to make improvements to our articles. We're all gonna make improvements, we're gonna do the best we can to make our article the best we possibly can. We're gonna submit them to our editor on Monday. (117-124)

However, Mary was not going to be rewriting an article over the weekend, only the students were.

Mary's use of "we" to represent herself and the students had several possible implications. First, it further established the contrast she was creating between herself and Newman. She and the students were one group; Newman was an outsider. If Mary was anticipating negative student reactions to Newman's comments, she was positioning herself as on the students' side (not Newman's). Although she didn't write an article during the timeframe she described in the above lines, by expressing ownership of that process she was also setting herself up to receive Newman's criticism *as a writer*, not as the teacher of the students who wrote the articles. Her pronoun use implied that she and the students were all in this together, in similar roles.

Mary continued positioning herself as "like the students" a few lines later by relating the story of her own writing experience from the past summer's professional development:

> I went through this same process and when I first, Alan, uh, you know, I thought, I know pretty much stuff, a science teacher working on my PhD, I'm a, I'm pretty

> good at this. I go ahead and put the article together, typed it up, and give it to him. I think, "Yeah, that's great." And I get it back and it was just, ugggggh, covered with track changes and I was like, "Oh my gosh, it can't be that bad." [Student: That's a low blow]. So, then, so, and it was. And I actually, I'll be honest with you, I kind of cried a little bit because I kind of felt like I, I'm an expert on my own, and, uh, and, and, and I just felt really decimated. But. But I let some time pass and I looked at it again, and I redid it, and I sent it in, and I got it back again, and then I re-edited it again and gave it back and he said it's fine. Next thing I know it's on the website. (55-86)

As she told this story, she held up a copy of her own article which the students had obviously seen and heard about before.

Through this narrative, Mary provided the students with a model for how to react to Newman's feedback. She began by declaring that she had the same experience as the students, inviting the students to identify with her. Yet immediately after calling her experience the "same process," she made a subtle distinction, reminding the students that she was *not* the same as them even if her *experience* was similar. She described her own credentials—"a science teacher working on my PhD"—which established the fact that she was more knowledgeable than the students and therefore could have been expected to be better at writing science news. Mary then characterized herself as cocky—"I think, 'Yeah, that's great'"—before getting her comeuppance in the form of negative feedback from Newman. By highlighting her status and then describing her downfall, Mary was preparing her students to accept Newman's critical comments on their own articles. If Mary (the teacher) received this kind of feedback, then there should be no shame in the students getting critical editing, she implied. When the student interrupted (“that’s a low blow”), her casual and empathetic language affirmed Mary’s positioning as an advanced peer.

Mary responded to the student’s interruption by going into more detail about her emotional reaction to Newman’s editing. As discussed earlier, Mary was highly sensitive to her students’ emotional states; the student’s interruption, probably coupled with the earlier class’s negative responses to Newman’s editing, seemed to feed into Mary’s worries. By describing herself as “decimated” and saying she “cried a little bit”—something she later told us was not literally true—Mary gave the students permission to react emotionally to Newman’s feedback. However, she didn’t allow them to remain in this negative, “decimated” state. After pausing to wallow in the negative feelings for a short while—“But. But I let some time pass”—Mary’s story continued with her editing her article two times and eventually publishing it online.

While early in the class period, Mary’s use of the pronoun “we” was notable, in this section it was her use of “I” that was most interesting. Mary told the story of her own experience entirely in the first person; even Newman had no active role until he approved Mary’s article for publication (“he said it’s fine”). Newman was certainly a character in Mary’s story, responsible for the track changes that covered her first draft and later the one who returned the article (“I got it back again”) and asked for more revision (“I re-edited it again”), but his actions always had to be inferred from Mary’s words, they were never directly described. Mary placed herself squarely in the center of this story, beginning with her self-confidence, lingering on her disappointment, and then moving through her revisions and publication. If the narrative was designed as a model for the students, Mary was inviting the students to see themselves, not Newman, as the active agents in the process.

Mary ended this story by expressing solidarity with Newman:

> I have to agree with Alan that this article that's on, posted on the website, is a much better article than the one I gave him originally. And I do, even though it was hurtful at the time, uh, it, it did help me improve my writing. (87-97)

Prior to this point, the students had only heard about Newman as an intimidating yet qualified expert. With these words, Mary gave Newman a specific function in the class: he could help them improve their writing (she did not suggest he could help them improve their science knowledge, a role she continued to reserve for herself). By expressing agreement with Newman's editing of her own article, Mary was offering a testimonial; in a sense, she was saying, 'I was like you and Newman helped.' This was the first instance of Mary positioning herself in alignment with the editor. Once she moved into her PowerPoint, this became the dominant role she took up for the remainder of the lesson as she transitioned from simply being a model for the students to being someone who could broker their entry into the world of a published writer.

Teacher as Broker-Translator

As a teacher highly committed to the idea of her students publishing, Mary ultimately had to find a way to push her students to meet Newman's expectations. He was, after all, the gatekeeper to publication. In other conversations we had with Mary, she also expressed her belief in the value of revision; for Mary, asking students to revise wasn't just about the accolades of a published article, it was also important to her core learning goals for her students. However else she positioned herself, at some point Mary was going to have to communicate her agreement with Newman or her students would have little reason to revise. Yet agreeing with him was fraught with the potential pitfalls that have already been discussed: Newman might hurt the students' feelings and Mary wanted to disassociate herself from that; Mary had already edited the articles so she couldn't claim to agree with Newman entirely without potentially having to explain why she hadn't commented on the same issues. Perhaps because of these issues, Mary's positioning of herself as in agreement with the editor was rarely done explicitly.

Mary's role as a broker/translator (as someone who agreed with Newman) was first established by the very existence of this lecture, PowerPoint, and handout. Had she found his feedback completely unacceptable, she could have ignored it; Newman was the outsider with no direct role in the class and no firm control over their activities. But not only did she decide to address his comments and ask the students to revise their articles, she also titled her PowerPoint and handout "Improvements to the Articles." However she chose to distance herself from Newman's tone and style, by titling her materials in this way she expressed confidence that his feedback could help make the student articles better. This confidence was also foreshadowed in the narrative of her own experience where she ended with herself as a better writer.

Once Mary began the lecture portion of the class she also shifted how she used pronouns to refer to the students. During the lecture, she only used first-person plural pronouns three times: "we went over how we were supposed to have multiple, credible sources" (133-135); "the next thing that he criticizes us about" (167); "occasionally he's questioning our facts" (239). This first instance involved a reference to something that had happened in the recent past, a time period that Mary had already described in this collaborative way (a more accurate sentence would probably have been "*I* went over how *you* were supposed to…"). The other two instances also served to position Mary as an insider, this time one who was aligned with the students against a threatening outsider. Newman didn't criticize and question *you*, he criticized and questioned *us*. But aside from these three strategic uses of "we" and "us," Mary used "you" to refer to the students throughout the lecture. The following are typical examples:

> What, um, Dr. Newman, Alan, says on a lot of your, uh, articles is that it looks like you did a Google search and you, you went through let's say the top ten and you picked the most credible of the top ten and that's where you went. (136-143)
>
> You knew who the expert was, you knew why you picked them as your expert, but you didn't share that with your readers. So you might have said their name and you might have even said their job, but you didn't then make the connection of why are you sort- citing them as an expert on that topic. (169-178)
>
> A lot of you, you're talking about your topic, you do a good job with your topic, but you don't ever get the teenage audience to understand what it has to do with them. (214-218)

In these examples (and others), Mary was describing the problems Newman had identified with the student articles; these problems were attributed to the students alone ("you") not to Mary and the students ("we"). By using "you," Mary was subtly aligning herself with Newman and filling the role of a translator of his comments.

