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EXPLORING THE NATURE OF HIGH SCHOOL STUDENT ENGAGEMENT WITH SCIENCE AND TECHNOLOGY AS AN OUTCOME OF PARTICIPATION IN SCIENCE JOURNALISM

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EXPLORING THE NATURE OF HIGH SCHOOL STUDENT ENGAGEMENT WITH SCIENCE AND TECHNOLOGY AS AN OUTCOME OF PARTICIPATION IN SCIENCE JOURNALISM

BY

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Abstract

In a mixed-methods study of high school student participants in the National Science Foundation-funded Science Literacy through Science Journalism (SciJourn) project, the new Youth Engagement with Science & Technology (YEST) Survey and classroom case studies were used to determine program impact on participant engagement with science and technology as well as describe the experience of SciJourn students. Student engagement with science and technology is considered as a construct made up of three components: student action, interest, and identification. Analysis of quasi-experimental administration of the (YEST) Survey resulted in rejection of the hypotheses that SciJourn high school student participants would exhibit higher engagement survey scores than their non-participant peers and also that students taught by teachers considered to be high level implementers of SciJourn would score higher than peers in classes of lower-level implementers. Three collective case studies of high school science classrooms involved in both the consumption and production of original science news illustrated the diverse roles of teacher-implementers and the resulting affordances and constraints allowed through the participation structures resulting from their project implementation choices. On an individual student level, case studies provided insight into the complexity of the engagement construct, and the potential for gains in engagement especially when student choice and long term participation in SciJourn were supported. Contrasts between the post-SciJourn engagement scores as measured by the YEST Survey and qualitative data support the conclusion that a response-shift bias occurred especially among students in high implementation classrooms, due to greater student specificity in the nature of what they consider to count as science in their everyday lives.

The complex nature of engagement as exhibited by classroom case study participant experiences is presented in a new interactive model of the interplay between interest, action, and identification, into which students may enter from a variety of points, and which drive one another.

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Chapter One: Introduction

Education has long been seen as the mechanism by which individuals are prepared for participation in a democratic society (Dewey, 1916). Hurd (1998) traces the history of efforts to create a scientifically literate society over 350 years—from Sir Francis Bacon, through the presidencies of Thomas Jefferson and Franklin Delano Roosevelt, to the science curriculum reform efforts of the 1970's, to 21st century efforts to blend science and technology into a "cultural force" (p. 410). In the 21st century, faced with such complex science-based issues as climate change and an increasing dependence upon rapidly-advancing technology, citizens must be knowledgeable in order to appropriately make choices. Indeed, knowledge of science links to positive attitudes toward science and engagement in related public policy (Sturgis & Allum, 2004). Beyond acquiring knowledge of science-related facts, the American Association for the Advancement of Science (AAAS, 1989) recommended that the scientifically literate, and therefore, appropriately educated, American citizenry should understand how science works, the role of mathematics in science endeavors, the nature of technology, the structure of the universe and its physical properties, the function and interaction of living things, and an awareness of self and society relative to science.

In order for American students to achieve such mastery, however, it is widely thought that the methods by which science is taught in American schools must be reformed (Bybee, 1997; DeBoer, 2000). School science is often taught in a compartmentalized, text-based approach that fails to interest students in the subject matter, and typically focuses on the memorization of facts rather than the acquisition of critical thinking and questioning skills of the professional field (O'Neill & Polman, 2004;

Turner, 2006). The lack of connection between school science classes and the real world (Hurd, 1998) is failing to prepare American students, and thus American society, toward AAAS' long-range goal of scientific literacy by the year 2061 (1989). Meanwhile, informal science education (ISE) institutions strive to increase their connections with school-age children and expand their audiences in order to assist the effort of improving science literacy for all age groups (Bell, Lewenstein, Shouse & Feder, 2009).

Conceptual Framework

Becoming effectively literate in science is generally understood to require some engagement with the practices of the domain. Lau and Roeser (2002) among others have studied the degree to which students are engaged in school science coursework based on student ability and motivation. Others (e.g., Basu & Barton, 2007; Markowitz, 2004; Martin, 2005) have focused on the ways in which participation in science activities outside of school may influence student interest, motivation, and perceived ability to succeed in science. Less well known, however, is how students translate school science to the "real world" outside the classroom, and what kinds of activities (within or outside of school) may influence the degree to which students engage with science concepts, ideas, and information beyond the classroom walls.

Influenced by the above background and additional research linking language and science literacies (e.g., Saul, 2004; Yore et. al, 2004), the University of Missouri St. Louis designed the "Science Literacy through Science Journalism" (SciJourn) project, sponsored by the National Science Foundation (NSF). The four-year project, begun in 2008, involved 40 St. Louis area teachers and their students at 26 middle and high schools, as well as participants in the Saint Louis Science Center's (SLSC) Youth

Exploring Science (YES) program in learning how to investigate and write science news stories like science journalists (Saul, Kohnen, Newman & Pearce, 2012). Throughout project implementation, the grant's principal investigators are researching the overarching 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 literate engagement in science?" (UMSL, 2008, p.1). Specifically, research related to the project is focused on the following three research questions:

1. Is the teaching of science journalism an efficacious, replicable and sustainable model for improving science literacy?
2. How useful are science-related standards and rubrics for scaffolding and evaluating students' science writing?
3. What is the nature of the engagement in science this apprenticeship model invites?

SciJourn involves science and English teachers and their students in the process of writing about science news (generating an original periodical for peer consumption, called *SciJourner*; see www.scijourner.org) toward the goal of improving high school student science literacy, as well as gaining an understanding of the ways in which high schoolers engage with science outside of school (Polman et al., 2010; Saul et al., 2012; UMSL, 2008). Within this project, science engagement is defined as the interplay of student actions, interest, and identification related to science and technology (McCarty, Hope, & Polman, 2010; Polman, McCarty & Hope, 2010; Polman et al., 2010).

Rosenzweig and Thelen (1998) addressed the engagement of the public with history-related concepts in their book, *The Presence of the Past*. Similarly, Falk, et al. (2007) surveyed the public in and around Los Angeles via phone to ascertain public engagement with science. The places in and means by which the public learns about science in informal settings is the focus of a report by the National Academy of Sciences (National Resource Council, 2009). However, the phenomenon of *student* engagement with science in non-school settings is less well documented. Masingila (2009) found that her elementary students were using mathematics skills at home, but that they did not recognize the activities as such. A small community of informal science educator-researchers is involved in the investigation of the ways in which small groups of elementary school students recognize science in non-school settings and enact science skills outside of school, especially focusing on what these youngsters consider to be "math" and "science" (Everyday Science and Technology Group, n.d.).

Falk, Storksdieck, & Dierking (2007) advocated for the development of a research tool to assess student engagement in science outside of school, specifying that use of such an assessment would need to "take into account individual differences and the unique personal and context-specific nature of knowledge" (p. 455). One component of the SciJourn project has been to develop such an assessment tool, called the Youth Engagement with Science and Technology (YEST) survey (McCarty et al., 2010), which will be utilized to collect the quantitative data in this study.

My own interest in the problem of science literacy and engagement has grown through professional experience working with children and adults of all ages in informal science education settings. I have led educational programs as an employee of five different informal education institutions. Through participation in the NSF-funded Center for Informal Learning and Schools (Center for Informal Learning and Schools, 2010), I became engaged in the broader discussion of the interplay between formal and informal education providers, and became conversant in the research related to these topics. A personal passion for environmental issues is at the root of my particular concern about the general lack of awareness and understanding the public holds, and the effect that has on consumer and political decisions. Many Americans persist in thinking widely accepted scientific theories, such as evolution and climate change, can be “believed” (or not), thus exhibiting a lack of understanding of scientific theory and evidence. I am of the opinion that such a lack of scientific understanding and critical thinking abilities is a result of an educational system failing to prepare its graduates for participation in public discourse, and that research and informal agencies have valuable contributions to make to advance the science literacy of our culture.

I became involved in the SciJourn project as a research intern during the summer of 2009. During that time, I conducted observations and interviews of SLSC student participants in the informal component of the SciJourn project, and worked with other researchers to develop the YEST survey. Current projects include establishing the reliability and validity of the survey, and analyzing the pre- and post- data collected from it in years two, three, and four of the program. I am no stranger to working with the teen audience; before delving into full-time graduate work, I spent six years as the coordinator of a high school environmental leadership program, and conducted an evaluation of that program as my master’s thesis.

Research Problem

What is yet to be known is how high school students, in general, are engaged in science and technology activities, both in and outside of school, and what types of interventions can influence the degree and quality of such engagement. In their review of twenty-five years of literature regarding the public understanding of science, Bauer, Allum, & Miller (2007) recommended that such studies expand beyond survey research to combine multiple types of data in order to best assess the current "fertile period" relative to this topic (p. 79). To do so, classroom observations and semi-structured interviews, were conducted and added to the existing project data (including survey and science literacy assessment results) to provide a richer set of data from the SciJourn project.

Purpose Statement

The purpose of this study is two-fold: to illuminate the experiences and perspectives of the high school student participants in the SciJourn program, and to investigate the impact of participation in the program on student engagement with science and technology.

Research questions.

Specifically, to what extent does the SciJourn project influence students' engagement with science and technology both in and outside of school? How do quality of participation and other individual participant characteristics relate to the degree and nature of science engagement?

Hypotheses.

The SciJourn project was developed expressly as a technique for increasing high school student science literacy and engagement with science. In this study, it was hypothesized that SciJourn participants would demonstrate an increased engagement with science and technology compared to non-participating peers. Secondarily, I expected that the degree and nature of engagement would vary according to qualities of teacher implementation, although I did not have a specific prediction as to what qualities will be most influential.

Guiding questions.

In addition to the above hypotheses, to be tested via quantitative data collection and analysis, there is an equally important qualitative component of this study, which will seek to answer the following key questions.

1. What is the role of SciJourn involvement with respect to student action, interest, and identification with science and technology?
2. What connections do students make between the program and other activities in which they are involved (both in and out of school)?
3. How does the way students relate to science change throughout their participation in the program?
4. What aspects of the program are most engaging to students?

Significance of the Study

It is important, in any study, and especially within research that seeks to evaluate the outcomes of a program for potential broad dissemination, to document the perspectives of all stakeholders. In the case of SciJourn, participant data, including demographics, achievement of program goals (assessed through performance tasks), and engagement are being collected from the over 1,000 high school student participants. Classroom case studies (Stake, 1994), however, allow for a deeper understanding of the SciJourn experience, and interviews with students gather the students' point of view on those experiences, which large quantitative data sets may not illuminate. This study gives a voice to the teens involved in the day-to-day activities of the project, and provides a richer description of and explanation for their engagement with science and technology than would the survey data alone.

Delimitations

Study participants are teachers and students involved in the SciJourn program, only, and thus limited in terms of geography to the metropolitan area surrounding a Midwestern city, and by school within that region to those employing voluntary teacher participants in SciJourn. The study is focused on student participants in the first full year of program implementation, the 2010-2011 school year. Case studies were purposively selected classrooms of teachers considered to be high level implementers (teachers who intended for their students to produce publishable science articles) of the SciJourn program based on initial classroom observations, and intentionally representative of the diverse overall project population in terms of gender, ethnicity, and socioeconomic status.

Assumptions

In order to conduct this research, it is assumed that the sample of high school classrooms selected is representative of the larger population of SciJourn participants; that the student participants responded to both the YEST survey and interviews openly and honestly; and that attrition from the program would be minimal.

Orientation to Subsequent Chapters

Following this introduction, the second chapter reviews scholarly literature pertinent to this study. Chapter 3 describes the quantitative and qualitative methods employed in the study. Chapter 4 presents results of the survey methods utilized to test the research hypothesis. Narrative analyses of the classroom case studies, specifically responding to the guiding questions above, are presented in Chapter 5. In Chapter 6 I present conclusions and limitations of the study, as well as suggestions for future research in this area.

Chapter Two: Literature Review

Within the larger SciJourn project, this research effort focuses on the program's potential influence on high school student engagement with science and technology, which is considered by many educators to be an important aspect of citizenship as well as a driver of science literacy (e.g., Barron, 2006; Basu & Barton, 2007; Markowitz, 2004; Polman, et al., 2010). In this section, a rationale for studying student engagement with science and technology both in and out of school (and how the two may influence each other) will be laid within the frame of education as a sociocultural practice. A review of the existing research on engagement will orient the reader to current thinking in this area before presenting the SciJourn definition of engagement and the related research on the three aspects of the conceptual framework: action, interest, and identification. In addition, types of assessments used by other researchers to consider the construct of engagement will be reviewed, with an emphasis on interviews, observations and surveys, the approaches to be used in this study. Engagement in educational activities has been studied broadly, but not deeply, and particularly not in consideration of high school student engagement with science and technology outside of school, or the role that school experiences might play in facilitating out-of-school engagement.

Learning Communities

As suggested first by Vygotsky (1978) and supported by the work of many others (e.g., Pea, 1997; Rogoff, 1995; Wertsch, 1991), learning involves more than the participant and the content to be learned. Vygotsky (1978) pioneered the concept that a learner's progress toward mastery is facilitated by interaction with others at a higher level of skill and or understanding. Wertsch (1991) integrated the ideas of Vygotsky with

Bakhtin's notions of dialogic processes to discuss how multiple voices intermingle in the actions of social groups and individuals with cultural tools such as language to contribute to learning. Pea (1997) stated that intelligence is distributed “across minds, persons, and the symbolic and physical environments, both natural and artificial” (p. 47). In the study of a classroom setting, consideration must be given to the interaction between the learner and these “others” in order to deeply understand learning.

Taking this concept further, Rogoff (1994) describes a community-of-learners model of instruction in which participants are involved in shared sociocultural endeavors. Such a model stands apart from those more traditional instructional approaches, in which the instruction is either “adult-run” and assumes a transmission of knowledge from expert to novice, or “child-run” where learning is acquired through discovery because in the participatory model, “students learn the information as they collaborate with other children and with adults in carrying out activities with purposes connected explicitly with the history and current practices of the community” (p. 210-211). Further, in this social approach,

> both mature members of the community and less mature members are conceived as active; no role has all the responsibility for knowing or directing, and no role is by definition passive. Children and adults together are active in structuring shared endeavors, with adults responsible for guiding the overall process and children learning to participate in the management of their own learning and involvement. (p. 213)

The SciJourn project seeks to engage young people in such a community of learners, where students and teachers exchange ideas and roles as they carry out the practices of science journalism. This research effort aims to gain insight into the experiences of those involved in that community, and how participation in that community relates to engagement with science and technology both within the community and beyond.

Defining Engagement

Many recent studies of science education interventions focus mainly on "engagement" as indicated by student achievement in the science classroom (Lichtenstein et. al, 2008; Markowitz, 2004; Martin, 2005). Such research considers engagement in academic terms—as a measure of time spent on tasks in the classroom (Lee & Anderson, 1993) and/or at home, such as planning, homework, and studying (Singh, Granville, & Dika, 2002). Additional variables studied in relation to student achievement in science include interest and perceived ability (Markowitz, 2004), motivation (Thompson & Windschitl, 2002), and interaction rituals and learning environment (Olitsky, 2007).

While still focused on the outcome of academic achievement, Lau and Roeser (2002) posed that engagement involves multiple facets, including positive feelings and focused attention during the learning activity as well as amount of time spent on school assignments or other science-related tasks during non-school hours. Wang and Holcombe (2010) conceptualized school engagement as made up of three dimensions: school participation, identification with school, and use of self-regulation strategies. Their longitudinal research on the relationships between middle school students' perceptions of school, their academic achievement, and their engagement in school supported the idea that engagement is indeed complex. Findings suggested that students' perceptions of the school environment influenced both achievement and engagement, with the various aspects of engagement being affected to differing degrees. These results align with Azevedo's (2004) finding that an individual's goals, interests, values and beliefs result in preferences which interact within sociocultural milieus to foster "persistent engagement in a practice."

Engagement in school science.

Few studies of organized education programs consider science engagement beyond the classroom. Pugh, Linnenbrink-Garcia, Koskey, Stewart, and Manzey (2009) studied what they referred to as "deep engagement" as a phenomenon resulting from a complex relationship between school-based learning opportunities and individual student characteristics. Their research identified the factors of high school biology student achievement goal orientation and identification with science as predictors for engagement in "transformative experiences" in science (p. 2). While rare, such experiences—the kind of "experiences in which students actively use science concepts to see and experience their everyday world in meaningful new ways" (Pugh et al., 2009, p. 2)—were related to increased student understanding of some concepts and transfer. In this case, identity was considered not as an aspect of engagement, but as a predictor of potential for deep engagement in science beyond the classroom.

Engagement in out of school science activities.

The literature on out-of-school, museum, and informal learning shows ways that people engage with science and technology in the public realm. Barton and colleagues (Basu & Barton, 2007; Furman & Barton, 2006) studied urban minority youth in after-school programs, finding that connecting science experiences with students' own future plans, in a social learning environment that supported student agency, led to what they considered a sustained interest in science, and to shifts in identity. Ethnographic research from the Learning in Informal and Formal Environments Center (e.g., Barron, 2006; Zimmerman & Bell, 2007), has shown the myriad ways that youth engage with science and technology activities in the out of school hours, including personally meaningful experiences at home of which school-based educators are rarely aware.

Research suggests that the science the public engages with and knows is not exclusively learned in school—the public perceives other sources to be of equal importance when seeking information and knowledge about science and technology (Falk, et.al, 2007; Durant, 1999). Falk's research in museums, national parks, and science centers (Falk, et al., 2001; Durant, 1999) shows the public does engage with science and technology, but the public's engagement with free-choice science learning is poorly understood (Falk, et al., 2007). Science learning is driven by the public's needs and interests (Korpan, et al., 1997). Data gathered about books being read, television programs watched, games played, and Internet searching, could lead to insights of how people learn science and influence practices in schools (Korpan, et al., 1997).

A New Integrative Framework

Within the SciJourn project, engagement has been defined by Polman, McCarty, & Hope (2010) independently from academic understanding, which is being addressed through performance-based assessments of science literacy (Farrar & Hope, 2011; Polman et al., 2010). In conceptualizing an integrative framework of engagement, these authors capture what is meaningful about the term as it is generally used, in three facets:

A. **Action**, or actual involvement with science and technology ideas and tools
B. **Interest**, or openness to and stance toward the science and technology in the

moment and across time

C. **Identification**, or ways that the science and technology connects to people's identity affiliations, in the past, present, and future

In other words, engagement involves an individual’s interest and participation in, as well as identification with, particular practices as embodied in actions. Each of these facets has been the subject of extensive educational research, the most relevant of which I will seek to describe in the following sections. Although conceptually it is helpful to identify and describe each facet in separate sections, the elements strongly interrelate to one another, as is noted in the following sections.

Action.

The first component of Polman, Hope, & McCarty’s (2010) model of engagement is action, or nature and degree of involvement in a particular practice. Also described as participation (Zimmerman & Bell, 1997) in an activity, such as school work, studying, or the use of a tool, like computer or video games, this component is what has been most commonly studied as “engagement.” The actual doing of tasks or enactment of intentional behaviors related to science and technology was observed by Zimmerman & Bell in their ethnographic studies of students’ engagement in science in their everyday lives. First-hand observation of science learners is modeled in the ethnographic studies of out-of-school science conducted by Zimmerman & Bell (2007), in which they sought to “better understand how and why elementary school children from diverse backgrounds identify with and continue to pursue science academically and personally” (p. 3). Those researchers found that in observing students across the contexts of school, home, and community, they could “focus on the roles of home life and community in fostering children's knowledge specific concepts and practices and their identification with science and technology as disciplines" (p. 3). While this study will not delve into observations of participants' out-of-school lives, it is hoped that direct observation of students' interactions in the SciJourn classroom will richly inform the researcher. This model follows that used by Polman, Hope, and McCarty (2010), who relied heavily on observations of students involved in the SciJourn project for the development of the case studies they used to construct and modify the YEST survey.

Interest.

It is logical to consider interest in a given topic or content area as a driver of further engagement. "Interest for content impacts learners' choices about how to spend time, the goals they set, and the activities in which they engage" (Renninger, 2009, p. 107). Renninger (2009) stresses the importance of knowing student level of interest and disciplinary identity for furthering interest, acknowledging that both develop through interactions with people and experiences. Four phases of interest development are outlined in Renninger's model, for which she provides a description of learner characteristics, feedback wants, and feedback needs: Phase 1, Triggered Situational Interest; Phase 2, Maintained Situational Interest; Phase 3, Emerging Individual Interest; and Phase 4, Well-developed Individual Interest. As interest develops, in this model, students progress from a phase in which they rely on teacher suggestions for completing a task to a state in which they seek answers on their own and need to be challenged by others to push them further.

Identifying an individual's phase of interest allows educators to support students' further development, or risk allowing even Phase 4 level interest to become dormant (Renninger, 2009). As an example, the researcher describes an eighth grader in Phase 1 who expresses no interest in becoming a scientist, but instead working with people. The perceived disconnect between science (as a collaborative process) and human-interest indicates both the student's limited awareness of the nature of scientific endeavors and the need for scaffolded "trigger" experiences (such as group work or a personally meaningful context) to support further interest development, which is likely to be gradual. Renninger cautions educators against misinterpreting positive responses to activities or expressions of content as "fun" as more developed interest, however, and also from considering only students with well-developed interest as those capable of deeply engaging with content: "Interest in all phases of development needs to be cultivated and sustained...learners need to develop enough content to value, question, and refine their understanding." (2009, p. 107).

Zimmerman & Bell (1997) studied the participation of elementary students from diverse backgrounds in science-related activities in order to better understand personal and academic identification with and persistence in science. In an ethnographic study focusing on the scientific practice of systemic observation of four students during their fourth and fifth grade years in school, Zimmerman & Bell

> …found places outside of school where all four students were interested not only in science knowledge or topics but also where they were involved in participating in scientific practices or in practices that could be seen as related to science.

> Understanding that our focal participants are interested in science outside of school is important because in many of our school observations, we found our focal participants (and their peers) off-task or not participating in science instruction. (1997, p. 37)

For example, a student (Bob) who professed strong interest in astronomy—which he described researching on the internet and in his personal book collection on the topic in his free time—constructed a solar system model provided by the research team without the instruction kit, going on to name the planets from memory and even noting lack of detail, such as moons of other planets. Space science and engineering "counted" as science for this student. In school, this same child was often observed to be passed over by the teacher when his hand was raised because he was such a consistent responder to teacher prompts. By middle school, Bob said "that science is just okay and school science doesn't cover what he is interested in" (p. 16). In their four cases, student interest and participation in the practice of science outside of school was unsupported in the classroom, where science class involved practices like reading and writing that the students did not identify with the doing of science (Zimmerman & Bell, 1997); they were interested and involved, and even viewed themselves as doing science, but only in the out-of-school context.

Basu and Barton (2007) conducted a critical ethnographic study of an urban after-school middle school science program, in which case studies of three students' science interest are presented in terms of how each connects to the future and is supported by social relationships and agency. Students' "funds of knowledge" (Moll, Amanti, Neff & Gonzalez, 2001)—their competencies and knowledge gained through experience—were valued and linked to science perspectives. For Neil, a budding cartoon artist, science was a source of inspiration for new drawings, as well as a means of having control over the outcome of an exploration or experiment. In the afterschool program, this translated into Neil working alone to invent a robot that sprung from his cartoon action-figure interests, and continuing this activity beyond the program itself. The connection of the science activity to Neil's own future plans (as cartoonist) and his social system (independent worker encouraged by his artistic brother) led to that lasting, or "sustained" interest—as exhibited by a student's "self-motivated science explorations outside the context of the classroom" or use of "science in an ongoing way to improve, expand, or enhance an exploration or activity to which they were already deeply committed" (p. 469). Connecting science experiences with students' own future plans, in a social learning environment that supported student agency led to what they considered a sustained interest in science, and to shifts in identity. This research points to the interconnectivity between interest and other components of the three-aspect model of engagement I seek to explore.

Identification.

As in the model set forth by Polman, Hope, and McCarty (2010), Renninger (2009) considers interest development as related to identity. Self-representation, or a learner's age-related understanding of his or her self and interactions, is considered because it "charts specific changes in the developing cognitive capacity of the learner," while the phase of interest in Renninger's model "describes the learners' cognitive and affective connections to content" (2009, p. 109). Self-representation in terms of content and skills, and especially the comparison of self to others as it develops through childhood and adolescence, plays a role in the reflective development of interest (Renninger, 2009); a small child who engages in hours of play with trains and tracks may be considered by her parent as a future engineer, while an adolescent who views himself more competent in science class than his peers may pursue more personally interesting topics in that area than the peers who indeed view themselves less competent as well.

Gee (2000) takes identity beyond the individual's representation and positioning of self in his proposal of identity as a means of understanding in educational research. The author clarifies his notion of identity as "being recognized as a certain 'kind of person' in a given context," of which a given individual may have many based on "their performances in society" and not on a "'core identity' that holds more uniformly, for ourselves and others, across contexts" (p. 99). Then Gee goes on to establish his framework, positing four interrelated types of identity development—nature, institutions, discourse, and affinity—resulting from the power of four different sources acting upon the individual, and resulting in multiple identities for a single person. Nature-identity is a person's biological status as developed by the power of forces in nature. Institution-identity is a position ascribed to an individual through the authority of an established institution. Discourse-identity is a personal trait ascribed through the interaction of an individual with others. Finally, Affinity-identity is the individual's role in a group of others also sharing in those practices.

According to Gee (2000), these four aspects of identity development should not be considered as compartmentalized, but have been disaggregated in this manner in order to propose “four ways to formulate questions about how identity is function for a specific person (child or adult) in a given context or across a set of different contexts” (p. 101). For example, a particular individual may at once be identified as an identical twin (as determined by nature), a college professor (as authorized by the university institution), be charismatic (as recognized through interactions with and by others in his social circle), and also be a ‘Trekkie’ (through his affinity groups). Gee’s socio-cultural perspective on identity as contextually situated is useful for consideration in educational (as established above as innately social) settings.

Content-specific identity development as a function of experiences both in and out of school has been considered by Nasir (2010) and colleagues (Nasir & Cooks, 2009; Nasir & Hand, 2008). In doing so, the researchers explored how the interaction of learners and the relationship of the learner to the setting relate to identity development, in both classroom and non-classroom settings, from the points of view of the various parties involved (i.e., teachers, peers, and coaches as well as the observer-researcher and the participants).

Nasir & Cooks (2009) investigated how beginning high school track runners take up identities offered to them within that activity by considering three types of resources: *material resources* (the physical artifacts in the setting), *relational resources* (interpersonal connections to others in the setting), and *ideational resources* (ideas about oneself and one's relationship to and place in the practice and the world, as well as ideas about what is valued and what is good) involved in the development of identity. In the sport of track, the starting block was considered a key material resource, the nicknames and encouragement rising from teammates as relational resources and the particular event in which a runner competes is an ideational resource defining the type of athlete the participant should be striving to become. Each defines some aspect of a runner's learning experience, and thus identity as a member of the track community; the authors argue that in learning communities beyond the track, these types of resources structure identity development as well.

Findings from the track study (Nasir & Cooks, 2009) were incorporated with those of a study of urban girls' school identities by Nasir (2010) to solidify ideas of identity formation within social practices. Aligning with the work of Wenger (1998) and Lave & Wenger (1991), in which it is posited that identity develops along with expertise in practices within a defined community, the author found that "students present multiple kinds of identities—learning identities, academic identities, and racial/ethnic identities—in observations of identity-salient moments in studies of learning in and outside of classroom settings" (Nasir, 2010, p. 7). The complexity of identity development, including the positioning of self and the perspectives of others, as well as the multiple resources at play within the learning community that may have influenced identity development, led the authors to state that either observation of participant actions and interactions or surveys of sense of self alone are insufficient sources of data for developing an understanding of individual identity.

In the context of this project, demographic information will provide insight into some of the N- and I-identities of the research participants, while survey, observation, and interview data will be used to elicit a picture of a given student's D- and A-identities in the SciJourn classroom setting—an established affinity group such as Gee (2000) would call "institutionally sanctioned" (p. 107). Therefore, a student in one of our classrooms may have the socially-constructed identities of being biologically female, institutionally a member of a public high school chemistry class, a "good" student, and a highly motivated participant in SciJourn activities. Through case studies, the research seeks to describe the 'kind of person' each participant is in order to understand the SciJourn experience on an individual level.

Gee (2000) asserts that Discourse Identity, or the kind of person one is, as established by the way others dialogue with (talk about, treat, and interact with) and recognize the individual. He equates his capital "D" form of Discourse with the concepts of communities of practice and distributed knowledge described above as the bases of the theoretical framework for this study, and states that an individual's "unique trajectory through 'Discourse space'" or series of ways of being recognized through life can "give us one way to define….a person's 'core identity'" (p. 111). This study inquires into the SciJourn Discourse and its role in students' development as participants in the process of becoming (or not) science journalists, and "achieved D-identity" per Gee (2000, p. 112).

Brown, Reveles, and Kelly (2005) state that "little attention has been given to the ways that discourses of science contributed to situated views of identity," (p. 781) citing Gee (2000) as well as Nasir and Saxe (2003) as the basis of their analytical framework for science learning. Brown, Reveles, and Kelly (2005) consider discourse as language use specifically, and not the entire package of interactional positioning of self and others in a social setting as Gee (2000) did in his D-identity. These authors stress that "learning the content and language practices of a discourse-rich subject matter like science requires some appropriation of an identity commensurate with scientific language use" such that a study of science student language use, or discursive identity, can provide insight into student learning. Within the SciJourn project, the use of language of students as they interact with one another and the teacher in the classroom, and as they produce written science news articles, is certainly relevant. However, this study will focus on interactional discourse, or "Discourse" as described by Gee (2000), and not turn by turn communication between students or students and teacher.

Expanding upon the above research in socio-cultural identity development, and especially Gee's notion of identity trajectories (2000, p. 111), Polman (2010) argues the existence of a Zone of Proximal Identity Development (ZPID). Based on Vygotsky's (1978) theory of sociocultural learning, Polman (2010) asserts that identity development is also "a dialogic phenomenon that stretches across time and space as multiple individuals seize meaning and project significance on their participation in activities, and their expectations for future identification with those activities" (p. 130). If, as research suggests, identification with specific content and related topics is important for furthering learning in those areas, it becomes increasingly important for educators to develop an awareness of students' science and technology-related ZPID, both in an effort to develop the future STEM professionals seen necessary for future economic success, and perhaps even more importantly to establish the increasing level of STEM literacy required for the public to make science and technology related decisions in their everyday personal lives and citizenship. Doing so requires an acknowledgement of each learner's unique opportunities and influences, or learning community, as Polman does in his study of engineering apprentices to find that

> a teen's interest and skill in tinkering with technology may have been cultivated by her parents, not recognized by her school, and viewed as odd by some of her

> peers; these others' opinions, as well as her own view of this aspect of her identity, would inform the teen's reaction to a youth program welcoming her tinkering skills and recognizing their value. (2010, p. 136)

The ZPID acknowledges that it is not only the individual's own ideas about his or her self in relation to content (such as science and technology), but also the learner's ideas about how others view him or her in relation to the content (Rahm, 2007) that contribute to a total concept of individual identity. Clearly, this is not a simple view, but adopting it provides the educational researcher and practitioner with a perspective that both acknowledges the complexity of influences involved in any given individual's identity development and highlights intersections of experience as points for making further connections.

Pugh et al (2009) define science identity as "the degree to which students view science as an important part of who they are, perceive themselves as science people, and can picture themselves pursuing science in the future" (p. 5). Carlone & Johnson (2007) studied the experiences and identities of women of color to gain an analytical understanding of the interplay between race and identity related to science and technology. This research led Carlone (University of North Carolina Greensboro College of Education, 2009) to state that advances in STEM education require moving beyond considering science programs only for those who "affiliate with a prototypical 'white, geeky boy' stereotype' to include those "who display interest, enthusiasm, and motivation for science, nature, and/or scientific thinking" so that a broader range of students "begin to see science as part of their multi-faceted selves" (p. 1). As such, change in identity is seen as an important outcome of science education interventions.

