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The Importance of Teacher Self-efficacy in the Implementation of a Middle and High School Science Writing Initiative

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The Common Core State standards place strong emphasis on discipline-specific writing, thus, making writing in science courses an increasingly important endeavor. It is well known that individuals do not simply appropriate scientific knowledge and apply it to their lives (Jarman & McClune, 2007). Rather, scientific knowledge has to be reworked, restructured, and integrated with prior knowledge. Promoting meaningful learning in science classrooms then demands the inclusion of writing tasks that facilitate this conceptual reorganization and restructuring. Rivard (1994) argues that tasks which maximize learning possibilities and develop higher order thinking skills require students to expand understandings, reprocess ideas, hypothesize, interpret, synthesize, debate and persuade. Thus, writing in science is a resource for thinking and learning, an avenue for students to clarify and consolidate their knowledge. Content teachers, however, often struggle to implement literacy and writing initiatives in their classrooms (Biancoarosa & Snow, 2004; Cantrell, Burns, & Callaway, 2009; Cantrell & Callaway, 2008; O'Brian, Stewart, & Moje, 1995;). Furthermore, content teachers often do not identify as writing and literacy teachers, which can lead to resistance in incorporating literacy practices (Alvermann & Moore, 1991; Cantrell et al., 2009; Carney & Indrisano, 2013; O'Brien et al., 1995). This study focuses on the experiences of two science teachers who worked to implement a writing-focused, science literacy project in their classrooms. Here, I uncover the ways these teachers' experiences differed and how these differences influenced their implementation. Findings confirm the importance of student engagement and also a teacher's sense of self-efficacy in teaching writing. This has implications for the ways we train and support content teachers as they integrate writing into their instructional practice.

Background – The Science Literacy through Science Journalism Project

The Science Literacy Through Science Journalism (SciJourn) project was a multi-year initiative funded by the National Science Foundation. SciJourn was a partnership between university-based researchers, a professional science news editor, and classroom teachers that focused on using science journalism as a method to foster science literacy. Over the course of five years, 51 teacher participants voluntarily came from a variety of contexts including: private and public schools; rural, urban, and suburban settings; high performing and struggling districts.

SciJourn was innovatively designed to include not only teachers and university-based researchers, but also a science news editor who brought a unique expertise to the project. This made SciJourn markedly different from other educational networks. SciJourn's training focused on authentically teaching educators about science journalism as a genre. In each of the three years of the program, new teacher participants joined SciJourn through an intensive two-week summer workshop. During this workshop, teachers were introduced to the concepts of science journalism by the editor, and were required to write and revise their own science news article for a teenage audience. Once approved by the editor, these articles appeared in the *SciJourn*, an online and print newsmagazine.

During the school year, researchers who worked on the grant assisted with implementation in teachers' classrooms, and the editor was available to help students select topics for their own news articles and conference with teachers and student writers on revisions.

Purpose

At the end of the SciJourn project, all teacher participants were given a survey assessing their experiences and the influence of the project on the ways they teach writing. The work presented here takes a closer look at two teachers who expressed widely different experiences with the project in that final survey. One of these teachers was successfully able to integrate the genre of science news in her courses while the other struggled to do so. Therefore, the purpose of this paper is to uncover these two science teachers' experiences with the SciJourn project and how these experiences influenced their implementation. To this end, I address the research question: Why was one teacher successfully able to implement the genre of science journalism into her classroom while another teacher was not?

Conceptual Framework

The primary conceptual framework used in this study is self-efficacy theory, based on Bandura's (1977) model, which suggests that individuals' self-efficacy beliefs influence their goals, the amount of effort they invest, as well as

their resilience when facing challenges. Teacher self-efficacy has been explored over the past three decades of educational research. This body of research supports Bandura's (1977) theory that teachers' self-efficacy beliefs influence their ambitions, the effort they invest, and their sense of resilience when they face challenges. In light of this, teachers who do not expect to be successful are more likely to give up when facing difficulties.

Teacher efficacy has been the subject of numerous studies (Evers, Brouwers, & Tomic, 2002; Guskey & Passaro, 1994; Howe, & Barry, 2016; Ross, 1992; Tschannen-Moran, Hoy & Hoy, 1998; Tschannen-Moran & Hoy, 2007.) Forces influencing a teacher's professional change come from within, including his or her knowledge, beliefs, and sense of self-efficacy (Nielson, Barry & Staab, 2008). As teachers assess their capabilities in a specific situation, they make two judgments. First, they assess the requirements of the particular task. These requirements may include resources, skills, contextual factors, and student capabilities. Next, they assess their own competence in relation to those requirements. These judgments are based on their sense of their own capabilities as well as their past experiences (Tschannen-Moran & Hoy, 2007). It is important to note that teachers' self-efficacy is context specific and thus, related to numerous school variables such as school climate, leadership within the school, as well as overall school performance (Bandura, 1997). However, most measures of teachers' self-efficacy are not content specific, and research exploring teacher self-efficacy as teachers of writing is lacking. Scholarship has shown that elementary teachers' self-efficacy is related to effective practices in teaching literacy and writing, both for practicing teachers and pre-service teachers (Ciampa & Gallagher, 2017; Graham, Harris, Fink, & MacArthur, 2001). Furthermore, research has demonstrated that teachers who showed higher efficacy prior to participating in professional development were more likely to implement recommended content literacy practices (Cantrell & Callaway, 2008; Cantrell & Hughes, 2008). Locke and Johnston (2016) created a teacher-of-writing self-efficacy scale (TWSES) designed for secondary content teachers in New Zealand. Their data suggest that teachers of language-based subjects have a substantially higher perception of their self-efficacy as writing teachers compared to other content teachers, particularly those who teach math and science. Beyond Locke and Johnston (2016), few studies explore the importance of teacher self-efficacy for teaching writing as it pertains to content area middle and high school teachers. Thus, there is a need for research that considers how to improve discipline-specific writing instruction at the secondary level.