In addition to these implicit moves, Mary explicitly approved of Newman's comments one time in the middle of her lecture: "Um, and I do believe, um, I actually agreed with a lot of his comments, it's just the way they were said would not have been the way I would have said ’em” (201-206). Mary’s hesitation at the beginning of this sentence could indicate that she was nervous about something, either Newman’s comments generally or her agreement with them. Furthermore, she was careful to agree with the *content* of his comments but not their *tone*, an important distinction for her and her various purposes. By disagreeing with his tone, Mary could preserve her identity as a caring figure; by agreeing with his content, she could align herself with his credentials and expertise. This sentence represents the clearest expression of brokering and hybridity in the class period and demonstrates the complicated nature of the dance of repositioning Mary was engaged in.

Conclusion

Underneath all of the roles Mary played in this short block of class time, she was always a teacher, someone who was working to help her students learn and grow. As a self-proclaimed “science expert,” Mary had considered the “sage on the stage” role to be the best way to do this, but once she began incorporating science journalism into her classes—and involving Newman in the editorial process—she had to find new ways to position herself, something she considered herself still working through, even at the end of the school year.

To be a successful teacher in the SciJourn project, a project that demanded that teachers think differently about genre, expertise, and writing, the kind of repositioning Mary engaged in may be necessary. Wenger (1998) described ideal educational environments as those where the goal is “to open new dimensions for the negotiation of the self,” to be “transformative” for students and their identities (p. 263). This analysis suggests that Mary, the teacher, transformed her own identity in this way. She moved from her position on the stage, where the students were a far-off and passive audience, to a place among them. This move was metaphorical in the block of class time analyzed above but later in the class period became literal as she walked around the room and talked to students about their work. In turn, the writing this class was engaged in resulted in new roles and identities being opened up for students. The students in Mary's class were asked to relate to her, to chemistry, to Newman, and to their article topics in a variety of ways beyond what would be required of them in a traditional lecture-based class. As they negotiated new roles and worked together toward publication, the third space became transformative for every person in the room.

XIV. Section Two Conclusions

In the second section of this dissertation, I explored the following research questions:

- From a teacher's perspective, what does SciJourn look like in classrooms? How do science teachers incorporate ideas about genre and authenticity? Does this look different in different classrooms? What meaning do teachers make of this experience?
- What does SciJourn look like in a single class period? How does a teacher facilitate the creation of a hybrid community of practice, one that includes characteristics of a professional newsroom and of a high school science classroom?

In this chapter, I will conclude Section Two by addressing my final research question—What characteristics of SciJourn implementation appear across classrooms?

SciJourn Implementation: Recurring Themes

Each SciJourn teacher I interviewed described a different experience working with science news in his or her classroom; from my discussions with other SciJourn teachers at professional development meetings, I knew there were as many stories of implementation as there were teachers in the program. However, as I read and reread these interview transcripts, a few recurring themes emerged that seemed related the specific genre of science news and the authentic way it was being used in the classrooms.

Out of the Comfort Zone

All five of the teachers I interviewed described the SciJourn experience as moving them out of their comfort zones, and for all five, this sense of discomfort began in the professional development. For Barbara, Mary, and Shelley, this feeling was caused, in part, by being asked to write in the genre of science news. All three of these teachers described themselves as capable writers in a more general academic way, but this particular genre was something different. The key difference seemed to be what Mary called “writing to catch and hold interest.” Jason also struggled with writing the article, although he characterized his struggle as a more general writing problem and not necessarily one related to the genre itself. For these teachers, I suspect it was essential that they actually had to write science news articles; without the experience of writing an article—gathering research, conducting interviews, writing a rough draft in an unfamiliar genre, and receiving editorial feedback—they may not have ever recognized how different the genre of science news is from other genres they had composed. Many teachers in the professional development (not just those who participated in my interviews) expressed surprise at what they learned about the genre—in particular, they were often surprised by the organization, especially the fact that journalistic articles don’t have “conclusions”—despite the fact that they had all read and viewed science news regularly. Without writing in the genre of science news, teachers may not have understood the SciJourn standards or this different definition of science literacy as well; if they did understand it, they may not have been as convinced of its value. The act of writing made an impression that only reading may not have.

Only Tom found the writing easy, but he had concerns about the rest of the professional development, in particular the idea that he would be responsible for creating implementation activities rather than being handed those activities to implement how (or if) he chose. Tom also seemed uncomfortable about the idea of teaching writing, a feeling he never overcame. The structure of the professional development also challenged Mary, who saw the activities as pushing her into a new, unfamiliar role, and Shelley, who found herself playing the role of her students and not always enjoying the experience.

Once they returned to the classroom, all five teachers seemed to find themselves in unfamiliar territory as they implemented SciJourn for the first time. The only one of the five to not require that his students write, Tom seemed to have the easiest transition back into the classroom, but he did describe moving into a new role in the classroom (perhaps despite himself; he seemed the most unwilling to push his own boundaries). The self-described “teacher-pleaser,” Tom also seemed to be uncomfortable about the fact that he wasn’t sure he was in Saul and Newman’s good graces. As she anticipated during the professional development, Mary found herself moving from the “sage on the stage” role into a different position in her classroom, a position that she was still adjusting to. Mary also worried that she wasn’t implementing SciJourn “right,” but couldn’t get any of the SciJourn team members to tell her whether or not she was doing things correctly. Barbara, too, wondered about her implementation strategies; her first year, she was especially concerned about the “regimented” nature of her lessons and decided, on her own, to change plans her second year. Finally, Shelley described the implementation experience as a challenge from beginning to end, as she tried to learn what skills her students needed and how to help weaker writers. Jason expressed the least amount of uncertainty about implementation, but I wonder if this was due to the fact that he invited Newman into his classroom frequently and had Newman do a lot of the SciJourn work (introducing the genre to the students, helping students select topics, editing student writing, and conferencing with students about revision).

Genre and authenticity were central to the discomfort these teachers felt back in the classroom. Even only reading in the genre of science news opened the classroom up to a different kind of science than students and teachers were used to. Science news is about the new and sometimes controversial; it is filled with different opinions on the same topic; sometimes there is no consensus and no final conclusion. Textbook science is about science that is stable and ready to be memorized; very few sources are attributed and controversy is usually absent (or historical). For science teachers, who often take pride in their content expertise, this genre was bound to be frightening. And for teachers who didn’t have much training or confidence in their ability to teach or respond to writing, asking students to write in the genre was bound to be even scarier.

Student Interest Sparked by Reading Science News

Although all of these teachers seemed at least somewhat nervous about implementing SciJourn, they all described their students as being quickly interested in the project, an interest most attributed to reading in the genre of science news. Mary thought that reading out loud to her honors students would be a terrible experience and was shocked at how much they enjoyed it. She described her students as being excited to comment on the content of the articles they were reading, to connect the article to things they had seen or done in their own lives. These news articles seemed to invite the students to make connections in ways that the traditional curriculum, and the traditional chemistry textbook reading, did not. Tom and Jason described the effect of RATAs with nearly identical anecdotes; their students enjoyed the news stories they heard in class and seemed inspired by the RATAs to attend to science news outside of class. Shelley did not specifically talk about RATAs (although members of the research team had witnessed

Shelley doing RATAs); instead, she said her students were inspired by reading and commenting on articles themselves on scijourner.org. She suggested that her students were very interested in the topics they read about online and saw the articles as something they could do themselves. Only Barbara didn't talk about reading as a key factor, although she did say that she used RATAs in order to prepare her students for their future assignment.