In their study of trajectories of identification (Wortham, 2004, 2006), Polman & Miller (2010) do exactly as Carlone suggests as they consider the experiences of urban African-American teen participants in an out-of-school science outreach program. Their ethnographic strategies reveal (as do those of Nasir, above) “that identifications are not static and that any one act of identification is contingent on specifics of that event” (p. 883). The current study seeks to further understand the taking up of identities, including “possible futures” (Polman & Miller, 2010, p. 912) offered to high school student participants in a project involving participation in science journalism, and how that process relates to expressed and observed student activity and interests in science and technology, acknowledging that “positionings of participants along positive trajectories within their environment are opportunities that are dialogically negotiated, which will not be accepted to the same degree or at the same rate by all” (p. 913).

Assessing Engagement

Interviews.

Interviews are well accepted as a means of collecting research participant perspectives on their own backgrounds and experiences (Creswell, 1998; Seidman, 1998). For gathering insight into American citizens’ engagement with history, Rosenzweig & Thelen (1998) developed a structured interview protocol they administered to 1,500 adults through randomized telephone calls. Because history is sometimes equated with textbooks and facts, the researchers phrased their questions around the concept of history as “the past.” Questions included inquiry into participant interest and participation in watching television shows or movies, studying family geology, visiting museums, etc. Through this study, the authors were able to reveal a layer of societal engagement with history-related content beyond the school years previously unidentified among Americans.

Falk, Storksdieck, & Dierking (1997) adopted similar methods to conduct phone interviews with adults in the metropolitan area surrounding a major science museum. These interviews sought to inquire into adult participation in and expertise related to science topics. Self-reports of personal involvement in science activities, and elaboration upon personal expertise in areas adults may not have previously considered to be related to science and/or technology (such as tinkering with electronics or learning about a disease after a loved one had been diagnosed) were provided.

Parent interviews have been used to gather information on the extent of early and upper elementary level students' participation in out-of-school science and technology-related activities (Korpan et al., 1997). Asking parents about their child's exposure to science on television, in books, in activities around the home (such as gardening or other hobbies, and using computers or other technological tools), and through community-based programs provided researchers with insight into the nature of science activities children are experiencing and the extent to which such experiences are being facilitated in the home. In their 1997 study, Korpan and colleagues were surprised to discover that their sample actually engaged in science at a high frequency. While this was a limited sample, such information provides educators a better understanding of student learning and interest which could be capitalized upon in the classroom.

Seidman (1998) provides a model for conducting interview research in education which allows for in-depth exploration of a participant's key experience, or phenomenon, which I utilized, in conjunction with a survey, to elicit students' experiences within the

SciJourn project. This method allows gathering both self-reported data, such as Korpan's, as well as first-hand student insight into that information.

Surveys.

Following their use of interviews to gather information about public (Falk, Storksdieck, & Dierking, 1997) and elementary school age children (Korpan et al, 1997) engagement with science, researchers called for the creation of survey methods for assessing this construct. In response, and for the explicit purpose of assessing engagement with science and technology as an outcome of the SciJourn project, McCarty, Hope, & Polman (2010) created the Youth Engagement with Science and Technology (YEST) Survey. An earlier version of the survey was piloted (Polman, et al., 2010; Polman, Hope, and McCarty, in preparation) with 104 SciJourn participants from 5 high schools. Comparison of pre and post program survey results showed significant gains ($p = .05$) in student participation in activities related to science and technology, such as reading books and magazines, seeking out websites, participating in groups, or providing opinions to others about science and/or technology topics. Participants also showed a significant increase in the degree to which they considered science to be important to their everyday lives. Results of the study were utilized to further edit the survey into the form used for this research.

While other studies have considered engagement as a complex construct, this approach of assessing engagement as a potential outcome of a science education intervention rather than as a factor contributing to the achievement of academic goals is unique. Prior research has been important to understanding how student characteristics influence learning, the complexity of learning itself requires that research delve into uncharted territory of what types of interventions may influence and change those student characteristics. A clear definition of the construct under study and valid and reliable measures to gather data of that construct are essential to quality research. As discussed earlier, direct observation of student activity enhances these research methods.

Summary of Literature

Highlighting engagement as an important outcome of science education, Pugh et al. (2009) posited that “a realistic goal for educators may be to focus on developing engagement” (p. 5). In order to do so, we must develop an understanding of this construct, which is illustrated by this collection of recent science education literature as a complex interaction of student action, interest, and identification relative to science and technology. This study strives to capitalize on the existing research related to three aspects of engagement and current best practices in education research to explore this construct further, identifying the possible relationship between involvement in a particular science journalism based intervention and development of increased student science and technology-related action, interest, and identification.

Chapter Three: Methods

This study was conducted within the framework of a larger federally funded project, which poses several strands of research questions related to 1) program implementation, 2) science literacy, and 3) science engagement. In the realm of science engagement, the purpose of this research is to document and illuminate the experiences and perspectives of high school student participants in the SciJourn program, as well as to describe the impact of participation in the SciJourn program on student engagement with science and technology. Specifically, I sought to understand how participation in SciJourn influences the students' thinking about and engagement with science and technology. How do qualities of project implementation and individual participant characteristics relate to engagement? What aspects of the intervention resonate with teens? Do some of the students feel more engaged in science issues, and if so, how did that engagement develop? In considering engagement in the SciJourn project throughout the school year through the lens of Lemke (2000), "do actions or events on one timescale come to add up to more than just a series of isolated happenings?" (p. 273). Data collection related to these questions contributes to a more complete understanding of the program's scope and impact.

Research Design

A mixed method design was utilized for this study, including a quantitative analysis of survey data from more than 500 SciJourn participants, and case studies of the experiences in a sub-sample of three participating teachers' classrooms. This approach was selected for its usefulness in allowing the researcher to collect the data considered most relevant to the inquiry (Creswell, 2009). As in the QUAN-QUAL model described by Gay and Airasian (2003), both quantitative and qualitative data are equally important to the study of the phenomenon of participation in the SciJourn program related to engagement with science and technology. Selected cases broadened understandings (Stake, 1978) of the SciJourn program as implemented in the school setting, while quantitative data analyses tested the hypothesis that participation in the project contributed to increased student engagement with science and technology. These two datasets were not only analyzed and reported independently, however. Results of quantitative data collection measures were utilized as one source of information considered alongside multiple sources (Creswell, 2009) of qualitative data (observations, interviews, and artifacts) gathered for the construction of narrative classroom cases.

Population and Sample

Before describing the specifics of the research population and sample, I will describe the SciJourn context. In two weeks of summer professional development (three weeks for pilot teachers) and four 1-day sessions throughout the school year, participating SciJourn teachers were actively involved in activities focused on two main areas: learning to be a science journalist and learning to use science journalism with students. Key components of these activities were, internet research (including searching strategies, determining website credibility, and saving search results for future reference), topic selection and pitching, interviewing, and writing in a journalistic style. Other topics included responding to student work, facilitating peer editing, and planning implementation strategies for the classroom. Many of these topics were illustrated through the use of the read aloud-think aloud (RATA) strategy, in which project staff, and later, teachers themselves, shared current science news stories aloud with the rest of the group, sharing aloud as they read the article their thinking about factors related to topic, sources, credibility of experts, and other content related to the SciJourn standards (Saul et al., 2012; UMSL 2008). In this manner, teachers became consumers and producers of science news, just as the project staff hoped they would train their own students to become.

The study population consists of all students (approximately 1300 students) in 28 participating SciJourn high school teachers' classrooms (See Appendix A). All of these classrooms are in schools distributed within the metropolitan area of a Midwestern city. The teachers self-selected for participation in the SciJourn project by applying for the opportunity, participating in program training, and agreeing to implement program components in their science or English classrooms. In the 2010-11 School Year, 20 of the 28 teachers were implementing SciJourn in their classrooms, following two weeks of summer training. The remaining eight teachers' students make up the comparison group for this and other project-related studies; they received training in the summer of 2011, and are implementing the SciJourn program in their classes in the 2011-12 school year. Students were obliged to participate in the program's activities as implemented by the teachers as a component of the regular coursework, and therefore are considered a convenience sample. However, students, and their parents, could opt not to participate in the research components of the project by not submitting signed consent and assent forms.

The sample of SciJourn students participating in this research is limited to those students in science classes who agreed to participate in the research and who also completed at least 75% of the YEST Survey both pre- and post- participation. Numbers of participants vary dramatically between teachers, as some teachers implemented SciJourn project activities in only one class, while others used the approach with multiple sections of a course offering, or across all of the classes taught (See Appendix A). Teachers also varied in their success at collecting signed parent consent and student assent forms.

The final sample consisted of 368 students in implementation classrooms and 101 in comparison classrooms. The implementation group, comprised of 142 males (39%) and 226 females, were 68% European American or White, 20% African American, 1% Hispanic or Latino students. Less than 1% of students identified themselves in any other ethnic group. These students attended suburban (39.4%), rural (40%), and urban (20.6%) schools, and resided in 65 different zip codes. A mean of 40% of students attending the same schools as students in the implementation group were eligible for the free and reduced lunch program (with the exception of the one parochial school included in this group). The average ACT score for graduates of these schools was 21. The comparison group of 101 students was made up of 27 males (27%) and 74 females. Fifty-two percent of the comparison group students identified themselves as African-American, and 35% were of European-American descent. Less than one percent of the comparison group identified themselves as belonging to any other ethnic group. This group represents residents of 13 zip codes in attendance at urban (52%), rural (28%), and suburban (20%) schools. Average eligibility for free and reduced lunch for the comparison group schools was 70.5%. Average ACT score for these schools was 18. Less than 1% of either group speaks English as a second language. All students in both groups are in science classes of some type (not English or Journalism).

Demographic Characteristics		Implementation (n = 368)	Comparison (n = 101)
Gender	% Male	39	27
	% Female	61	73
Ethnicity	% European American	68	35
	% African American	20	52
	% Hispanic or Latino	1	<1
Setting	% Urban	21	52
	% Rural	40	28
	% Suburban	39	20
Poverty Level	Average % Qualified for Free or Reduced Lunch	40	71
Achievement	Average ACT Score	21	18

Table 1. Summary of Implementation and Comparison Group Demographics

The implementation and comparison teachers are considered equivalent in their motivation to participate in the intervention, and representative of secondary school teachers nationally. Combined, the sample teacher group is made up of 67% females and over half (55%) hold a master's degree in either education or science. One has also recently completed a PhD. The average number of years of classroom teaching experience is nine. National statistics for secondary science teachers also show the majority (53.8%) are female, have earned a master's degree as their highest degree (51.4%) and have 3-20 years teaching experience (64.4%) (U.S. Department of Education Institute of Education Sciences, 2010).

Three case study classrooms were selected based on initial observations conducted by project team researchers. Factors considered in case selection included degree of implementation, class type, school demographics, and willingness to participate. Purposeful classroom case study selection supported the intention to focus this engagement research on classroom situations most likely to represent best case implementation, or, as Schofield (1990) described, "what could be" (p. 226). In the

SciJourn classroom, the best case scenario is viewed by the project team as one in which the teacher exhibits a high level of engagement. He or she is highly involved, or *active*, in classroom implementation strategies; exhibits *interest* in science journalism as a mechanism for improving student science literacy and the project overall as well as its role in his/her own classroom; and *identifies* him/herself as an integral part of the SciJourn team. “High implementation” classrooms were those in which students participated in SciJourn as producers of original science news, as well as consumers. See Appendix A for identification of high, medium, and low implanting teachers. Interviews were conducted with three to five students in each the case study classrooms (see "Interviews with select participants" below). These participants were selected based on initial levels of engagement as illustrated by their YEST Survey responses and their observed participation in SciJourn (i.e., I purposefully selected students with low and high engagement with science and technology and with SciJourn).

Teacher 007, called Luke VerVelde (all names are pseudonyms), is a male who has 18 years of teaching experience and holds a Bachelor’s degree in education. Luke is a second year participant in SciJourn, having been a part of the pilot program during the 2009-10 school year. In 2010-11, he taught environmental science and biology classes at School 004, a large public suburban high school located on the outer edge of metropolitan sprawl. The vast majority of students at School 004 are white and middle to upper class. The Fifth Period Environmental Science class is a yearlong full science credit for juniors and seniors. Class meets for 50 minutes per day, every day, in the hour just before the lunch period. There are fifteen students in the class, five female and ten male. One African American male and one Asian American male are the only students of color in the class. Situated at the very edge of exaggerated suburban sprawl, students at School 004 represent two dramatic “types” of teenagers: pick-up truck driving, boot and camouflage-wearing “country” kids and highly-tanned and fashionable suburbanites. This class is made up of both. Of Teacher 007’s classes, this hour was chosen for convenience purposes, and is demographically similar to the other sections of the course.

Interviews were conducted during class time with four students in the hallway outside the classroom. One interviewee was suspended for the remainder of the school year after his first interview, and thus excluded from the sample. Another student requested that he be interviewed on the last day of interviewing, expressing that he had never been interviewed before and would like to try it. An interview was conducted, but not included in the analysis, as that data, also, was considered incomplete. Three male students, all high school seniors, participated in the two-interview set: Kristopher (pre-score on YEST: 0.14), Brendan (0.30), and Ramiz (0.52) Brendan and Kristopher are white, and Ramiz is Asian-American.

The second case study class is taught by Cynthia Morella, a middle-aged white female who has been teaching high school for 19 years, all but the first year at School 011. She has a BA in biology, MA in secondary school administration and had just (the prior year) completed a PhD in Educational Leadership. School 011 is technically a suburban school, located several miles from the urban center, although it meets criteria for consideration as what is typically considered a struggling urban school. Also a large school, the student body is made up of nearly all African American students, over half of whom are eligible to receive free or reduced lunch. The school is one of three high schools in a giant school district, and the school itself is in the process of a major reform effort.

Cynthia's case study classroom is a year-long Pre-AP Chemistry course for sophomores and juniors who are considered advanced beyond the basic required Chemistry course. The class meets during the first class period of the day, which begins at 7:20 AM, on a block schedule (every other day). There are 24 students in the class, all of whom except for one white female student are African American. Eleven (46%) of the classmates are male.

In each of the case study classrooms, interviewees were selected based on their beginning-of-the-year YEST survey responses. Two initially selected students in Cynthia's class (one determined to have medium engagement and another with high engagement) had too infrequent class attendance to allow for interviewing, and were replaced with the two below (both of whom happened to show high engagement on the initial YEST survey). Two interviews were conducted with each of the three students in the hallway outside the classroom during class time. Students were given extra time to complete any work they missed during interviews.

Angel, Sean, and Terrence are all three African-American students. Angel and Sean both had high initial engagement scores on the YEST Survey, 0.66 and 0.49 respectively. Terrence exhibited low engagement with a score of 0.18. All three of these students were sophomores.

Mary Connor is an older female teacher who has taught all of her 35 years at School 014, where she teaches freshman and honors chemistry courses. Mary holds bachelor's degrees in biology, chemistry, and education, a Master's degree in Secondary

Science Education, and is currently enrolled in a doctoral program at the university conducting this research. School 014 is a mid-sized private college preparatory Roman Catholic high school for girls located in the most affluent zip code of the metropolitan area of this study. Nearly all of the students at school 014 are white, and almost all of them go on to attend a four-year college following graduation.

A freshman chemistry course was selected as a case study classroom, in order to consider the SciJourn experience within a semester-long course. The case study class at School 014 is a semester-long Introduction to Chemistry course for freshmen, held in the spring semester. All of the 20 students in the class are white females. The school schedule operates on a modified rotating block schedule, resulting in this class meeting once each week for 75 minutes at a time.

The three students selected as interviewees in this class were Clare, Hailey, and Molly. Their scores were all relatively low; however they showed the low-medium-high diversity within their class. Bailey had the lowest score, at 0.08. Clare's score of 0.17, considered low in other classes, represents the middle scores in this particular group of students. Hailey's score of 0.23 was among the highest in the class.

In total, ten students were interviewed across the three classes studied. This sample size was both realistic in terms of data collection and analysis, and also sufficient to provide characterization of a range of participant experience.

Demographic Characteristics		Case Study Classes: Luke: Environmental Science (n = 15)	Cynthia: Pre-AP Chemistry (n = 24)	Mary: Intro to Chemistry (n = 20)
Gender	% Male	66	46	0
	% Female	33	54	100
Ethnicity	% European American	86	4	100
	% African American	7	96	0
	% Hispanic or Latino	0	0	0
	% Asian	7	0	0
Setting	Urban		X*	
	Rural			
	Suburban	X		X
Poverty Level	% Eligible for Free or Reduced Lunch	2	69	n/a
School Type	Public	X	X	
	Parochial			X
Course Type	Elective	X		
	Required		X	X
	Advanced		X	
Grade Level	9^{th}			X
	10^{th}		X	
	11th	X	X	
	12th	X		
Engagement Level	Average Pre-SciJourn YEST Survey Score	0.32	0.39	0.23

***** Although this school is outside the city limits, it is a setting that most demographers would consider "urban."

Table 2. Summary of Case Study Class Demographics

Participant Protection and Confidentiality

As mentioned above, study participants were limited to those students and classroom teachers who submitted signed forms of consent (or parental consent, for those under 18 years of age) and assented to research participation. Students in the comparison participated in the research as a component of the regular school day and were not required to do additional out-of-school activities related to the project. All teacher and student participants were assigned numeric identification codes. These codes were applied to survey forms by another member of the SciJourn team before it was entered into an electronic document. All electronic data are stored in password protected electronic documents. Hard copies of documents are stored in a locked storage room accessible only by SciJourn project team members. Pseudonyms have been assigned to the teachers and students in the case studies, and no school names are given. All procedures for protecting participant confidentiality are detailed in the large grant project's existing Institutional Review Board (IRB) approval at University of Missouri-St. Louis (see Appendix G for IRB Approval).

Data Collection

Within the larger SciJourn project, multiple types of data were collected from all of the nearly 1,500 students. For this component of the SciJourn project, the relevant data consist of responses to the YEST survey, administered before and after participation in the project’s activities as well as observations of case study classrooms throughout the school year and interviews with select participants and their teachers at the end of the study period. Table 3 shows a timeline of the research activities.

	2010					2011											
Task	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Survey Administration	X	X			X	X				X							
Survey Data Entry			X	X	X	X	X	X			X	X					
Survey Data Analysis												X	X	X			
Interviews					X				X	X	X	X	X				
Observations			X	X	X	X	X	X	X	X							
Artifact Collection			X	X	X	X	X	X	X	X	X						
Qual. Data Analysis														X	X	X	X

Table 3. Research Timeline

Surveys of the population.

In order to test the stated hypotheses, a quasi-experimental approach to survey research was employed using the Youth Engagement with Science and Technology (YEST) survey (see Appendix B) in a one-way repeated measures design. SciJourn implementation was considered as the independent variable in relation to the three dependent variables of action, interest and identification (the engagement framework) for the four implementation level groups: low, medium, high, and comparison/non-intervention.

The YEST survey itself is an outcome of the SciJourn project, developed in response to the literature (Falk et al., 2007; Korpan, 1997) calling for an instrument to assess student engagement with science. The author and colleagues Glenda McCarty and Joseph Polman (McCarty et al., 2010) designed the survey based on three factors considered to be interrelated within the construct of engagement: action, interest, and identification. Interviews, think-aloud protocols, and case studies were conducted to refine the survey instrument, and then a pilot survey was administered to a broad audience. The resulting edited survey (used in this study) showed an overall test-retest reliability of 0.85. Litwin (1995) considers anything above 0.70 as acceptably reliable for survey research. This survey was designed expressly for high school students and is typically completed in less than twenty minutes of class time. Both a paper and pencil and an online version are available for a teacher's convenience.

The YEST survey was administered by SciJourn teachers to their classes at the beginning and the end of the term for year-long classes, September, 2010 & May, 2011; for semester-long courses, either September & December, 2010, or January & May 2011.

Teachers determined for themselves whether the written or online version of the survey was best for their students, mainly based on the availability of technology required for the online version. Because the survey (typically) was administered during the class period, response rates were expected to be relatively high. Project researchers collected completed surveys from classroom teachers and the online service used to host the electronic version of the YEST survey. Surveys were anonymized by assigning each student participant an individual code number by teacher. A system for coding responses (See Appendix E) was developed by the researcher and subsequently used in the process of inputting and analyzing SciJourn project data entered into Excel spreadsheets by project staff and cleaned by the researcher.

Classroom observations.

In order to capture the nature of implementation of the SciJourn program in each of the case study classrooms, an effort was made to observe each and every class period focused on SciJourn activities. Observations were scheduled with teachers to coincide with their plans for teaching SciJourn-related lessons. A total of 23 observation visits were made by a single researcher, where the observation protocol (Appendix C) was completed, along with field notes and a digital video recording of the lesson. The number of observations varied by teacher, based on their individual choices for implementation. See Table 4 for a synopsis of classroom visits by teacher.

Teacher	Observation Dates	Total Observations
Luke	1/25, 1/27, 2/9, 2/10, 2/11, 2/14, 2/15, 2/16, 5/9, 5/12, 5/13, 5/16, 5/18, 5/20	13
Cynthia	10/13, 11/4, 11/22, 11/24, 1/25	5
Mary	1/27, 1/28, 2/17, 3/28, 4/26	5

Table 4. Classroom Observation Summary

Completed observation protocols, supplemented by video recording and researcher notes providing documentation of these experiences, were then analyzed for themes of action, interest, and identification using NVivo 9 qualitative data analysis software. Teachers were provided with digital video recorders to capture lesson components that arose organically or that he/she considered too brief to warrant the researcher's trip to the school. This strategy was also used for recording lessons on the rare occasion when the researcher was unavailable for direct observation of a particular lesson. Video was then transferred by the researcher on her next classroom visit from the camera to a computer for review and notation. The researcher communicated regularly with the classroom teachers using informal interviews before and after class time and email to gather teacher perspective on his/her implementation and student progress. Notes from these interactions were included in the data set and utilized to create a thick description of the classroom cases.

Interviews with select participants.

In addition to direct observation of teacher implementation and student experience in the case study classrooms, it was important to gain insight into the participants' personal experiences with science and technology prior to, and during SciJourn experience. Using the protocol for phenomenological interviewing in education set forth by Seidman (1998), interviews were conducted with nine select students (three students in each classroom) to capture student perspectives on their own engagement with science and technology in the SciJourn project and beyond (see Appendix D for phenomenological interview protocol). As described above, interviewee selection was made based on responses to the pre-YEST survey, selecting at least one student from each classroom showing low, medium, and high overall engagement with science and technology on the pre-participation administration of the YEST survey in order to incorporate purposeful maximum variation in the sample, such as Patton (1990) has suggested for qualitative inquiry. Similar interviews were conducted with each of the three case study classroom teachers as well.

According to Seidman (1998), the ideal phenomenological interview cycle contains three interviews, each with a specific purpose: 1) life history, 2) contemporary experience, and 3) meaning making. Given constraints of time and availability of high school students, however, the interviews in this study were conducted in two sessions, with the first being the life history, and the second a description of contemporary experience and meaning making. In personal communication, Seidman (2011) agreed with this changed strategy, given practical constraints.

Seidman's standardized structure for interviewing was selected for its capacity to guide the researcher in going "to such depth in the interview that surface considerations of representativeness and generalizability are replaced by a compelling evocation of the individual's experience" (1998, p. 44). In contrast with the quantitative survey data, the interview results are not intended to be generalizable to the entire population of SciJourn participants, but rather meant to illuminate the experience of a few individuals in best-case implementation settings. A similar protocol was followed in case studies of participants in the SciJourn project in a non-formal setting.

As described above, two interviews were conducted with each interview participant. Student interviews were conducted with teacher permission either during the science class period or during a free period for students, during the school day, near the end of the 2010-11 school year. Teacher interviews were conducted in locations and at times selected by the teachers for convenience over the following summer. Each interview was digitally audio-recorded while the researcher took notes. Recordings were transcribed by a professional third party in preparation for analysis.

Additional data sources.

The case studies were enriched by the inclusion of additional data sources, including articles written for *SciJourner*, informal interviews with case study classroom teachers throughout the school year (often before and/or after observed lessons), and the field notes and/or anecdotal data of other SciJourn research team members. These data were utilized as triangulation points with the observations and interviews described above.

Data Analysis

YEST Survey pre- and post-implementation data were analyzed and described using means and standard deviations of 1) overall engagement scores and 2) individual survey item responses. Additionally, so that any observed changes in engagement could be attributed to participation in SciJourn, and not another difference between groups, implementation group results were compared with survey results from the comparison group of students using *t*-tests, in order to determine whether there was a significant difference between the two groups. Table 5 provides a summary of YEST Survey items by engagement framework category.

In order to test the first hypothesis, “SciJourn participants will demonstrate an increased engagement with science and technology compared to non-participating peers,” data were compared for pre- and post- program differences using a *t*-test for independent samples. The second hypothesis, “the degree and nature of engagement will vary according to qualities of teacher implementation” was tested through *t*-test comparison of all four implementation level groups (High, Medium, Low, and Comparison).

Aspect	**# of Questions**	**Types of Questions**
Demographics	7	Gender, grade level, zip code
Interest	16	Level of interest in school, science, & technology Specific areas of interest
Action	20	Frequency of participation in related activities Ways of spending free time
Identification	24	Related activities in everyday life Views of self Future plans

Table 5. Categories of Items in the YEST Survey

Qualitative data described above were used to construct cases for exploring (Creswell, 2009) questions about the nature of student involvement in SciJourn and connections between science and the students’ own lives, as described in the guiding questions for the qualitative inquiry. Analysis of these data followed Creswell’s (2009) recommendations for case studies: description, themes, and assertions (p. 63). Observation notes and video transcripts were utilized to create a thick description (Geertz, 1973) of each classroom, thus setting the context of the case (Merriam, 1988).

Observation notes and interview transcriptions were analyzed for the themes (Aronson, 1994) in order to create a narrative case for each of the three classrooms.

Following the two-phase model of analysis for interview responses provided by Seidman (1998), individual participant responses were grouped into these and additional categories determined as they were identified in the data. Selected passages from all participants were grouped into categories and analyzed for themes within and across participants. Students' and teachers' own words from the observation and interview transcripts were carefully selected for inclusion in a narrative description of each class' SciJourn experience.

Reporting

Results of the quantitative and qualitative research approaches are reported separately in the following two chapters. Chapter 4 provides the reader with descriptive statistics for the results of the YEST survey of high school students in participating SciJourn classrooms, and a comparison with their non-participating peers. Results of analysis of survey results by level of project implementation are also presented. Chapter 5 presents the narrative cases of three different SciJourn classes, providing survey results alongside a detailed description of each classroom case, and themes within it, and then a cross-case analysis of themes across the three classrooms (Creswell, 2009). An interpretation of the data for "lessons learned" (Lincoln and Guba (1985) and discussion of the implications of and conclusions drawn from the overall inquiry are blended in the final chapter, along with suggestions for further research in this field.

Chapter Four: Results of the YEST Survey

This study was conducted using a combination of quantitative and qualitative data analysis in order to gain insight into both the big picture of student engagement with science and technology through SciJourn as measured by a survey, and also the goings on in the classroom, and at the student level as related to the survey results. This chapter presents the results of survey data analyses and the findings of that work as it relates to the stated research questions.

A quasi-experimental administration of the YEST survey was conducted to test two hypotheses. Before conducting *t*-tests for dependent samples, however, Levene's test for equal variance was performed. Despite some demographic differences between the implementation and comparison groups described in the previous chapter, statistical results showed there was not a significant difference between the means of the pre-survey engagement scores of the implementation (n = 368, M = 0.31, SD = 0.15) and comparison (n = 101, M = 0.32, SD = 0.14) groups, who varied equally $t(467) = -0.26$, $p = 0.70$). Testing of hypotheses could then be conducted assuming equal variance among the two groups.

Hypothesis Testing

Two hypotheses were tested using *t*-tests to analyze differences between mean engagement scores. First, it was hypothesized that SciJourn students would show a greater gain in composite engagement with science and technology scores (comprised of all items on the survey) than their non-SciJourn peers in a comparison group. Results of a *t*-test for independent samples shows no significant difference between the means of the post-SciJourn composite engagement scores of the implementation (n = 368, M = 0.29, *SD* = 0.15) and comparison (n = 101, *M* = 0.31, *SD* = 0.13) groups *t*(466) = -0.98, *p* = 0.33). The difference between pre (*M* = 0.31, *SD* = 0.14) and post (*M* = 0.29, *SD* = 0.15) engagement scores for the implementation group (n = 368) was significant (*t*(366) = 2.80, *p* = 0.01). However, since these results are negative, the hypothesis must therefore be rejected.

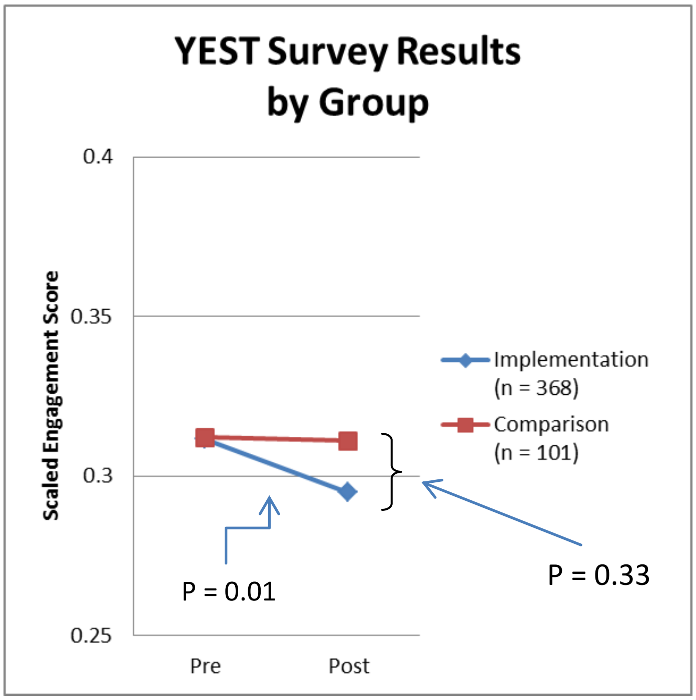

Figure 1. Implementation and Comparison Group YEST Survey Results

The second hypothesis posited that increases in engagement with science and technology would vary with classroom implementation level. In other words, it was expected that students involved in both the consumption and production of science and technology news articles (high implementation classrooms), would show the greatest gains in engagement as measured by the YEST.

Means of the high implementation groups (n = 262) scores were 0.31 (*SD* = 0.14) for the pre survey and 0.28 (*SD* = 0.14) post. The medium (n = 82, *M* = 0.30, *SD* = .0.15 and *M* = 0.31, *SD* = 0.14) and low (n = 24, *M* = 0.35, *SD* = 0.15 and *M* = 0.35, *SD* = 0.17) showed little change from pre to post. Using a *t*-test for dependent samples, the change for the high implementation group (n = 262), while negative, was found to be significant $t(286) = 3.67$, $p = 0.00$. No significant difference was found between pre and post engagement scores for the low (n = 24, $t(23) = -0.19$, $p = 0.85$) and medium (n = 82, $t(55) = -0.46$, $p = 0.65$) implementation groups. In fact, analysis of pre/post scores for the implementation sub-groups shows an inverse relationship between implementation and positive engagement survey score. Therefore, the second hypothesis must also be rejected. These results were so surprising that item-by-item analysis was conducted to gain understanding beyond a simple rejection of the original hypotheses.

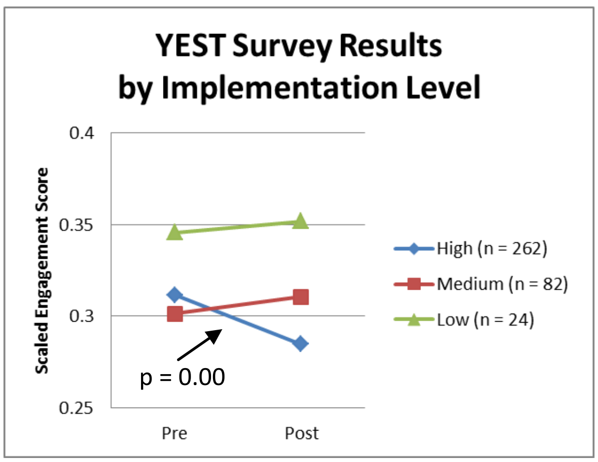

Figure 2. YEST Survey Results by Implementation Level

Selected-response Survey Items

The SciJourn project aims to increase student engagement with science and technology, and therefore further research into the survey results was considered key to discovering what is actually happening with regard to engagement in the SciJourn classroom across this sample. First, implementation group ($n = 368$) results were considered together. *T*-tests for dependent samples conducted on each of the 43 selected-response survey items showed significant differences from pre to post on 28 items. Of these, 22 were gains, and six were negative shifts in reported engagement. Attention was focused on these items of significance.