Writing in Science Classrooms

Constructing sound explanations and arguments is an essential component of science literacy (Krajcik & Sutherland, 2010). Thus, it is critical for students to have opportunities to write about science and to practice supporting their ideas with evidence. The discourse of science includes not only precise language but also specific ways in which language is used and particular ways in which explanations and arguments are constructed. Writing in science typically emphasizes the traditional lab report. This approach assumes that the best way for students to learn to write scientifically is to mimic the work of professional scientists. Some researchers argue, however, that science classrooms need to include diverse forms of writing, requiring that students write for different purposes using various audiences (Prain, 2006; Prain & Hand, 1996). In their study of writing to learn strategies in secondary Biology classrooms, Hohenshell and Hand (2006) found that engaging in different writing tasks, such as pre-writing and summarizing, provided students with a different set of cognitive experiences compared with the conventional laboratory tasks associated with science writing. Writing summaries, for instance, helped students to integrate their understandings. Similarly, Hildebrand (1998) reported that diverse forms of writing were motivating for students and had positive effects on learning processes and outcomes. Rivard and Straw (2000) investigated the role of talk and writing on learning science. Their findings suggest that talk was used by students for interpreting tasks, and for generating, sharing, and focusing ideas. Writing, on the other hand, was used to organize ideas into coherent responses, was more focused, and placed greater cognitive demands on the students. They argue that talk is a necessary precursor to writing, but writing is critically important for the retention of science knowledge over time.

Despite the popularity of news and media, there are few studies that consider the use of news resources in the science classroom. Jarman and McClune (2007) offer one exception as they consider how reading news media can be used to cultivate science literacy in the classroom. They argue that science in the news demonstrates relevance of science in everyday life and bridges the classroom with the wider scientific world. Stories in the news are also current, dealing with contemporary issues in the community. Newspapers also offer a local perspective that may make the content more relevant and engaging for the reader. Essentially, they suggest that teachers can capitalize on the news to help students connect to the science that surrounds them.

SciJournal aligned with this perspective but was unique in its cultivation of science literacy through the use of an apprenticeship model, where students were not only asked to read science news, but were invited into the conversation as science journalists. The SciJournal project was designed to answer the following

question: Does the teaching of science journalism using an apprenticeship model, reliable data sources and science-specific writing standards improve high school students' understanding of and science-related public literacy?

As science journalists, students called on multiple, credible sources of information to research topics of personal interest and then they synthesized this information into news stories targeted to a general audience (Polman, et al., 2012). A foundational premise of SciJourn was that students should be allowed to choose their own topics for research to help increase student engagement. Another priority of the project was that students learn to evaluate the credibility of sources of information, a life skill that would enhance their science literacy well into their adult lives. As such, the project attuned teachers and students to the process of researching and writing for science news. By asking students to step into this genre, SciJourn gave them the opportunity to start thinking, feeling, and reacting like a journalist. The intention was that science would no longer seem out of their reach. Furthermore, science journalism offers a unique avenue to explore science in an investigative way that is both fun and engaging. By inviting them into the conversation, students were given the opportunity to become part of the scientific community while also cultivating the science literacy skills that are necessary for success in an unknown, future world.

Methods

The research presented here is a multiple case study that used qualitative data collection strategies, drawing heavily on phenomenological techniques. Creswell (2007) describes the case study as a qualitative approach with a case or cases situated within a single setting or context. Here, I have adopted a multiple-case study design using a cross-case analysis. For the phenomenologist, the experience itself is of interest. According to Patton (2002), the defining characteristic of phenomenology is the assumption of essence, which represents the core meanings mutually understood through a common experience. In this context, I sought to take a deep dive into these two science teachers' experiences as participants in the SciJourn project.

The study was grounded in in-depth interviews based on Seidman's (1991)¹ three-interview series. According to Seidman, people's experiences are only understandable when placed in the context of their lives. Without context, it is impossible to explore meaning in any depth. In Seidman's series, the first interview focuses on life history, where the participant tells about his or her past life up until the present time. The second interview explores the details of the participant's present experiences as related to the topic of study. In the third interview, the

¹ Originally published in 1991, Seidman's text is now in its fourth edition (2012).

participant reflects on his or her experiences. Together, these three interviews build on one another allowing for reflection on the past, as well as the present situation.

Informed by Seidman's (1991) approach, I established these interviews as an invitation for the participants to tell me their stories. I used questions and prompts that gave the teachers the opportunity to think aloud about their experiences. In doing so, I let my respondents talk freely about what they considered to be important. Consequently, I designed my protocol to include questions and topics (Appendix A). For each interview, I began with a question as a starting point, establishing the territory to be explored. From there, I let the interview flow in a manner that made sense to the interviewee. By actively listening, I was able to guide the interviews through the use of appropriate follow-up questions while still allowing the participant to talk freely about what she determined to be relevant.