When science editors Newman and Miller talked about the key qualities of science journalism and science journalists, recognizing what is interesting about current science was an important quality. As the students of Barbara, Jason, Tom, Mary, and Shelley listened to science news and read it themselves, they seemed to find their interest piqued in science in a way that their teachers hadn't seen before. The teachers talked about their students making connections to science that stretched beyond the classroom, an unsurprising outcome if the science journalist had done his or her job in the way Newman and Miller described it.

SciJourn and Student/Teacher Roles

Many of the teachers joined the SciJourn program looking for a contained set of activities that they could use in their classes, often with the goal of improving student reading and writing. Few were looking for something that would change their teaching in radical ways (most of the teachers who joined SciJourn seemed to feel confident that they were "good" teachers, seeking to become better, rather than teachers who needed to completely rethink their pedagogy). However, a notable feature of the SciJourn stories of Barbara, Jason, Tom, Mary, and Shelley was the idea that SciJourn did not stay contained in “SciJourn activities;” ways of talking and thinking from the project seemed to change both the teacher’s and the students’ roles in the class and, in some cases, beyond.

For Tom, the impact of SciJourn started with the way the project interacted with the traditional role he liked to play. His daily RATAs could be seen as reinforcing the central role he played in the course since he was always the one who chose the articles and did the reading. However, as the weeks went by, he also moved from simply reading and voicing his own thoughts to reading and asking for student opinions. The students responded. This relationship led Tom to ask more questions during his typical lectures, and Tom credited the RATAs with creating an environment where his students felt comfortable enough to respond to these questions too. The result of all this, according to Tom, was an improved “closeness”: he actually liked his students better and thought they liked him better in return.

Mary, too, saw herself as the center of her course, most often playing the role of the “expert.” The move away from this role was what scared her most about SciJourn, but it was a move that her students responded to enthusiastically. Although she still struggled with the transition , Mary said that she thought SciJourn “was kind of changing the way I teach also the rest of the time,” not just during SciJourn activities. In particular, she saw herself emphasizing connections between the content and the students’ lives more than she had in the past; she was using the idea of connections to help her decide what she could cut from her curriculum and what she had to continue to cover in her traditional manner.

Jason was particularly impressed with the way SciJourn seemed to change his students’ attitudes about credibility. In addition to the story he told me about the girls investigating the pseudo-documentary horror film (an incident where SciJourn values had altered students' out-of-school behaviors and beliefs), Jason talked about how successfully his students were able to talk to one another about their projects. He described walking around the classroom as his students worked on their projects, listening to conversations among groups. Often, he said, he would overhear them asking each other questions about the credibility of sources and whether or not facts could be verified. The students positioned themselves as capable of challenging one another on this issue; they also seemed to value credible sources in a way they hadn't prior to SciJourn. Barbara also had her students work to provide feedback to one another during her speed pitching, PowerPoint, and peer editing activities. Her students, too, took on the values of science journalism in new ways. She said they were able to tell one another if a topic was "boring" or not—putting themselves in the science journalist's position of identifying interesting science stories. They also liked to challenge one another about sources of information. While Shelley had been surprised by how little her students initially knew about credible sources, by the end of the year they were much like Jason's and Barbara's students, eagerly asking one another where they found their information and how they knew it was credible. Shelley also was able to use her published students in a "teacher" role, playing "mini-me's." Because they had been through the revision process, Shelley said, these students were fully capable of helping their peers revise. By the time they left her class, Shelley believed that her students had acquired the habits of mind and values of SciJourn for themselves, an entirely new, and empowered, role for them.

"Ownership" and Writing

While Tom believed that only reading science news articles could have an impact on students, the teachers who asked their students to write talked about a more profound change than what Tom found through the RATAs, a feeling that was supported by Farrar's (2012) research into student science literacy. Several teachers specifically used the idea of "ownership" to describe this change, telling me that the students who worked on their articles through to publication "own" the knowledge and the process in a deep way. Perhaps this "ownership" grows out of the role-playing and role shifting described in the previous section, that as students become more comfortable in these new roles they are able to inhabit them more completely, but it seems to require that the students actively work as science journalists and not just listen to their teacher reading.

Final Thoughts: Did the Genre Matter?

The teachers do not speak with a uniform voice on this question, either in the interviews or in other contexts. I have watched SciJourn teachers give presentations at national conferences where they downplay the genre and highlight some of the skills their students are learning, particularly skills related to Internet searching and credibility. However, I would argue that the genre—and its authentic use—was absolutely essential to the transformation described by these teachers and experienced by other SciJourn participants[56]. And, as I listen to the teachers carefully, I believe they are in agreement

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[56] I do not mean to suggest that science news is the *only* genre that could lead to such transformation; other genres could be selected by analyzing the authentic qualities of the genre and their overlap with classroom goals.

with me; we just don’t speak the same language on this issue (or on others). In general, the teachers don’t really care about the genre itself, but they do care about the learning outcomes, and the learning outcomes occur (and least in part) because of the genre. For teachers who describe their past writing assignments with words like “horrible” and “tortuous,” enthusiasm for a writing assignment is a startling outcome but one that was common across the project.

XV. Conclusions and Recommendations for Further Research

In this dissertation, I set out to understand something about genre, authenticity, and learning. My questions led me to talk to a variety of interesting people and to analyze a myriad of data sources. As I read over these pages, I realize that what I've learned is only the beginning of what could be learned from the data I've collected, that what I've written in these chapters inspires more questions than answers. In this final chapter, I will begin with a brief summary of the main points I have taken away from this project and conclude with recommendations for further research, research I hope others will join me in pursuing.

Genre and Functional Authenticity

Science journalism is a unique genre. The genre itself creates third space, existing between the world of scientists and the everyday language of most citizens. As teachers begin reading science news articles with their students, their classrooms almost automatically become third spaces. If the news article is well written, the text will attempt to interest the reader (and listener); the words will be technical yet understandable; the voices included will not be limited to a select few from an isolated academy. Just listening to science news moves students into third space and becomes an engaging activity where science is more exciting and accessible than textbooks ever manage to make it. But only *listening* to science news isn't enough to fully take advantage of the genre. Students who are asked to write in the genre of science news, and to write to the standards of professionals, gain much more than those who simply sit as spectators. By assuming the role of a science journalist, the student isn't just experiencing third space as created by another individual; the student is actively constructing third space for him/herself. The student takes on the responsibility of understanding science content deeply enough to convey it to a non-expert reader which means becoming an expert of sorts him/herself; the student becomes the one who evaluates the credibility of sources and determines how many perspectives must be included; the student is required to become aware of audience and to make topics interesting. This is truly functional authenticity.

Most science teachers aren't thinking about genre nor are they usually thinking about writing as much more than an assessment tool. They *are* worried about reading and writing skills, particularly when their administration asks them to be worried about reading and writing skills, and they are often dismayed by what they see as their students' lack of interest in their subject matter. Many SciJourn teachers hoped the project would help them with overall student literacy, but they often found that science news sparked their students' interest in surprising ways. I have come to believe that genre demanded that this would happen. The teachers also found that through an authentic assignment like science news, they were able to work with their students on science literacy skills, skills like evaluating credibility and understanding science issues that were personally relevant and interesting. Many of the teachers had never thought about these skills before; if they had, they had never articulated them in exactly this way. But the call to engage in more relevant and contemporary science resonated with the teachers and, through the genre of science news, they found an authentic means to explore the skills their students needed to engage in contemporary, relevant science. Using the SciJourn standards on a five-paragraph essay wouldn't have had the same result; functional authenticity would have been missing.