Action.

Most of the items showing negative change in reported engagement from pre to post were those asking students to indicate the frequency with which they participated in science or technology-related activities in the last six months. These questions made up much of the "action" section of the survey. The possible range for items related to frequency of participation in a variety of science or technology-related activities was 0 – 5, where higher numbers indicated higher frequency of participation (0 = not at all, 5 = daily). The obtained range for responses to these items was 0.76 to 2.96 on the pre survey and 0.63 to 2.58 on the post, representing the range of responses of 0 = not at all, 1 = once, 2 = monthly, and 3 = twice a month.

Following participation in SciJourn, students rated themselves as less frequent participants in activities like reading of science books (Pre: $M = 1.78$, SD: 1.50; Post: $M = 1.56$, $SD = 1.51$) $t(366) = 2.43$, $p = 0.02$), watching of technology-related TV shows or movies (Pre: $M = 2.32$, $SD = 1.85$; Post: $M = 2.09$, $SD = 1.73$) $t(357) = 2.22$, $p = 0.03$, or science-related TV shows or movies (Pre: $M = 2.96$, $SD = 1.82$; Post: $M = 2.58$, $SD = 1.80$) $t(364) = 3.45$, $p = 0.00$, conversing with friends and/or family about science (Pre: $M = 2.46$, $SD = 1.95$; Post: $M = 2.01$, $SD = 1.81$) $t(361) = 4.27$, $p = 0.00$; and writing, blogging or texting about science (Pre: $M = 1.77$, $SD = 2.09$; Post: $M = 1.47$, $SD = 1.87$) $t(358) = 2.54$, $p = 0.01$. These results are shown in Table 6. While statistically significant, it is important to note that only the mean change in the "writing, blogging, and texting" item frequency shows a shift large enough to affect a change in the survey response; 1.77 (the pre-SciJourn mean), rounds up to “monthly,” while the post-SciJourn mean of 1.47 rounds down to “once” in the last 6 months. Possible explanations for the puzzling “action” results are explored in the “Insight into Unexpected Results” section of Chapter 6.

Frequency of		Pre		Post			
	N	*M*	*SD*	*M*	*SD*	*t*	*p*
Reading Science Books	367	1.78	1.50	1.56	1.51	2.43	0.02
Watching technology-related TV/Movie	258	2.32	1.85	2.09	1.73	2.22	0.03
Watching science-related TV/Movie	365	2.96	1.82	2.58	1.80	3.45	0.00
Talk w/friends & family about science	362	2.46	1.95	2.01	1.81	4.27	0.00
Writing, blogging, texting about science	359	1.77	2.09	1.47	1.87	2.54	0.01

Table 6. Survey Items Related to Action with Significant Results

Involvement in certain activities related to science and technology showed a significant decrease in reported frequency, but most students’ stated reasons for participating in science and technology activities showed positive change as shown in the following mean scores. Students gave more reasons for being involved in science and technology activities following SciJourn participation. As expected, students indicated that they were being assigned or required to do more science and technology-related activities. See Table 7 for a summary of significant results.

Students stated that they were more often required to read science books for their work (M = 0.22, SD = 0.41; $t(206)$ = -2.16, p = 0.03). They indicated class assignments (M = 0.51, SD = 0.50; $t(198)$ = -3.59, p = 0.00) and work requirements (M = 0.14, SD = 0.35; $t(172)$ = -2.99, p = 0.03) as reasons for reading science articles. Results for reading technology-related articles showed students more likely giving the reason as assignment

(*M* = 0.52, *SD* = 0.50; *t*(156) = -3.54, *p* = 0.00). Assignment for class (*M* = 0.25, *SD* = 0.44) and requirement for work (*M = 0*.05, *SD = 0*.22) were also significantly more often reasons for watching TV shows or movies related to science (*t*(264) = -2.95, *p* = 0.00 and *t*(246) = -2.20, *p* = 0.03 respectively). Implementation group students were more likely to watch a technology-related TV show or movie because it was required for their work as well (*M* = 0.07, *SD = 0*.25; *t*(198) = -2.16, *p* = 0.03).

Reason	Activity	Mean change				
		N	*M*	*SD*	*t*	*p*
Assigned	Read science articles	199	0.51	0.50	-3.59	0.00
	Read technology articles	157	0.52	0.50	-3.54	0.00
	Watch science TV/Movies	265	0.25	0.44	-2.95	0.00
	Visit science website	261	0.66	0.48	-2.71	0.01
	Visit technology website	220	0.42	0.50	-2.45	0.01
	Talk with friends/family about technology	196	0.16	0.37	-3.02	0.00
	Write blog or text about science	122	0.34	0.48	-2.68	0.01
	Write blog or text about technology	121	0.21	0.41	-2.50	0.01
Required for work	Read science books	207	0.22	0.41	-2.16	0.03
	Read science articles	173	0.14	0.35	-2.99	0.03
	Watch science TV/Movies	247	0.05	0.22	-2.20	0.03
	Watch technology TV/Movies	199	0.07	0.25	-2.16	0.03
	Visit science website	219	0.21	0.41	-2.28	0.02
	Talk with friends/family about science	194	0.09	0.29	-2.43	0.02
Fun or enjoyment	Visit science website	212	-0.08	0.50	2.05	0.04

Table 7. Significant Changes in reasons for Participation in Science and Technology Activities

Students indicated that class assignments (*M* = 0.66, *SD* = 0.48; *t*(260) = -2.71, *p* = 0.01) and work requirements (*M* = 0.21, *SD* = 0.41; *t*(218) = -2.28, *p* = 0.02) were more often the reason for visiting science websites. Assignment was also more often a reason for student visits to technology-related websites (*M* = 0.42, *SD* = 0.50;

$t(219) = -2.45$, $p = 0.01$). This is not surprising, considering the key part Internet research plays in SciJourn implementation. However, they selected "fun or personal enjoyment" significantly less (Pre: $M = 0.53$, $SD = 0.5$, Post: $M = 0.45$, $SD = 0.50$) $t(211) = 2.05$, $p = 0.04$ as a reason for visiting science websites. In the implementation group overall, this was the only "reason for doing" science and technology-related activities marked significantly less after SciJourn participation. It is possible students who were immersed in online science research during the school day did not find themselves having as much free time to do so for fun. Thus, there were increases in some reasons for doing, in addition to stability in the previous reasons for doing the same activities. This result may also relate to the discussion with teachers described in the "Insights into Unexpected Results" section of Chapter 6.

Assignments and work requirements are also reflected in students' reasons for communication with others. Students stated that they talked with friends and/or family members about science because it was required of them for work more often ($M = 0.09$, $SD = 0.29$; $t(193) = -2.43$, $p = 0.02$) after SciJourn participation, and class assignment was more often their reason for talking with friends and/or family about technology ($M = 0.16$, $SD = 0.37$, $t(195) = -3.02$, $p = 0.00$). Writing, blogging, and texting about science ($M = 0.34$, $SD = 0.48$; $t(121) = -2.68$, $p = 0.01$) and technology ($M = 0.21$, $SD = 0.41$; $t(120) = -2.50$, $p = 0.01$) were more often in response to class assignments.

Interest.

Beyond classroom expectations, students were also more likely to watch a science-related TV show or movie for the purpose of finding information to make a decision ($M = 0.05$, $SD = 0.23$, $t(243) = -2.20$, $p = 0.03$). There were also significantly more students talking to friends and family about science to learn more about it (*M* = 0.45, *SD* = 0.50; *t*(208) = -2.19, *p* = 0.03) and/or about technology to find information to make a decision (*M* = 0.25, *SD* = 0.43; *t*(196) = -2.48, *p* = 0.01). Table 8 depicts these results.

Reason	Activity	Mean change				
		N	*M*	*SD*	*T*	*P*
Find information to make decision	Watch science TV/Movie	244	0.05	0.23	-2.20	0.03
	Talk technology with friends/family	197	0.25	0.43	-2.48	0.01
Learn more about topic	Talk science with friends/family	209	0.45	0.50	-2.19	0.03

Table 8. Significant Changes in Interest-related reasons for Science and Technology Activities

Identification.

Significant change was seen in implementation group mean responses to five of the 24 YEST Survey items related to identification with science and technology. Students indicated that they were more likely to read a science article because it was related to future career or educational plans (*M* = 0.10, *SD* = 0.30, *t*(168) = -1.98, *p* = 0.05). The mean response to the question asking students, “Can you see yourself using science or technology in your career?” shifted slightly (M = 0.13, SD = 0.01), but significantly (*t*(355) = -2.15, *p* = 0.03), while still within the “probably yes” answer range. Slight shifts in perception of how students are viewed by others with regard to being “science” or “technology” people were also made, from an average in the “disagree” range to the “not sure” range about being viewed as a science person, and slightly higher mean within the “not sure” range for technology. Pre to post, participants rated their knowledge of science compared with their peers on average as a three out of five, but significantly higher within that range on the post.

Similar trends appeared in the data from high implementation group students. Since students in high implementing classes were the largest component of the implementation group overall (n = 276), this is not surprising. However, significant differences were seen in an additional eight survey items among only the high implementation group. Students in high level implementation classes gave the reason of "assigned for class" significantly more often for reading a science book (M = 0.78, SD = 0.41) $t(172) = -2.00$, $p = 0.05$. They indicated that they read technology books more often to find decision-making information (M = 0.25, SD = 0.44; $t(95) = -1.99$, $p = 0.05$). They reported that they provided opinions about technology less often, but when they did so it was more often in response to a class assignment (M = 0.19, SD = 0.39; $t(151) = -2.52$, $p = 0.01$). These students also gave class assignment more often as their reasons for talking with friends and family (M = 0.24, SD = 0.43; $t(156) = -2.16$; $p = 0.03$) and providing opinions (M = 0.32, SD = 0.48; $t(148) = -2.25$, $p = 0.03$) about science. These students wrote, blogged or texted about technology for the reasons of learning more (M = 0.25, SD = 0.24; $t(80) = -2.78$, $p = 0.01$) or finding information to make a decision (M = 0.16, SD = 0.37; $t(82) = -2.04$, $p = 0.05$). On average the high implementation group rated themselves slightly higher as student learners $t(266) = -1.96$, $p = 0.05$ although still within the "good" range on the survey (M = 2.90, SD = 0.87).

Analysis of survey items revealed that implementation of SciJourn most affected student responses relating to the action component of the engagement framework. This was expected, especially because pilot administration of the YEST Survey in the 2009-10 school year showed the most significant increases in action-related items. Also in keeping with original thinking about the survey results is the increase in class assignment and work requirements as reasons for being involved in many of the science and technology related activities the survey measures. Many of these activities are key to SciJourn involvement, and so we would expect an increase in teacher assignments of this type in classrooms where SciJourn is being implemented. So, while the area of greatest change is not surprising, finding *decreases* in reported frequency of participation in science and technology activities was definitely unexpected. These decreases contribute to the overall engagement score, which resulted in the rejection of both research hypotheses.

Reason	Activity	Mean change				
		N	*M*	*SD*	*t*	*P*
Assigned	Read science book	173	0.78	0.41	-2.00	0.05
	Talk science with friends/family	157	0.24	0.43	-2.16	0.03
	Provide opinion about science	149	0.32	0.48	-2.25	0.03
	Provide opinion about technology	152	0.19	0.39	-2.52	0.01
Learn more about topic	Write, blog or text about technology	81	0.25	0.24	-2.78	0.01
Find information to make decision	Read technology book	96	0.25	0.44	-1.99	0.05
	Write, blog or text about technology	83	0.16	0.37	-2.04	0.05

Table 9. Significant Differences in Item Responses for High Implementation Group

It is unlikely, based on classroom observations and conversations with teachers, that students in the implementation group are actually participating in specified science and technology-related activity less often while involved in SciJourn, especially given the higher prevalence of significant negative shifts in frequency of participation among students in high implementation classrooms. It was thus suspected—see the case study results below and the "Insights into Unexpected Results" section of the final chapter—

that students' definition of what "counts" as science has been somehow affected by their SciJourn experience.

Open-ended Survey Items

In addition to the selected response items above, the YEST Survey poses seven open-ended questions. Analyzed using open coding for themes emergent from the responses themselves, student responses to these items also showed decreases in engagement with science and technology pre to post, in many areas.

How do you use science in your everyday life?

Responses were coded into thirteen categories that arose from the data itself. 84 students said "none" or "don't know" in the pre, and 55 (29 fewer) gave that response in the post, indicating that students had a better idea of how they used science day to day by the end of the year. (This code only received one less response in the comparison group.) More students indicated technology use (from 59 pre to 92 post) and nature or outdoor activities (from 24 pre to 33 post) as everyday science activities. "All," or responses in which students indicated that everything or most everything they do is somehow related to science increased by eight (from 25 to 32). At the same time, ten fewer students provided a response of bodily movement or function as science in the post survey, indicating perhaps an increased awareness of science "use" rather than involuntary scientific processes (such as digestion). The Comparison Group indicated fewer uses for science in their everyday lives post (from 133 to 127), with the main categories of change being technology use (from 21 pre down to 14 post), personal care (17 pre to 12 post) and household activities (from 23 pre to 18 post). Comparison group students showed a 50% increase in both "nature" and "all" categories from pre to post.

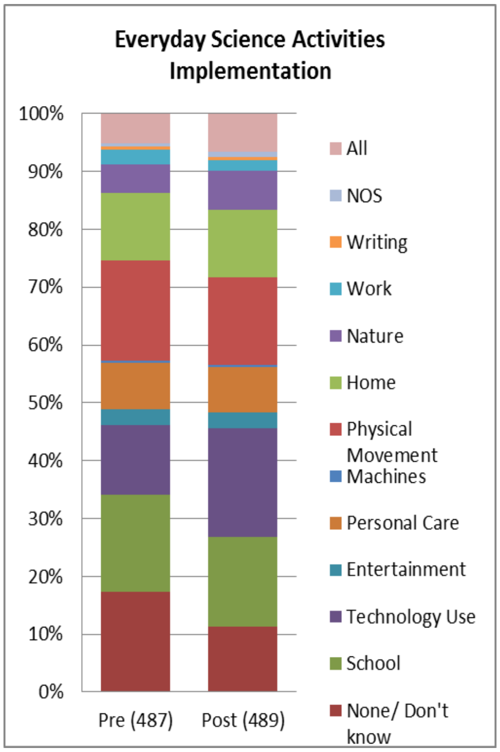

Figure 3. Everyday Uses of Science

How do you use technology in your everyday life?

Everyday use of technology also remained stable from pre to post, with a slight decrease from 454 to 440 coded responses from the 368 participants. These numbers are slightly lower than the number of "everyday use of science" codes in the previous item; however, technology use was included by many students (59 pre, 92 post) as a use of science in everyday life. Technology use responses were coded into 13 emergent themes. Unlike responses to the similar item for science, where "none" was answered by more than 15% of students (on the post; this number was over 20% on the pre-survey), less than 3% of students in either group responded "none" or "don't know" to ways they use technology in everyday life. The most common ways students said they use technology were talking or texting on phones, computers, and watching TV or movies. Internet/social networking, music, school work, gaming, and transportation were in the next tier of responses. Increases from pre to post were seen in the areas of phone use, internet/social networking, transportation, sports/exercise, and cleaning/chores as well as "Everything," which showed the greatest gain, from 14 pre to 27 post. Phone, computer, and TV/movie were also the most common uses of technology among the comparison group.

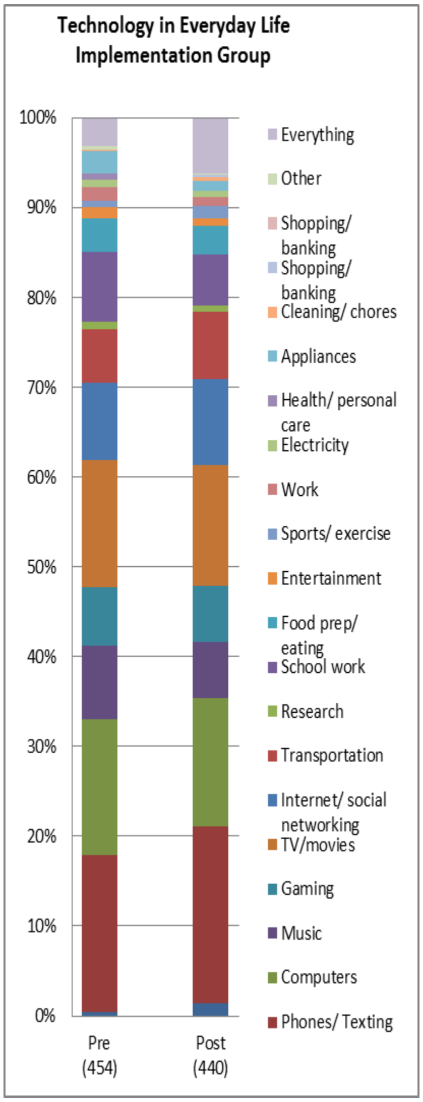

Figure 4. Everyday Uses of Technology

What specific aspects of science and technology do you find interesting?

Participant interests in science and technology were coded into 21 emergent categories, which ranged from specific content areas (physics, genetics, biology) to entire fields (medicine, engineering) and approaches (hands-on activities and nature of science activities such as observation and pursuing answers to self-initiated questions). Students generated many responses (542 pre, 508 post), with the greatest percentages of the total in the areas of "none" or "I don't know" (69 pre/143 post). Content areas most commonly cited as interesting to students include anatomy/physiology (54 pre/19 post), biology (36 pre/16 post), and physical sciences (36/27), although every content area saw decreases in interest from the pre to post survey, perhaps due to end-of-year school fatigue. Computers and electronics were also of less interest to students in the post survey (27 and 17 respectively). Gains were seen in the areas of innovation (32/57), engineering/how things work (48/51), medicine (11/19), general science or technology (11/18), everyday applications (11/24), and NOS (2/9). I wonder if these areas were more commonly considered as areas of news worthiness through SciJourn and thus interest was fostered. "Other" interests were those that were mentioned by fewer than 5 individuals in the entire data set. Trends in the data were consistent across both the implementation and comparison groups, with the exception of "general" interest in science and technology, which increased for the implementation group (11/18) and decreased for the comparison group (7/1). In addition, there were increases in interest in earth, environmental, and "other" areas of science and technology and no change in interest in facts among the comparison group while decreases were seen in each of these areas for the implementation group. The implementation group showed gains in interest related to engineering or how things work, but the comparison group decreased in interest in that area.

	Implementation n=368		Comparison n=101	
	Pre	Post	Pre	Post
Anatomy/Physiology	54	19	5	1
Animals/Agriculture	27	13	7	1
Astronomy	26	14	1	0
Biology	36	16	3	1
Computers/Internet	56	27	16	6
Earth	7	4	0	1
Electronics	41	17	11	7
Engineering/How things work	48	51	16	12
Environmental	10	8	0	1
Everyday applications	11	24	1	3
Everything	8	1	0	0
Facts	6	2	2	2
Forensics	6	4	2	2
General	11	18	7	1
Genetics	9	5	3	0
Hands-on	13	9	4	0
Innovation	32	57	3	9
Medicine	11	19	3	4
None/don't know	69	143	34	52
NOS	2	9	2	5
Other	23	21	7	8
Physical	36	27	10	2

Table 10. Specific Interests in Science and Technology

What do you see yourself doing 5 years from now?

Students' future year plans were coded into fourteen categories emerging from the data, illustrated in Figure 4. More than half of the implementation group responses referred to post-high school plans for further education, with an increase from pre to post (226/266), 20% of which were in STEM-related fields (post). Slightly fewer students in the post survey than the pre indicated that they anticipated being in the workforce in five years, with one-third of those in STEM-related jobs (post). In the post survey, 86 students (23% of the implementation group) indicated plans to be pursuing STEM-related futures, either through schooling or career. Both the implementation and comparison group data represent a pre-to post increase of 4% with regard to STEM-related education or career plans. Students in the implementation group increased in their plans for a writing career by 1.5%, (but decreased in regard to a writing-related education from 1% to 0% of the total group), while the comparison group showed no plans for education or career in writing in the post survey.

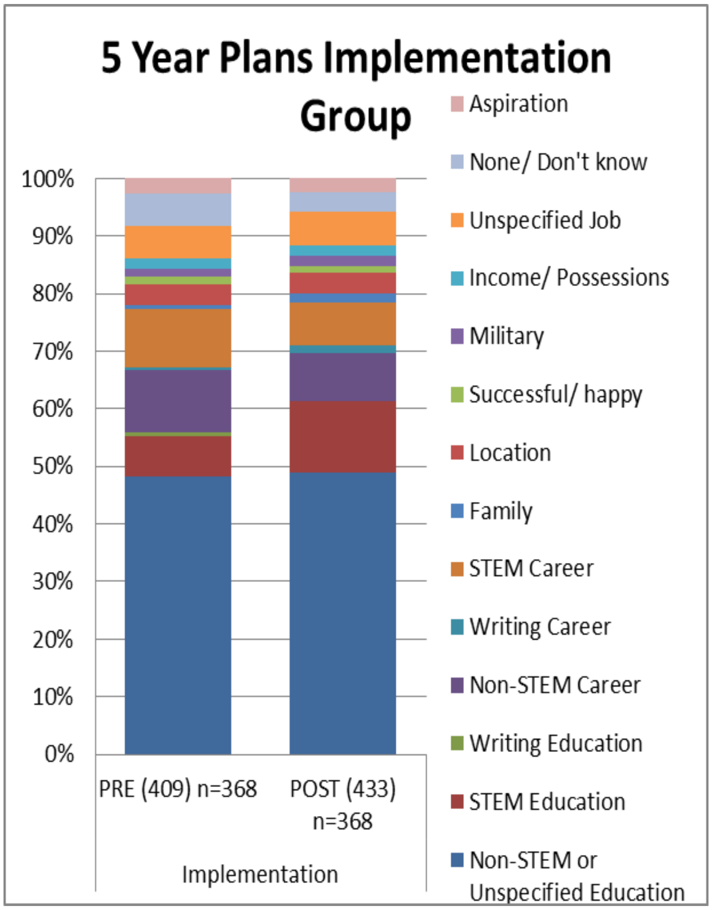

Figure 5. Implementation Group Five-Year Plans

What do you see yourself doing 10 years from now?

The same codes were used to analyze responses to the question "Where do you see yourself 10 years from now?" in order to compare responses to the two questions, as well as within responses from pre to post. Figure 5 illustrates the results. The main difference between students' stated five and ten-year plans was as expected: many more students anticipate involvement in a career in ten years than in education, which was the most common response to the five year plans question. About one third of responding students stated a specific career path they expected to be on ten years in the future. Five percent of students expect to be continuing their education. Students' visions of their lives in ten years were also stable. There was only a difference of seven (637/630) coded responses pre to post among the implementation group. Of those, there was a slight gain in intent of students to be pursuing an education (+4 non-STEM, +2 STEM) in the post survey. The number of students planning to be working in STEM-related jobs stayed the same (112), but the number of those who would be involved in the field of medicine increased from 56 to 67. Other increases were in the code of family-related plans (married or parenting, +7), income or possessions (+6), and sports-related careers (+4). Viewed as percentages, all of these changes are minimal.

Future relationship with science or technology.

The final two open-ended questions in the survey elaborated upon selected response items focused on students' conceptions of how they may relate to science and or technology through their future educational and/or career paths. As described previously, students were asked to determine the likelihood of pursuing college degrees in STEM, and how they might use science and/or technology once in the workforce. See Table 8 for a summary of responses.

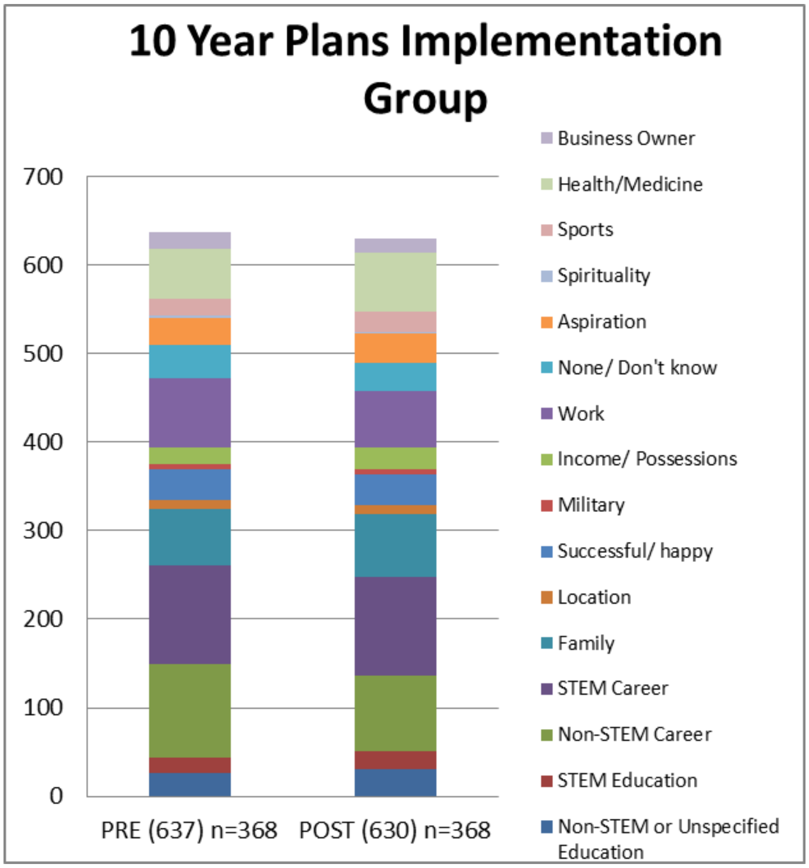

Figure 6. Implementation Group Ten-Year Plans

While the implementation group did show a significant shift in these data, it is clear from looking at the data by response option that the change was actually quite a small change, toward more "Maybe" responses from "Probably not."

How likely are you to…		Definitely Not	Probably Not	Maybe	Probably	Definitely
major in a science or technology-related field in college?	Pre n = 365	62	92	111	60	40
	Post n = 364	66	94	107	62	35
use science and/or technology in your career?	Pre n = 362	15	30	106	101	110
	Post n = 362	12	45	114	96	95

Table 11. Future Relationships with Science and Technology

Responses of students who “Maybe,” “Probably,” or “Definitely” saw themselves majoring in a science or technology field in college (n = 211 pre, 204 post) were coded by specific field. Responses occurring only once were coded as “Other.” Responses like “something related to science” (or technology) were coded as “Science (or technology) (general).” The number of coded responses decreased from 194 pre to 108 post (see Figure 6). A similar rate of decrease was seen in the comparison group (47 to 20). As students progress in school, we expect them to become more aware of themselves and narrow their focus and interests in possible future plans. However, in this case, it appears that the decrease may have been proportional to the decrease in responses to the question from pre to post (Implementation group n-size decreased from 294 pre to 105 post; Comparison group from 47 to 21). Medicine (33), engineering (16), and animal sciences (11) were the most common post-survey implementation group responses, although responses were fewer for those codes in the post than in the pre. Biology, Computer Sciences, Forensics and “Don’t Know” were common responses in the pre survey which decreased dramatically in the post data.

Many more students (84%, post) than those considering a possible college major in a STEM field “Maybe,” “Probably,” or “Definitely” saw themselves applying STEM-related information or practices in their planned future career. Again, this number shifted from pre to post toward the mean, rather than significantly toward the “Definitely Yes” response option. A pre to post decrease was also seen in the number of codes of responses to the question, “Can you see yourself using science or technology in your career?” (Figure 7). This shift, consistent across the comparison and implementation groups, much more than the decrease in number of students planning a future STEM degree or career, does not represent the anticipated trend post SciJourn, in which we would hope to see more, and not fewer students seeing themselves using computers, science content knowledge, or science tools in their careers. While the observed shift associates logically with a decrease in student plans to major in a science or technology field in college, the SciJourn project goal of increasing scientific literacy with all students, not just those intent upon futures in STEM is not reflected well in these responses. Through consumption and production of science news, the intent is that students gain insight into the many ways even non-scientists use and rely upon science information and strategies in everyday life.

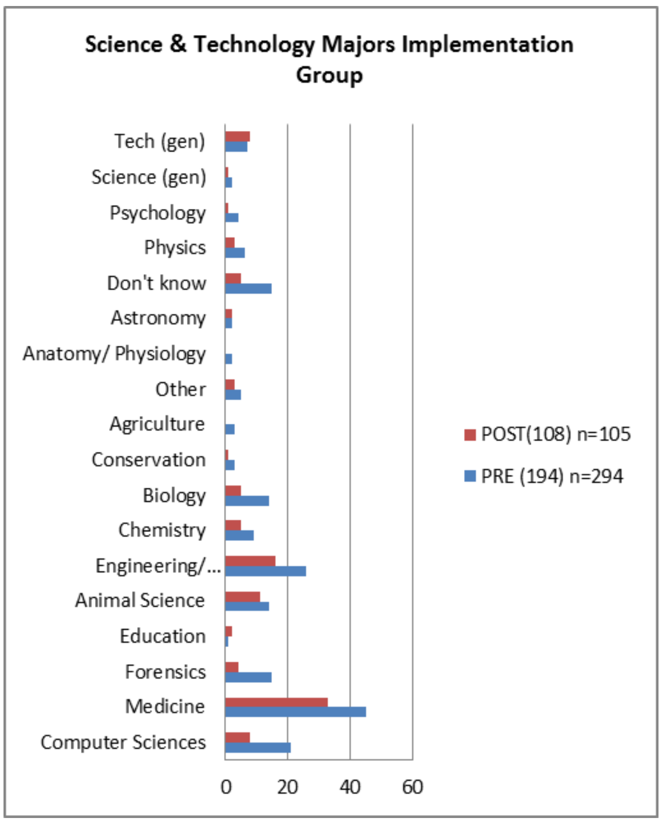

Figure 7. Planned STEM Majors

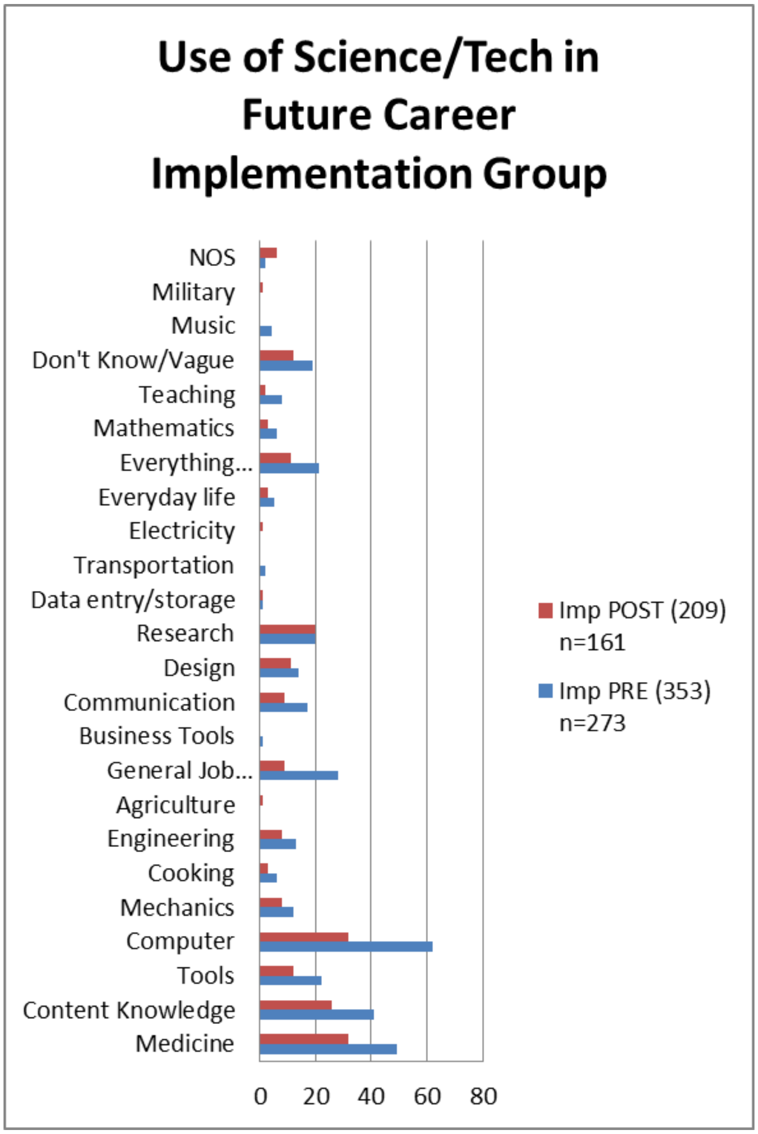

Figure 8. Anticipated STEM Applications in the Future Workplace

These open ended questions relate most to the identification aspect of the engagement framework. As in the data from the pilot of the YEST survey, responses to these questions remained more stable than those of interest and action. This was anticipated due to the nature of identification as both difficult to influence and to measure.