The first of the three-interview series provided the context that was necessary to understand each teacher's experience. The primary question that guided this interview was: "Why did you become a science teacher?" The second interview was used to explore the participants' experiences with SciJourn. The initial prompt that focused this interview was: "Describe what it was like to participate in SciJourn." The third interview gave the teachers an opportunity to reflect on their experiences with SciJourn, its long-term effects, and whatever they felt was important to share about their journey with the project. The prompt that guided this interview was: "What, if anything, did you take away from your participation in the SciJourn project?" I conducted the interviews myself and took notes during the process. At the end of each interview, I reviewed my notes and created a research memo to help inform the next interview.

I began the qualitative analysis by first open coding all of the interview transcripts, creating a lengthy list of codes before moving on to axial coding (Merriam, 2009). This was followed by a second round of coding where I looked closely for moments of tension, while also attending to the similarities and differences in the teachers' stories. From that analysis, two primary themes emerged that were significant: student engagement and self-efficacy in writing.

I then went back to my coded transcripts and pulled excerpts that I had marked as representing each of these major themes and compiled these excerpts together (Appendix B). From these excerpts, I created two, separate poetic representations for each teacher that were representative of their diverging experiences with the project. Lawrence-Lightfoot and Davis (1997) suggest that narratives offer a way to record the subtle details of experience while preserving the nuances and complexities. Thus, the purpose of this kind of poetic, narrative display was to preserve the meaning of my speakers, while bringing the data to life to illuminate their experiences. According to Mears (2009), displaying data in this

kind of narrative form is visually powerful. Paragraphing draws our attention to structure and grammatical characteristics. A narrative display, similar to a poem, focuses the reader's attention directly to the message that is being conveyed.

According to Glesne (1997), poetic transcription creates a third voice, one that is neither the researcher's nor the interviewee's, but rather, a combination of both. Glesne also argues that while poetic transcription can impose meaning, it can also help us derive meaning. This approach positions the researcher closer to the data as he or she strives to shape a participant's words into poetry. Furthermore, the process of writing up data in different modes of presentation pushes researchers to try out different analytical ideas. I chose this approach because I wanted to capture the essence of these two teachers' experiences with this particular writing project. Poetic transcription allowed me to concentrate my data while also telling these teachers' stories. It also functioned as another, deeper, layer of analysis. While these poetic narratives represent my interpretations, the words and phrases came directly from the transcripts. I also maintained the chronological order of the excerpts to preserve the storyline presented by each speaker. As a member check, I shared these poetic representations with the teacher participants to ensure my interpretations aligned with their experiences.

Here, I present these poetic representations by theme. I then offer my interpretations regarding the differences between Denise and Jessica's experiences as they attempted to integrate this writing initiative into their science classrooms.

Cases

Denise, a middle-aged, white female, has been teaching high school science for 16 years. She teaches in a large, high performing, suburban school district where the average American College Testing (ACT) score is a 23 (in the 68th percentile). Her school has almost 1,300 students, 85% of whom are white, 10% are African American, and the other 5% are either Asian, Indian or Hispanic. Her primary subject is chemistry, but she also teaches an Authentic Science Research course for advanced students, which is the course where she implemented SciJourn.

Jessica is a white female in her late twenties who is in her third year of teaching. At the time of the study, she taught at a suburban middle school in a large Midwestern city. Her school had a population of 921 students, 93% are white, and the other 7% were either African American, Hispanic or Asian. It was a high performing school where 90% of the students met the math proficiency benchmarks on state assessments. She implemented SciJourn in her seventh-grade science classes.

Before I go into depth exploring these two teachers' differing experiences, it's important to discuss the reasons Denise and Jessica came to the SciJourn project in the first place. Denise joined the project because she was given a course to teach,

Authentic Science Research, without any set curriculum. SciJourn gave Denise a framework by which she could structure her course and provided her with a set of tools that she could draw upon. Jessica, on the other hand, was searching for a way to teach her students the research and writing skills that she felt they needed to be successful in high school and college. She was confident that she had the skill-set to help her students but was unsure how to bring these skills to her science classroom.

Kenneth Burke writes, "Critical and imaginative works are answers to questions posed by situations in which they arose. They are not merely answers, they are strategic answers, stylized answers" (Burke, 1974, p. 1). For Denise and Jessica, therefore, the SciJourn project provided different answers to different questions. In Jessica's case, her implementation of SciJourn was driven by an essential question: What would an authentic, engaging, science research project look like? While Jessica was seeking answers to her essential question, Denise was looking for a toolkit of strategies that she could use to fill-in her curriculum. Jessica's concept of the ideal research project was quite specific. She suggested that it needed to be authentic and engaging, and SciJourn was well suited to meet these criteria. Denise, on the other hand, was really just looking for something to help her structure her course and to give her some sense of feeling prepared at the start of the school year. Unlike Jessica, her participation was not driven by an essential question; thus, she did not *need* the project in the same way that Jessica did. These differences in these teachers' experiences were certainly significant. However, there is more to the story.

Findings

The findings presented here illustrate how different these teachers' experiences were while implementing the SciJourn project in their classrooms. Denise's students wrote the news articles, but many of them gave up during the revision process. They were not engaged by the authenticity of writing science news or by the excitement of writing for a real audience. Jessica's students, on the other hand, were highly invested in researching and writing about their self-selected topics and sustained their engagement through multiple revisions.

The teachers' perceptions of themselves as writers also proved to be influential. Denise did not identify as a highly efficacious writer. She was unsure how to respond to her students' writing and to help them make revisions. Jessica, however, identified as a strong writer and took it upon herself to coach her students through several stages of revision. As detailed below, these differences between Denise and Jessica's experiences significantly impacted their implementation of the

SciJourn project and ultimately determined their success or lack of success with the project.