But what does this mean for those outside the SciJourn project? For those outside the field of science education? To me, it means that we must think more carefully about the genres we select in our classrooms. What other genres create third space? This may be important for classrooms where students are working with unfamiliar and alienating content (the case in most science classrooms, Lemke (1990) suggested, but also true in other disciplines). What other genres authentically demand that students grapple with the skills we are hoping they acquire? Bazerman (2009) argued that by learning new genres student can develop into certain kinds of individuals; what kinds of development do the genres we assign encourage? In order to use genre authentically, I would argue, we must understand genre authentically ourselves and be able to articulate the essential features to our students, something other researchers have shown to be a difficult task for expert writers (e.g., Geller, 2005; Soliday, 2005), but one that I believe we must try.

For Further Research

The questions listed above are all potential avenues for further research outside of SciJourn, but the project itself is a rich field of further study. As I finish this dissertation, I know it is lacking an important perspective, the perspective of students involved in SciJourn. Originally I had planned to include a chapter discussing how the students talked about the genre of science news and their own relationship to writing, science content, and the professional world, and I conducted phenomenological interviews with five students for this purpose; in the end, though, I had too much data to explore in this single study. In addition, the student interviews were the least rich data source I had available. As I think about a follow-up study, I will need to experiment with different interview protocols to find one that enables me to talk more easily with students about these issues.

In addition, four of the five teachers who participated in my study continue their involvement with SciJourn; following up with them longitudinally would offer insights as to how (or if) teachers sustain a change over time. A longitudinal study would also provide the opportunity to see how teachers' meaning-making changed after several years in the project.

Finally, as Miller pointed out during our second interview, the genre of science news is itself changing. I would like to talk to additional science journalists, particularly those who were trained in the age of Internet journalism. Pairing this research with close content analysis of science news articles themselves would give me a more complete picture of the genre.

Coda: A Basketball Metaphor

I am a basketball player. I say this in the present tense even though I haven't played competitively since I graduated from college nearly fifteen years ago. When you play a sport the way I played basketball—starting at a very young age and continuing, year-round, for a decade and a half—you don't just shake off the identity. To this day I have basketball nightmares where I'm getting ready to go onto the court and I can't remember the playbook, this is how deeply basketball is ingrained in me.

And I know basketball. I married a non-basketball player but after years of watching games with me he's learned to quickly tell a zone defense from man-to-man, to identify who on the team plays good help-side and who blocks out well. He recognizes when a coach is making offensive/defensive substitutions late in the game before some of the commentators even mention it. He will never see the sport quite the way I do, but he's learned a lot of the nuance.

Prior to meeting me, most of my husband's basketball knowledge came from gym class. The teacher brought out the ball rack and announced, "Basketball today. Pick teams." My husband is athletic and enjoyed playing basketball in gym, but no one ever explained the sport. It was assumed that the boys knew enough already, but Andrew, not having grown up in a sports-watching family, didn't know much beyond the basic concept: get the ball in one basket, keep the other team from putting the ball in the other. As he played those gym class games—the only time he ever played basketball in his life—he picked up on some of the other rules but never on strategy. There was no need to understand the sport deeply; it was just something to do for a few days before they moved on to the next thing, soccer, perhaps, or running on the track. Exercise was the real goal.

The metaphor may be obvious but I didn't come up with this myself. My advisor proposed the idea. "Are normal school practices around genre much like the gym-class approach to sports?" she asked me. "And is being a part of SciJourn more like being on the team?" It was worth thinking through.

In most gym classes, sports are something to play, not something to learn. You play one for a few days, maybe a month, and then play another. Even in schools where the P.E. teacher explains the rules (and tests the students on their knowledge of them), the learning is superficial. In fact, the P.E. teacher him/herself may not know much more. Likewise, many times when teachers assign unusual genres they do so without explaining the "rules" beyond the most basic; the expectation isn't that students will deeply understand the genre but that they will enjoy themselves and meet some class goals. Giving students several different genres to choose from, as I sometimes did in my classes, would be something like the days the P.E. teacher pulled out a lot of different equipment and said, "Free choice day. Do whatever you want." As long as you chose something and put some effort into it, you were going to do fine.

So far this metaphor doesn't get me much further than the "cheese on the veggies" idea I introduced near the beginning of this dissertation, but let's extend it for a minute to think about what happens when you play on a team. Being on the team is different from playing a sport in gym class in significant ways. You practice, and in practice you break down the complicated sport into pieces. Practice time is subdivided into segments focused on skills (shooting off the pass, shooting off the dribble, dribbling around cones, post moves, etc.), segments focused on physical fitness, segments focused on learning defenses, learning offenses, preparing for specific game situations, and, finally, scrimmaging. Through practice, you learn much more about the sport than you would just by playing games. You learn about the parts that make up the whole and the better you get, the more detail you learn.

I think of the RATAs and the other non-writing activities the SciJourn teachers do as the equivalent of basketball practice. Teachers begin by reading and thinking about the genre of science news, verbally breaking it down into more and more finely detailed parts. They ask their students to look at and understand the genre deeply, engaging them in conversations about the subparts like credibility and relevance that science journalists would find familiar. When the students begin their own article-writing process, they engage in the equivalent of "scrimmage," working on putting all of the pieces of the genre together in a protected environment, away from the consequences of the real world.

But on a competitive basketball team, you don't just scrimmage. You play official games and these games are played with a coach on the sidelines and an audience in the stands. The coach has expertise, designs strategy, decides who will play (when and what position) and who will sit on the bench. But the players themselves do the actual playing. To push the metaphor further, in SciJourn, *SciJourner* is the official game, Newman is the coach, the readers are the audience, and the students are the players. Writing an article for *SciJourner* is different than writing an article for the teacher's eyes alone in the same way that playing a regular-season game is different from playing a practice scrimmage. More is at stake and more is demanded. Not everyone on the team will get into the game—and just trying really hard in practice may not be enough to get you on the court when it really counts.

Yet if you're on the team, if you're working with a coach who has expertise and you're experiencing the real games even if only from the bench, you learn something about the sport that those who never played on a team may never understand. Being a part of the team, listening to the coach in practice, trying to improve according to an authentic standard—all of these things endow you with a deeper understanding, a kind of "sight" that others don't have. Which is a fairly meaningless outcome when the thing you're seeing is a sporting event—unless you happen to want to contribute to conversations at my family gatherings during basketball season—but has a lot more importance when the thing is a science news article and the conversations are about the science-related issues you need to understand as a citizen.

In the end, my research question—did the genre matter?—seems like a silly one, like asking if the sport mattered in gym class. If you were only interested in exercise—if you were only interested in assessing factual information—probably not. But if you were interested in learning more about a particular sport, then, yes, it would be better to play that sport. And yet it wouldn't be good enough. If you wanted a deeper knowledge of that sport, you would need an opportunity to work with someone who knew it deeply. For SciJourn students, the opportunity to work with their teachers, teachers who had learned the genre themselves, would be something like my husband learning basketball by listening to me or like players practicing with an amateur coach. You can get pretty far that way, but you're never going to get a full understanding until you have the authentic experience for yourself, with an expert on hand to help you make sense of it.