Summary of Survey Findings

Analysis of implementation and comparison group responses to the YEST Survey resulted in rejection of the hypothesis that significant increases in survey-assessed student engagement with science and technology would result from participation in SciJourn. Participation in higher levels of implementation also did not, across the board, result in higher engagement survey scores. Areas of greatest impact on student engagement were in the realm of student action, which was expected. Unexpected, however, were significant decreases in reported student involvement in many of the particular activities explicitly related to SciJourn implementation. Some possible explanations for these reported pre to post changes in the direction opposite of the hypothesis are given in the final chapter.

Chapter Five: Case Studies

In addition to the YEST Survey for collecting data about student engagement across the composite SciJourn participant population, case studies were undertaken in three classrooms to gain insight into the relation between engagement and the implementation strategies utilized by teachers with the stated goal of student news production. This chapter presents the results of these classroom case studies, and illustrates three different approaches to implementing SciJourn at a high level. In an advanced chemistry course, a freshman introductory chemistry course, and an elective environmental science class, teachers' implementation strategies were unique, each providing distinct affordances and constraints for development of their student journalists' engagement with science and technology in the process. Each case illustrates student choice as an important aspect of participation, especially in terms of relating the SciJourn writing assignment to personal persistent interests. Students in the elective course, involved in multiple iterations of SciJourn across the school year, showed the greatest potential for positive shifts in engagement.

Luke VerVelde's 5th Period Environmental Science Class

The case of Luke VerVelde's Environmental Science Class presents both what is possible when SciJourn is woven into the class curriculum throughout the school year as well as how an intervention such as SciJourn, when implemented in a structured manner that also allows for student freedom of choice, can result in increased student engagement with science and technology beyond the classroom.

Luke, or "Mr. V," is a very tall middle aged white male. He was raised in rural areas of the same state in which he now teaches, and attended two state colleges to receive a teaching degree. Even though education had been a common career field for family members, Luke never expected to become a teacher himself. He thought he would be a research scientist, but found isolation in the lab and the attitude of lab scientists he encountered in college courses contrary to his own gregarious nature. He now thrives on the interaction with students he has in the classroom, and continues his personal study of nature, which began as he tracked, hunted, and fished with his dad on the family farm. He talked about what he and his dad would do when they were out in nature:

> …You know, if we do this we're likely to see this, so let's go and be real calm and careful as we pop our head up over this next little hill kind of thing… You know, around this tree, you know if you're looking for deer that's where they're going to go down, and just that sort of thing. So, yeah he really did model those things with little formal science education training. I mean, he's a banker…But he also grew up on a farm and had a real tie to, you know being outdoors.

As he got older, Luke says, his dad would drop him off at the farm for solo exploration, the kind of "letting nature be your teacher" he came to value as a true education. In an interview about his early influences in science, Luke also recalled a "very inspirational" middle school teacher by name, whose approach to science was inquiry based and "truly fit." His interest in science was further fostered by another teacher when the family relocated in Luke's high school years. This teacher involved Luke in research that he had the opportunity to present at state-wide high school science events and provided a marine biology class for Luke, the student who had "always really enjoyed fish." Luke felt he "found his place in research" during a difficult transition as a newcomer to a small town community high school, saying “that was my thing.” However, education suited him better once college and career choice were to be made. He tells me,

> My mom’s a teacher, my grandmother’s a teacher. I’ve got, you know, teachers all through the family, and so I did just think, you know, “I’m a people person.” I have always truly just enjoyed seeing, you know, the little light bulb thing. I sometimes like to entertain, and find myself probably way more amazing than anyone else does, and so then, you know it just really seemed like a real fit. So, yeah so that’s what prompted me really to get into education and [I] have never looked back and just enjoyed it ever since.

Luke has also continued to pursue his interest in marine biology research through an out-of-school teen program he has led at a local aquarium for the last five years, which travels to Florida for field projects each summer. He considers himself a marine taxonomist, and his collection of bottled marine specimens is packed into the shelves that line the back of the classroom. Currently, however, he is pursuing a Master’s degree in Education. He has long-term goals of becoming a professor at a small college in order to gain tuition assistance for his two daughters.

Luke taught an assortment of chemistry, biology, and environmental science classes at three different high schools in the eleven years prior to landing at School 004 seven years ago. In addition to teaching environmental and biology classes and being involved with SciJourn, Luke supports student involvement in the state science research program (in which he participated as a teen), Stream Team (a state wide waterway cleanup initiative), and SAFE: Students Acting For the Environment—the school club responsible for campus recycling. SciJourn was recommended to him by the school science department chair, and Luke volunteered, recalling that he had already used some news in his courses.

> Luke: Well, I mean I've always been kind of interested [in] the news to begin with, and I did have my kids always look at current events and what's going on in science. And so in that sense it wasn't a big stretch to, you know, to want to be involved in the [SciJourn] program. And because the kids are, I mean that is where they're going to get their science, and I've seen that for years and years, they're not going to, you know. I've thought for years, "Yeah, this could be the last science class you're taking."
>
> JH: Right
>
> Luke: (as though talking to students in class) "You know for some of you, but you're still going to have to be literate, um and be able to vote and you know, be able to do all the things that." And so really I've always kind of used the news, um, and, and so I was curious about the PD [SciJourn Professional Development] from that perspective as well.

The professional development turned out to suit Luke very well, and he recalls thinking that it was one of the better organized, more practical opportunities he has had as a teacher. He left the summer program feeling like "you could, you know, take away, drive home and just talk about how would you do this, how would you do that, and trying to use some of the things that came out of it." Luke's long-time girlfriend is also a high school science teacher (at another school) who became involved in SciJourn at the same time, and they often planned their lessons together.

Luke loves teaching in a school where "the biggest behavior problem we have [among students] is tardies." Luke has his own classroom, which is a very busy place in terms of décor. Posters related to animals or science ideas cover every flat surface, including the ceiling.

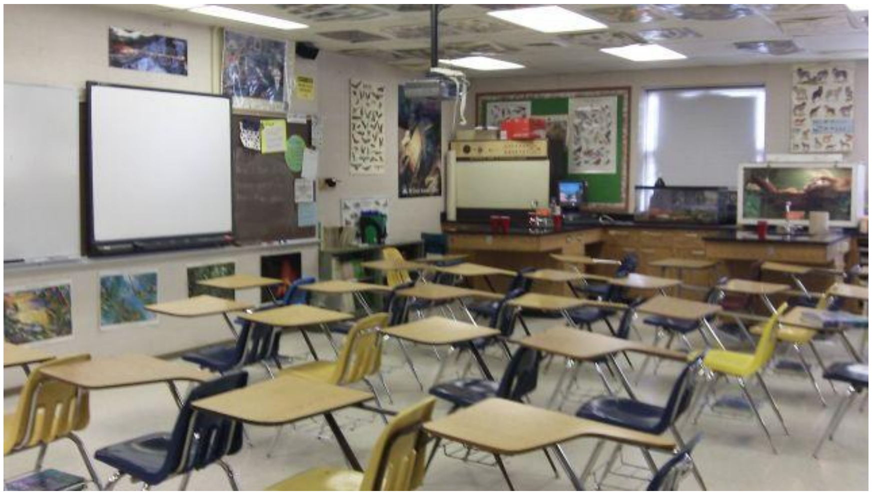

Figure 9. Luke VerVelde's Classroom, Front

Figure 10. Luke VerVelde's Classroom, Rear

Lab counter space in the back and side off the room is shared with multiple classroom animals, including a piranha, feeder fish in a separate tank, a turtle, a snake, and, added late in the year, two degus. The classroom sports a SmartBoard™ interactive whiteboard and digital projection, as well as chalk board. Students access computers when necessary via either a science department laptop cart reserved in advance by the teacher (utilizing wireless access to the school network and internet), or one of several computer labs located in the school library. Students sit in desks according to a seating chart, but their social interactions indicate that these seats were likely selected by the students themselves at some point. Students express in the interviews that this course is their alternative to a physics class taught by a teacher known to be tough. Based on experience of prior students in the class, they expected this class to be fairly easy, and also anticipated spending a significant amount of class time (about one day a week) outside. None of them knew about or expected the writing assignments they were going to be given throughout the year, and several reconsidered their course selection at the point of the first article assignment.

Students were probably unaware of the writing component because although the teacher was a 2nd year SciJourn participant in 2010-11 (having been part of the pilot project the year before); his first endeavor with article-writing took place at the very end of the prior school year. Seeing the value of the experience for those students, in terms of engagement in personally-interesting science topics and embellished college applications for published students, Luke committed to making SciJourn a more significant part of his environmental science course in the second year. In biology classes, which spend the school year in preparation for a high stakes state exam in April, SciJourn activities were planned only for the last month of the school year.

Following a strong sense of success with the biology students at the end of the pilot year, Luke planned and executed four distinct SciJourn units, each about 10 days long (which the research team began to refer to as “blitzes”) in each of the environmental science classes. Students were introduced to SciJourn early in the first quarter of the school year and assigned a SciJourn project each quarter. The teacher presented the students a syllabus of activities outlining their responsibilities, which included not only writing the article, but also reviewing related source articles (in print or online), editing the work of their peers, and commenting on other teen articles published on SciJourner.org. Table 12 provides a basic outline of the activities in Luke's class each quarter. Luke describes the rationale for his framework as follows.

> And so I said, "Yeah we're going to do this" and I already had kind of a program that I liked, a ten day, ten step process [in which] "we're going to do this and this" ...so it really meshed with the kids. Uh, and they understood what they were doing, they understood why, and then to keep some of those other elements in place as you go through it, the kids start bringing stuff in, you know and it just kind of feeds on itself.

Within this assignment framework, a few elements of the article-writing component changed somewhat throughout the year. The topic of each student's first article was to be preferably, but not necessarily, related to environmental science. The teacher found the activity of searching for topics to be a good alternative to traditional lecture:

> They really looked through ideas. I just said it has to be something environmental and they all have their little preconceived ideas of what is and what isn't, and so they come in and they look, and look and look, and search through three, four or five different topics, and then they look at each other's work and start to get I think a back door approach or a back door feel for, you know, really "What is environmental studies?" and "What do we need to do?" and it really is the more

practical every day. “What do we need to do, what do we need to look out for?” you know, “Why does this occur?” rather than just hearing me spout off [lecture] about the curriculum.

Class Session	Activity
1	Daily Discussion Topic selection
2	Daily discussion Article Review (supporting your topic) Narrow down list of potential interviewees
3	Read Aloud Daily Discussion Write or choose from free choice Dream Quote worksheet
4	Read Aloud Daily Discussion Article Review Identify interviewee to teacher Source interview worksheet
5	Daily Discussion Write or choose from free choice Conduct interview
6	Read Aloud Daily Discussion Write/Free Choice Draft Due
7	Student Read Aloud Daily Discussion Peer Edit Write/Free Choice
8	Student Read Aloud Daily Discussion Receive & Respond to peer edits
9	Student Read Aloud Daily Discussion Write/Free Choice Follow up with Interviewee if needed
10	Daily Discussion Write/Free Choice Article Due by Midnight

Table 12. Sample of Luke VerVelde’s SciJourn “Blitz” Schedule

The second article was required to be within the environmental science focus. At this point, says Luke,

> then I just upped the stakes a little bit and did more of the one-on-one counseling with them where I did call them up and we'd talk one on one about what it was. But that was a real easy setting because they could sit and work on their laptop and then one at a time come up and sit with me, just like we are, and have those conversations about where they're at, what they need to do. I still felt like it was fast, you know, that I never really… I try to check in with every kid every day, and still you got 18-20 kids in fifty minutes. You know, that's a minute and a half a kid.

However brief, these one-on-one sessions kept Luke up to speed on student progress, throughout which time it would otherwise be fairly easy for a student to drop the ball since no grades were given until the final draft. Luke kept this strategy in place throughout the rest of the year. For the third quarter writing assignment, students had the option to return to one of their first two drafts to make improvements, or to select a new topic. Either way, the third submission required an interview with an expert within the article. In the fourth and final quarter, the assignment was expanded to include other forms of science news products featured on SciJourner.org: photo captions, podcasts, videos and information graphics. Each quarter, the SciJourn assignment was the "performance event" half of the students' quarter exam, the other half of which was a multiple choice paper and pencil test. Table 13 gives an overview of the SciJourn assignments in VerVelde's class each quarter.

Qtr.	Assignment	Published	Sample topics
1	Original Science (Any) News Article	2	Blackberry thumb, School waste, Concussions in high school sports
2	Original Environmental Science News Article	0	Elk reintroduction, Mountain lions in our area, tiger sharks
3	Enhance prior article, or choose new topic to write an article; Include interview	1	Arsenic life, Hazardous waste disposal, Feral hogs
4	Write 4^{th} article, or try an alternative format: photo caption, podcast, video, or info graphic	0	Local incidence of tornadoes infographic, Google map of class research sites, Sport shoe recycling interview podcast

Table 13. Summary of Environmental Science Class SciJourn Assignments

Matched pre/post surveys were completed by eleven of the fourteen students in the class. The class composite engagement mean score increased at a slight, though not statistically significant level, from pre (M = 0.32) to post (M = 0.33) ($t(10)$ = -0.76, p = 0.46), as indicated in Figure 10. These positive results, unique among the three case study classes, and also among the “high” implementation level group scores across the study sample, set Luke’s class apart.

Analysis of individual experiences in the class in terms of their engagement with the project and with science and technology, shed light on the survey results, and also raise further questions, in the following sections.

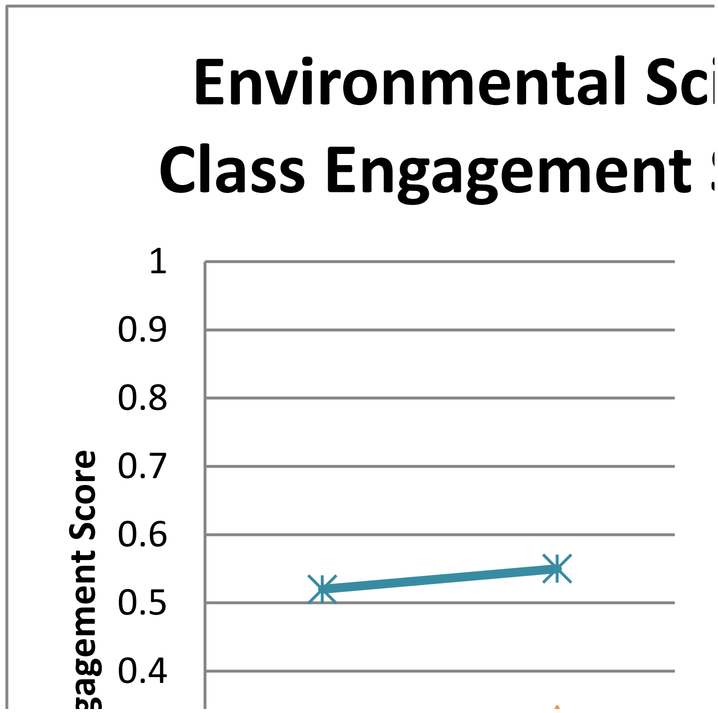

Figure 11. Luke's Environmental Science Class Engagement Scores

Brendan.

Brendan is a white male high school senior who sits quietly in a fairly social class and focuses on getting his work done. He wore a sport or team t-shirt every day, and only talks to others before and after class. He's a self-proclaimed sports fanatic, heavily involved in watching, playing, and investing in (through fantasy leagues) them.

> I'm a big sports fan. I'm from St. Louis but I love all the Chicago teams because that's like the kind of house that I grew up in. I like to play sports. I'm good at playing basketball; I'm good at golf…Outside of school [I] play sports, nothing really school related or anything, just, like, stuff. I play, sports is like the biggest one for me, so…

Brendan has four brothers and a sister and lives with both of his divorced parents who remain amicable. His dad is a GM pipefitter with an AS degree, and his mom has a

Master's and works as a dietician. Brendan's observed focus in the class is attributed to his confessed desire to get his work done during the class period so he doesn't have to worry about it at home. In response to my comment that I notice his focus in the classroom, he says, "Yes, I hate doing work outside of class." He also feels confident about his writing ability, so those unexpected responsibilities don't bother him as much as some of the other students in class.

> Brendan: Yeah, I didn't know we'd be doing it. Like, a lot of my friends are like, "This is like English class." I'm just like, "I'm always pretty good in English so I don't mind it that much," like if we get the adequate time to do it, so I'm pretty OK with it, so…
>
> JH: He gives you adequate time in class you mean?
>
> Brendan: Yeah, class time. I don't do it outside of class though.
>
> JH: Right, but other students kind of think it's boring? Is that what they mean by "It's like English class?" or are they just surprised that they have to do it?
>
> Brendan: Well, like they're just like, like he wants it to be 500 words, so it's like typing a page and a half. To some students that's, like, a lot. Like, I'm doing dual enrolled, I go to community college. I type a five page paper, so it's no big deal to me.

Brendan's only area of interest in science, when asked in an interview, is astronomy. He doesn't pursue information about it, but has always found it interesting, since his cousin is an astronomer.

> Brendan: I don't see myself like pursuing anything I think it's really interesting.

JH: Yeah, and do you ever like go to events or watch shows or anything about astronomy or you just think it's cool?

Brendan: No, whatever's on the Internet or on the TV about it I'll kind of watch it or something.

JH: If you come across it you'll watch it?

Brendan: Yeah.

Environmental science was Brendan's fourth science class in high school. In prior years, he had taken honors physical science and biology, as well as earth science. He chose environmental science over physics for his senior year because the physics teacher is known to be "a pretty tough teacher" and "I didn't want to deal with that my senior year." He likes science less in high school than he did in middle school, saying that "it got harder in high school, as well." Brendan seems to be a student who excels in school and likes school even better when it is easy for him. He found VerVelde's class "weird," picking up on the teacher's need to ad lib a bit at the beginning of the year when a new curriculum that had been ordered didn't arrive in time.

Like the rest of the students in the class, and in Mr. VerVelde's environmental science classes overall, Brendan had four opportunities to earn half of each of his quarter exam grade through a SciJourn project. As he described it, Brendan's first effort was:

> the NFL concussions thing. The first one he [Mr. V] didn't necessarily want to be environmental science, so I picked something I was more interested in, and the second one he wanted like more related to environmental studies so I did the arsenic one.

The writing, for Brendan, was not the challenge so much as coming up with an initial topic. He said, "I'm terrible at coming up with these topics so I just pick like whatever's out in the news." This strategy worked in terms of meeting the project requirement that the news article be focused on a topic that is both recent and relevant to the teen audience (SciJourn). However, without recognizing them as such himself, what Brendan actually identified in the news as potential topics were perhaps most relevant to his own stated (in both the interviews and on the YEST Survey) personal interests in sports and space science, perhaps because this was the news that caught his attention.

> JH: So, the NFL concussion that was really in the news already; at the beginning of the school year that was really going on and a sports connection so you picked that?
>
> Brendan: Yeah, yeah.

Brendan wrote two unique articles, using the third quarter opportunity to improve upon his second topic. In each case, Brendan said he completed three rounds of revisions: "I'd say three, I want to say three. Like I did it, I peer reviewed it, and then Dr. Newman reviewed it; [and] I did it one more time, so…" In response to the NFL concussions draft submitted to Dr. Newman, he said, "I got this thing [an edited version of the article via email] that it wasn't that good, and I could tell that it wasn't that good either." In fact, the editor's comments were as follows:

> This is a good topic and you have some really good information. However, it all reads like you have summarized a single CNN sports or ESPN article. Where is the science? And where is the attribution to multiple, credible sources? You have a few sources, but nowhere near enough. Also, I would hold back on the opinions.

> Let the reader come to their own conclusion. If you want an opinion, ask some of your fellow students that are football fans. Or ask someone on the team if they worry about concussions and their long-term effects. Keep yourself out of the story.
>
> P.S. Add some paragraph breaks…paragraphs are your friend, and they make it easier to read a story

Instead of sounding like the story was "not very good," the comments from the editor are encouraging about the topic and information included thus far. However, with the suggestions for additions to be made, and a lengthy paragraph the editor deleted entirely because it was Brendan "editorializing," revising the article further did look like a large task. By the time he received this feedback, Brendan had his quarter grade for the class and was ready to move on. He seemed to use the editing process as an excuse to do so.

At the start of the second quarter, Luke informed his students they would be writing again. About this, Brendan said the process was pretty much the same as before, and for him personally, it was about accomplishing the assigned task.

> The second one? It was about the same as the first one; just like, "I want to get a good grade on it," and, like, that's what I'm going to shoot for. I'm like, "I'm busy, my other class is doing other things," so…

Despite this attitude of just wanting to get through the assignment and get it over with, Brendan once again found a topic to write about (potential life on other planets) connected to a personal interest (in astronomy). This connection, however, is not one he made himself.

> JH: With the arsenic story, how did you come up with that topic?

Brendan: It was discovered in early December and the second one was like around that time, so that was something pretty recent.

JH: OK, and you heard about it how at first?

Brendan: He [Mr. V] had [shown in class] like a little thing on the Internet, like, oh what was it, like alien life discovered on earth, like that was what it was first, like, cited as, but I kind of followed the story a little bit after that, so…

JH: Got it. On your own you followed it?

Brendan: Yeah.

Despite not being upset that his first two articles hadn't passed the editor's cut, or pursuing the editor's feedback, Brendan did feel motivated to re-write his second article for another try at being published, or, if not that, at least improving upon his prior work. Perhaps, he perceived this as an "easier" option than starting over with a new topic.

Brendan: I didn't do very good on that [Arsenic Life] one, and this time [Mr. V] said you can do one and I redid the arsenic one and I made it a lot better, like I felt like it was a lot better.

JH: What do you think made it better?

Brendan: I put a lot more work into it.

JH: More work?

Brendan: Yeah, well he said like if you're going to redo it has to be different, so instead of coming up with a different topic I put more work into it, so…

JH: Yeah, you seemed pretty focused when I was here and you were working on that.

Brendan: Yeah.

JH: So, were you proud of what you did in the end?

Brendan: Yeah, I thought I had a pretty good like end product.

This improved third quarter effort was published on SciJourner.org in the summer following the 2010-11 school year. “Arsenic Life Discovered?” was published after school was out, and he had graduated, so I did not have the opportunity to follow up on the meaning of this accomplishment to him personally. However, given his attitude toward the SciJourn article-writing process, I wonder if it would matter one way or another. In his words:

> I don’t know it’s just an assignment to take. I have never actually gotten any of these back with like a grade written on it, so, and like if I have an A throughout the class I just assume like if I turn it in then I get an A, so…

It may be safe to assume that getting an A out of the class was sufficient to satisfy his needs in the role of “outta here” high school senior. Continuing on the theme of class not being difficult for him, he says about the class,

> Brendan: Yeah, this is like, I wasn’t expecting this at all, like writing newspaper articles and stuff, so … I never know what I’m doing in this class, like I always have an idea what I’m doing every day except this class.
>
> JH: OK, it’s like never a dull moment?
>
> Brendan: Yeah, well I wouldn’t say that. I just don’t know what I’m going to do, but it’s probably either going to be we’re outside at the lake or I’m going to be writing articles.
>
> JH: OK, are those the things that you feel good about?

Brendan: Yeah, well they’re both easy, so, it’s easy in this class to write articles, so…

Brendan: Yeah, like there’s work to do but it’s pretty, like I have like a 96%, 97% in the class, so that’s what I expected, so…

JH: Do you think that’s pretty consistent; like that everybody in the class has a grade like that?

Brendan: No.

JH: No?

Brendan: No.

JH: Just because you’re a good student?

Brendan: I do the work, so...

Brendan professed to be a good student overall, and he attended classes at the local community college in the second half of the school day. He was accepted to the state university, where he intended to be an engineering major. “My mom wants me to do engineering; it’s like a good career field, like I know like I said I’d give it a try, like see if I do it. If I do good at it I’ll stick with it but I can always change.” Hedging that bet, he opted to attend the main campus of the state university system, rather than the regional campus known for its engineering program. This may also have been influenced by his “sports fan” identity as a supporter of the main campus' large conference Division 1 teams.

Toward the end of the school year, Brendan expressed hopes that another article would not be assigned, because he wasn’t sure he could come up with another topic. Given the choice of non-article projects in the fourth quarter, Brendan chose to work on a photo caption. The assignment of a photo caption turned out to be helpful in spawning some ideas. Eventually Brendan landed on describing before and after photos of the recent earthquake in Japan. He embarked on a mission to find and compare before and after photos of the recent tsunami in Japan. When he asked about the length of written product to accompany the photo caption project option and received the response of 250 words, Brendan was enthusiastic about the ease with which he could accomplish the task. Finding copyright-free photos of the tsunami area, however, was more time consuming, and the project did not make it to a final draft form before the end of the school year, like many other students' final assignments.

Brendan's engagement score did increase, but barely(from 0.30 pre to 0.32 post). This is not surprising, considering his attitude toward the projects as a fairly unchallenging means to an end (a good grade). Interview and survey responses with regard to Brendan's out-of-school interests in sports and astronomy do appear in Brendan's topic choices, though. This, too, may be because he wanted to pursue something easy for him, but I find this confirmatory of his persistent interest in space science, inspired by family experience with that topic through his cousin's work as an astronomer.

Ramiz.

Ramiz is the middle of three first-generation American children of Pakistani parents. He is a senior in high school planning to major in business, engineering, or math, "I haven't really decided which one." He speaks his native tongue of Urdu, at the preference of his father, at home, but also speaks perfectly clear English at school. He said he struggled a bit with the language duality in elementary school but does okay with it now. Ramiz's father works in retail sales, and his mother is an elementary school classroom aide in the same elementary school Ramiz and his sisters attended. His parents emphasize education as "probably the number one priority of almost everything," and Ramiz is an excellent student, who will "usually try not to go below a B."

As a child, Ramiz remembers enjoying visits to the local science museum and assisting with his older sister's science fair projects. At the time of the study, Ramiz was in his second year of participation in the school-sponsored after-school Robotics group, which he finds rewarding and challenging especially because of the opportunity it provides him to work with professional engineers who provide support to the team. This experience has increased his interest in and likelihood of his pursuing a career in engineering, although he tells me that "what I've been advised to do is go to the community college first so I can check out like how business classes are and figure out which one and then go from there" to decide whether to go to the state university for business or the state engineering school.

Ramiz also investigates technology topics on his own time through internet research and paying attention to the related media. His after school job in retail sales of computers helps him "keep up" as well. Ramiz doesn't seem to have a lot of free time, but when he does, he prefers to spend it playing console-based video games. He occasionally also watches TV when time allows and movies when he hears about "a nice good one that's out." Ramiz is clearly the highly STEM- engaged student his pre-SciJourn survey score of 0.52 showed him to be.

Like Brendan, Ramiz found the initial selection of a topic more challenging than the writing itself, saying, "I think picking the topic which was local and was newsworthy and no one really talked about was probably one of the hardest parts other than writing it." The topic for his first article, "How Green is Your School?" came to him through

> inspiration from Mr. VerVelde to think about topics, and I mean I think it was when I was even in the lunchroom just seeing all the trash being thrown away and thinking, "You know, people talk about energy efficient buildings and stuff and what about schools?" You know, I don't think really anyone… I never even heard an article about it too much really, pay attention you know, so I thought that'd be kind of neat…To be honest I never really thought about it too much, just like probably anyone really hasn't, I can say like in school, but then after thinking about it, you know, seeing the lunch room and all that kind of stuff then you start realizing that, wow, it's pretty wasteful and no one really pays attention to it…

Once the topic was decided, the student probed further into the practices at his own school and also used Internet searching strategies to build the story:

> What I mainly did was actually use our own school as an example because it's pretty old, and just seeing some of the activities that teachers do like leave the lights on when they're not in there, you know, keeping the computers on all day, and stuff like that just kind of adds up, and seeing also that it's not very insulated. Well, the door's always open and the AC's on and whatnot…So, I kind of looked at small things like that with my own experience.

To build the story further, Ramiz went on to say,

> I tried to go on some websites to see if I could get like statistics like how much electricity it uses, how much it costs, and about the HVAC system, and I came across some. I know one's Sierra Club which is also in Missouri and it's like a

little conservation club, and they had some information like about how much waste an average like elementary school will actually dispose of in lunch which was pretty interesting. It was like I believe like 60 pounds a month or something just from waste…So, I started off with like little things like that, and then also then I went to the EPA's website and then they gave some statistics on actual electricity usage and all that and ways you can actually save on that.

JH: And were those resources that you knew about, or how did you find, I mean how did you know to go to, like, EPA?

Ramiz: Well, I know the EPA does a lot of things in that, but usually I Google'd a lot of stuff about it. But I just went to, like, sources I knew that were legit, straight to them, and then did a search on theirs [site].

Since this was Ramiz's first experience writing a science news story, it is apparent that he entered the class with some awareness of governmental organizations, like the EPA he refers to here, involved in science. This prior knowledge gave Ramiz an edge in early success as a science journalist, and also supports his higher than average incoming engagement score. In addition, Ramiz' thorough research and proper attribution of sources gave him a leg up in the publishing process. While Ramiz is a good student all of the time, and obviously a bright teen based on the explanations of complex topics he provided to me in interviews, he excels in science classes, in which he says his grades are "probably just as good if not a little bit better" than the others. Ramiz thought it was "pretty exciting" to find out that his first article could be published if a few changes Dr. Newman suggested were made; he hadn't been sure "that it was something that could be getting published or whatnot or if it would impress kids," or even if the editor would like the topic. Another student in the same class also had her first article accepted, which resulted in a bit of a buzz around the class, and the school, about SciJourn.

Following his first successful effort, Ramiz began a story on hazardous waste disposal. This idea for a second article was also prompted by Mr. VerVelde, who told the student about his friend's work at a cement company "where they basically use hazardous waste that they get from other companies from various sources and they actually use it to power their cement kilns to make cement… the topic on that one was using hazardous materials as an energy generator." Despite Mr. VerVelde's perceived "in" at a nearby company involved in this practice, Ramiz hit a roadblock when he tried to pursue further information. As he reported,

> They actually denied an interview for whatever reason with me, but I'm looking into another source. They actually represent companies that do that, because like they're not the only ones that do it so I'm going to see if I can email and have a talk with them.

This kind of persistence is one characteristic of teen writers that Editor Dr. Newman often describes as most important for succeeding at publishing. Ramiz found the process of converting hazardous waste into cement "pretty interesting to do" and explained to me that he did, despite being denied an interview,

> manage to find some information out of them on, you know, how does the process work, where do they get it from. And it's basically just from other companies or other sources that have hazardous waste from doing something and they just send it to them and they burn it, but you have to have a lot of federal licensing and they have to come inspect and see if you've got everything.

Another example of Ramiz's strong engagement is his transfer of topics from one context to another and persistence in pursuing information about topics of interest. For the fourth SciJourn assignment, Ramiz returned to a topic with which he became familiar through the school district's gifted program:

> I'm in Spectra and they were actually talking about how an article came out about it [Bloom Box technology] and how there's some kind of a machine that can produce electricity by itself and I'm like this is probably something that can revolutionize things.

Following the initial awareness of the topic, Ramiz went on to pursue more information through a television show: "I just went from there looking at it, and also they had an interview with *60 Minutes* on this with the CEO of the company. So, there was a lot of information that went out from there." Taking the initiative to pursue further research about a science topic is the kind of action a student engaged with science and technology pursues on a regular basis.