Student Engagement

Denise -

I had this new class
I didn't have a curriculum
At least I felt I had something
To get us started

These are not your average students
Independent
Specific goals
Motivation was difficult

Kids kept trying
To change their writing
But no follow-up
They needed more support

A lot would give up
I never got them to buy in

Kids thought of it
As a waste of their time
Just another thing
Another hoop they have to jump through

Jessica -

They were motivated
I set the tone
I encourage them
Lucky you for being in my class!

It's the engagement
The personal
The authenticity
Writing about something you know

I'm a kid
Let me write about myself
Let me write to understand myself
They're doing it
Something magical

Engagement
This is my choice
Big choices
Ownership

Young scholars
Motivated by personal curiosity
Learning for the sake of learning

Teaching Context. These poetic representations of Denise and Jessica's stories illustrate their very different experiences with the project and their differing perceptions of its influence on their students. At first glance, Denise and Jessica's teaching context appear to be similar. Both teach in high-performing, suburban school districts. Their classrooms are adequately equipped and they have access to the most recent technology. An important difference, however, is that Denise teaches at the high school level, while Jessica teaches middle school. Furthermore, Denise did not implement SciJournal in her regular Chemistry courses. Instead, she opted to only implement SciJournal in her Authentic Science Research class, which is comprised of sophomores, juniors, and seniors, who conduct independent, science experiments over the course of three years. The result was mediocre student engagement. Denise attributed the lack of engagement to the nature of the class, having above average students, and also her students not being adequately supported by the editor as they attempted to make revisions to their articles. She suggested that high performing students are sometimes more difficult to motivate than others. Furthermore, her students felt as though the project took time away from their research projects that were the primary focus of the class. Denise also indicated that because her students were high performing, the editor had higher expectations for her students but did not give them enough support and did not adequately communicate with them regarding their revisions. Consequently, her students became frustrated and eventually lost interest.

Jessica, on the other hand, had the opposite experience with her seventh graders who were highly engaged. She described how she intentionally endorsed the project and promoted it as being an exclusive opportunity that her students were privileged to have. Jessica also explained that the authenticity of the project was

significant as it provided a real audience for her students' writing. From her point of view, the most important influence on her students' engagement was that the project cultivated a sense of ownership by giving her students an opportunity to make choices according to their own interests.

Student Motivation. In considering these differing levels of engagement between Denise and Jessica's students there are a few variables at play. While Denise tried to persuade her students to do the project, she ultimately left the decision to them and did not give them any real incentive to participate. In contrast, Jessica heavily promoted the project and used social media to convey the project as an exclusive opportunity for her students. Perhaps the sense of ownership that SciJourn provided for the middle school students was not as significant for Denise's students because her students were already enrolled in a course that was designed as a long-term, independent study. Thus, the freedom to choose their own topic to research and write about was not as novel or enticing as it was for the younger students. At the middle school level, students have little freedom over their schooling, whereas high school students get to choose from a variety of elective courses. Having the freedom, therefore, to choose their own topics to research was highly motivating for the middle school students as it gave them a rare opportunity to exercise some control. Denise also suggested that her students' ability-level hindered their engagement with the project, and her most advanced students did not feel that the project was worth their time. While she did not implement SciJourn in her general Chemistry courses, perhaps those students might have been more engaged by the project. Of interest, these two teachers seem to view their students quite differently. Denise views her students as advanced but also resistant. Her course is designed to prepare them to pursue science-related fields, and her goal in having her students get published in SciJourn's newsletter was that it would enhance their college applications. Jessica, on the other hand, views her students as curious individuals. She does not aspire to train her students to be "little scientists," but rather, she wants to help them understand their world.

Implementation. Another area where these teachers' stories diverge is in the ways they structured the project. While Denise implemented the project at the start of the school year, because of the nature of her course, her implementation was only loosely structured. In total, Denise only had six students working on SciJourn while the other six students did their independent work; she typically only used two or three SciJourn lessons a month. Jessica, on the other hand, used highly structured lessons and materials to implement the project. She introduced SciJourn at the start of the year but did not begin implementing the project until the week before fall break. After that, her students worked on SciJourn every Friday for the duration of the semester. Because her students were younger, Jessica felt that she needed to provide more scaffolds for her students so she created lesson materials

and rubrics to help structure the process. Denise, however, gave her students more freedom and only offered them loose guidance as they worked through the project. Once her students had a draft, she sent it directly to the editor and let him take the lead on editing their writing. This may have thwarted her students' efforts as she indicated that her students struggled, particularly during the revision process. While she felt her students needed more one-on-one attention, Denise provided little structure or guidance, relying instead on the editor to do so.

Self-efficacy in Writing

Denise -

I'm not always real comfortable
With writing
Having to write myself
Was a big deal

Science people
Don't really know how to write

I wasn't comfortable
That was tough
A learning experience

I'm not a writing teacher
I didn't get much back-up
Maybe it was me
I felt on my own

I really didn't know how
I would read through his edits
So I had a better idea of what I should have done