To mix the metaphor, the genre mattered, but so did the chance to play in the game.

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Appendices

Appendix A: SciJourn Standards

Scientifically literate individuals are able to:

1. Identify personal and civic concerns that benefit from scientific and technological understanding.
2. Effectively search for and recognize relevant, credible information.
3. Digest, present and properly attribute information from multiple, credible sources.
4. Contextualize technologies and discoveries, differentiating between those that are widely accepted and emergent; attending to the nature, limits and risks of a discovery; and integrating information into broader policy and lifestyle choices.
5. Fact-check both big ideas and scientific details.

A science news article is a tangible display of scientific literacy. A good SciJourner student article:

1. Has most or all of these elements: is local, narrow, focused, timely, and presents a unique angle
   a. findings are meaningfully applied to personal or civic issues
   b. readers' likely questions are anticipated and addressed
2. Uses information from relevant, credible sources including the internet and interviews. Successful authors:
   a. use internet search terms and search engines effectively

   b. privilege data from credible government and non profit sites and can justify the use of “other” sites
   c. locate and query experts and relevant stakeholders
3. Is based on multiple, credible, attributed sources
   a. sources are relevant and reliable
   b. stakeholders with varying expertise and experiences are consulted
   c. sources are identified and basis of expertise is explained
   d. all assertions, numbers, details and opinions are attributed
4. Contextualizes information
   a. tells why the information presented is important
   b. indicates which ideas are widely accepted and which are preliminary
5. Is factually accurate and forefronts important information
   a. science connection is evident
   b. difficult concepts are explained
   c. precise language is employed
   d. quantitative measures are given in correct and comparable units
   e. information is up-to-date
   f. captions and graphics are checked for accuracy

Appendix B: Interview Protocol: Professional Science Journalists

Modified from Seidman, 1998

Each participant will be asked to participate in a series of two to three interviews[57] related to their experience with SciJourn. Each interview should take approximately 60-90 minutes.

First Interview:

The purpose of the first interview is to understand the participant's background prior to becoming a science journalist. The overarching question is: "How did you come to be a science journalist?"

Topics to cover:

- ✓ Early experiences with science (in and out of school)
- ✓ Family attitudes about science
- ✓ Early experiences with writing (in and out of school)
- ✓ Mentors who were writers and scientists
- ✓ Additional probes as needed

Interview Procedure:
For interviews with journalists, I usually begin by reviewing the purpose of the three interview structure. I explain that I want to understand what the experience of being a science journalist means to them, but that in order to do so I would first like to discuss their background in as much detail as they can remember. In particular, I am interested in their early experiences with writing and science. I tell them that the interview will cover their life up until they became a professional science journalist as well as highlights from their early career.

After this explanation, I begin by asking them to talk about their early childhood experiences with science. As the journalists talk, I take notes and follow up on points related to the topics listed above. For journalists who were previously bench scientists, I also ask about why they left the science profession for writing.

I end the interview by explaining the purpose of the second interview and explain that I will be asking for specific details of the experience of writing science news. I suggest that they may want to think about a particularly important article or articles to discuss, perhaps even rereading the article before the interview.

[57] When only two interviews are conducted, the topics of interviews two and three will be combined.

Second Interview:

The purpose of the second interview is to ask the participant to recreate the experience of writing science news.

Topics to cover:

- ✓ Specific details of writing a particularly important article: topic, gathering sources, writing, revising, receiving editorial feedback
- ✓ Details of additional articles that were important to their career
- ✓ Additional probes as needed

Interview Procedure:
In this interview, I begin by telling the journalist that the purpose of this interview is to recreate the experiences of writing science news in as much detail as possible. Although it is tempting to talk about these experiences from their current perspective, I encourage them to focus on remembering the events as they happened. Reflection will be the topic of the final interview.

Because I end the previous interview by asking journalists to choose an article (or articles) to discuss, this interview usually begins very easily. I ask journalists to walk me through the entire process from the time they received (or selected) the topic through publication.

After discussing one article, I often follow up by asking about other articles the journalist believes are important in some way (to their career, to society, etc). If I am only conducting two interviews, after the journalist describes the process of writing a specific article we move on to the third interview topics (described below).

Third Interview:

The third interview is designed to ask participants to make meaning of the experience of writing science news.

Topics to cover:

- ✓ The importance of their own science news writing, particularly the article/s discussed in interview 2
- ✓ Lessons learned from writing the article/s in interview 2
- ✓ The qualities of high quality science journalism
- ✓ The significance of science news writing in society
- ✓ Additional probes as needed

Interview Procedure:
I prepare for this interview by reviewing my notes from the previous two and identifying any particular issues I want to be sure to follow up on. I begin by reminding the journalists that this is the reflection interview where they are invited to talk about the

meaning writing science news has for them. In my experience, this is usually enough to get the interview started. I follow up with specific questions as necessary.

Appendix C: Interview Protocol: Teachers

Modified from Seidman, 1998

Each participant will be asked to participate in a series of three interviews related to their experience with SciJourn. Each interview should take approximately 60-90 minutes.

First Interview:

The purpose of the first interview is to understand the participant's background prior to SciJourn. The overarching question is: "How did you come to be involved with the SciJourn program?"

<u>Topics to cover:</u>

- ✓ Early experiences with science (in and out of school)
- ✓ Family attitudes about science
- ✓ Early experiences with writing (in and out of school)
- ✓ Mentors who were writers, scientists, or teachers
- ✓ Entry into the teaching profession
- ✓ Previous experience in professional development
- ✓ Previous uses of writing in their classes
- ✓ Decision to enroll in SciJourn professional development
- ✓ Additional probes as necessary

<u>Interview Procedure:</u>

For interviews with teachers, I begin by reviewing the purpose of the three interview structure. I explain that I want to understand what the experience of being involved in SciJourn means to them, but that in order to do so I would first like to discuss their background in as much detail as they can remember. In particular, I am interested in their early experiences with writing, science, and education. I tell them that the interview will cover their life up until the day they began SciJourn professional development.

After this explanation, I begin by asking them to talk about their early childhood experiences with science. As teachers talk, I take notes and follow up on points related to the topics listed above. Teachers seem to want to jump ahead very quickly and tend to want to talk about their teaching. How I handle this varies from interview to interview, but I tend to listen until a natural breaking point and then return them chronologically to where they jumped ahead. Some teachers have more to say about some of the topics above than others so probes will depend upon the specific teacher.

Second Interview:

The purpose of the second interview is to ask the participant to recreate the experience of being involved in SciJourn. For teachers, this means recreating the experiences of writing an article and of teaching with SciJourn.

Topics to cover:

- ✓ Specific details of writing an article: topic selection, gathering sources, writing, revising, receiving editorial feedback
- ✓ Recreate pivotal moments from the professional development and from implementation
- ✓ Additional probes as needed

Interview Procedure:

In this interview, I begin by telling teachers that the purpose of this interview is to recreate the experiences of SciJourn in as much detail as possible. Although it is tempting to talk about these experiences from their current perspective, I encourage them to focus on remembering the events as they happened. Reflection will be the topic of the final interview.

I first ask teachers to describe the first day of the SciJourn professional development, including details about their impressions of the teachers involved, of the professors, and of the structure. I ask them how they felt when they found out they would have to write an article themselves and ask them to walk me through their process. To help with their memories, I bring along copies of their own writing from the SciJourn research database, including copies of editorial feedback.