"In elementary school," said Ramiz, "I don't think I really understood or cared too much about science. I don't think they really emphasized it too much in my opinion from what I remember, but I think as I got into middle school and high then it became pretty important and interesting." In middle school, he "liked the [physical] science classes I took" because he got to "kind of do a little more hands on things" that he didn't do in younger grades since, "when you're in elementary they don't want you messing around with that stuff." He remembered fondly a sixth grade project in which "we actually had to go out and find a particular type of rock that we looked up in this book somewhere, and then write a story about it, like how I got there and all of that." Ramiz's affinity for that project, combining science and writing, may relate to his productivity in SciJourn; Ramiz was one of the first students to be published in the 2010-11 school year.

Ramiz's interest in hands-on science contributed to his choice of environmental science as the favorite of the four science classes he's taken in high school. He likes it best "because we do some pretty neat activities and it has to do more with what's around us. I mean chemistry is kind of neat but it's all about atoms and molecules and stuff…" The best part of environmental science class, though, was

> how we kind of get into, um, doing actually hands on stuff, like in the fields, Lake Nine [a study site near the school] we did a lot at, like capture, like mark and capture, and also at ([neighboring conservation area)] with working with actual like activities that deal with the environment. I thought that was pretty neat.

Ramiz is most interested, though, in technology: "Technology basically is probably one big one just because I'm kind of looking for careers in that. I think it's pretty neat how they figure out things and how to work it." He likes to find out "about like the latest thing about basically, you know, and how it works." Through the First Robotics program at school, he has been able to pursue his interests in technology in the applied, hands-on fashion he prefers. He described the process for me in an interview:

> … first we have to get our constraints as they call it; like how big the robot can be, the size, and what it can or can't do. So, they have formal regulation on that, and then we make it according to that, and usually what we do is just take apart the old one and then use materials from that because being a veteran they don't give you as much because you normally get them from the first. So, I guess you do that and test it which is, and then programming I think is probably one of the

> hardest stuff because you have to program everything, and then just hope you win the competition.

Of this challenge, he enjoys most the building aspect. He tells me,

> I mean you can, like they have where you basically have a team like programming but you can move around and do other stuff but mine was mainly programming and putting up the electrical stuff…But I didn't know anything about programming at all so I kind of got to learn that.

In his SciJourn articles, Ramiz managed to get at the "how it works" of several environmental science topics. He also analyzed the efficiency of the new bloom box technology for his final project, and shows his "persistent interest" (Azevedo, 2004) in the science topics he researched earlier in the year by remaining involved in learning about school greening issues "especially as the new ["green"] building is being built" on the high school campus.

Ramiz found working side by side with professional engineers in the robotics program was "pretty neat and challenging trying to learn all that because normally they assume you know it sometimes so you've kind of got to tell them, you know, 'Wait. What does that mean?'" I probed about how this experience has influenced Ramiz's plans for the future.

> JH: And has that [working with the engineers] helped you at all in deciding about what you think you want to do for your degree?
>
> Ramiz: Oh yeah I would say so, yeah.
>
> JH: Yeah? So, does it make you think more likely to do engineering?
>
> Ramiz: Yeah, most probably.

In Ramiz's case, the SciJourn experience provided an opportunity for broadening an already-engaged student's lens of what science is, and especially of connecting science topics to everyday life. Ramiz had never noticed, through twelve years of school, the waste in a school building until challenged by the teacher to select a topic of relevance to a teen audience. His final topic, the Bloom Box, was a merging of the technology he pursues in his personal life and experience in the environmental science class. In an interview, he explains the technology as follows:

> Ramiz: [Assignment] Number four, the one I'm working on, is actually about this. It's pretty new, it's this thing called the Bloom Box.
>
> JH: Bloom?
>
> Ramiz: Yeah, you probably haven't heard of it.
>
> JH: I haven't.
>
> Ramiz: It's this very secretive and small company that have come out in California and they're making this machine that's, or device you can call it, it's about the size of like a parking lot, about there, and what it does is it has these ceramic kind of bricks in there which have this secret as they call green and black ink, I don't know what it is, that they use to actually heat up to around 800-1000 Celsius degrees.
>
> JH: Whoa.
>
> Ramiz: And they use, it says it only inputs, you can do like natural gas or what they're trying to push for is biogas which is just like gas from like from waste of some sort, you know, landfills they have biogas, so just input that to heat it up to that much and it'll actually output electricity.

JH: Oh.

Ramiz: Yes, and companies like Google, eBay, FedEx, even Wal-Mart are using these to actually power their buildings. If you look on Google's

JH: (interrupting) Are they using it now?

Ramiz: Yes, they're using it now, and if you look on, I know you can find one easily on eBay's, on one of their buildings on the side you just type that, like, "Bloom Box eBay," and you'll see like they have five of those just lined up and it's powering their whole building, their headquarters for that.

JH: But yet you said it's secretive.

Ramiz: They're secretive about what actually goes into it, yes, and they have a patent on that.

JH: Oh, that's right.

Ramiz: But they're actually starting to come out a little bit more now since they're trying to get it out there. The machine it does cost $700,000-$800,000 for that but eBay said that they saved about $100,000 from it already in electricity costs. And they've had it on for I think a year or two.

JH: That's a decent initial investment but then after that it's, yeah.

Ramiz: Yeah, but after that it's good.

In order to create the infographic product for the SciJourn assignment, Ramiz applied prior skills as a "technology" person to the new task.

Ramiz: Info-graph, I mean it's probably the first time I'll be doing it, something of graphs and showing the difference. But I've done it in like, like I had taken a couple computer classes, microcomputer, where we actually make a graph from Excel and do that and compare stuff, so I think I can use that to do it.

JH: So, again you'll be applying some skills that you had from other classes to actually make the graphic?

Ramiz: Yes, yeah, and I'm just going to be comparing like solar energy and wind energy to it, so…

JH: To the Bloom Box in terms of efficiency?

Ramiz: Yeah, yes, efficiency I think on the Bloom Box is like 80%, while like wind is 10%-20%.

JH: Wow.

Providing a visual comparison of the variances in the costs and efficiencies of these different green energy options was the goal of Ramiz' final SciJourn project, an infographic. Figure 12 shows one of the three graphs in Ramiz' initial draft.

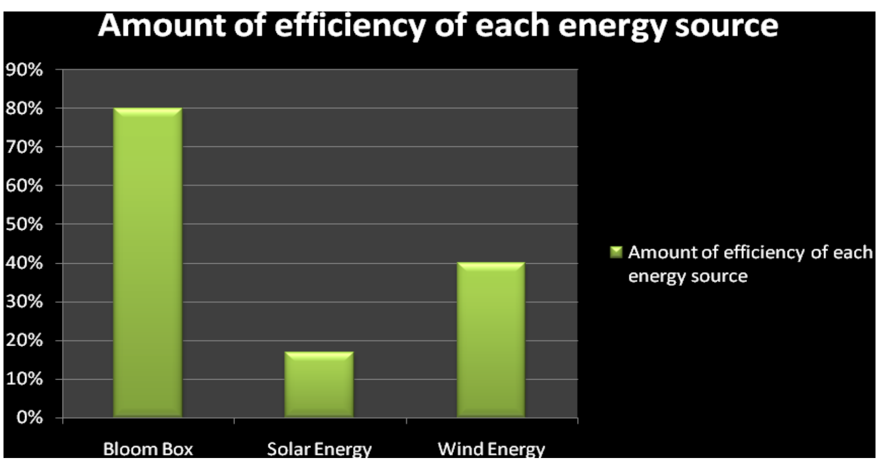

Figure 12. Bloom Box Technology Infographic, Sample Graph by Ramiz

While Ramiz ran out of time in the school year to perfect the three-graph series he called "The Magic Box" on green energy options for publication at SciJourner.org, Ramiz's identification with technology and environmental science is reflected in the depth of research he conducted to develop understanding of the new technology sufficient to adopt the role of expert to explain and engage an ignorant ("you've probably never heard of it") interviewer in the topic. Ramiz' engagement score, one of the highest in the entire study sample at the beginning of the year, increased slightly from 0.53 to 0.55 as measured by the post-survey. However slightly, Ramiz showed growth in engagement with science and technology, likely fostered by his involvement in SciJourn as well as robotics.

Kristopher.

Another senior, Kristopher is a white male who plans to become a teacher, following in the steps of both of his parents and two grandparents who all have careers in education. Kristopher has the compact build of the competitive track and cross-country runner he is and plans on continuing to be when he moves on to a regional public university in the fall and on into his teaching career, which he hopes will allow him to coach or direct high school athletics. He has two younger siblings and lives in the country where the family keeps two horses, four dogs, three cats, and breeds Labrador retriever puppies. The family spends a lot of time together, caring for family pets, supporting sibling sports involvement or local professional sports teams, going out to eat, fishing in their stocked farm ponds, and watching movies at home. Kristopher tells me that he spends several hours a day outdoors, which he enjoys, but that he is also a 'typical teenager" who watches plenty of TV and movies. The family's decision to live in a rural area hinged on Kristopher's desire for a horse. "We moved to the country because I always wanted a horse my whole life. I took lessons and everything, and I really wanted one, so we got a horse." I was fascinated by a family that makes such an investment and transition for a child's interest, and asked Kristopher how this interest developed.

> Kristopher: Well, I guess since I was like really little I always liked horses, like for my birthday I'd always ask for horses, like the toy horses and stuff. I just really was fascinated by them I guess, and then my grandma took me, they have a therapeutic course place in [the rural town his grandparents live in] that they give lessons to kids to around like seven. I'd always go to her house for a week over the summer and she took me to get horse lessons, and I decided I really wanted a horse, and my parents took me to take lessons and everything, and we shopped around because it was, like, expensive, and we had to move for it and everything. So, we shopped around and we found a house and then like within a year I got one for my birthday when I was 12.
>
> JH: You were 12?
>
> Kristopher: It was my birthday present, and then after that my sister had to get one, so my little sister got one, and then my dad wanted to get one because he wanted to ride with us or at least learn, but we had, you know…That's kind of how I got into it I guess. I wanted to do barrel racing and everything, but it ended up that I was just, I couldn't do everything; you can't do sports and that. And I decided that I want to do sports and I kind of had to decide, but I still like it I'm just not…It wasn't like enough that I really, really…
>
> JH: Yeah, and that's something that you have to commit a ton of time to; you can't only do it halfway.

> Kristopher: Right, when both my parents work. They don't stay home, and like you have to, like, do all these things, like, make sure they're getting fed all the time and clean, and you have to ride them like once a day. Especially if you're going to train them for the barrel racing and stuff. [Now] they just stay in the pasture and run around.

Kristopher has re-focused his athletic energy more on running, and spends time with the horses and dogs in a caregiver mode. "So, now they're just kind of like, they're basically like big dogs; they'll just follow you around and stuff and they eat a lot...But they're more like just big pets. So, we have just been feeding them stuff."

Because of his dad's job in education administration, Kristopher's family moved frequently when he was younger, resulting in his attendance at four different elementary schools. The enjoyable parts of school for Kristopher were social in nature: group performances through a special program for other students, group meals at a babysitter's before and after school, and recess. "I never really liked school a whole lot when I was younger as much. I just liked to go to recess and stuff. I wasn't really into the school part, but I never had trouble or anything, pretty good kid." Middle school was more enjoyable because he was already familiar with his peers, for once, and he also developed a close relationship with the teachers who looped up with his class from 6^{th} to 7^{th} grade and involved the students in "a lot of fun activities" like going to see book-based movies in the theatre, doing group projects for the community, and being rewarded for school success with trips to the local recreation complex. As a student, Kristopher says,

> I never got in trouble or anything, I was just kind of like I liked to have fun, like I talked a lot; I like to talk a lot with my friends. I got my schoolwork done I just

> wasn't always like focused on the school part as much as like the hanging out with friends part of school.

Like many other students, what Kristopher likes best about science is the opportunity for hands-on learning. "I like especially like experiment stuff I think that's always really fascinating and neat to do. ...I never took chemistry but if I wanted to take another science class I'd want to take that just for the experiments." In high school, Kristopher has taken physical science and biology, along with a semester-long attempt at anatomy, which "hurt my GPA a little bit." He took it, however, because

> I thought I wanted to be a physical therapist for like a team, like I just thought that I want to try it, and so I tried it and it didn't go so hot. I mean maybe I'll come back to it, I don't know, but it was a lot of, I didn't realize how much I would have had to study, and I don't study a lot. I just kind of take the test. I mean I do all right, but in anatomy like you had to know the stuff.

Kristopher was able to drop the class at semester with a D, and enrolled in the present environmental science class his senior year in order to have the required three science credits for graduation.

In elementary and middle school, Kristopher tells me that he always really liked science, "a lot."

> Out of my core subjects [other than arts and recess] I always liked science a lot because the history would kind of bore me a little bit and like math I wasn't that great at, and Comm Arts was a lot of writing…But I always liked science, like learning about biology and like the animals and stuff. I always found that interesting. So, I really liked animals, and I guess the anatomy thing just came

> along with like athletic training type stuff I have no doubt about it. But yeah, I definitely always liked science and was fascinated, like we always had video's we'd watch, like science videos and stuff, and those are always entertaining. Yeah, I've always liked experiments too; I thought that was really neat, like hands on experience.

He recalled a specific experience from Kindergarten from which he learned an important lesson:

> I think it was kindergarten my teacher was a scuba diver so she always had all this like stuff that she would bring, and she had like a suit that was hanging in the room and everything, and we had a guy come in that she knew, this had nothing to do with like scuba diving, but he brought in like a cow brain and stuff and we got to like touch it and like see what it was like and he brought in like a heart and all this stuff and that was really cool because I always thought a heart was shaped like a heart until then and then found out that it wasn't.

Kristopher's actions and interests in science align with his identity as an "animal person" from a "sports family." In biology, he liked "the animal part of it" best but enjoyed learning about other topics "that wasn't just animals and like" as well. He especially connected with the first-year teacher of biology, because "she was adjusting to teaching and I was adjusting to high school, and then I had her sophomore year as well so I got to know her pretty well; it was kind of like the middle school thing." She "helped me a lot and helped me understand it better and she knew like if you worked hard like she was really understanding of all the students that tried." He selected the environmental science class over Chemistry and Earth Science for his third science credit because,

> I don't know how many options there were but environmental was definitely like the animal part of it and stuff would be me…I just went with this class because I thought it would be interesting and something that wouldn't be like just talking about rocks and stuff.

Kristopher also didn't want to risk his GPA in chemistry, despite his interest in conducting experiments. "I was like well, I want to make a good grade so my GPA doesn't like go lower, and I need this credit so I didn't want to take something that would be like too stressful I guess." He likes the class because it melds his hands-on learning preference and interest in the outdoors and animals.

> I really like going outside, and like doing things outside and like seeing it actually rather than just sitting in a classroom and like looking at pictures on a smart board and talking about it, but yeah I really like doing the stuff outside and just like hands on stuff, not tests, is fun…. I guess it's also nice and kind of neat that we had like animals in the classroom; I've never had that in other classes before so that's kind of neat.

Kristopher's identity as a socializer is apparent in Mr. VerVelde's class, where he sits among four girls with whom he maintains a chatty social relationship. He was also observed using social media through the internet and his cell phone in class. He is a good, but not great student, maintaining mostly A's and B's, which satisfies his parents, who have "always been like, 'don't get C's.' Like, of course they want me to get all A's, but they know I'm not, like, all about school, but' just don't get C's.'"

In the present class, Kristopher started out with an article on "electronic waste, like what happens to old TV's and phones and stuff, like how do they recycle it," which was not an easy choice for him to make:

> Well, he told us that we had to do an environmental topic so that narrowed it down like a big deal, and then we had just talked in class about different topics and thoughts. I was like one of the last ones to decide because I really had no idea what I was going to do, and like because cell phones are really big now and people are always getting new TV's and getting the new stuff I was like electronics, like what do they do with it all? I narrowed it to like environment.
>
> JH: Yeah.
>
> Kristopher: And there was a lot on the internet when I searched it, so it was an easy topic too.
>
> JH: So, how far did you get with that?
>
> Kristopher: I just did a basic article, got my grade for it, and just kind of was like OK I'm done with that one.
>
> JH: And for that one you did mostly internet research?
>
> Kristopher: Right, correct.

Kristopher only thought he was "done" with SciJourn, which continued throughout the year in Mr. VerVelde's class. As it continued, Kristopher found connections to his interests in the articles he was required to review and edit. "I thought it was interesting like when we read the other student's because I found out I never knew that they were introducing elk back into Missouri. I thought that was really interesting how there used to be elk a long time ago." For the second article assignment, Kristopher chose a topic about which he knew a bit through a family member's hunting experience.

> …the white-tailed deer blue tongue disease that deer get and it was killing off a lot of deer in around like [rural portions of this state]. The case started, I don't know where it started, it started in [a neighboring Midwestern state] but it moved to [this state], and, like, my cousins own a lake down in [rural area of the state], and they were hunting down there, and they had to stop hunting for a couple years because the blue tongue disease was too bad, and my uncle actually killed a deer that had it and it was killing off a lot of the like livestock like sheep, cows, and it was affecting the white tailed deer. So, that was my first topic [actually his second. The interviewee's recollection was incorrect], and how that was, like, the disease that was affecting the environment down there, and then I think I carried that through to my second topic [actually, third] because we could keep our train rolling.
>
> JH: So, how did you first decide on that being your topic?
>
> Kristopher: I, it was something that I knew about, and I was interested to know if it was still going on because I knew it happened, like, five years earlier but I didn't know. They said it's like, mild now, but they still see cases of it rarely.
>
> JH: So, was it five years ago when your uncle hunted that deer?
>
> Kristopher: And he actually killed a deer that had it, so, yeah.

Kristopher took the opportunity to improve upon his first version of this article for the third SciJourn assignment, incorporating the required interview the second time around.

> …The first time I wrote it I didn't even get an interview, like, I didn't even have an interview or anything like that. I just wrote a basic, like, article, just how you set it up, and I didn't really take it that seriously. I mean, I didn't know. I didn't even know the guy [a state conservation agent] went to our church. Like I talked to my dad about it later and he told me about it, and then the second time we had to have an interview, like it was a requirement, and so I got an interview with him.

Kristopher ended up saying that this interviewing experience was the greatest take away of the SciJourn experience, because it helped him develop confidence.

> Well, I definitely learned, like, how to, I guess, like, I've never taken a journalism class or anything like that, so, like, how to, like, approach people with, like, questions and get research from them, and, like, imply at the end of a paper, like put their quotes in the paper. Because at first I didn't, I mean usually [for school papers] you just look up online and get stuff and, like, quote it but you don't actually, like, talk to the person.
>
> JH: Right. Yeah.
>
> Kristopher: So, yeah that was, I learned how to do that, which at first I didn't really want to because he [Mr. VerVelde] kept saying, like, "Call people" or, like, email them, and I'd email people because that's not like actually talking to them, but then I actually, like, had to go talk to someone in my church who I didn't know very well which was kind of different, but
>
> JH: Was it scary?
>
> Kristopher: It was scary at first, yeah, but it was a good experience I think.

Kristopher's persistence with the blue tongue disease article eventually resulted in an invitation from Dr. Newman to make further edits for publication, for which Kristopher said he didn't have time, although he thought it was "a cool idea" to have something he wrote published in the science newspaper.

Like the first two, Kristopher's final SciJourn project capitalized on a personal experience with and interest in a recycling program related to his sporting passion, Nike's Grind, a sports shoe recycling program. Kristopher described how he found out about it:

> Well, like three or two years ago, we were at the Nike Outlet Store and they had a bin of we recycle your shoes and we brought some shoes back in and like just put them in there, and they put like any time, like where and how the shoes are worn, and then last year, or first semester my friend for her senior leadership project did that. She just went around and got shoes that people were recycling, and she handed out flyers and stuff, and it was for the same program. So they took it to Nike, and then the Nike Outlet I guess just ships it to the main program. Then I looked it up, and I found out more about it, and I didn't realize they did… I thought they just did like track surfaces because that was what they were advertising at the running store, the Nike store, but they do all sorts of things, so that's how I found out about it.

As a SciJourn topic,

> That was something I really wanted to do because I was interested in it but I didn't, like, it would be hard to get a direct interview unless it was by phone or whatever, and I was just going to go, like, with, like, have an interview and then just, like, talk about it on the podcast because my topic would have been hard for

> that actually, but I don't know. I guess I don't think. There's not a location here that is in charge of that or manufactures that or whatever, it's out of state. So, it'd be kind of hard to get, like, a direct interview, but yeah, I thought the podcast would be something new, different, and fun, and I really liked like The Grind. I thought it was really interesting, because how they take, like, recycled shoes and make all sorts of things out of it from, like, basketball courts to, like, new track surfaces to playground surfaces for kids so they don't get hurt, and they even use it for padding on carpet, like underneath the carpet the padding, they use it for that.

In this topic, Kristopher found personal interests in sports aligned with an environmental issue highly relevant to teens just like himself involved in sports, and to schools in general in which he hopes to establish a career in his father's footsteps.

In high school, Kristopher's interests revolve around sports and social events.

> I was really excited to be able to participate in the sports in high school, and so the first thing I did with the high school was over the summer for my freshman year they had soccer conditioning and I went to that and I got to know the guys on the team, it was really fun, and then I played JV, and like me and three other kids that were freshman played JV so we became really close because there was only four of us, and then school like I liked the teachers a lot it was just… Like in middle school we could redo everything we did, like if we did bad on a test, "Oh don't worry we can get rid of it," but like in high school it was hard adjusting at first to it's your grade and you've got to do better next time. That was hard for me, but I liked high school. I always wanted to go to my dad's high school that

he's at because I've been around it so long, so it kind of, at first I was a little disappointed I guess, but I like the sports of it and the school part of it. I liked most of my teachers that I've had.

Kristopher's engagement score increased from 0.14 to 0.30 over the course of the school year. Clearly, he was a student involved in outdoor activity and interested in animals from an early age. However, he did not excel at science academically or see a future for himself in it. From pre to post, the change in Kristopher's reported engagement can be attributed most to gains in frequency of science and technology-related actions and his self-motivation (for fun, to learn more, or because of relationship to future plans) for participating in them. Kristopher also reported slightly more interest in science pre to post. In terms of identification, however, Kristopher's engagement score dropped slightly. This is attributable somewhat to his more focused future plans in education, and coaching however. It seems that perhaps Kristopher did not, until becoming involved in a class that often met outdoors and involved him in writing about topics of personal interest, identify his personal pursuits as science. His outdoor-loving family spends time outside playing and watching sports, and is also involved in hunting and fishing. Kristopher spends a lot of his own time running and tending to animals in the outdoors. These activities don't fit the "experiment" kind of hands-on science model Kristopher held before the class (and were shown as not counting as science in Kristopher's low pre-SciJourn engagement score of 0.14) but certainly were validated as relevant topics in environmental science. Kristopher's identity as a social, sporty, outdoors-person did not change, but his ideas about what counts as science, and his relation with science in daily life activities, may have.

Summary.

In each student case, there was evidence of students making both 1) sense of and space for the SciJourn research and writing within their own school identities (Nasir, 2010), and 2) connections between persistent personal interests and topic selection. Topics Brendan said he chose due to their prevalence in popular media (such as Yahoo.com) were also closely aligned with personal interests in sports and astronomy, and the writing tasks, while unexpected in science class, were not beyond his capabilities as a focused student. Ramiz selected topics he thought would align well with the teacher's goals (of environmental science learning) as well as his own interest in technology as a means of bettering the world. Topic selection for Kristopher was also personal, and his work on each project, including interviews, was framed within his social life with friends and at church.

In addition, Luke's repeated "blitz" approach to involving students in SciJourn provided students with several invitations to engaging in both the SciJourn project and science/technology within the environmental science classroom context. Most valuable to students were:

- Exposure to multiple sources of science news and topics
- Authentic writing for publication beyond the classroom
- Open topic selection, capitalizing on student personal interests
- Regular one-on-one interaction with the teacher to push projects forward
- Variation in SciJourn assignment requirements and format across four rounds

I will briefly summarize each of these elements below.

Throughout each "blitz," Luke's students were expected to interact with science news topics through three different mechanisms. They read and reviewed articles published by credible sources in print and online sources, read and commented on teen articles published on SciJourner.org, and read and provided feedback to their peers' writing projects. This frequent and ongoing exposure to science news sources and topics served to both raise student engagement scores (several "Action" items related to the accessing, reading, and sharing of science information) above those of other classes, but also increased student awareness of science news topics related to their personal lives. Kristopher describes his response to the ongoing state news story of elk reintroduction:

> Like the elk one [article], I just found that, I don't know, I never thought, because like if you saw an elk crossing the road or something you'd freak out, or I don't know what you'd do, or if you saw, like, a, if you saw a deer that got hit, or, like, on the side [of the road], like, I saw an elk, and they're huge, in comparison to a deer. Yeah, and honestly I've never even, I mean I've seen them, in like [a nearby animal theme park] and stuff, but I've never seen one in the wild, I don't think, so that really, after I read that I was really interested in that.

Kristopher's lifelong interest in animals was piqued by a local news story he would not have been aware of had he and his classmates not been exposed to Luke's collection of state conservation agency news magazines, which spurred a wealth of student articles on conservation-related topics as well.

In addition to their persistent involvement with science news as consumers, Luke's students were also involved in the practice of producing science news as journalists. SciJourn editor, Alan Newman, visited class several times at Luke's invitation. For both Luke and the students, this lent authenticity to the process of writing news articles by putting a face and a personality with the process. In Luke's words,

> for the kids to see that it's not just me…to meet Alan…here's the person who's editing, and there really is a person…I did find that to be of value to the kids and to me as well, I mean from my perspective I think their work was better because of it because I think they really did take some time and some notes and some opportunity to shape that a little bit.

The students' awareness of the real opportunity for publishing their work at SciJourner.org (fostered by the assigned review of articles posted there as described above) underscored for students the difference of authenticity between writing assignments in Luke's class and those they completed elsewhere. Kristopher said,

> it gave us something, it was more like a project where you weren't always just sitting in class listening to lectures; you got to go out and explore on your own and like find your own topics and ideas and write whatever you want to about them, and then people gave their feedback and helped you out… I liked how it was set up like a newspaper.

Ramiz also commented on the unique opportunity to have something he created be made public. He thought VerVelde's class "was pretty good, I mean I learned a lot, like not just environmental wise but like I wrote stuff, you know, which I didn't know too much about journalism at all, so I think it's pretty neat." SciJourn provided him with

> a great opportunity to actually publish something and make it more widespread known that can actually help people out, you know, something like have a greener school to reduce emissions and, you know, control the recycling and everything.

> So, I think it's actually probably the best opportunity I've had in high school and I'm actually doing something really good that you can show off and whatnot.

In addition to valuing the journalism aspect of SciJourn, Ramiz, a student already highly engaged with science and technology both in and out of school, appreciated the kind of authentic science learning SciJourn enabled him to do. Luke himself emphasized the value of publication for students in promoting their work on college applications, and made sure administrators at the high school were aware of his students' publications as well.

Like many other SciJourn teachers, Luke allowed his student journalists to select their own topics, with a stated preference toward environmentally-related topics. This freedom, another rarity in high school assignments, allowed students to explore deeply within areas of personal interest, as exhibited by Brendan, Ramiz, and Kristopher in the cases presented above, as well as another published classmate who wrote about "Blackberry thumb" in response to hand cramps she experienced as a frequent text messenger herself. Kristopher described the freedom of choice as well as of the journalistic style as follows:

> I really liked that [being able to choose his own topic] because it's a lot easier to write your own feelings. Like, it's not like you're like boxed up in a certain one topic thing, because actually I never even had to do a lot of writing before in science classes which was cool to learn how to do that, and the stories aren't structured like Communication Arts classes where it's like, "the opener and then the three bodies and then the closer," so it was nice. It was more like free writing to just kind of tell the story and not worry about having a certain amount of

> sentences in this paragraph or whatever. So that was nice, but yeah, usually, like, the only other writings I had to do before in science classes would be, like, on a test, an essay question which everyone has the same question, and it's kind of boring.

Student topic selection lent itself to relevance to the teen reading audience as well. When Luke distributed a new print edition of *SciJourner*, his students dove in. Kristopher said, "the things that I saw, other ideas people did, I thought were interesting in that way."

Luke's structure of the class time students spent on SciJourn work included positioning himself as a facilitator of their individual forward progress. Other than welcoming the students to class and reviewing daily expectations as noted on the project syllabus, Luke rarely addressed the class as a whole. Instead, he pulled aside a pair of student desks and sat with each student one-on-one to ask about his/her work. Students were free to address him even when it wasn't their "turn" to speak with the teacher, but were required to engage one-on-one for at least a quick check in session each class period. Brendan said, "he did provide a lot of help, like he did really good on the, like if I had a question for him he like had a good response that would help me." Luke learned from his experience with student projects in the prior school year that without these structured sessions, some students simply would not ask for or get the nudge they needed to keep going with the research or writing.

Although the basic structure of the SciJourn component of Luke's class stayed the same throughout the school year, small changes to each quarter's article kept the students from becoming bored with the task. In the second quarter, students were charged with including an original interview or survey. The third article could be an original piece of news or an improvement upon the third quarter assignment. As Kristopher put it, the third quarter option "was nice…because we just got to add on to the one we had before." While students who made this choice also were required to complete additional peer edits or article reviews, modifying a prior draft was often considered the easier option, since it didn't involve identification of a new topic. And finally, in the 4^{th} quarter, students had the choice of completing a science news photo caption, infographic, video, or audio interview. By playing some examples of published multimedia projects from SciJourner.org for the class, Luke exhibited the simplicity of these projects that offered a new approach for students tired of writing. Kristopher, for example, said "when I heard it, it was like three or four minutes and the girl just basically gave what she would have written except she gave it verbally which I thought was cool and I wanted to do that." Also welcoming to students was Luke's assurance that even multimedia projects went through a drafting process. He told students, "if you're doing the picture caption or the infographic, formatting I'm not going to worry about that, I'm going to let the SciJourn people worry about formatting, because no matter what we do, they're going to change it anyway." These changes to the basic structure of the assignment and increased student options, along with Luke's encouraging personality, served to keep students invested in the SciJourn components of the class.

Some aspects of Luke's implementation style served to frustrate students or otherwise bar student engagement in the SciJourn process, most notably lack of teacher feedback on the students' final products. Students provided feedback to their peers and received multiple reviews of their own work each quarter and Luke met with students regularly to chart their progress toward the goal of assignment completion. However, Luke limited his assessment of papers to 1) completion grades for the exam, and 2) the decision of whether or not the article held potential for publishing (if so, it was then forwarded to the editor). Brendan expressed surprise to have spent so much time on an assignment and yet not receive the graded work back from the teacher:

> JH: Hmm, OK. So, your feedback from Mr. VerVelde is quality stuff, or like answers your questions but you don't get like any bad grade on an article?
>
> Brendan: Yeah, I've never seen like an actual, like the second one was our performance event for the final, so, well I got an A on the final so I'm assuming I did good on it, so…

Luke often expressed a sense of being overwhelmed with the amount of paper shuffling required to facilitate his approach to peer editing, which resulted in each student (who turned in a rough draft by the original deadline) receiving multiple edits by peers before submitting a final draft to the teacher. The value of this editing varied by student. A responsible student himself, Brendan says, with regard to peer editing of his classmates' draft articles,

> I gave away good edits. I didn't really receive any [good edits] but I don't care enough, so…
>
> JH: OK, that's what I wanted to know was the quality of the feedback that you got.
>
> Brendan: Every once in a while there was a good one. Like, my friend's in sixth hour, and he's just like, "Oh, I just write, slap, no, no, yes, no, so…
>
> JH: Oh, got it. OK, so it's luck of the draw whether you actually got some decent feedback.

Brendan: Yeah.

Another student, Ramiz, found the peer edits more useful. While his previous experiences in Communication Arts and Speech classes "helped out" in preparing him for the writing in the environmental science class, peer editors' comments about grammar were important on each article, "since my weakness is grammar kind of and all that, so I got a lot of help from peers on that." In the SciJourn project overall, it has been observed and documented that science teachers and high school students typically default to "grading" or editing article drafts following established rules for grammar and spelling rather than focusing on science information presented in the text (Kohnen, in press). For a student like Ramiz who continues to work on his English writing, such feedback was viewed as valuable. Meanwhile, Brendan, an experienced writer, would have benefited more from edits challenging the content of his prose; peer feedback identifying much of his draft on concussions as editorial commentary may have pushed Brendan to improve that piece before submitting it to the SciJourn editor with those errors included, much later in the writing process. It is one goal of the SciJourn project to foster such critical feedback on science literacy-related aspects of student writing and minimize time spent correcting writing mechanics (Saul et al., 2012). That said, some students, like Kristopher did find the limited feedback they received helpful:

> I mean obviously it got kind of boring, like some of them because some of them [topics] were the same repeated, but we kind of got to be the teachers I guess and grade, well not grade, but see what other people wrote and see how ours compares to how other kids wrote theirs and stuff like that, and it was nice to get the feedback from other people because it's better for people to be honest, because if

> they don't know who you are or know anything about you, like they're obviously going to be honest with you about your paper and it helps you to know what to change and do differently.
>
> JH: So, you got some useful feedback?
>
> Kristopher: Yes.