A little bit more support
Would have been good

Jessica -

I've been waiting for this project
I was looking for it

Writing has never been a problem for me

I'm a really strong writer
My confidence
That helped

I could write
I could write lab reports really well
I was good at research too

I looked at all the resources
I made them my own

Meeting other teachers
A sense of community
Gave me validation

I had to use my imagination
I was taking a risk

Rigor needs to happen
You write
You read
In every class

A cultural shift
I have the skill set to teach that

Perceptions of Themselves as Writers. These poetic representations point to Denise and Jessica's differing perceptions of their writing abilities. This was another critical difference in their experiences with the project. Denise positioned herself as not being a strong writer, identifying as one of those "science people" who struggle to write. She also did not identify as a reading or writing teacher and did not feel that she had the time to integrate much writing into her general chemistry courses. Despite the training that she received in SciJourn's PD, she continued to struggle as her students edited and revised their articles. While she tried to read through the editor's comments to learn his approach, she never developed a sense of proficiency. As a result of her lack of confidence, Denise relied heavily on the editor to communicate with her students. Throughout the interviews, she repeatedly spoke of wanting more support and suggested that she could have used more training on how to edit. It is unclear how Denise's student population might have further perpetuated her lack of confidence. If she had

implemented the project in her general chemistry courses might she have felt more confident in editing her students work? Perhaps her advanced students were strong writers and she was unsure how to improve on their writing. If she had implemented SciJourn with a more "average" group of students, she might have felt more effective in her implementation.

Unlike Denise, Jessica identified as having confidence and being a good writer; she frequently integrated writing into her science classes. Yet, it was not until SciJourn that she felt she had a writing project that met her students' needs. She intentionally made time for the project explaining that it gave her something meaningful to use to fill instructional time. She did not experience difficulties editing her students' work, and she even went beyond the suggested level of editing. She also developed a series of rubrics and scaffolds that helped her students to focus on specific aspects rather than trying to edit the entire article at once. For instance, they would focus specifically on editing their attributions and would only make revisions to those sections of their articles. In that way, Jessica made the editing process more manageable for both her students and herself. Her sense of effectiveness was further validated when she shared her strategies with other teachers and they began using her materials.

Self-efficacy as Writing Teachers. As I explored Denise and Jessica's experiences the notion of self-efficacy emerged as an important construct that was critical to their experiences in implementing SciJourn in their classrooms. Before I explore this further, I want to point out that both Denise and Jessica appear to be efficacious teachers, meaning that they both believe that they have the capacity to influence how their students learn (Guskey & Passaro, 1994). Thus, their overall sense of efficacy is high. We have known for decades that efficacious teachers have been shown to be more open to incorporating new ideas and more willing to try new teaching strategies (Evers et al., 2002; Stein & Wang, 1988). Both Denise and Jessica convey a sense of ownership over their classrooms and their students' learning. They also regularly seek out professional learning experiences to further their growth and development as teachers. The defining difference between them is not in their overall sense of self-efficacy as teachers, but rather, their sense of capability as *writers* and *writing teachers*. This is an important distinction because much of the research around teachers' self-efficacy focuses on their generalized sense of their teaching performance, rather than their sense of self-efficacy in teaching particular subjects (Locke & Johnston, 2016; Tschannen-Moran, Hoy, & Hoy, 1998). For the purposes of this study, the level of specificity is vital because both Denise and Jessica are efficacious teachers. However, their perceived self-efficacy as writers, and writing teachers, is distinctly different.

If we look to Bandura's (1977) theory, he suggests that an individual's beliefs regarding his or her efficacy are influenced by four sources: mastery experiences, vicarious experiences, verbal persuasion, and physiological arousal. The first source, mastery experiences is when an individual feels successful in accomplishing a desired outcome. In Denise's case, she never developed a sense of mastery in implementing SciJourn in her classroom. She came to the SciJourn project doubting her abilities as a writer. Her lack of confidence was further perpetuated when she took the project back to her classroom and found herself struggling to edit her students' work. Furthermore, her students were not engaged by the project and she had difficulties motivating them to participate. Consequently, she never felt successful in her implementation of the project. According to Bandura (1977), the rise in efficacy beliefs causes subsequent expectations of being successful and increases an individual's desire to persist in the face of challenges. In Denise's case, while she tried to implement the project over the course of two years, she never developed a sense of proficiency and continuously struggled. Though she did ask for help, she did not feel that she received adequate support and eventually became frustrated and gave up on the project.

In contrast, Jessica's sense of efficacy as a writer was high before she found SciJourn. Because she felt comfortable teaching writing, she intentionally built meaningful writing activities into her science classroom early on as a teacher. While Jessica often referred to herself as a "baby teacher," it was clear that she felt confident in her teaching ability, which was evidenced by her motivation to play an active role in her district. For example, when she first arrived at her school, she did not like the textbook she was given nor the curriculum that she used. So, she took it upon herself to write a new science curriculum for her district. She also conveyed a willingness to share her ideas and resources with other teachers. Because she was a strong writer, she felt that she was adequately equipped to develop SciJourn teaching materials and also to edit her students' work. Additionally, her students' positive responses and authentic engagement reinforced her sense of success. As a result, she continued with the project, continuously tweaking her implementation and working to overcome various challenges along the way.

The second source of influence on an individual's sense of self-efficacy is vicarious experiences, which suggests that self-efficacy is greatly influenced by the extent to which individuals perceive themselves to be similar to others who model desired outcomes (Bandura, 1977). In Denise's case, while she wanted to become proficient at editing, the editor's expertise seemed outside the realm of her capabilities. So rather than feeling as though she could improve, her sense of self-efficacy was further diminished when she could not model his editing process. Unlike Denise, Jessica did not rely on the editor for support, but instead, relied on

her own writing skills. Seeing her students revise their work based on her edits further reinforced her sense of efficacy as a writing teacher.