Once we have discussed the professional development, I ask the teachers to talk about their implementation. Because this covers a long period of time, I ask them to pick out the pivotal moments from the year to describe in detail. As they describe these, I ask them for as many concrete details, including student reactions and comments, as they can remember.

Third Interview:

The third interview is designed to ask participants to make meaning of the SciJourn experience.

Topics to cover:

- ✓ The importance of their own science news writing
- ✓ Lessons learned from the experience that will be useful in the future
- ✓ The significance of science news writing in society, the classroom, or the individual's life
- ✓ What they plan to change and keep for next school year
- ✓ Additional probes as needed

Interview Procedure:

The third interview is where the participant makes meaning of the experience. I prepare for this interview by reviewing my notes from the previous two and identifying any particular issues I want to be sure to follow up on. In my experience, teachers are eager to reflect and I have to ask them throughout the first two interviews to save certain comments for the final interview. I make a list of these issues so I can be certain to address them.

I begin by reminding the teachers that this is the reflection interview where they are invited to talk about the meaning being involved with SciJourn has for them. In my experience, this is usually enough to get the interview started. I follow up with specific questions as necessary.

Appendix D: February 2012 Professional Development Survey

1. Full Name:

2. Briefly, why did you originally sign up for SciJourn?

3. Before SciJourn, how often did you assign the following types of writing?

	~1 x/month or more	~ 1 x/quarter	~ 1 x/semester	~ 1 x/school year	Never
Lab Report					
Answers to questions at the end of the chapter					
Short essay (fewer than 5 pages)					
Long essay (5 or more pages)					
Learning logs					
Summary of reading					
Vocabulary/Key terms					
Other (please explain in comment box)					

4. Before SciJourn (please choose the option that was most typical of your experience prior to SciJourn)

	Yes	No
I could grade my writing assignments by looking for specific pieces of content information		
I required my students to revise their writing		
I found the writing I assigned to be useful for learning purposes		
I found the writing I assigned to be enjoyable to read		
I felt comfortable assigning and responding to writing		
I allowed my students to choose their own topics for their writing		
I had training in how to TEACH writing		
I had training in how to ASSESS/RESPOND TO writing (if yes, please explain below)		
I assigned creative writing (if yes, please explain below)		

5. Before SciJourn, the writing I assigned was based on (check all that apply):

School Policies (if yes, please explain in comment box)

Conversations with colleagues

My own ideas

6. For each of the following statements, please select the appropriate box. Please use the comment box to add any clarifying information you think is necessary.

	Strongly disagree	Disagree	Agree	Strongly agree
Part of my job is to translate complicated or technical concepts into language my students can understand.				
Prior to SciJourn, I found it easy to get my students excited about course content.				
I consider myself a scientist.				
When someone asks me what I do for a living, I usually feel the need to explain why I became a teacher.				
Prior to SciJourn, I found it easy to show my students how the content we learn in my class affects their everyday lives.				
Prior to SciJourn, I considered myself a good writer.				
I understand a broad range of scientific topics and concepts well enough to teach them.				
I understand a small set of scientific topics and concepts at an expert level.				
I am proud of my science knowledge.				

7. As a teacher, I consider myself accountable to

	Strongly disagree	Disagree	Agree	Strongly agree
My students				
My administrators				
My students' parents/guardians				
Taxpayers				
My department chair				
The teacher in my field (high school or beyond) who will teach my students next				

Myself				
Other (please specific in comment box)				

8. In the previous question, you marked individuals and groups to whom you feel accountable. Which ONE of these is your top priority?

Appendix E: Teacher Interview Codebook

Code	Definition	Example
Alternate careers	Career choices other than teaching chosen or taken	"I thought well optometry, I could see myself getting into optometry"
Characteristics of students	What different kinds of students are like in general (not a description of a single student)	"The kids weren't as defiant."
Choice and interest	Choosing own topics or assignments (both teachers and students); interest and engagement in school/classes	"95% of them, even more than that were really excited about what they worked on"
Connections with students	Relationships or emotional connections with students	"I really felt a closer connection to my experimental group than I did to my control group"
Early experiences with science	Science experiences prior to college	"when we were little kids we were always doing science activities, like for example going up to the local pond and collecting algae and snails"
Early years teaching	First three years teaching	"the first year I taught they handed me a biology book and said you're teaching biology, a student edition of a biology book"
Family	Any relatives	"we were low income and so my mom didn't want anything bad to happen"
Good teachers/educational techniques	Effective teachers or educational methods	"somehow he talked really slowly and at the end of class, we'd go really slow but you'd understand everything perfectly, so even though he went really slow we wouldn't need like 85 examples we'd just need one and we could recreate it"
Meaning of SciJourn	SciJourn's impact on teacher or students (reflective)	"there's something about going from a research paper report to a news story that makes it more alive and more real"

Own teachers/schooling	Any comment about own teacher/schooling, positive or negative, from any grade level	“the high school where my mom taught and where I went to school it was a, you probably would call it a packet school now. We worked at our own pace and we worked through packets”
Pivotal moments with SciJourn	Incidents from SciJourn professional development and implementation described as key	“I go OK what’s new, as they turn it in, and some of them are telling me about their entire paper and what they loved about it and what, and I’m like I’m not even asking that much; I just said what’s new, but if you can tell me all of this stuff, because they are all excited that they have a topic that they like to work on.”
Problems with teachers/education	Bad teachers or educational methods, including systematic problems with the educational system	“I had an English teacher in fourth grade who, that was pushed down from the honors program, just regular kids and she was mean, she was brutal, you know, many, many parents went up there to complain about her, and you know it was the first time and I think the only time I’ve ever been called stupid.”
Professional development/teacher learning	Experiences designed to improve teacher practice, including workshops/classes/reading	“I was always taking classes, taking workshops, taking summer institutes; anything that I thought would either increase my skills in my curriculum or increase my skills as a teacher.”
Reading	Critical reading, reading with students, reading personally and professionally	“so I really became creative in my imagination due to the reading.”
Relationship between school and world	Explicit comments about the relationship between school and the rest of life	“it gets them looking at real world examples a little differently.”
Role playing	Playing a part, life/teaching as acting	“you know you’ve got to be accepted by them in the role that you’re playing”

Science literacy	Explicit definitions of science literacy	"To me science literacy is when you have an understanding of the real world of science so that you can make intelligent decisions on the personal level, on the family level, in bills and things that come up."
SciJourn with students	Description of implementation of SciJourn with students	"in all the parts; the read aloud, the activities we would do they would really get into them."
Self as expert	Participant describes self as knowledgeable about science, writing, teaching; also includes negatives (self as NOT expert)	"I have never been an expert on any one section of science, maybe, maybe biology I'm pretty good at for general, but what I am is a massive reader of this stuff and when there's something that's interesting to me or I see something on the news I go and learn about it."
Why/how became a teacher	Entry into profession	"I tell them my journey of how I became a science teacher, and I became a science teacher because I didn't like French."
Writing	Writing background and writing used with students	"But there are things in writing that I still don't do right to this day. I don't use the right tense of there, or the right "there" I still don't use it."