In addition to receiving valuable feedback on their own work, students found the peer editing as an opportunity to read articles about environmental science topics of interest to them, as well. Ramiz said,

> I know there was a lot of topics that I got that I thought was pretty interesting too, doing that [peer editing], but usually I didn't like to grade them on grammar because I'm pretty bad with it. So I just went on, like, story wise and, you know, just saying what else you can add onto it. As far as like spelling or something like that I didn't really do it [edit].

Peer editing as a structural component of the journalism apprenticeship program turned out to also be a means for students to broaden their content knowledge and to discover new science topics of personal interest.

> Ramiz: I would never have thought of anything like the Bloom Box technology wise how it uses sand basically, they're ceramic made, so I think it's pretty valuable. I'm learning because I get to look stuff up and how it actually works instead of just saying, you know, that it just works how it is, you know, kind of like a car I guess, like you know how to drive and all but do you know how it works? So, I think stuff like that, and then you can take stuff from that and use it in other terms you know what I'm saying?

JH: Yeah.

Ramiz: So, I guess I learned a lot science wise doing this.

Kristopher also gained knowledge about science that he feels is relevant to his life:

> I think I did gain, like, the importance of being environmental friendly more, because I never thought honestly about recycling stuff. Who thinks about, like, recycling cell phones really? Because usually with old electronics we either give them to someone else or they sit in the basement and we don't do anything with them, like. So yeah, I definitely took that out of it, the environmental part of what you do with your electronics and that stuff. And the deer one was just affected by my family with the, I mean that was obviously environmental, but that was just through the animals and all that, so I took the science part of that, but I kind of already, I mean I know there's diseases with animals.

In addition to knowledge of science topics, students gained skills that have application beyond the classroom. Kristopher said,

> Well, definitely like writing a journalism article type of thing that's definitely different than writing class, how they teach you to write, and the way it's like structured, because my dad wanted to be a journalist and he did all that in high school and stuff so he helped me a lot too, like how to help me write them. And then the interviewing, like I said. I mean I'll have to go through interviews to get jobs and stuff and probably have to interview people eventually. My dad has to interview people as a principal hiring people for jobs and stuff, so that was what I took out of it. Like, learning it, how to approach people I guess with questions and stuff like that. Also, to put something together, I guess getting your own

> information offline and from other people and putting it together to write an article. That's different than a lot of classes, like what we have to do, and I'll have to do that in college a lot with research papers and stuff.

These transferrable research skills are exactly the types of abilities SciJourn hopes to foster in students in order to contribute to the development of a more scientifically literate citizenry—a population that is capable, fifteen years after high school, to find and use the science information they need to make personal decisions with regard to health, environment, and society.

Luke's method of implementing SciJourn as a strand of repeated activities throughout the school year was the most intensive model of all of the teachers involved; he was the only teacher in the group to involve students in the production of multiple original pieces of science news. While, from a research approach, this resulted in his rise to the top in terms of a true apprenticeship model of repeated engagement in an authentic task, students also responded to the repeated nature of the assignment as a bit of a bore. For example, Kristopher admitted that "those [articles] are fun. I mean, they're challenging, like, sometimes you get frustrated because you, like, have to do another one or…" Regardless of student attitude toward the work itself, it appears that Luke's approach was the most successful in terms of resulting engagement.

In the following sections, two other teachers, also considered highly engaged in the SciJourn project will be discussed in terms of how their implementation strategies invited or possibly detracted from student engagement. "High" implementation was determined by the research team as teachers who expected their students to write science news articles as a part of class. However, these data show that goal was achieved through greatly varied styles, even among the same category of teachers.

Cynthia Morella's Pre-AP Chemistry Class

Cynthia Morella teaches an advanced section of a required Chemistry course with a much more structured curriculum than that of the elective Environmental Science course described above. While she shared Luke's goal of writing toward publication, course time for SciJourn-related activities was limited to a few class periods in the first semester. During this time, Cynthia's students became familiar with SciJourn through teacher-led read aloud-think alouds of internet-based science news articles and student review of print editions of Scijourner.org. Little structure for researching, writing, or peer editing was provided, but the teacher was highly responsive to the students who pursued these activities outside of the introductory class periods, yielding two published journalists by the end of the school year.

Like Luke, Cynthia set out with career plans other than teaching. A competitive swimmer from an early age, she was inspired by a physical therapist who worked with her after an injury to follow in that career path. The human cadaver in a college anatomy course changed her mind, however, and she completed a biology degree with plans in research. Cynthia's father is a retired biology professor with a thick research portfolio, but it was through assisting her mom with math as she pursued a degree late in life that Cynthia was convinced that she might enjoy being a teacher. She returned to school for certification and never looked back. Although certified to teach high school biology, chemistry, and physics (her favorite to teach), she currently teaches mostly chemistry courses "because they [the school] needed chemistry." Cynthia expressed on several occasions that she fears for her job due to what she considers a “buddy system” amongst a new principal and the principal’s preference for teachers among the staff who are also African American and her personal friends. In self-defense, Cynthia has adopted a strategy of making herself essential to the function of the science department as well as the many other school committees to which she devotes her time in order to secure her position on faculty.

Cynthia views herself as a teacher leader and as a high quality science teacher—perhaps the best in her school. Her desire to position herself in the same way before others and also to show herself as one who keeps up with new ideas in science education (unlike peers at her school whom she described in an interview as not having changed anything about the way they teach in the last 20 years) was one motivator of her participation in SciJourn. She is also a lifelong learner. During one of our interviews, Cynthia gestured to a stack of five large books by Paige Keeley on her coffee table, which she bought herself at a summer PD session and planned to read before writing lesson plans for the start of the school year.

Cynthia and another chemistry teacher in the school were involved in a lunch meeting organized by the district Science Coordinator, who had invited Dr. Newman to describe and invite participation from this school district in the project. They decided “I will if you will” and managed to convince another of their colleagues who had not attended the meeting, to participate as well. Even in the summer after graduating with her PhD, when many would have felt they earned a break, Cynthia felt compelled to be involved in whatever opportunities she could find to improve her teaching. Cynthia tells me about the experience of becoming involved in a writing project so soon after the "nightmare" of dissertation writing behind her.

> Cynthia: I never wanted to write another thing again which is probably why I never finished, you know, the SciJourn article, you know, mine; I had no desire.
>
> JH: I think it's interesting you took on a writing project because I can relate to not wanting to write.
>
> Cynthia: Well, first off I didn't think I was going to do any writing, you know.
>
> JH: Right, OK.
>
> Cynthia: That was first off. I'm like, "I'm not writing crap." But I did. I mean, I went through the process, which I think was more important than anything else. Even if I didn't get it published and whatever, I went through a couple edits. So that was important to me, but it was also important because I know my kids cannot write. They don't want to write, they don't want to elaborate, and I know it is so important that they write.

Cynthia is a student advocate, who expressed feeling needed by the kids she teaches, and whom they seem to adore in return. Many current and former students stop by her classroom to say hello during class transition periods and extra-help hour. Many of the students in the case study chemistry class took their required biology course with Cynthia as freshmen and were glad (according to both Cynthia and the students' self-reports to me) to return to her classroom for a second time. Before and after class periods, and during advisory time, former students often visit the classroom to say hello or seek extra help, even though they are not currently taking a course with Cynthia. "Our kids need a lot of pats on the back, a lot of hugs, a lot of love, a lot of high fives, a lot of encouragement, and then when they're successful that's when they see everything come together…" She tells me she is happy to help them because, "they need me" for that kind of support (especially in the case of physics, which she loves to teach but is instead taught by a teacher she scorns as a poor teacher who "never even gets up from his desk").

Cynthia wants her students to be successful. Her own struggles with the writing of a science news article and her awareness of her students' reading and writing challenges caused her to be somewhat hesitant in starting out with SciJourn at the beginning of the school year. In summer planning, she decided to try SciJourn out with her most advanced classes: AP Physics and Pre-AP chemistry. To the teacher's surprise, the pre-AP students were actually more successful than the older, more advanced students in terms of persisting through multiple edits to generate a publishable article:

> I think it works better with the kids that aren't your necessarily seniors, your AP kids. Even though I've got some great kids…two kids that were tied for #1 in the sophomore class. They did two or three rough drafts and that was it. They just kind of, they didn't produce. Like Terrence is a B-C student, man he's really a C student, you know, [with] a few B's here and there. So, it worked better with him. It's amazing; some of my lower level kids really sunk their teeth into it and did more...My upper level kids didn't. So, that was interesting to me.

The case classroom is a Pre-AP chemistry course of 24 students, mostly sophomores and a few juniors, all of whom are considered the more advanced students (there is a more basic chemistry course offered). All but one white female student are African American. Upon observation, attendance is an issue even among these students considered to be more advanced than their peers at this struggling school; there are rarely even twenty students present on a given day.

Figure 13. Cynthia Morella's Classroom, Front

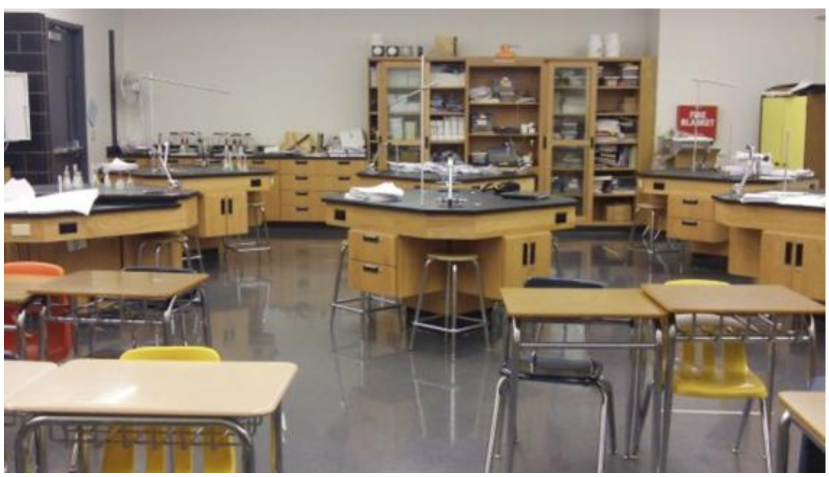

Figure 14. Cynthia Morella's Classroom, Rear

At the outset of the school year, Cynthia introduced SciJourn to her students through distribution of printed copies of *SciJourner* and a few read alouds of science news stories. In terms of the article-writing assignment, students were aware of the ultimate goal: writing a science news article worthy of publishing in the SciJourn newspaper the teacher introduced to them in class and made available to each student as new editions were published during the school year. However, unlike Luke, who laid out a specific plan for the completion of the article and several associated assignments which would be incorporated into the students' grade at the level of a final exam, Cynthia did not assign a grade value to the article writing process or final product. While this may have been a deterrent to the effort of the Honors AP students (none of whom finished an article), it didn't seem to hamper the energy of some of the Pre-AP chemistry students, two of whom ended up earning extra credit points for persisting through the process over many months and edits to become journalists published in *SciJourner*.

At first, it was unclear, however, whether the finished article was a required assignment. Cynthia considered that it was, and devoted some class time to the process, but did little to follow up with the class on their progress. Cynthia said if you added up all the time she spent on SciJourn related activities, it would probably only total five whole 95-minute class periods. On three different occasions, a portion of class time was focused on the processes of topic selection, identifying quality internet resources, and peer editing. Two of these were spent conducting internet research, for which the teacher had reserved the science department laptop cart, but mostly seemed to be wasted time as the students had no mechanism for saving their work; the teacher did not utilize Diigo (the social web bookmarking tool which the project had encouraged teachers to employ) and there is not an established school-wide network for students to use for document storage or email. Cynthia recognized this lack of technological resources as a barrier to her ability to implement SciJourn most effectively, saying, "that's the big issue, is having the access to the computers to do what we need to do, and that's the big thing for me is getting that access." Other than these few class times, students were on their own to conduct the research—at home, at the public library, or during extra help time in the school day—and draft an article. Cynthia didn't expect them to all become SciJourn published authors, though.

> There's a lot of good things [about SciJourn], but I just think the getting them to research and read science and realize it's not just chemistry in [this class]; it's not just physics when you're a freshman; it's not just biology when you're a junior. It's in your world, everything's mixed together. That was really important to me. Now, I wanted to produce papers, you know, articles, but it wasn't a main priority. The main priority was getting them to at least…I wanted them to write at least a few drafts, but publishing I wasn't as keen on. I figured, "Oh if I get five or six on it," which is basically what I think I got was five or six, and I was happy, but I wanted them to at least write a few drafts and do that research.

When the date came, about ten days following the initial assignment, for students to submit their first drafts, only three of the 24 students had anything to turn in. Rather than see this as a failure, Cynthia proceeded with her plans for peer editing, making multiple copies of the few articles she had, distributing them to four groups of students, and conducting group feedback sessions for the three authors. While most of the students had done little to no work on their own to generate a first draft, the entire class seemed well engaged in this interactive session of peer review, which one student even asked if they could do again another day. The teacher's response was simply that if they wanted to do this again, she would need more students to turn in articles. Eventually, the teacher says, she thinks ten of the students in the class (less than half) did submit a first draft, and five of those (20% of the class) went on to make edits and submit further drafts for review. She managed these submissions, typically handed in on paper, on a one-on-one basis, at the students' own pace. Near the end of the school year, Cynthia told me she had pretty much been working on SciJourn one on one with the students in the class, and that they've done "fairly well" with it:

> They would give me the draft and I would get it read and done by the end of the day because, you know I have five minutes, 10 minutes here, you know. I'm pretty good, or even that night, or by the next morning, and see I see them every other day. Well, some of the kids, they come to my extra help [period], so I'd see them every day because they wanted to be with me, God knows why, but, and one girl that said, "I'm on a permanent pass," [to your extra help period]. So, they would stop by even the next morning and go, "Do you have it done?" "Yeah, here you go." So, I would give it to them and I'd say, and it would be very written out, and I said, "If you have any questions on what I wrote you can talk to me when we have a few minutes during class time."

So, students were very much on their own in terms of motivation and follow-through to get to the point of having written a draft the teacher felt she could forward to the SciJourn editor.

Once the first of the students' articles was published, after many, many edits by the teacher even before submission to the SciJourn editor, Cynthia printed it out, and it could be seen posted on the wall in the classroom alongside the other two SciJourn documents in the room: a poster on thinking like a science journalist and a diagram of the inverted triangle. Her strategy of challenging students to rise to the level of their highest achieving classmates was put in place again, and seemed to work at re-kindling the spark of potentially being published for at least one other student, Angel, who said, "if he

[Terrence, who she knows is not as high achieving a science student as she is] can do this, I can." And she did go on to have her article published on scijourner.org.

Sixteen of the 24 students in Cynthia's class completed pre and post YEST Surveys. Overall, student scores decreased from *M* = 0.39 (*SD* = 0.14) to *M* = 0.33 (*SD* = 0.13), but not at a statistically significant level ($t(15) = 1.76$, $p = 0.99$). Two interviews were conducted with each of the following students in the hallway outside the classroom during chemistry class. Students were given extra time to complete any work they missed during interviews.

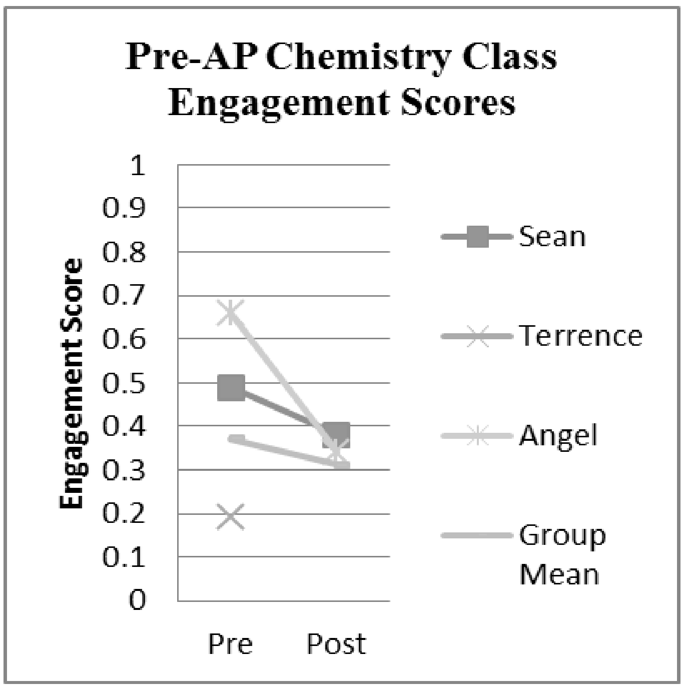

Figure 15. Pre-AP Chemistry Class Engagement Scores

Terrence.

Terrence is a charming and outgoing African American sophomore male. School 011 is his fifth school, due to frequent family relocations. Terrence explained to me that he had matured a lot in high school so far, overcoming some of the behavior issues he admits to having in elementary and early middle school. He talked freely in the interview, smiling the entire time, happy to share his story. Terrence has a personality that thrives on attention. As a freshman, he became involved in school theatre and was quickly recognized as a talent by the older students who he says took him under their wings and imparted their wisdom and blessings as a leader (he became treasurer of the thespians group) to him as they approached graduation during his sophomore year. He is also active in DECA (an international student organization for business students), another group that values presentation skills. Terrence dreams of being an actor.

Terrence's interest in science is also for the dramatic: "tubes and explosions" conducted by crazy guys in "science coats and glasses" as he saw on his favorite cartoon superhero shows, specifically *The Power Puff Girls*, growing up. He remembers fondly his sixth grade science teacher, who did demonstrations with test tubes to make smoke and mixtures.

Terrence told me he had an "A" in English class and that writing was "one of my many passions" that he even pursues in his free time. For SciJourn, Terrence was one of the few students to submit an article draft at the first deadline. This first draft, however, was merely a lot of words handwritten on a piece of notebook paper. The topic was mold, which he said was an idea that just "came to me," and later connected it to a local news issue the teacher shared with the class since it related to Terrence's story. Cynthia tells me about the process of moving Terrence toward publication.

> Cynthia: Well, I'll tell you with Terrence, the first one I read I was like, "Oh my God who was his English teacher and how the hell did he pass?" I mean, those were my thoughts completely; he had blogs in there [as sources]. I mean, it was just his writing was no sentences, no periods, or run-on sentences. I was just

floored, and I knew, you know and I'm not really a writer because I like to say things in short sentences: "Bam! Bam! Bam! I'm done" because that's the science in me.

Interviewer: Science writing, yeah.

Cynthia: And even reading him he didn't even have "bam, bam, bam," [science facts] so I went, you know he worked with me and worked. I was amazed he did it all, I was amazed because I really, but I think I did it in a nice way where I gave him encouragement because I said, "Good start, but let's go from here," you know.

Once this encouragement began, Terrence made incremental steps at improving his written work by responding to Cynthia's edits, bringing her his work before school and between classes for further feedback. Cynthia was quick to respond, rarely allowing a day to go by before returning his drafts, which worked to keep Terrence in the teacher's spotlight and therefore motivated to continue the writing process. Throughout this time period of a couple of weeks (which included work by Terrence over the winter break from school), Terrence seemed to become more invested in science class as well, as illustrated by his choice to move from his typical seat in the 2nd or 3rd row to a front row seat. According to other teachers' reports to Cynthia, he became more attentive in their classes as well. When Cynthia finally felt Terrence's draft article was "good enough" for editing by Dr. Newman, the student had already responded to more than ten of her edits. By this point, Cynthia had already shared her excitement over Terrence's persistence with the rest of the Pre-AP class, the SciJourn research team, and even the district science coordinator. Cynthia could scarce believe the endurance she was witnessing from

Terrence and praised him vocally, hoping to spur on other students in their writing as well. This public attention was exactly the kind of praise Terrence craved, and he persisted through several more rounds of editorial feedback.

To communicate drafts and edits with Dr. Newman, students needed to provide their document electronically to the teacher, who would email it to Dr. Newman for editing using Microsoft Word's "Track Changes" feature, and send the new document back to Cynthia, who would then provide it to the student. Without classroom access to computers, Terrence needed to put forth extra effort to find time between classes or during an extra help period to respond to the edits and reverse the process back to Dr. Newman. After several more edits to his work facilitated in this way, Cynthia and Terrence were both finally alerted, in early March, that Terrence's article, "Watch Out for Mold" would be published in *SciJourner*.

Terrence's persistence caught the attention of the SciJourn team, and Dr. Newman—along with Cynthia—encouraged him, if he was interested, to apply to the extracurricular SciJourn program hosted by the local science museum. This would allow Terrence to continue to pursue his writing, within a workplace setting that would even provide him a paycheck for his efforts. I happened to visit the classroom the morning after the evening Terrence was informed by phone that he had been accepted into that program. He was proud as a peacock about this, and so was Cynthia, who by now identified herself strongly as a member of the SciJourn team, wearing her school identification badge around her neck (as required), but attached to her SciJourn press pass and lanyard. She said to me, smiling widely, "That's what this program did. This is just what he needed. I mean he did the work but the program got him a job. I feel like I helped a kid." In this way, her own positioning as a helper of children in need, and as involved professional were aligned through SciJourn, a project that engages students who have perhaps been less traditionally successful in school science through bridging their personal lives and science classroom activities. Meanwhile, Terrence, whose grade in pre-AP chemistry was improved through his greater attentiveness in class but still not stellar, received a major boost in his semester grade from extra credit points earned through publishing. Overall, observational evidence support a positive shift in Terrence's engagement with science and technology. Terrence did not complete a post-SciJourn YEST Survey, so a quantitative assessment of his change in engagement as measured on the survey cannot be made, however.

Angel.

Angel is a stylish and energetic freshman female, tiny in stature with an athletic build. In our interviews, she is a sweet bubbly girl, but Cynthia let me know her mood swings can be dramatic, and are easily seen on Angel's face when she enters the classroom each day. Angel plays softball and runs track for the high school team, and prides herself in being competitive in school sports. Like Terrence, Angel has also moved around a lot, attending four elementary and two middle schools. She is the third oldest of seven kids living with single mom. Angel is inspired to be a judge, after seeing the power they have in the courtroom when she's been there with her mother, and says she will design her own gavel for use in her courtroom when the time comes. At sixteen, Angel considers herself the head, or self-proclaimed "drill sergeant" of her household, a role she relishes. Despite, or perhaps because of, her tough childhood, Angel talks positively of relationships she developed with teachers outside of school, saying the time she spent with them was "always fun." She loves school, and favors math, which she says "has always been easy." In the present year as a sophomore, she was taking both Geometry and Algebra II. Angel professes to also loving science, which "is everywhere." She is struggling with Pre-AP Chemistry, though.

JH: So, is chemistry pretty easy for you?

Angel: The math part's easy, but the information I can't keep it in, like I'll…

JH: Like what kind of information?

Angel: Like the science info and stuff like that, I will not keep that in.

JH: You can't keep it in?

Angel: No.

JH: So, there's a lot you have to memorize?

Angel: Yeah.

JH: Like give me an example of something that is hard for you to remember.

Angel: Like when we had to do the solution and stuff and all of them properties and differences I couldn't remember that stuff.

Showing the importance of her family, Angel chose to write her science news article about her seven-year-old brother who is autistic. Angel didn't originally have a good idea for an article, but when another student was writing about a family member's sickle cell anemia, she realized that she also had a personal topic that related to science and started to research autism:

> Someone in my class was going to write about their momma, that she got sick. I don't know, I think she had sickle cell or something. She had something, and I

> was like, “I want to write about somebody that,” I wanted to write about my little brother, so, he has autism so…

Angel enjoyed and learned a lot in the process of doing the research. Seeing Terrence’s article published and hearing the teacher rave about it spurred her on to finish her own. The teacher’s contribution of frequent and widespread praise for another student served as motivation for this competitive student to earn some rave reviews of her own, although she tells me that she would have finished her own article, anyway because “I always like to finish what I start so I’m not going to stop now; it’s going to get done.”

On the day of our second interview, Cynthia informed me that Angel had made the editor’s suggested revisions to her article and resubmitted it, so the teacher is “hopeful” that they will hear soon that it will be published. (Angel’s article was published on scijourner.org a few days later.) Meanwhile, Angel was already thinking about what she might do next for SciJourn, despite the fact that school was almost coming to a close for the year.

> JH: OK, OK. What was it like to get that feedback from the editor?
>
> Angel: It was good. I was excited, and I wanted to write another one. I wanted to get it done.
>
> JH: You wanted to get it done? Do you know what you were going to do the other one about?
>
> Angel: Huh?
>
> JH: Have you thought about what you would write another one about?
>
> Angel: Yeah, I’m writing another one this summer, like I’m going to keep on doing it because it’s fun and it’s like a goal that people can do every year because

> it's not that hard. We just find the information and then just putting it together, so that's not that bad. Yeah, I haven't thought about what I want to…

However, this interest in continuing to write science news seemed isolated from interest in science.

> JH: Cool. Has writing about science affected your feelings about science in general?
>
> Angel: No, because, well, I don't know.
>
> JH: You don't know?
>
> Angel: Writing about it, you find when you're actually in the set of mind of writing about it you find more information that's connected to science.
>
> JH: Were you surprised how much science was related to autism?
>
> Angel: Yeah, I was surprised. Well, no because science is everything and everywhere so I wasn't that surprised. I knew it was somewhere; I just had to find it.

At the end of the year, Angel still felt that science is in everything around her in the world, but didn't express an increased interest in it overall. In the post-survey, Angel's engagement score fell dramatically, to 0.34. I am curious whether a change in attitude or mood such as Cynthia described to me as being common for Angel, may have contributed to her lower responses on the post survey.

Sean.

Sean is an African American sophomore male. He is a straight-A student who excelled in science classes in elementary and middle school and "still loves science." His initial engagement score was medium, at 0.49. Sean is a well-rounded high school student who is on the school tennis and wrestling teams and also plays violin, which he started at age seven. He wanted to take chemistry with Ms. Morella after having her for biology class the year before, and is also taking physics this year, with another teacher. Sean's mom has a degree in "some kind of science" and helps with science homework. She also encourages scientific exploration at home, for which she requires him to keep a science notebook. Sean explained conducting a Mentos candy and diet soda demo (after the explosive results became popular in the media) in the kitchen at home under his mom's supervision.

On the first day of SciJourn topic selection, Sean pitched an article in class on "The Elements," representing the kind of struggle Cynthia described as common among her higher-performing students.

> I [told] them it just had to be science related. The interesting thing was a lot of the kids wanted to pick topics that they thought would please me. And then they wanted me to tell them what to do, and that's, and I looked at the kids and I said, "Whatever you want to do," and that was really hard for them. And I've got to find, to figure out a way to just say, "Hey, you've got the freedom, pick something that interests you a little," bit more clear to them. "You're not pleasing me," because your "A" kids, they're people-pleasers, a lot of them, and they really want to just please the teacher and pick something the teacher would like. And my thing is, "I learn from you, so pick something you like." So, that was kind of rough on a lot of them.

In the class period of topic pitching, Cynthia left most of the questioning to the students, who had feedback for some, but not all student ideas. Even when she asked

Sean about how he would approach the topic of elements, he was unable to clarify what particular angle he would take or how he would make the topic relevant to teens. Soon after, though, Sean submitted a well-written traditional research paper on the elements in general, but nothing near what would make a good science news article. Rather than advising the selection of an individual element that may be newsworthy (a strategy we will see in the next case class), Sean was encouraged to scratch this first effort and find a new topic. In our second interview, several months after this incident, Sean revealed that he had begun a rough draft on "tennis elbow," an ailment experienced by one of his teammates, but had not yet submitted it to Cynthia. He said he understood, after reading other students' articles, what is meant by the SciJourn goals for news being "relevant to the teen audience" and "newsworthy," and admitted to writing the first article based on what he thought would please the teacher, just as she suspected was the case with some of the higher-achieving types of students.

A strong science student, both active in exploring and interested in science topics, Sean was not "hooked" by the SciJourn opportunity, or deeply interactive with science information or science news in the process. His YEST score, like those of the rest of the class, showed a decrease from pre to post.

Summary.

Cynthia's Pre-AP Chemistry students presented more opportunity for viewing SciJourn participation through the lens of each individual's asserted school identity. Terrence, the performer who viewed himself as a writer, excelled in science, perhaps for the first time, when he had a chance to address an audience with a topic of his choice. Angel, a competitor with strong interpersonal ties, strove to complete the task at hand when she saw a student she considered less capable than herself excel, and was inspired by the opportunity to write about a family member, her own brother. Sean, a strong student, followed what he perceived to be the teacher's direction with little further guidance, achieving completion, but not the ultimate goal, which ended up not affecting his grade, or his positive relationship with the teacher.

Even though little class time was spent on SciJourn in the Pre-AP Chemistry class, Cynthia observed the project's impact on some of her students, mainly in terms of science interest, but also in school performance overall:

> … [SciJourn is] great for the kids. You know it gets them interested in science too. I mean look at some of my kids, now they're like, "Oh, I love science!" And I know some of the freshman I'm getting next year, sophomores, they don't like science because their teacher was not motivated, and he's kind of flat, and they didn't do well in there, and he doesn't, he's very intelligent, but he can't teach these kids…And I'm really afraid getting them next year with that negative attitude coming in and I'm hoping, well I know. I'm not hoping; I know with a lot of them SciJourn will change it like it did Terrence: it changed his total outlook on science. It's amazing. Even my ADHD kid it changed, even though I did it later with him. He was in a different [class period]. It changed him a little bit too; he tried to behave better for me and another teacher that was, the Family Consumer Science [teacher] that was working with him too. So, he was trying. I mean, it didn't make him perfect, but he was trying to be better behavior wise.

The YEST Survey did not capture this change Cynthia saw in her students, and in fact showed a decrease in reported engagement across the case study class much like that seen in the implementation group of students overall. It is possible that Cynthia was observing a positive change in attitude towards school in general, a wonderful program outcome, but not one measured by the YEST survey.

Mary Connor's Freshman Intro to Chemistry Class

In a semester-long introductory chemistry course, Mary Connor implemented SciJourn as an extension of an established research project on elements of the periodic table. Mary expected each student to produce a news article about an element and its relevance to teen life, but did not anticipate having time to polish student writing sufficiently for *SciJourner* publication. Her students, all 9th graders, were eager to earn a good grade on the project, and to utilize technology to conduct research and edit peer work. In terms of engagement, however, these young teens exhibited only tangential relation to science and technology, before, during, or after the course.

Mary Connor considers herself fortunate to be teaching at a school where the students are largely extrinsically motivated, informing me that the girls typically hold one another accountable for doing their best work. "They won't let each other get a C," she told me one day after class. Like her students, Mary holds herself to a high standard: "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 is dutiful to the SciJourn research project in completing and organizing all of the data collection and reporting tasks asked of her. Mary goes above and beyond in assisting with this research, providing the researcher with a class schedule to assist in navigating the school's confusing system, video-recording any snippet of a class she thinks may be relevant to the project, and providing hard and electronic copies of power point presentations and other supporting materials students received throughout the semester. Further showing her dedication to SciJourn, she's begun recruiting other teachers at the school to assign science articles to students in their classes, and shares SciJourn regularly amongst the staff:

> Yeah, I do I talk about it at almost every department meeting… at that Back-to-School meeting, [the school principal] had a "what did you do over the summer?" [discussion], and I gave a little blurb about what I did for SciJourn, what it is. I handed out the newspapers, you know, I did a presentation on Diigo, and then I followed it up by sending copies of the file to everybody. You know, I made a PowerPoint, and I sent that PowerPoint. So, I sent that to everybody in the school…

Mary is among the most zealous of all SciJourn teachers about sharing professional development experience with the rest of the school, and promoting her students' work as well:

> …every time something big would happen with SciJourn, like a first one published, that was in the school newspaper. It was on the daily announcements, "Congratulations to [Student 025-078] our first student to get, and then I would include, "This is the title of her paper, and this is the link to the SciJourn website." So, people at my school knew. I mean, every time a kid got published [all the teachers] got an email blast from me: who they were, what their article was, and the link to their article online, so.