The third source of efficacy is verbal persuasion, where a teacher receives verbal feedback on his or her performance (Bandura, 1977). In Denise's case, the primary feedback that she received from her students was a lack of motivation and mediocre engagement. This was accompanied by communication from the editor that her students were not making the suggested revisions. Together, these messages perpetuated her frustration with the project and led her to doubt her implementation. Jessica, on the other hand, received positive feedback from her students, the editor, and other teachers who used her materials, which reinforced her sense of being successful.

The fourth source of efficacy is physiological arousal, which refers to the emotions that an individual feels when he or she feels either capable or incompetent in an endeavor (Bandura, 1977). Denise repeatedly expressed her sense of frustration with the project during her interviews. Several variables contributed to these feelings but her students' lack of engagement and her lack of self-efficacy as a writer were the most significant. For Jessica, the project transformed her classroom. Thus, her sense of competence was reinforced through her students' enthusiasm as well as her confidence as a writer and writing teacher.

As I sought to understand more deeply the differences between Denise and Jessica's experiences with the SciJourn project, both the students' level of engagement and the teacher's sense of self-efficacy as a writer proved to be important influences. Moreover, the students' level of engagement seemed to contribute to each teacher's sense of self-efficacy, or lack thereof, as she worked to implement the project. As we have seen, Denise expressed a need for stronger support and more guidance in learning to edit her students' writing. This aligns with findings from a previous study that suggests during the first year of an initiative, teachers often view themselves primarily as learners and thus, feel a need to rely on external support (Nielson, Barry & Staab, 2008). By the end of the first year of that initiative, however, many teachers were beginning to shift from learner to change agent. That shift was further enhanced as the initiative moved into its second year. The key element that influenced the shift was the teacher's sense of self-efficacy regarding new ways of teaching. As they moved from learner to change agent, their focus transitioned from themselves as learners to their students' learning (Nielson, Barry & Staab, 2008). As seen here, in Denise's case, she was never able to move beyond the role of learner as she struggled to adapt the project to her specific context.

Conclusion

The primary difference between the two cases presented here were the grade level of the students, the level of student engagement, and each science teacher's sense of self-efficacy as a writer and writing teacher. Due to its focus on two teachers, this study is limited in its scope. However, Denise and Jessica's experiences suggest that it would behoove researchers to consider teachers' perceptions of themselves and their writing abilities as we work to promote writing initiatives in middle and secondary content classrooms.

Training teachers in content writing initiatives typically focuses strictly on strategies for implementation. We often assume that providing content teachers with instructional materials, writing prompts, and rubrics is sufficient. Denise's story, however, suggests that before we focus on implementation, we need to begin by assessing content teachers' perceptions of themselves as writers and writing teachers. In order to foster these initiatives, special attention should be paid to supporting those teachers who don't perceive themselves as strong writers. This necessitates creating professional development opportunities that support their personal growth as writers and writing teachers. It also suggests that these teachers need ongoing support as they work to implement writing initiatives in their classrooms. For Denise, giving students feedback on their writing was particularly challenging. We know that secondary teachers typically focus on grammar when responding to student writing (Furneaux, Paran, & Fairfax, 2007). However, there is little research that explores how to support secondary teachers in learning to give students meaningful and actionable feedback focused on improving writing content.

Furthermore, the grade level and degree of student engagement proved to be intricately tied to these teachers' self-efficacy as they worked to implement the SciJourn project in their classrooms. While Denise's students' lack of engagement further diminished her sense of efficacy as a writing teacher, Jessica's students' enthusiasm for the project reinforced her sense of confidence. This suggests that the ways content teachers perceive their ability to teach writing is strongly dependent on the response of their students as they attempt to implement a particular initiative. Consequently, developing writing initiatives that are both engaging and relevant for students can help reinforce content teachers' perceptions of themselves as writing teachers, in turn persuading them to integrate more writing in their classes.

The present study focuses on practicing classroom teachers. However, nurturing content teachers to develop as writing teachers should begin in their educator preparation programs. Most middle and secondary pre-service teachers are required to take a content literacy course for certification, but these courses often focus heavily on reading strategies with only a slight focus on writing. The

work presented here highlights a need to explore ways to better support pre-service content teachers to develop as writers and writing teachers.

As Tschannen-Moran and Hoy (2007) write, “Teachers’ self-efficacy is a little idea with a big impact” (p. 954). Thus, as we seek to integrate more writing in content classrooms, we should aim to develop mastery experiences where content teachers can garner a sense of success and build their confidence as writing teachers. Aside from wanting to implement a writing project, a teacher also needs to believe that he or she is capable of successfully doing so.

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Appendix A: Teacher Interview Protocol

The First Interview

Explain: *This first interview has to do with your experiences as a science teacher up until your participation in the SciJourn project.*

Initial question: “Why did you become a science teacher?”

Topics that I would like to see covered in this interview are:

- Meaningful experiences that led to an interest in science
- Meaningful experiences that led to an interest in education
- Other careers before teaching or careers that were considered
- What a good teaching day looks like for you as a teacher
- What a bad teaching day looks like for you as a teacher
- Professional identity (strengths and weaknesses)
- Context of local teaching environment
- Professional development experiences (prior to SciJourn)

The Second Interview

Explain: *This interview will focus on your experiences as a teacher participant in SciJourn.*

Initial question: “Describe what it was like to participate in SciJourn”

Topics that I would like to see covered in this interview are:

- Perceptions of the professional development sessions
- Implementation (past and present)
- Challenges and successes with the project
- Stories about classroom experiences (positives and negatives)
- Reasons for participating in SciJourn

The Third Interview

Explain: *This interview will provide an opportunity for you to reflect on your SciJourn experience.*

Initial question: “What, if anything, did you take away from your participation in the SciJourn project?”