Note: Codes are not exclusive

Appendix F: Editing Codebook

Category: Content (*what* is being said, not *how* it is being said)

Code:	Example:
Sources of information: edits about credibility of sources, lack of attribution to sources, and the number of viewpoints represented by the sources	"Says who?" "Where did you get this percentage?"
Information put into context: edits about the implications of the article topic, including controversies and political/economic/ethical ramifications	"show why this is important" "how much will it cost?'
Information made relevant: edits that point out the article should be accessible to a teenage audience or that topics should be local and/or unusual	"I think you assume the reader knows too much"
Information factually accurate: edits about the necessity for information that is clear, fully explained, up-to-date, and includes quantitative measures.	"I tend to doubt that this statement is true." "I don't understand this"

Category: Form (writing, including edits about the structure of a news article; often insertions/deletions/rewrites).

Code:	Example:
Lede[58]*:* edits that have to do with catching the readers' attention; often involves moving, shortening or rewriting the opening	Deletion of several sentences to shorten the opening paragraph.
Conclusion: journalism articles do not have conclusions	Deletion of a concluding paragraph
Style (simplification and fluency): edits that put writing into a journalistic style without changing content. Often shortening of sentences but sometimes combining sentences or adding transitions.	Original: "Young people may think that they will never get this type of influenza due to their age or good health, but they are wrong." Edit: "Even healthy young people are at risk."
Conventions: edits that have to do with spelling, grammar, and punctuation	Original: "ballay" Edit: "ballet"
Quality of quotes: edits about the nature of a direct quote; quotes are not factually inaccurate but are unhelpful to the story (boring or wordy)	"Didn't one of you say anything like 'I'm really excited about this opportunity'? This quote makes it sound like a trip to the dentist—it will

[58] This is the spelling of "lead" in the sense of "lead paragraph" that many journalists have adopted.

	hurt but it is better than a cavity. Aren't you thrilled to have this really cool trip?"
Category: Coaching (more characteristic of a teacher than an editor. Mostly comments rather than direct changes to the text)	
Code:	**Example:**
Compliments: positive comments about what has been done; if it has to do with a feature of form or content, double code	"I like this topic" "You have a lot of information here, which suggests you worked hard"
References to the assignment: direct references to the fact that this was created in a classroom, for a teacher (not a "real" journalism article)	"the assignment was to write a credible news story"
Encouragement: positive comments about what should be done next	"I hope you will take the time to revise"
Explanation of change/clarifying comment: edits that explain other edits; usually they come right after an insertion/deletion/rewrite	"say it simply"

Appendix G: Previous Version of SciJourn Standards

Standard	Elaboration on Standard
I: Students are able to search effectively for and recognize relevant, credible information sources, especially on the Internet.	I.: Reporters are expected to research their subject before writing a story, collecting background information, identifying credible sources and exploring the issues and controversies surrounding the topic. The Internet is an efficient way to search all of this worldwide.
I.A: Knows how to use search engines and search terms	I.A.: Choosing the right terms makes a search more efficient. For example, "astrobiology" as a search term returns more credible sites than "life on other other planets" because it is the word used by scientists.
I.B.: Privileges data from credible government and nonprofit sites (e.g.; nih.gov and cancer.org) and can ascertain the credibility of "other" websites, using the About Us for clues.	I.B. Reporters understand the value of citing primary sources of data. The Internet is filled with sites that provide recycled content surrounded with ads. A challenge for teens is to identify those sites that keep their information up-to-date and maintain quality control on their material. As a rule this is typically government and nonprofit websites.
I. C.: Keeps track of sources, including dates of publication, author names and expertise and home institution for purposes of attribution.	I.C. A reporter's notebook is a prized and carefully guarded record of who said what, when and where. Collecting information from the Internet requires the same attention to detail.
II: Student articles are based on multiple, credible, attributed sources.	
II.A multiple sources:	II.A: The goal of this standard is to recognize that science is an ongoing discussion and that various opinions or views help inform the research process. A more sophisticated analysis would lead a student to realize that even credible sources have certain biases or leanings, which is another reason to favor multiple sources.
II.B credible sources:	II.B: It is important for students to understand and assess the limitations of sources of information.

II.B.1: Sources are relevant and reliable.	II.B.1: Relevance is context specific. For example, quoting U.S. data from the Centers for Disease Control and Prevention for a story on AIDS in Africa may not be as relevant or reliable as information from the World Health Organization.
II.B.2: Appropriate stakeholders are consulted.	II.B.2: Some science stories naturally lead to questions of how "other" communities and society as a whole are affected. For example, a story on a new medical treatment could quote someone affected by the disease. A new technology to eliminate mercury from coal might include a comment from an industry representative. This underscores the connection between science and society.
II.C.: Attributed sources:	II.C: Attribution recognizes that information has a source (who/which may have a certain agenda), provides a pathway for the reader to verify and expand on something in the story (just as science journal articles must provide sufficient information to replicate the experiments), and establishes a historical record for where an opinion or concept started. Less formal than a reference, attribution includes individual names or organizations, websites, newspapers/TV shows, reports, and press releases. Attribution is particularly important because of the "talk radio" or the "high school social network" model of repeating "facts" that are never sourced. Learning to read journalistic and academic conventions is key to the understanding and use of attribution.
II.C.1: Except for accepted facts, ideas and theories, all assertions, numbers, details and opinions are attributed.	II.C.1: For students used to textbooks and teacher lectures, this may be the greatest challenge. Any information that could be seen as new, not widely known, opinion, or controversial should be attributed in some way. Attribution prevents the author from making blanket or false statements, especially by quoting credible sources.
II.C.2: The names of the experts/organizations are given and their area of	II.C.2: These details help the reader form an opinion on whether or not the information is trustworthy. In some cases, it may mean understanding who supports the work

expertise/qualification is identified. Any biases or potential conflicts of interest are noted.	of a researcher or organization. It also imposes a discipline on the student; they pay attention to details such as who supports or funds certain types of work.
II.C.3: Copyright rules are followed and relevant URLs are given.	II.C.3: Following copyright rules protects the publisher and author from unwanted fees or legal action; URLs provide the reader with a source for more information.
III. Scientific information, discoveries and technologies are contextualized; broader implications as well as reflections on past and future understandings are noted.	III. Context puts the story in perspective. A description of the broader context helps the author and readers understand why they should care about the discovery/technology and why researchers are interested in the topic. It underscores the interconnections between science and society and the cumulative nature of scientific research. In finding context, students are asked to understand the nature, limits and risks of a discovery, emerging concept or technology.
III. A: The import of the information for society is understood and sufficiently detailed	III.A: Detailed information helps the reader determine the implications and importance of the information for society. Social, ethical, economic, and political effects are important to consider.
III.B: The article indicates which data/ideas are widely accepted in the scientific community and which are preliminary. The article sensibly weights the import of findings and, where appropriate, uses qualified rather than declarative language.	III.B: Does the new knowledge significantly change how experts view the topic or does it confirm what is known and believed? Researchers typically qualify their findings; reporters should do the same to reflect the uncertainty. Preliminary knowledge carries the risk of being wrong or unsuccessful in the long run. On the other hand, good science writers understand which ideas carry greater scientific weight and therefore are less likely to be drawn into futile debates that are more social, political, or ideological in nature, such as whether global warming is real or intelligent design is a theory.
IV. Scientific information is relevant to readers.	IV: Reporters have a duty to address the interests of their audience.
IV.A: Reported findings are linked to local or personal concerns and new applications are considered.	IV.A: They build on the fact that science and technology affect each of us personally.