Following the SciJourn PD, Mary began to see her role in the classroom as that of a connector of science to students' lives, especially for the majority of her students who she knows do not see themselves pursuing a career in a science or technology-based field.

> …in my Freshman class I have a responsibility to lay a base or foundation of science knowledge and science skills…the SciJourn project helped build skills, and it also helped them see that these pieces of information, this knowledge base was changing constantly and related to them, not something dead and memorized and put in a file box and forgotten about. It actually had some application to their life, and so that actually then feeds into the next responsibility [which] is to try to engage them in science to where they see that it's a part of their life. So, it's not just enough to make this foundation for the rest of their coursework, they have to, I believe my responsibility is also for them to see that it does fit with the rest of their lives.

Mary had experience with teaching focused on scientific literacy through a course called "ChemComm" (Chemistry in the Community) the effectiveness of which she believes strongly in, despite the fact that it is no longer offered at her school due to a change in administrative priorities. As a result, she found SciJourn interesting the first time she heard about it from a fellow student in graduate school. She didn't realize until later, however, how well the project supported her school's accreditation initiatives of writing across the curriculum and educational technology. Due to those links, she has found the principal (a former theology teacher) and the school leadership in general to be very supportive.

The case study class at School 014 is a semester-long Introduction to Chemistry for freshmen students held in the spring semester. As in the rest of the school, all of the 20 students in the class are female, and all are white. The school schedule operates on a modified rotating block schedule, resulting in this class meeting once each week for 75 minutes at a time, and occasionally for a second, shorter period, later in the week. In addition to longer class periods, another significant difference between School 014 and other participating schools is a 1:1 technology initiative. Like many other independent parochial schools in this metropolitan area, School 014 has implemented a program to provide each incoming freshman student with her own Macintosh ™ laptop; this technologically enhanced approach to education is viewed by many in the community as an advantage of parochial schools over the public schools in the region (although a few cutting-edge school districts in the area are now following suit.

Mary began the school year with a plan for implementing SciJourn with her year-long honors chemistry students right away in the fall semester. After doing so with some success (in terms of student participation and even a few published articles), Mary decided she would approach the project with the freshmen. Over the semester break she developed a plan to incorporate some of the research strategies and tools she encountered through SciJourn, such as ways of determining website credibility and Diigo, into her standard "Get to Know an Element" project, and then introduce the article-writing as a separate component of the group project later on. It was never Mary's goal for these freshmen students to publish their work in *SciJourner*, but she did introduce them to the paper and the website as a means of understanding what was meant by credible sources and relevant science news at the outset of the course.

Figure 16. Mary Connor's Classroom

Mary's identification with SciJourn was also apparent to a classroom visitor: One bulletin board was covered with issues of ChemMatters Journal, and another wall area was papered with every print edition of *SciJourner* to date. The SciJourn poster "Thinking like a science journalist" was posted in the center of the back of the room as soon as Mary received it. The classroom was furnished with tables and chairs arranged in groups for seating four students together. These features are shown in Figure 15. As mentioned previously, each student has her own laptop to carry from class to class. Mary started the semester in SciJourn style with a read aloud about an accidental death caused by mixing two cleaning solutions together in a prison setting, instead of her usual lecture about lab safety and "a bunch of pictures of things that would never really happen." Mary described in writing (at the request of the SciJourn project team) how she proceeded from there with SciJourn in the case study class.

> Each student chose an element by lottery to research from one of the main groups on the periodic table. Teams of three students crafted a movie using Windows

Live Movie Maker which described their assigned elements and the family to which they belonged. The students used Diigo in order to keep track of their sources and to share them with each other as they worked. Once the movies were completed and the class had viewed all of the student produced movies we moved on to the actual article that they would be writing for SciJourn.

The SciJourn assignment began with the student looking back over their work on their element and finding one area or use of that element which had some relationship or context to their lives. This would become the topic for their SciJourn article. We spent a class period brainstorming ideas and looking up ideas by Googling, "The importance of (element name)" and "Uses of (element name)." Most students had already done some work on this as the movie required them to find uses of the elements in their lives and to explain the importance of the element to life on earth.

Some students felt they had very easy and interesting elements; fluorine in toothpaste, chlorine in swimming pool, helium gas in balloons. Other students had to stretch to find context; rubidium in fireworks, argon in light bulbs and lasers, carbon's role in global warming. By the end of the class period most students were on the trail to their topic.

Over the following weeks topics were decided and experts were interviewed on their topic by each student. This was followed by lessons on attributions, giving credit to our experts and sources of information. Students peer edited each other's papers twice and received feedback from me, their teacher using track changes. The final papers were submitted and they each had a story to tell about their

> element. Each student had made a connection to their element and saw its importance in their lives. They had varying success with writing in the inverted triangle style of the journalist as they were well indoctrinated in the five paragraph essay method.

As described above, once the group movie projects were complete, Mary asked students to write an article about their assigned element. Mary made the process transparent for the students by using her own original article, written during the professional development sessions the summer before, as an example. Even though publishing was not her ultimate goal for them, she involved the freshmen in multiple rounds of peer editing and feedback, utilizing SciJourn processes and the school's unusually high technology resources to an advantage other schools do not have. Using the school's Wi-Fi system in class, it was easy and efficient for the students to conduct internet research, set up Diigo accounts to save their sources, email documents to one another for editing, and deposit their work in the digital class folder established by the teacher for this purpose.

In addition to topics that related to the girls' own lives as important entrees into SciJourn and science interest, Mary believes that the actual writing was essential to achieving the SciJourn project (which were also her own) goals for skill development.

> …for the freshmen I thought it was important that they had this article they were writing the whole time, and it, we kept using that. Like, what I would do is, "OK write your article," OK now we learn about credible sources, "Now find credible sources for your article," and OK now we learn about attribution, "OK go back to your article and put the attributions in," OK now we learned about experts. "Go find an expert." You know, "Put the expert in [and] show me where you put the

expert." OK now, you know, "Here, let's put a picture in there, let's put a caption." So, it was kind of like the backbone for a lot of the SciJourn topics, and I don't really know if you're [a teacher] doing attributions, why you would do attributions, if all you're doing is reading other people's attributions rather, or reading about other experts rather than finding your own expert who's an expert on the topic you're writing on. So, I think that's really important…

The authenticity of this focus on news production characterizes Mary's class as a high implementation classroom. The formal organization of her students' SciJourn experience around their own articles allowed the teacher to serve as monitor of the student writing process, especially as she continually referred to her own article as an example. As a group, the twenty students in Mary's class started the year with a low mean engagement score of 0.23 (*SD* = 0.13).

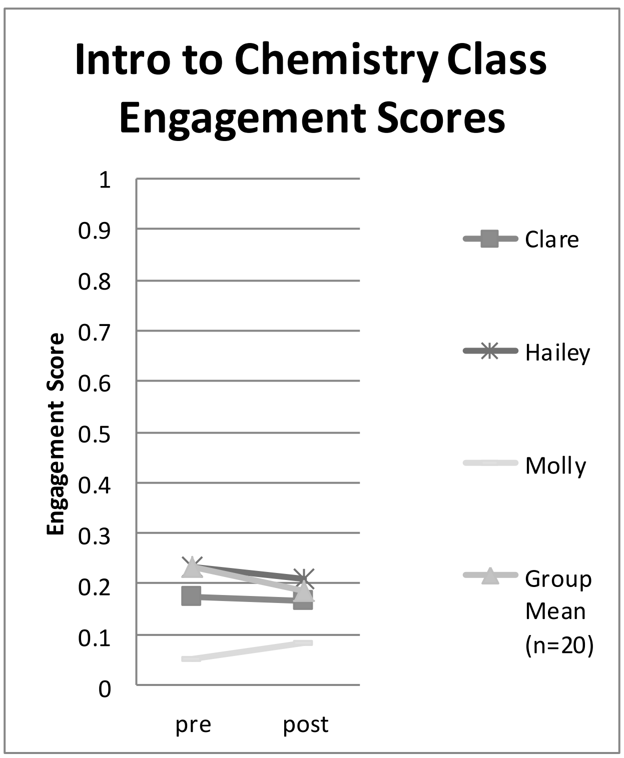

Figure 17. Introduction to Chemistry Class Engagement Scores

Even from this low starting point, however, the group score decreased, however insignificantly ($t(19) = 1.61$, $p = 0.12$) to a mean of 0.19 ($SD = 0.10$) at the end of the year. Three of these students told me about themselves and their experiences in this setting during the spring semester Intro to Chemistry class.

Hailey.

Hailey has long brown hair, freckles, braces, and strikes me as sort of an average 15 year old—although appearances can be deceiving in an all-girls school where students spend little time on themselves other than schlepping into a uniform and slicking hair back into a ponytail each morning. She spends time with her family (including a younger sister and two working parents) either at home, church, or out to eat, and otherwise occupies her free time shopping or going to movies with friends. She also knits and has recently taught herself to play the guitar.

Hailey scored low (0.23) on the pre-SciJourn YEST Survey, but was selected for interviewing anyway due to the teacher's description of her as a student who identifies with science, particularly in terms of her future plans. Hailey's only school activity is "Club Sandwich" which she explains to me as basically meaning she contributes $5.00 per week to have a sub sandwich for lunch once a week. Beyond this, Hailey tells me she is focusing on academics as a freshman as she transitions from middle to high school, and plans to run school track in her sophomore year. On the survey, she stated that she wanted to become a veterinarian (an interest confirmed by Mary), definitely a field deeply involved in science, and requiring a lot of science schooling. In our interview, however, it became apparent that Hailey's true motivation for pursuing that profession is actually her love of animals:

> [I'm] always asking my dad for, like, a kitten or a puppy, and he's always telling me that when I grow up and I have a farm or something I can have as many animals as I want, so, and I don't like to see like when animals are hurt, so…

She would like to have a job where she could work with them every day and heal them. Hailey has several pets (three dogs and two cats) at home for which she is primarily responsible. After finding science "confusing" in her elementary school experience, Hailey's interest in life science was fostered in middle school by a teacher who "was cool…he did a lot of experiments and he would like explain it in like ways so you would, like, understand what was going on." Hailey is mainly interested in science related to the human body and animals: "I like to know how, like, everything works because it's like, you see someone on the outside, and it's, like, weird to think there's, like, stuff on the inside that's, like, doing work to keep your body, like, going."

Hailey considered herself fortunate in having randomly selected the element fluorine as the topic of her element project. She found writing about how fluorine is important in tooth health "interesting. It's been kind of fun to, like, learn about my element…And I got to learn, like, what it does to your teeth, and why we need it, and what happens if you don't have it. That was cool." Through her internet-based research, Hailey "found out that we have to have [fluoride] because it strengthens your tooth enamel, and if you don't have tooth enamel then your teeth will start to rot away." This topic, although literally drawn from a hat at random, connected directly to Hailey's established interest in health and anatomy.

With regard to the two peer edits Hailey had the opportunity to make using "Track Changes" in Word, she "thought it was fun. I liked reading other people's articles and learning about their topic." Hailey also enjoyed reading articles in SciJourner. She said it "was kind of cool to like read what other teens found on like other subjects and what they knew and then they were like teaching us and we could like understand it because it was written by people like the same age." Reading their work made her "think" she might want to have her own article published someday. She says SciJourn activities helped her recognize that "There's a lot, like there's a lot of stuff in your daily life that involves science that you wouldn't really think does."

Hailey said her article was based on internet research as well as an interview with her own dentist, although none of these sources were directly attributed in her writing. Through reading her peers' drafted articles on magnesium and potassium, Hailey said she learned about science as "something that's in your everyday life." She attributed an increase in drinking water to learning what she did about the importance of fluorine through her own article research: "Like, when I drank water I didn't really know that there was fluorine in it, but then I learned there was, and so now I kind of drink more water so that my teeth will stay healthy." Through SciJourn, Hailey realized that, "There's a lot of stuff in your daily life that involves science every day that you didn't think of before."

When prompted, Hailey said she would be interested in writing more articles, if given the opportunity in her science class the following year (biology). She has ideas for future articles related to animal dissection and causes of animal diseases for which she would go to the vet for more information. Despite this stated increase in recognition of science in her everyday life, and her persistent identification as a future veterinarian, Hailey's YEST Survey engagement score dropped slightly over the semester, from 0.23

to 0.21. This low score seems surprising for a student set on pursuing a science-based career like veterinarian, however, in our discussion, Hailey tells me that she only sees herself as a scientist when she is "doing experiments and like thinking about how things work" which she may not see as a vet's work. Also, her motivation for being a vet is more focused on the love of animals than the science or medicine behind treating them, if she is even aware of that at the young age of fifteen.

Molly.

Molly is an only child who spends most of her free time at home with her parents or friends. Her social pastimes include shopping, movies, and ice skating, and when she's alone, she does a lot of reading, listening to music, and writing what she calls "novels" for which she gets the ideas from music. Molly favors history and English as school subjects. In an interview, she couldn't think of a single topic of interest to her in science or technology, although she did think the labs in her 8th grade chemistry and biology classes were "fun."

For Mrs. Connor's class, Molly wrote an article about potassium, focusing on the body's need for the element. Molly expressed repeatedly how she resented being "assigned" a topic for her paper (although it was actually selected at random), and cites the articles she read for peer review (on topics of rubidium and fluoride by classmates Hailey and Clare) as far more interesting topics. Even though she considers herself a creative writer, Molly did not see the purpose of writing in the science class. She understood the inverted triangle structure for a news article, but rolled her eyes as she explained the details of it to me. She wished aloud that if they did have to write that the students could have at least had a say in their topic selection.

When given time in class to read a new edition of *SciJourner*, Molly found the article on mono "The Kissing Disease" interesting because it was "relatable," since she shares drinks with her friends all of the time. However, when she wrote her own article, she received an edit from peer reviewer (Clare) suggesting that she try to make the article more relevant to teens through perhaps a catchier lede, or beginning, to the story. In her final draft, Molly made only the grammatical and phrasing changes suggested by her peer editor, and did nothing to add to the initial appeal of the article overall. Also missing from the story was attribution. The day before the first draft of the article was due, Molly was still considering who to contact as the first-person expert for her story. She told me she may call her cousin, who is "like a sister" to her and also a nurse who has witnessed the effects of low potassium on the body, but they had not made arrangements for the interview yet. If she did, indeed, consult this "expert," the results of their conversation were mingled with other unattributed facts about Potassium in the article such that the reader would never know the source for any of the information presented.

Molly's original YEST Survey score of 0.07 was one of the lowest across the entire implementation group. At the end of the year, her score increased only slightly, to 0.09. However, she received an A in the class, possibly because she had studied Chemistry topics in an 8^{th} grade science class, which she found challenging at the time, but may have been more comfortable with as a result of its recency. Regardless of the reason for her high final grade, Molly's case raises questions about the potential relationship between achievement in school and engagement with science and technology.

Clare.

Clare showed initial low engagement (0.17) on the YEST Survey. She has three siblings and enjoys soccer, art, photography, and writing. She became involved in photography when her aunt, who is a professional photographer, gave her a camera in 6th grade. She "looks for light" to create portraits of others. Clare is an excellent player of soccer, "the only sport I like," which she has played since Kindergarten on an undefeated team. She likes school and learning, and considers herself a "pretty good" science student. Grades are important to her family. In an interview, she recalled projects completed in prior grades that she enjoyed, especially eighth grade explorations of the periodic table and Rube Goldberg design.

Clare's article for SciJourn was written about the element rubidium, which she told me (and wrote) is the element responsible for purple-colored fireworks. The article, according to feedback from peer editor Molly, was, in the first draft, "interesting, but short." Molly pointed out only a couple of specific changes to be made to the article, including clarification of the science behind the release of colored light in the firework explosion. She also urged Clare to lengthen the article, perhaps by adding some history of the element or of fireworks in general. Clare took neither of these suggestions in her final draft, however. And, like Molly, her article lacked attribution of information sources entirely.

Clare found Mrs. Connor's use of her own SciJourn article as an example in class especially inviting. Clare liked the actual writing—she would like to be a published novelist someday—and appreciated that "everyone has a chance" to be published in SciJourner, an insight she gained through her teacher's habit of spreading the word far and wide throughout the school when her other students were published and recognized that the authors were not only A-students or typical school leaders. Writing an article, according to Clare, “helped me like science better. There are things about science I like now.” Despite what might be described as a change in interest, Clare’s overall engagement score remained exactly the same at the end of the school year (0.17).

Summary.

Across these three interviews, it is apparent that Mary’s freshman students gained some skills in researching their topics that are explicitly related to their teacher’s organization of the coursework around a framework of SciJourn activities. They also grasped the concepts of the inverted triangle journalistic story structure and credible sources. In talking with me, each of the girls cited a gain in awareness of personally-relevant science topics through reading the articles of their peers, both in the process of peer editing and in reading published *SciJourner* articles in class. Molly even said she had gained awareness and changed her behavior of sharing drinks with her friends after reading an article on mono in *SciJourner.* Clare and Molly, who started with the lowest engagement scores on the survey, made few associations between what they were doing in their own SciJourn assignments and the rest of their lives. Mary was not convinced of the girls’ efficacy in providing strong feedback to their peers, in fear of hurting feelings of or offending their friends, but the action of peer editing, along with reading of the published *SciJourner* and scijourner.org articles, served as an invitation to students to learn more about teen-relevant science topics in this case as it did in Luke’s class. Additionally, Mary’s use of her own published *SciJourner* article, and the steps she took in drafting it, as an example for the girls’ learning process, helped her students connect to her as a fellow learner and also understand the persistence necessary to complete the task at hand. Mary's encouragement led these case study students to pursue internet and first-person sources whose credibility they scrutinized. But perhaps in part because Mary did not have a goal of these students publishing their articles, they submitted final drafts that lacked attribution of the internet and first-person sources they had used. A review of eighteen articles submitted by students (after responding to peer review) in this class revealed four articles including any attribution, three of whom attributed multiple components of the article to outside sources. In the other fifteen article drafts, two students listed website(s) from which they sourced information at the end of the text. Three other students appear to have included quoted information in the article without quite understanding the purpose of the requirement; the quotes were attributed to irrelevant, and sometimes historical (e.g. Thomas Edison) individuals with unclear connections to the topics at hand. The remaining seven included no quotes or delineation of sources for the information they wrote. Despite this, only two students received less than the maximum of five points for attribution in Mary's grade book, and 19 of the 20 students in the class received fifty out of fifty possible points for the final article draft.

As a class, the freshman students in Intro to Chemistry started with a low average (0.23) engagement score and finished even lower, although not statistically so. While similar to the trend in the implementation data overall, these survey scores do not support the students' statements and Mary's sense that, "the biggest overall thing it helped was it helped them get interested in science; to me that's the biggest thing that happened was they became interested in science." Mary's perception of interest may be the type of awareness each of the student's expressed as having gained in the process of either researching their own topics or reading the work of their classmates. In terms of the YEST Survey, which is designed to capture evidence of a more persistent interest, what SciJourn may have introduced to these early high school students is something more like a taste of the potential for science connections to their everyday lives. While not the sort of “capital I” Interest measured with the YEST survey, this increased awareness is a positive outcome of the SciJourn project, a necessity for the development of deeper or longer term interest. As a research outcome, it is important to recognize that the YEST Survey may be better at collecting information about persistent interest than about the sort of “in the moment” positive stances toward science and technology that a short-term intervention (like writing one science news article in a semester-long Chemistry course) may be more likely to yield.

Summary of Case Studies

Each of the case study teachers entered SciJourn for a different reason; Luke at the bidding of his division chair and in the interest of additional income and re-invigoration of his teaching, Cynthia as a collector of strategies for helping students achieve, and Mary to meet her personal and school goal of connecting chemistry students to the science around them. They also each built SciJourn activities into an established curriculum in an equally unique fashion. Their varied strategies fostered (or didn’t) student engagement in as many diverse ways, as illustrated by the productivity of their students and the gains or losses in student engagement with science and technology observed and shown in YEST Survey results. In terms of growth in student engagement through SciJourn, key affordances observed in these case studies include clearly outlined activity requirements and goals, peer editing, frequent and ongoing teacher-student dialogue, freedom of topic selection, and multiple opportunities for news production throughout the school term.

Chapter Six: Conclusions and Implications

This research was developed to consider high school student engagement with science and technology as affected by participation in the Science Literacy through Science Journalism (SciJourn) Project. The specific questions under inquiry were stated as:

1. To what extent does the SciJourn project influence students' engagement with science and technology both in and outside of school?
2. How do quality of participation and other individual participant characteristics relate to the degree and nature of science engagement?

As noted in the previous chapter, results of the YEST Survey, analysis of which resulted in the rejection of both hypotheses, confounded this researcher and others involved in the SciJourn project. It was known from the outset of this inquiry that assessing a complex construct such as engagement with a survey was not ideal. However, the efforts made to develop a survey for this purpose, and pilot results of the YEST Survey gave reason for hope that progress may be made toward a large scale analysis of engagement data. In reality, this effort gave mixed results.

Insights into Unexpected Results

Focus groups conducted with small groups of SciJourn teachers in September, 2011 provided insight into possible reasons for these confounding results. A brief overview of the survey results was presented, and the question "How would you explain these results?" was posed as a discussion starter. Teachers came up with several factors that may affect all student data, such as timing of the end-of-year survey-taking coinciding with a period in the school year when students are feeling "stressed, when they are fed up, probably, with science." Many mentioned the end-of-year timing and accompanying apathy, especially of seniors, as a possible factor in skewing responses. Teacher 034 thought that students might be making a concerted effort NOT to count activities in their out-of-school life, saying students think, "I really want to have my school life and my real life, quote 'real life' separate.' Another issue teachers perceive with the survey is that students have to cast their memory back to consider activities in the last six months. Teacher 019 said, teens "sometimes, if they're doing it right now, they're doing it a lot. If they did it in the past, they're not doing it anymore." Other students may not be sure what to count as science or technology-related activities, since they often express confusion in the classroom about the same. Teacher 019's students, when they were brainstorming topics for articles related to science "come to me and they said, 'Well, I wanna do mine on cancer. Is that science?'" and that this confusion as to what is and isn't "real" science may have contributed to confused answers on the survey. After clarifying to focus groups that these concerns are all valid in administration of surveys to high school students, but that these factors should affect the entire group, and not just the students in high implementation classrooms (where the data were most confusing), teachers dug a little deeper.

Further discussion led to identification of one main factor that rose consistently, unprompted, out of all four focus group conversations: Teachers believed the responses of students who were involved in the production as well as consumption of science news through SciJourn showed that they must have developed a different, and perhaps even a more scientifically literate, view of what "counts" as science, particularly credible science. Or, as Teacher 003 put it at the outset of a focus group discussion, "They didn't know about it before, and now they're doing it, and I think they're, they're 'over grading' themselves. They're, I think that they're over-picking themselves" as this teacher has seen students do in an unrelated self-grading activity his students complete. He believed students could represent the learning they've done orally more so than they have done on the written survey. "I think if you sat down with any of those kids and said, 'So, tell me about this, this, and this' [survey items], they'd come, you know, verbal diarrhea would come flying out, and…" Other teachers interrupt to agree:

> TCH006: "Yeah, I do this, yeah, we do this" [imitating a student]
>
> TCH035: They'd say, "Oh, yeah, yeah, I do that!"

Teacher 006 believed taking the YEST Survey caused the students involved in SciJourn, who gained this increase awareness of science in their daily lives to be "critical. Like, 'Well, I really *don't* do it that much, as much as I should.'" Teacher 035 concurred, "I think that's kind of the concept that's happening here is, they've learned more and actually realize they know less, and I think they actually are being overcritical or something." Teacher 003 had seen this happen with other students:

> But they do, you know. I do that [kind of assessment] with my [basic science] kids every year. We're talking about, we're talking about low, low level kids. You know, we talk about, "Do you use the scientific method?" [and they respond] "No, I never use it." And then you start going through cues and then every four minutes or so, you're using some form of it.

He believed the students had internalized what they'd learned through SciJourn to an extent that they don't even realize when they are referring to that knowledge

> …I think, I think now they have a concept of what they do know…it's like when you learn more, you realize you know less...I think, I think that it becomes more ornate as time goes on, and it's not a recognized old thing. "Hey, I just read an article on science," but it just kind of blurs in. [Teacher 006 agrees.] I think a lot of the stuff becomes naturally part of their meaning over time and [they] just *don't* [think they] realize that they're doing it.

He related this directly to student responses on the YEST Survey, which asks students to recall specific "science" and "technology" activities, which they may no longer even 'count' as science because of their new, more sophisticated view of these subjects.

> I think it, I think before they started, if you sit them down and said, "Let's look at something in science," they're going to say, "Okay, well, I'll watch Discovery tonight for an hour." They might still watch *Mythbusters* or something else, and they, but they'll see it from a far different depth than they saw it before and be more critical on it. But I don't think they realize it.

Another focus group had essentially the same conversation:

> TCH024: I think what it is is that you're having more educated response. In the fall, "Oh, yeah, I do science all the time"
>
> TCH055: I agree.
>
> TCH024: I watched after school "Mr. Bill," you know
>
> Luke: Shark Week!
>
> TCH024: and whereas now they're more critical about what research is, they're more critical about am I going deeper and they're realizing that

TCH038: [interrupting, voicing as student] "I didn't do as much science as I thought I did."

TCH024: Right.

TCH038: That's what I think.

TCH055: That's what I think. When you were going over [the data], that's the first thing that came to my mind.

TCH038: [interrupting] that what they thought was science before isn't really science anymore so

TCH055: [interrupting] or they're becoming more critical of themselves as they go in depth.

TCH038: So *Bill Nye* or watching *Animal Planet* really isn't science [to them] anymore, where it used to be. But it still is, but they just don't get that it still is.

According to SciJourn classroom teachers, two things happen as students participate in SciJourn that may have caused in the unexpected results of the YEST Survey. One phenomenon is that the students become more critical of science sources and experts, and then, in the end of the year survey, apply this criticism as they consider what science or technology activities they have engaged in themselves.

Agreement with this idea was found in all of the groups, including the following, in which teachers hypothesized that the observed shift in response to YEST Survey questions was a result of increased scientific literacy resulting from SciJourn involvement.

TCH061: But did the definition of what is science change? Because once they started doin' it, then they figured out this is what science is…so now that they've started researching and they've written an article, now they know what science really is…So maybe their definition of what was science has changed.

TCH026: I think that sounds like it, it, it really might be the answer because, um, they know more and now they're making judgments that they wouldn't have made… [overlapped talk by a few teacher participants, indecipherable]

TCH052: As an example, I, I know some of my students asked me during the survey, they're like, "Is cooking science?" and I said, "Just put what you think."

TCH061: Exactly.

TCH052: And yes, there's a lot of science in cooking. But I wonder if focusing on other science-related topics as the year goes on, at the end of the year, they might not consider that science.

TCH061: And if that's the case it's not a bad thing cause…if you go a step further and you find out it's 'cause they have become more scientifically literate, that now that maybe they could [trails off]

TCH026: And that's the only thing that even makes sense because now they know they're doing more.

Teacher 057, after taking in the confounding results and the conversation amongst his peers, said he thought these were "cooler results" than if the finding had been increases in engagement across interest, action, and identification components of engagement. Teacher 055 found the results "fascinating… [because] it appears to be maybe that they're thinking of things differently and they, they've grown in their knowledge and so they're being more specific about what, what science articles are." Additionally, students in SciJourn classrooms may have become so immersed in science reading, writing, and other activities that they don’t even recognize them as standing out from the rest of their daily lives. Another focus group came to the same conclusions, as illustrated in the following section of the conversation.

> Luke: So, I think in my experience, the kids think science is something lofty; it’s way up here, and we can’t do science because we’re not smart enough. We’re not-whatever criteria they have established for themselves…And I think by the end of the year with what I did, it’s so broken down and so basic, and so much a part of their life that they don’t think of it as science anymore. But it is, in reality, but it’s not, and, and so, yeah, I think that it’s hard. [Continues, imitating hypothetical student] “Oh, but I’m writing this article, so it isn’t that hard. It’s kind, I kind of enjoyed it. And, and if I’m enjoying it, it can’t be science.”

Another alternative explanation for the survey results is that students are not considering the activities they do as part of their SciJourn work science or technology activities, since they are associated with writing—which is in their view a non-science endeavor:

> TCH038: Right. "SciJourn isn’t science; it’s journalism. It’s not science, it’s writing." You know, “I’m looking at the Mayo Clinic, that’s not science, that’s”
>
> Female teacher: [interrupting] research
>
> Luke, agreeing: Yeah.
>
> TCH038, continuing: “…It’s research. It’s medicine.”

Teachers were convinced, as were my SciJourn project colleagues and I, that at least one of these explanations of the data must be at play. Teacher 003 said, “I really do think they’re doing [science] more, because they’re bringing me in articles [about science on their own]. I mean, they’ve gotta be doing it more. They’re asking me questions they’ve never asked before. They've *gotta* be doing more." While these conclusions about the data trends are more encouraging than the initial perception that SciJourn was actually resulting in decreased student engagement with science and technology, there is still a challenge to be resolved. As stated by Principal Investigator, Dr. Joseph Polman in one of the focus group discussions,

> ...[we want students] distinguishing between credible sources and less credible sources, and sources that are appropriate for making tough decisions, and what kind of expertise do they have, and all that kind of stuff. Yet, we want 'em, them to see that science is everywhere, and it's [relevant] to them...

Both recognizing that sources vary in how credible they are for obtaining rigorous science information and recognizing science in the world around us are aspects of scientific literacy, and the project does not wish to preference one over the other. However, pushing students to be more selective about what sources of science information they consider credible may sometimes result in students seeing less of what they encounter in the world as counting as science. Teacher 038 said,

> … [In the classroom] that never comes up when we push credible sources and stuff. You don't, you don't, we talk about looking for scientific sources to do research in our own lives, but we don't then still go back and say, "You guys probably do science for fun all the time and don't realize it. How many people watch *Animal Planet*, how many people have ever seen you know… the zoo animals? That's science."

Such reminders embedded in SciJourn teacher practices may help assuage the situation represented by the student data, if indeed the issues of credibility and student science action are linked.

As illustrated by the conversations presented above, teacher focus groups mostly agreed that somehow, students in the high implementation groups—those involved in both the production and consumption of science news through their SciJourn participation—developed a heightened awareness of what is "credible" science. This more critical outlook, perhaps a result of analyzing credible sources of science information and experts related to the science issues they researched in class, may have resulted in their "counting" less of the activities at the end of the year than they considered as science-related in the pre-survey.

Given the outcomes, it appears that the SciJourn intervention itself may have reduced the reliability of the YEST Survey in measuring engagement with science through its effective achievement of shifting student views of "what counts as credible science"—an explicit target of the project. If this is the case, and SciJourn involvement did influence student perspective of real, or good, science, the YEST Survey appears to have captured that shift, rather than student action. For students in the comparison group, who did not experience the SciJourn intervention, "science" may have been more static from pre to post, and there was also no change in the intended construct to be measured by the survey: engagement.

Lamb and Tschillard (2005) experienced a similar surprising result "when teachers in our workshops told us they already knew all about inquiry-based teaching and used it all the time in their classes. Our observations told us just the opposite." According to Howard (1980),

> In using self-report instruments, researchers assume that a subject's understanding of the standard of measurement for the dimension being assessed will not change from one testing to the next (pretest to posttest). If the standard of measurement were to change, the ratings would reflect this shift in understanding in addition to any actual changes in the subject. Consequently, comparisons of the ratings would not accurately reflect change due to treatment and would be invalid. (p. 94)

This phenomenon is not unheard of in the evaluation of program effects; in 1979, Howard, Schmeck, and Bray coined the term "response-shift bias" to describe instances in which "an experimental intervention alters subjects' understanding of their level of functioning or interpretation of self-report items" (p. 131) thus negatively impacting internal validity of the measure by confounding historical and instrumentation threats to internal validity (Howard, Schmeck and Bray, 1979). In their review of studies citing response-shift bias, Allen & Nimon (2007) found that

> In most cases, when participants do not have sufficient knowledge to gauge their pre-intervention behavior, they tend to overestimate their level of functioning. In traditional pretest-posttest designs, this effect has a negative influence on program outcome measures. (p. 30)

Given the case study research presented in Chapter 5, as well as a large number of SciJourn researcher and teacher observations, it does appear that response-shift bias is exactly the problem in student responses to the YEST Survey.