Topics that I would like to see covered in this interview are:

- Influential qualities of the project
- Future implementation
- Impact on teaching philosophy and beliefs about teaching
- Impact on classroom practices

- Influence on professional identity

Note: Because phenomenological interviewing is participant-driven, each interview was unique. Beyond the first question, each interview did not include the same questions, though all the topics listed above were covered with each participant.

Appendix B: Thematic Excerpts from Denise and Jessica's Interviews

Denise - "Getting them to be motivated was difficult"

I had this new class I was teaching
That I really didn't have a curriculum for
So at least I felt like I had something to present to these kids
That would help get us started

This class is a three year course
I had sophomores
I had juniors
I had seniors

Kids felt like it was a waste of their time
And I guess I understand that
Because the kids that I would get in this course
Are not your average students

Most of them are above average students
And those types of children didn't feel like
That's what they needed to be doing
So getting them to be motivated was difficult

However, some of the kids
That I thought would not do as well
Because they're more of the average student
Actually did better with that project

So it really kind of was different
Than what I thought it would be

Which I thought was cool at the same time
The ones you wouldn't expect to do so well
Did much better

The older kids
I really feel like I never really got them to buy in
But they had already been in this class a year or two
And had specific goals that they had set

And I understood that, you know
This was probably a little behind what they had already done

A couple of them tried
But they had their own goals
Like I said, it's an independent learning class
So I couldn't really deny them to do the work
That they had already planned

I think at least half of them were published eventually
It took a little while to get through the revisions
And do everything that the editor wanted

The kids that I have are probably a little more upper level kids
Than a lot of people might have had
And so I almost felt like
Since I had those better students
That they expected it to be easier for those kids

That I shouldn't be having any issues
That I should be getting better work
I'm not saying anybody ever actually said that
But that's the impression I got

Where, in all honesty,
If you're teaching those kinds of kids
Sometimes they're harder to motivate
They're harder to get to change the way they think
And you might have trouble getting them to do things

I just think that there were certain expectations

That they wanted to happen
And if the kids weren't producing that
then they weren't really responding to them

The kids felt they kept trying to do things
To change their writing
And understand what they wanted
Some of them did really well at taking that advice
and some of them did not

That's when a lot of them would give up
And I feel like that was because they didn't get a follow-up

Or I would get the email back saying,
"They didn't do anything different."
And I would be like,
"Well, maybe they didn't understand"
You know, I'm not sure

I just felt like that was the kind of thing
That maybe they needed a little more one-on-one support

Some of them could have cared less about the project
I told the kids, "Think about it this way
When you go to apply for colleges
You can put down
That you have a published article in a science journal"

I think that should be an incentive
But some of them were like,
"Yeah, I've got other things that are just as important, if not better."

Kids thought of it as just another thing they had to do
That's another problem with some of the upper level kids
It's just another hoop they have to jump through
And didn't like doing it

If they didn't like it
It was because it was just something
That adds onto what they had to do for the course

The idea behind the course is that they find a topic
They research it
They perform an experiment
They do this whole scientific process with it
And then, in the end, they have to present that

The presentation part is very formal
So for them, it was good that first year
And they've said that, too
It was good to learn the basics of how to do research
How to find credible sources
How to determine what's good, what's bad.
That part was good

But then, the following year
I think they felt like they didn't have the time
To spend writing that style
When they knew they had this other style
This rigid, science journal article type of writing
That they had to do

Jessica - "They're motivated by personal curiosity"

They were motivated
I really set the tone
We talked about why I want to do this project with them
And what can they get from it

I encourage them to share their projects
In unconventional ways
That their parents don't like, probably
I put it in the newsletter
This year I tweet about it
I try to make it cool

I try to make it like this exclusive thing
Because if the rest of the school ain't going to take it on
I'm going to make it this exclusive thing

That's happening to you in my class
Lucky you for being in my class!

I sent an invitation for all kids to publish
If you want to, you must be committed to revising
So about five kids submitted theirs to be revised
They got feedback
Only one kid actually finished it

My grading is way more focused on the process
It's checkpoints
They had as many points last year for just completing the checkpoints
As they did the final product
The final product was easy to grade

These authors of the book subscribe to the idea
That every child should be scientifically literate
Which is really just an offshoot of information literacy
And so the child's right is to information literacy

If my kids take that from my class
I've taught them everything
I would ever have dreamed to teach them

How to use information
How to understand it
How to understand your world
How to figure out more about it
How to write

But it's the engagement piece
The kids don't even care
That they're doing research when they're doing SciJourn
They're just doing it

It's the personal piece
And the authenticity of the project
So you're writing about something you know
The research is there

But I'm a kid.
Let me write about myself a little bit
Let me write to understand myself
You know, kids should have that right

They're scholars
But they're young scholars
And the authentic audience
I couldn't give it to them
SciJourn gave it to them

And I don't know that they're even motivated by that
So much as the personal angle
They're motivated by personal curiosity
That's authentic engagement

Authentic engagement is learning for the sake of learning
They're doing it for the sake of doing it
And their curiosity

I sort of knew that as soon as I really unleashed the project
Something magical might happen

And I was just like, "whoa"
The class is completely silent
And they were authentically engaged

The kids were into it
And so I made the time
And it was really worth it
Plus they like it
And they're actually using the Internet for real things

I felt like it could be authentically engaging
And I felt like it could help kids push themselves beyond their lexile
Or beyond their measured abilities
And it did