IV.B: Readers' implied questions are anticipated and addressed.	IV.B: Reporters' questions should be critical and reflect those of the readers.
V: Information is factually accurate and important information is fore-fronted.	V: Reporters pay attention to details, including ensuring that the facts are checked for accuracy, spelling and attribution. Who, what, where, when and why – the 5 W's of journalism—are typically present in the first few paragraphs.
V.A: The story structure indicates what is more and less important from a reader's and writer's perspective. The science connection is noted.	V.A: The writer determines the gist of the story, what details are most important (these come next) and which details come later down to help flesh out the story.
V.B: The article shows an understanding of the content and is able to explain concepts and information, including methods of scientific inquiry.	V.B: The writer understands the scientific inquiry methods and scientific processes she or he reports. In the long run, the new discovery or technology may be incorrect or fail (e.g., cold fusion), but the initial reporting should be as accurate as possible. Depending on the story's audience, the student author should provide sufficient information so that the reader understands the finding and how scientists arrived at it. This requires the student to understand and digest the technical elements of the research.
V.C: Precise language is employed and scientific terms are used appropriately.	V.C: The author's challenge is to explain scientific ideas simply, without changing the science. Consider the problem of astronauts "floating" in space vs. living in a low gravity environment. Or not differentiating between type I and type II diabetes.
V.D: Quantitative measures are given in correct and comparable units.	V.D: Nearly every story has a number—a percentage, cost, patients tested, etc. Citing those numbers is an important element of science practice. Quantitative measures can be given as analogies.
V.E: The latest/up-to-date information is presented.	V.E: Reporters strive to "break a story" or to be the first to analyze events. Students may lack the resources to be first, but they should determine that their information and the issues are up-to-date. No one, for instance, wants to promote a medical treatment that has been discredited. An interest in timeliness encourages students to look at publication/announcement dates as a means to determine whether it is up-to-date.

V.F.: The headline and photo caption accurately reflect the content of the story.	V.F.: The headline should capture the gist of the story; the photo caption should briefly summarize a key aspect of the story as reflected in the image.

Appendix H: The Inverted Triangle

Story structure

Lede

Opening: What is new!

5 W’s

Background information

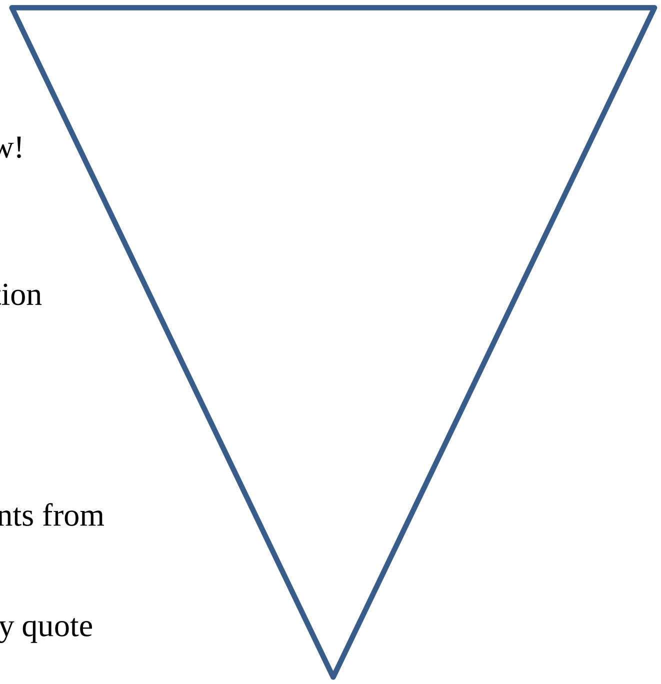
Details of the work

More details

Reaction and comments from others

Future plans/summary quote

Don’t worry about an ending!
No summation of the story!



Writing characteristics

Good lede: Strong quote, teaser, amazing fact, short story

Write for your audience

Strong action verbs

Concise, clear sentences

Attribution with direct and indirect quotes

Clearly identify the people and organizations that you quote

Define any technical terms; use analogies to explain concepts

Avoid jargon and clichés

Tight writing (less is more)

Follow the style guide

Appendix I: Selections from Discourse Analysis Pronoun Chart

I: Mary Connor	**We: Mary Connor and students**	**You: Students**	**He: Newman (the editor)**
I thought, I know pretty much stuff (72-73)	We have been through quite a bit with these SciJourn articles, haven't we? (15-16)	What, uh, Dr. Newman, Alan says on a lot of your, uh, articles is that it looks like you did a google search and you, you went through, let's say the top ten, and you picked the most credible out of the top ten and that's where you went (178-187)	His name is Alan (44)
I'm a, I'm pretty good at this (76-77)	We wrote the aritcles (22)	Think of your topic and then say who would be the, the best source to go to for this topic (190-193)	He has a PhD in chemistry (45)
I go ahead and put the article together (78-79)	We did a lot of research (23)	Is it the best source that you can possible find? (212-213)	He's, he's been a research scientist (46)
I think, yeah, that's great and I get it back and it was just covered with track changes (82-86)	We wrote our articles (25)	You'll see that in some of his comments (216-217)	He's also been an editor of a science journal for about 20 years (47-48)
And I was like, "Oh my gosh, it can't be that bad" (87-88)	We peer-edited each other's articles (26)	You knew who the expert was, you knew why you picked them as your expert, but you didn't share that with your readers. So you might have said their name and you might have even said their job but you didn't then make the	He, he really knows his stuff (49)

		connection of why are you sort- citing them as an expert on that topic (225-235)

Appendix J: Abridged Version of the Discourse Analysis Verb Tense Chart

	Stable	**Distant Past**	**Recent Past (summer)**	**Collective Past (school year)**	**Present**	**Future**
He (Newman)	Named Alan, is different from the teacher	Got a PhD in chemistry, was a research scientist, was an editor				
I (Connor)	Knows students and school well, is different from the editor		Wrote an article, got very harsh feedback, was surprised and upset, revised and succeeded in getting published	Edited student articles	Agree with the editor's comments but not his tone; found patterns in his responses and will go through common issues; am asking you to do your best	
We (Connor and Students)				Have been through a lot together, learned about writing, wrote, peer	Are getting the articles back from the editor	Will revise over the weekend; will resubmit articles; will do

				edited, used response sheets, sent articles to the editor		the best possible
You (Students)				Didn't attribute well, wrote about topic well but didn't make it relevant	May be able to get published but may have to start over	Will do the best possible; will show the editor, prove him wrong

Appendix K: Discourse Analysis Codebook

Code	Definition	Example
Teacher as teacher	Instances where the teacher is explicitly controlling time or activities	"I'm asking everybody to turn off their computers" (1) "I was gonna let you have some time" (309-310)
Teacher establishes editor's credibility	Teacher creates the authority of the editor by directly listing his credentials but also by calling him the boss and by explaining how the editing helped the teacher improve	"he's been a research scientist. He's also been an editor of a science journal for about 20 years" (34-35)
Teacher in solidarity with students	Teacher is aligning herself with students either through pronoun use ("we") or by telling stories where she is similar to the students	"we wrote our articles, we peer-edited each other's articles" (18) "I went through this same process" (55)
Teacher contrasting self with editor	Teacher explicitly draws attention to the differences between herself and the editor—always done directly	"he's a very different person than me, right?" (37) "there's just some things that I wouldn't have said the way he said" (105-106)
Teacher in solidarity with the editor	Teacher aligns herself with the editor; very rarely is this explicit (although she does say it explicitly once); mostly it is done through pronoun uses and through the existence of the PowerPoint and handouts explaining the editor's comments	"I actually agreed with a lot of his comments" (202) Uses of "you" when describing mistakes students made