I knew once we started
The kids got into the research

That we were going to have authentic engagement
And it did

It was all quiet
There was just the typing
And they were just in it
They were researching

So yes, the engagement
I wouldn't keep it if it wasn't engaging
I would never drag the kids
Through four and a half weeks worth of stuff

Never, never, never would I do that
I teach engaging
I try to engage the kids every single day as much as possible
That's a number one consideration

Even though sometimes, I don't get them
But this project gets them
If they put something into it
They get that thing out of it times ten

So yes, engagement
Choice.
Big choices
I don't restrict them at all

The ownership is there
Like, hey, this is my choice
It's not my teacher's choice
It's not this kid's choice

The only person who chose this is me
So therefore it's my project
It's not the science class project
This is my project

Denise – “I’m not always real comfortable writing”

I'm not always real comfortable with writing
Having to actually research and write myself was a big deal
And that, to me, was a real eye opener

I was right back in that student seat
Learning how to do something that I wasn't comfortable with
That was tough
Because I felt like I wasn't prepared

And the editor was quite tough
But had great criticism
Even though it was hard to hear sometimes
I think I went through three revisions

I think in general
Science people don't really know how to write

I was the first one in my group to be published
I was very proud of myself
I worked pretty hard on that

I may have bit off more than I can chew
I wish they would have came more
Maybe I didn't request that enough

Not that I couldn't handle it
But I was still learning myself, too
That was a tough year
They expected me to be able to do more than I really could

That was my first year of teaching this course
So it was a learning experience for me, too

I'd like to incorporate much more writing
But I really never have had a lot of time in my general chemistry courses

I'm not an English teacher

I'm not a language arts teacher
I'm not a writing teacher
I'm not a reading teacher
However you want to look at it

To get more avenues to approach writing
Really helped me out
I do have to say that

I didn't get as much back-up as I would have liked to have had
Maybe it was me
Maybe I didn't ask as often as I probably could have
Or should have
I always felt like once I walked out of the door
I was on my own

Sometimes I didn't really know
Especially at the very beginning
I really didn't know how

I mean
I had written my own article
With a couple of revisions over the summer
But that was it

So, I would submit a lot of those original kids that I had
I'd just submit them directly to him
When I would get those back from him
I would read through his edits
So that I had an idea of what he was looking for

That way I had an idea
A better idea of what I should have done

We would do a little bit of editing here and there
But then we'd go on
And do something else
And do something else

I think they tried to help us with the editing process

But I just don't
Yes, I just don't think there was enough time

To get more examples
And being able to compare more with the editor,
What he was looking for
And what we were seeing

I think there were a lot of things
That were helpful
But there was a lot left off the other side
That kind of just left me hanging

I didn't have a way to pull it into my courses
Like I wanted to
I think if we just maybe had a little bit more support
That would have been good

Jessica - "Writing has never been a problem for me"

The first year I was really nervous about the project
I didn't know there were other people out there doing it

When I read the book
I was like this is exactly what I think
And I'm really glad that somebody else has already researched it
And written a book about it
Because I've been waiting for this project
Yes, otherwise I would have invented it myself

I felt like I did a lot of writing my first year
I did projects
I did writing

I really didn't feel like I could sign off on myself
For my own personal accountability
That I was giving the kids the skill they needed

I knew I was preparing them for high school
but I wasn't preparing them for the world

And so I was looking for it, yes

Writing has never been a problem for me
I'm a really strong writer myself
My instincts as a reader and writer are spot-on

My confidence in myself as a writer and reader
That helped

Making time for it was actually not a problem
I liked it to fill the gaps
It actually took some pressure off of me for content
So I always had something to plug in for flexibility

I didn't have to force something with chemistry
Like watch a dumb video that we didn't want to watch
I would no longer put fluff in

I'm a good writer myself
I was the kid who read the textbook in college
Always before the lecture and then reread it

So I guess I wasn't really afraid to read on any level
So yes, I was pretty scientifically literate
I could write
I could definitely write lab reports really well
I was good at research, too

I pretty much did everything they said in the book
Except I didn't spend much time on pitching last year
Which I am planning to do at the end of this week
And we did more on editing than what is in the book

I also looked at all the online resources
And pretty much made them my own
And made them assessable

Meeting other SciJourn teachers gave me a lot of validation
That the way I interpreted the book
Was the way that the researchers had interpreted the book

And other teachers thought that my stuff was usable
So it gave me a ton of validation

I would have kept the project
But it was just a lot cooler to meet other people
And to be more collaborative
So there was a sense of community, too

So I definitely would have kept it
But it was a little isolating

I really had to use my imagination
I felt like I was taking a risk for sure

How big the project is
When I say this took four and a half weeks
People are like, whoa I don't have four and a half weeks
Well, you actually do if you compact your curriculum a little bit

I think science teachers are just still fighting the writing
They're fighting it
Or they only want to grade on the content
Which this is really content but it's also process

I'm not going through and taking them down for spelling
But it needs to be readable
And we do, we edit for that
It needs to be understandable

I just think it's really intimidating
I went to a good high school
But I also went to a good college

I thought I would be middle of the road at best
Writing, reading or anything
I wasn't
I was the top

People thought I was, like, crazy genius
Because I could do those things

T/W

Well, all kids should be able to do those things going into college
And so technical writing
Or the rigor needs to happen in the science classroom
And be expected to

You write
You read in every class

It's like a cultural shift
It's a communication skill that I think should be really universal
And it's not
I have the skill set to teach that
So the kids in my class at least can have that opportunity