In response to the challenges of response-shift bias in self-report data collection, Howard, Schmeck and Bray (1979) suggest the use of a retrospective pre-test in addition to the traditional pre and posttest measures. Originally described by Campbell & Stanley (1963) for use in cases where it is otherwise impossible for the researcher to garner insight into pre-intervention status, Howard, Schmeck & Bray (1979) suggest that "retrospective measures are called for…in instances where response-shift bias is probable" (p. 131). This recommendation was made after observing that their own findings, in four different pre-post studies, "favor[ed] the Retrospective Pretest-Posttest Design in providing a measure of self-reported change which is in closer agreement with the behavioral changes observed" (p. 131). In other words, "their research found that, when individuals did not have sufficient information to judge their initial level of functioning (i.e., individuals did not know what they did not know), the retrospective pretest provided a more accurate measure of pre-intervention behavior" (Allen & Nimon, 2007). Similar results have been found in subsequent studies (e.g. Sibthorp, Paisley, Gookin, & Ward, 2007; Lamb & Tschillard, 2005), and in a review of several studies conducted by Nimon and Allen (2007) in which they reported that

> retrospective pretests provide a more accurate measure of preintervention behavior. Allowing individuals to report their pre- and post-intervention level of functioning using the knowledge they gained from the intervention mitigates the effect of measurement standard variance that can occur in traditional pretest-posttest designs…When participants' pre-intervention behavior is measured retrospectively, they generally provide more conservative estimates than they

> provide prior to the intervention. This effect has a positive influence on program outcome measures. (p. 30)

As stated by Howard, Schmeck, & Bray (1979),

> when an experimental intervention alters subjects' understanding of their level of functioning or interpretation of self-report items, posttest-only comparisons are not appropriate since treatment and control subjects' ratings are made with respect to different scales. In this case we suggest retrospective measures to gain perspective and control for the effects of response-shift bias. (p. 131)

Based on a brief review of the research on response-shift bias as described here, it appears clear that this phenomenon may be responsible for the unexpected results of the implementation group post-SciJurn YEST Survey. Given the research-supported potential of retrospective pre-testing as a method for overcoming the invalidating effects for response-shift bias, it is recommended that a retrospective pretest version of the YEST Survey be administered to SciJourn students in the 2011-12 school year to investigate further.

As mentioned in the Classroom Case Study section of the prior chapter, Luke’s student scores on the YEST Survey stand apart from those of the other two case study classes, and from the aggregate scores of the implementation group overall, and the high implementation sub-group, in that they show class-wide and individual *increases* in engagement. While it expected that Luke’s implementation of multiple “rounds” of SciJourn throughout the year served to increase student awareness of their involvement in specific “actions” measured by the YEST Survey, the explanations for the decreases in engagement scores provided in the previous chapter would lead one to believe that of all the scores, Luke's students should be among the lowest. The cases of Brendan, Ramiz, and Kristopher provide insight to the contrary: when involved in SciJourn as a process embedded across the school year, students were able to forge more frequent and meaningful connections between their persistent interests and identifications. Thus, a decrease in areas of action may have been masked, among Luke's students, but greater gains in interest and identification than those in other classes. While interesting to ponder, these layers of confounding results support the need for research into student thinking around survey completion and improvements to future iterations of the YEST Survey, as will be described in a later section.

Connections to the Literature

In addition to understanding changes (or not) in student engagement through the use of the YEST Survey as a measuring tool, the case study research presented here responds to Tabak & Baumgartner's (2004) call for research "on instructional moves that can demystify the process of science and help students identify themselves as ratified participants who can contend with scientific issues as adults" (p. 393). Through observation of three case classrooms, evidence was gathered regarding the choices and roles of SciJourn teachers and how those decisions impacted student participation in SciJourn as well as the outcome of student engagement with science and technology.

Like Tabak & Baumgartner (2004), who speak of "symmetry" in teacher-student discourse as key to successful scaffolding, it appears that, in addition to repeated involvement in an authentic practice, another strong factor in shifting student engagement with science was the role of the teacher, or the "positioning" (p.400) of that teacher in the SciJourn process. As participants themselves, charged with producing a science news article of their own during SciJourn summer professional development, teachers were poised as mentors to their science news journalist students. Through persistent references to her own experiences with drafting and editing the article she wrote on chemical hazards of automobile safety airbags, Mary mentored her students through the process of finding sources, linking a chemistry topic to everyday life experiences, and responding to comments from editors. As mentor, Cynthia set the task of writing a science news article to the students, providing it as an optional challenge to which she provided targeted feedback at every turn by the students who chose to response to the challenge. In the extreme positive case, this yielded over a dozen drafts (by Terrence) of an article before it was accepted for publication, many of these before anything was submitted to the SciJourn Editor. In the more common cases, this resulted in students not producing any article drafts but nonetheless participating in conversations about credible sources for science information and developing a greater appreciation of how science and technology relate to their everyday lives. Luke mentored student journalists through ongoing one-on-one conversations with students about their research and writing.

In each classroom, the teacher also played the more traditional role of monitor, largely toward the goal of moving students toward completion of the assignment and the reaching of curricular goals. For example, Mary, after modeling each step in her SciJourn project for the students, checked on their progress throughout, in a sort of checklist fashion, with no grade assigned to the students until they had completed the entire list of tasks, including responding to the edits of multiple peers. She attempted, by sharing her own work with students, to establish herself in a mentor role, and yet by not participating in a balanced discourse with the students about their own work along the way, remained in an authoritative monitoring role. In keeping with their findings in the inquiry science classroom (Tabak & Baumgartner, 2004), symmetry of positioning between teacher and student to achieve the greatest outcome seems to apply to the outcome of engagement in the SciJourn classroom as well. These results, along with Tabak & Baumgartner's work, align with the longer-standing philosophies of learning associated with Dewey (e.g. 1916), Vygotsky (e.g. 1978), and Rogoff (e.g., 1994) described in the literature review section of this study as well.

Similar to many of the prior engagement studies described earlier in this paper, I have found that factors outside of the action, interest, and identification with science and technology seem to also play a role in student engagement. The degree to which a student participates in a science or technology-related activity either in school (like SciJourn) or out of school (like robotics) relates to positive feelings (as found by Lau and Roeser, 2002) as well as the self-regulation strategies espoused by Holcombe (2010). In this study, our "most" engaged student as indicated by survey responses, Ramiz, described "fun" times exploring robot programming and green technologies in extracurricular activities. Mary's much less engaged students didn't find much to be excited about in terms of science. However, although not the focus of this study, SciJourn student grades (our most common measure of student achievement) do not appear to be a predictor for meaningful participation in SciJourn (at least as evidenced in the self-report data we have); students' perceptions of themselves as science learners, however, may. Further study of pre-SciJourn engagement scores is needed (perhaps along with objectively collected achievement data) before conjecture may be made about identification with science and technology as a predictor for SciJourn "success" via publishing.

Implications

Results of the Youth Engagement with Science and Technology (YEST) Survey and collective case studies show that the ways in which SciJourn influences student engagement are nuanced, especially related to the 'action' component of the engagement framework of action, interest, and identification. Sustained involvement in SciJourn activities, such as the experience of students in an environmental science class who were charged with producing up to four pieces of original science news, resulted in the greatest increases in student engagement. The nature of these students' engagement was increased interest in science topics related to their everyday lives in addition to the obvious increase in the science and technology related activities required of SciJourn participation, such as internet searching and discussion of related topics with family members. Student identification also served as an entry point to further engagement with science and technology through SciJourn, such as in the case of Terrence, a student who rose to the challenge of writing when his identity as a performer and audience-pleaser was engaged by the classroom teacher.

These results help solidify the assertion that engagement is a multi-faceted construct, perhaps even more complex than described at the outset of this study. Case study findings, in particular, led to the conceptualization of engagement as an inter-dependent working of gears, as depicted in Figure 18, into which a student may enter from any or several points, and each of which serves to drive the other further. When considered from this point of view, Terrence's personal interest in mold may have served as the starting point for his research and writing on the topic (action), which was energized by Ms. Morella's quick feedback on his efforts. As mentioned above, the teacher's praise of Terrence both private and public fed his identity, further driving both Terrence's interest in the topic and persistence in the writing and editing process toward the driven the possibility of publication--further public approval. Through Terrence's ongoing work as a SciJourn participant at the local informal science institution, we can imagine that the inner workings of the engagement machine continue.

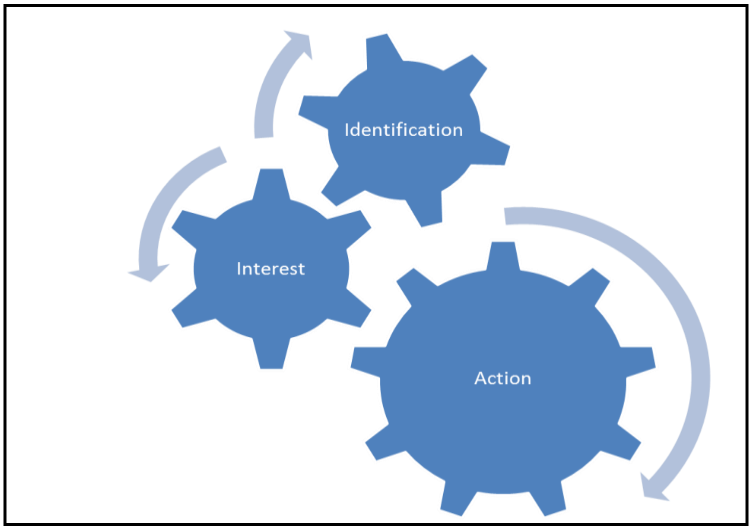

Figure 18. New Interactive Model of Engagement

As a mechanism of action, interest, and identification, engagement is not significantly impacted by brief encounters with a phenomenon. It is possible, as shown by the experiences of Brendan, Ramiz, and Kristopher in Luke's class that more substantial (through repeated opportunity) involvement in an activity system has a greater impact. This finding supports assertions by Azevedo (2004) emphasizing the sustained, rather than cursory, participation in a practice as the key to lasting impact.

There are, however, lessons to be taken from each aspect of the interactive model of engagement posited here.

First, it is important to note that while a major assumption of SciJourn is that the project activities take place in a classroom setting that is transformed into a community of learners such as that described by Rogoff (1994) as an effective learning environment, the reality of these three classroom situations was somewhat different from the ideal. For the most part, the activity structures in these classes consisted of individual work, punctuated by intermittent feedback by an individual— a peer, the teacher, or the SciJourn editor— and then more individual work in response. Luke set the stage for more frequent interaction with students, but still on a one-on-one basis, and not in the form of a "community" of learners influencing one another's process. The most notable outcome of the level of community these teachers did establish through SciJourn, however, was exposure to and learning from one another's topics. Most often, this occurred through peer editing, although sometimes in conversation with a classmate about the assignment. In Angel's case, simply overhearing another student's discussion with the teacher about a story related to a parent's illness fostered Angel's launch of a topic coming from her own family experience. It may be that the degree to which a learning community is established with SciJourn is an important factor in fostering student engagement.

In this study, engagement was hypothesized to vary with implementation level. However, the designation of high, medium, and low levels of implementation may have over-simplified the differences between teacher implementation strategies; rather than uni-dimensional (goal of producing news versus news consumption only), there are layers of implementation strategies interacting in each implementation setting. In this research, I've presented close examination of the similarities and differences between three classes of teachers first designated as "high" implementers, which included the above consideration of community, along with the teachers' own positioning choices, as well as decisions about utilizing technology, peer editing, and topic selection, which all played a role in engagement outcomes beyond their shared intentions toward producing science news. Another perspective would be to regard implementation status at the student level. For example, students who persist through the editing process to the point of their working being published may be the high implementing SciJourn participants. Consideration of implementation by teacher or student, and the relationship of that implementation to student outcomes generates further questions.

Future research.

This initial study of SciJourn student engagement is only the beginning of the investigations that may be conducted using the YEST Survey and case study data. Already, several opportunities for research into the phenomenon of engagement with science and technology among SciJourn participants have been identified. Some suggested research questions for further investigation are posed below.

1. When disaggregated, do student engagement scores in the areas of action, interest, and identification support the explanations for survey results given by this researcher, the SciJourn team, and participating teachers?
2. How do students' ideas about science change through SciJourn, and how do student perspectives on science relate to responses to the YEST Survey?
3. Do results of a retrospective pre-test version of the YEST Survey better represent observed shifts in engagement among student participants?
4. What is the relationship between sustained participation (more than one article, possibly more than one school year) in SciJourn and engagement with science and technology? This would be an elaboration on the trends appearing

in Luke's classroom, which was the only example of this phenomenon available in the current study.

5. What can YEST Survey engagement scores tell us about the kinds of students who persist to publication? What is the effect of publication-level SciJourn involvement on engagement scores? Does this effect vary with initial score?
6. Further study is needed to look at which teachers' students made the greatest engagement gains, and what implementation strategies were used to achieve them.
7. Potential correlations between Scientific Literacy Assessment (SLA) (Farrar, 2012; Farrar & Hope, 2011) and YEST scores, to see if indeed the observed decrease in engagement is a function of increased literacy.

Several subsets of the data collected with the YEST survey offer potential for insight into development of students as future STEM professionals. Within SciJourn, or another multi-year STEM initiative, it would be interesting to track changes in future plans over time, including the major with which they choose and enter college. I am curious about factors that contribute to student consideration of STEM-related careers. In the cases, parental input and career seemed to weigh heavily in student planning for the future. In the survey results, medicine and engineering fields made up the majority of STEM career-identified students' possible futures. I am curious whether student science interests lie in these fields, or if students are simply more aware of career options in these fields than in other areas of science.

Survey modifications.

In addition to further analysis of the current YEST Survey data (and that from participants in the 2011-12 school year), it is recommended that the survey itself be modified to reflect the findings of this study. Discussion of the results found here with those most closely connected with the participants—the teachers themselves—led to the suggestion of many revisions to the survey in hopes of better capturing the nature of high school student engagement with science and technology.

It was anticipated from the outset of the design of the YEST Survey that there would be difficulty found in attempting to measure this complex construct with a paper and pencil approach. As described above, even the seemingly straightforward aspect of action did not present so simply in the results. However, interest and identification, first considered to be the more difficult to measure in this manner, did seem to come through accurately. Review of the results of the YEST Survey alongside case study data, as presented in Chapter 5, show that one could get an idea of the "kind of person" (Gee, 2000) each SciJourn student was from the survey that was verifiable through interview and observational evidence.

In addition to providing insight to the conundrum represented in the data, teachers made several suggestions for improving the survey itself in order to remedy the same issue in future administrations. These recommendations included:

1. Modification of the "How often have you…" section to reflect "daily life" and "classroom" contexts in which students might do those behaviors, since perhaps they are not including both in their responses.

2. Addition of options for selecting from specific websites, magazines, TV shows, etc. for students to clarify what is meant by "science" and "technology" activities.

These suggestions will be taken into consideration as an improved YEST Survey is developed in the near future. Based on the results described in the previous chapters, it is evident that the most work needed or the YEST Survey to reflect student engagement adequately is required in the area of action. Interviews with students in implementation classrooms are planned for spring 2012, immediately following their completion of the YEST Survey. It is hoped that these discussions, focused on understanding students' means for making sense of and responding to survey items will provide insight into our hunch about responses to action items. This feedback from students will be incorporated into edits to the survey design, specifically in modifications to the questions, "How do you use science (technology) in your everyday life?"

Even before receiving that information, however, I recommend a few specific edits. First, the survey length could be reduced by eliminating questions that yielded less useful information. Two questions asking, "How often do you use each of the following resources?" to find science (technology) information were intended specifically for the SciJourn context. Since the data they yielded do not directly relate to engagement overall, they should be removed. These two questions take a lot of space on the paper version of the survey and their removal would reduce the document fourteen items and nearly three-quarters of a page. The items, "How interested are you in school?" could also be eliminated, since the focus of the YEST Survey is on science and technology engagement overall, not school engagement.

Responses to the open-ended items, while interesting on an individual basis for confirming impressions given by participants' interviews, for example, did not, in the collective, yield results more informative than the selected response items. These items, positioned near the end of the somewhat lengthy survey (in its current form) require more time and effort from the teen respondent, as well, and thus may be most affected by the end-of-year and end-of-survey fatigue teachers described as a concern. I recommend removing the open ended questions, and perhaps adding selected response items as follow-ups to the two questions about college major and career choices related to science and/or technology.

I also agree with the suggestion by teachers (above), and suggest the additional change of options for answering, “How often have you…” questions. Established surveys in use among teens will be reviewed for a more appropriate range of options for answering, as well as, perhaps, a narrower window of assessment (e.g., instead of “within the last six months,” perhaps students could respond more accurately to “within the last month.”) Sudman, Bradburn, and Schwarz (1996) suggest that respondents asked to consider behaviors over a long period of time typically extrapolate an answer based on a rate within a shorter time period anyway. Our initial rationale for using the six-month window was in hopes that students taking the survey at the outset of a new school year would include experiences in the prior school year in their responses. Sudman, Bradburn, and Schwarz’ (1996) research, however, shows this is unlikely, and that responses to a prompt of “in the last month” would likely be more accurate overall. This change would also contribute further to the reduction in survey length.

Once these edits have been made, and interview responses from recent survey respondents have been applied, a pre-post administration to a new set of SciJourn participants in high implementing classrooms should be conducted and the results analyzed to consider effectiveness of the changes in achieving greater reliability.

Limitations of the Study

Although the YEST survey was administered to all students of SciJourn teachers, for both the experimental and comparison group, only survey data from students who assented to participate in the research, and are either 18 years of age and consenting, or also have submitted a signed parental consent form, were included in the data analysis. Therefore, the final quantitative sample size is a direct result of the degree to which students in participating SciJourn teachers' classrooms and their parents agree to participate in the SciJourn research project. Issues with the set up and support of the online version of the YEST survey resulted in the loss of survey data from 172 participants, reducing the sample size significantly. Despite efforts to recruit a comparison group similar to the implementation group sample, demographic differences between the two groups were large. Results of this study are generalizable only within the SciJourn project as it is currently implemented. If the grant is considered a success at its completion, and the SciJourn program is disseminated more widely, these results will be generalizable to similar populations of high school students, as well.

Case studies are necessarily conducted as a "bounded system" of place (specific teachers' classrooms) and time (the 2010-11 school year) during which a specific program—SciJourn—is being implemented (Creswell, 2009), and thus are inherently limited in their scope of inquiry. Cases have been constructed for classrooms of teachers considered strong implementers, and cannot, therefore, be considered typical of the experiences of all SciJourn participants. Instead of generalizability of the analysis, *particularizability* (Erickson, 1986) is the goal of "considering the different layers of context that are shared with other settings, [so that] the interpretive researcher can begin to indicate what aspects of the concrete case under study may apply to other cases" (Polman, 2000, p. 8). In this manner, focused case study research will be of interest to science educators concerned with how teens' engagement with science and technology changes over time, and with the encouragement of an innovative educational program.

Conclusions

This study serves to assist in the understanding of ways in which a community-of-learners model of science journalism in high school classrooms relates to student engagement with science and technology. Through a mixed-method approach, the researcher hoped to discover both if such an intervention influences student engagement, and if so, how that influences project participants. The existing research on engagement and the components of engagement described here suggest the complexity of understanding how learners, the learning setting, and learners' multiple identities are intertwined, let alone affected by one another. In presenting a new model of engagement that conceptualizes action, interest, and identification as gears in a common system with multiple points of entry, the complexity of the engagement construct becomes a useful tool in fostering these student connections.

Learning how teens think about science issues and science learning will be of intrinsic interest to science teachers and those trying to increase engagement and literacy in science more broadly. In their National Resource Council report, Bell et. al. (2009)

posed “developing science interests” and “identifying with the scientific enterprise” as two of six key informal science learning strands. The outcomes of this study show that involvement in science journalism, and especially science news related to students’ persistent interests in science and technology does indeed affect how students relate to science in their everyday lives as well as how they “think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science” (Bell et. al., 2009).

These research findings highlight the importance of understanding the ways in which individuals recognize and relate to science in their daily lives. Specifically, students already inclined toward science and technology can develop further engagement through opportunities to select and pursue topics of their own choosing in those fields. For most students, even those showing little engagement with science and technology, personal relevance of topics for both reading and writing, was a key motivator for participation, as well as a spark to ignite interest in these areas necessary for the development of more sustained interest over time. This outcome speaks directly to educators as they design learning activities toward the goal of increasing student involvement with science and technology in and beyond the classroom.

References

American Association for the Advancement of Science. (1989). Science for all Americans: A Project 2061 report on literacy goals in science, mathematics and technology. Washington, DC.

Aronson, J. (1994, Spring). A pragmatic view of thematic analysis. *The Qualitative Report*, *2*(1). Retrieved from *http://www.nova.edu/ssss/QR/BackIssues/QR2-1/aronson.html*

Azevedo, F. S. (2004). What does it mean to be interested in a practice? In Y. B. Kafai, Sandoval, W. A., Enyedy, N., Nixon, A. S., & Herrera, F. (Eds.), Proceedings of the Sixth International Conference of the Learning Sciences 2004: Embracing diversity in the learning sciences (pp. 10-11). Mahwah, NJ: Lawrence Erlbaum Associates.

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development*, *49*, 193-224.

Basu, S. J., & Barton, A. C. (2007). Developing a sustained interest in science among urban minority youth. *Journal of Research in Science Teaching*, *44*(3), 466-489.

Bauer, M. W., Allum, N., & Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding of Science*, *16*(1), 79-95.

Bell, P., Lewenstein, B., Shouse, A.W., & Feder, M.A. (Eds.). (2009). *Learning science in informal environments: People, places, and pursuits.* Committee on Learning Science in Informal Environments, National Resource Council. Washington, D.C.: National Academies Press, Inc.

Bergin, D.A. (1996). Adolescents' out of school learning strategies. *Journal of Experimental Education, 62*, 309-323.

Bodmer, W. (1985). The public understanding of science. Royal Society: London.

Brown, B.A., Reveles, J.M., & Kelly, G.J. (2005). Scientific literacy and discursive identity: A theoretical framework for understanding science learning. *Science Education, 85(9)*, 779-802.

Bruner, J. (1996). *The culture of education.* Cambridge, MA: Harvard University Press.

Bybee, R. W. (1997). *Achieving scientific literacy*. Portsmouth, NH: Heinemann.

Campbell, D.T., & Stanley, J.C. (1963). Experimental and quasi-experimental designs for research. In N. L. Gage (Ed.), *Handbook of research on teaching*. Chicago: Rand McNally.

Carlone, H. B. & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching, 44*(8), 1187-1218.

Center for Informal Learning and Schools. (November 18, 2010). *CILS Home Page*. Retrieved from http://www.cils.exploratorium.edu.

Creswell, J.W. (1998). *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage Publications, Inc.

Creswell, J.W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches.* Thousand Oaks, CA: Sage Publications, Inc.

Davidson, R. (May, 2011). *The element project: Integrating SciJourn into freshman Introduction to Chemistry.* Rose Davidson personal collection.

DeBoer, G. E. (2000). Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching*, *37*(6), 582-601

Devlin, K. (1998). Rather than scientific literacy, colleges should teach scientific awareness. *American Journal of Physics, 66*(7), 559–560.

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education.* New York: MacMillan.

Everyday Science and Technology Group. (n.d.) *Everyday science and technology group*. Retrieved from http://depts.washington.edu/cogstudy/everydaycognition/

Falk, J.H., Storksdieck, M., & Dierking, L.D. (2007). Investigating public science interest and understanding: Evidence for the importance of free-choice learning. *Public Understanding of Science, 16*, 455-469.

Farrar, C. (2012). Assessing the impact participation in science journalism has on scientific literacy among high school students. (Unpublished doctoral dissertation). University of Missouri, St. Louis.

Farrar, C., and Hope, J. (2011, April). Assessing scientific literacy: Content knowledge, skills, and contextualization. Paper presented at the Annual Meeting of the National Association for Research on Science Teaching (NARST), Orlando, FL.

Fensham, P. J. (2004). Increasing the relevance of science and technology education for all students in the 21st Century. *Science Education International, 15*(1), 7–26.

Furman, M. & Barton, A. C. (2006). Capturing urban student voices in the creation of a Science mini-documentary. *Journal of Research in Science Teaching, 43*(7), 667-694.

Gay, L.R. & Airansian, P. (2003). *Educational research: Competencies for analysis and applications*. Upper Saddle River, NJ: Merrill Prentice Hall.

Gee, J.P. (2000). Identity as an analytical lens for research in education. *Review of Research in Education, 25,* (pp. 99-125).

Hill, L.G., & Betz, L. (2005). Revisiting the retrospective pretest. *American Journal of Evaluation, 26*(4): 501-517.

Howard, G.S., Schmeck, R.R., & Bray, J.H. (1979). Internal invalidity in studies employing self-report instruments: A suggested remedy. *Journal of Educational Measurement*, *16*(2): 129-135.

House of Lords. (2000). Science and society. Her Majesty's Stationary Office: London.

Hurd, P. D. (1998). Scientific literacy: New minds for a changing world. *Science Education, 82*(3), 407–416.

Kohnen, A.M. (in press). Teachers as editors, editors as teachers. In C. Bazerman, P. Rogers, & S. Null, (Eds.). Forthcoming volume on work presented at the Writing Research Across Borders II Conference. West Lafayette, IN: Parlor Press and the WAC Clearinghouse.

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

Lau, S. & Roeser, R. W. (2002). Cognitive abilities and motivational processes in high school students' situational engagement and achievement in science. *Educational Assessment*, *8*(2), 139-162.

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

Lemke, J. L. (2000). Across scales of time: Artifacts, activities, and meanings in Ecosocial systems. *Mind, Culture, and Activity, 7*(4), 273–290.

Lichtenstein, M. J., Owen, S. V., Blalock, C. L., Liu, Y., Ramirez, K. A., & Pruski, L. A. (2008). Psychometric reevaluation of the scientific attitude inventory-revised (SAI-II). *Journal of Research in Science Teaching*, *45*(5), 600-616.

Litwin, M.S. (1995). How to measure survey reliability and validity. Thousand Oaks, CA: Sage Publications, Inc.

Markowitz, D. G. (2004). Evaluation of the long-term impact of a university high school summer science program on students' interest and perceived abilities in science. *Journal of Science Education and Technology*, *13*(3).

Martin, A. J. (2005). Exploring the effects of a youth enrichment program on academic motivation and engagement. *Social Psychology of Education*, *8*(2), 179-206.

Masingila, J. O. (2009). Examining students' perceptions of their everyday mathematics practice. *Journal for Research in Mathematics Education*, *11*(2002), 30-39.

Merriam, S. (1988). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass.

McCarty, G., Hope, J., & Polman, J. L. (2010, March). The Youth Engagement with Science and Technology Survey: Informing practice and measuring outcomes. Paper presented at the Annual Meeting of the National Association for Research on Science Teaching, Philadelphia, PA.

Moll, L., Amanti, C., Neff, D. and Gonzalez, N. (2001). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice, XXXI*, 2, 132-141.

Moore, D. (2009). Measuring change in a short-term educational program using a retrospective pretest design. *American Journal of Evaluation, 30*(2): 189-202.

Nasir, N. & Cooks, B. (2009). Becoming a hurdler: How learning settings afford identities. *Anthropology & Education Quarterly, 40(1),* 41-61.

Nasir, N. S. (2010). Studying identity in learning contexts from a human sciences perspective. In Penuel, W. R. & O'Connor, K. (Eds.) *Learning research as a human science*. New York: Teachers College Press.

Nasir, N. S. & Hand, V. (2008). From the court to the classroom: Opportunities for engagement, learning, and identity in basketball and classroom mathematics. *The Journal of the Learning Sciences, 17*(2), 143-179.

Nasir, N.S. & Saxe, G.B. (2003). Ethnic and academic identities: A cultural practice Perspective on emerging tensions and their management in the lives of minority students. *Educational Researcher, 32*(5), 14-18.

Nimon, K., Zigarmi, P., & Allen, J. (2011). Measures of program effectiveness based on retrospective pretest data: Are all created equal? *American Journal of Evaluation, 32*(1): 8-28.

O'Neill, D. K., & Polman, J. L. (2004). Why educate "little scientists?" Examining the potential of practice-based scientific literacy. *Journal of Research in Science Teaching*, *41*(3), 234-266.

Patton, M.Q. (1990). *Qualitative evaluation and research methods* (2nd Ed.). Thousand Oaks, CA: Sage Publications, Inc.

Pea, R. (1997). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations*. Cambridge: Cambridge University Press.

Pitrelli, N. (2003). The crisis of the "Public Understanding of Science" in Great Britain. *Journal of Science Communication, 2*(1), 1-9.

Polman, J.L. (2000). *Designing project-based science: Connecting learners through guided inquiry*. New York: Teachers College Press.

Polman, J. L. (2010). The zone of proximal identity development in apprenticeship learning. *Revista de Educación, 353* (September-December), 129-155.

Polman, J.L., Hope, J., & McCarty, G. (2010, April). Reframing and measuring Engagement with science and technology. Paper discussed at the meeting of the American Educational Research Association, Denver, CO.

Polman, J. L., Hope, J., & McCarty, G. (in preparation). Engagement with science and technology as an aim and outcome of a learning environment for citizen science journalism.

Polman, J. L. & Miller, D. (2010). Changing stories: Trajectories of identification among African American youth in a science outreach apprenticeship. *American Educational Research Journal*, *47*(4), 879-918.

Polman, J. L., Saul, E. W., Newman, A., Farrar, C., Singer, N., Turley, E., Pearce, L., Hope, J., & McCarty, G. (2010, July). A cognitive apprenticeship for science literacy based on journalism. Symposium presented at the International Conference of the Learning Sciences, Chicago.

Pratt, C.C., McGuigan, W.M., & Katzev, A.R. (2000). Measuring program outcomes: Using retrospective pretest methodology. *American Journal of Evaluation, 21*: 341-349.

Pugh, K.J., Linnenbrink-Garcia, L, Koskey, K.L., Stewart, V.C., & Manzey, C. (2009). Motivation, learning and transformative experience: A study of deep engagement in science. *Science Education, 94*(1), 1-28.

Renninger, K.A. (2009). Interest and identity development in instruction: An inductive model. *Educational Psychologist*, 44(2), 105-118.

Roeser, R.W., Peck, S.C., & Nasir, N.S. (2006). Self and identity processes in school motivation, learning, and achievement. In P.A. Alexander and P.H. Winne (Eds.), *Handbook of Educational Psychology (2nd ed.*, pp. 391-424) Mahwah, NJ: Erlbaum.

Rogoff, B. (1994). Developing understanding of the idea of communities of learners. *Mind, Culture, and Activity, 1*(4), 209-229.

Rogoff, B. (1995). Observing sociocultural activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In J.V. Wertsch, P. Del Rio & A. Alvarez (Eds.), *Sociocultural Studies of Mind*, (pp. 139-164). Cambridge: Cambridge University Press.

Rosenzweig, R. & Thelen, D. (1998). *The presence of the past: Popular uses of history in American life*. New York: Columbia University Press.

Saul, E.W. (Ed.). (2004). *Crossing borders in literacy and science instruction: Perspectives on theory and practice*. Newark, DE: International Reading Association.

Saul, W., Kohnen, A., Newman, A., & Pearce, L. (2012). *Front page science: Engaging teens in science literacy.* NSTA Press.

Schofield, J. W. (1990). Increasing the generalizability of qualitative research. In E. W. Eisner, & Peshkin, A. (Ed.), *Qualitative inquiry in education: The continuing debate* (pp. 201-232). New York: Teachers College Press.

Seidman, I. (1998). *Interviewing as qualitative research: A guide for researchers in education and the social sciences* (2nd Ed.). New York: Teachers College Press.

Seidman, I. (March 4, 2011). Personal communication. University of Missouri, St. Louis.

Sibthorp, J., Paisley, K., Gookin, J. & Ward,P. (2007). Addressing response-shift bias: Retrospective pretests in recreation research and evaluation. *Journal of Leisure Research*, *39*(2): 295-315.

Stake, R.E. (1978). The case study method in social inquiry. *Educational Researcher, 7*(2), 5-8.

Stake, R.E. (1997). Case study methods in educational research: Seeking sweet water. In *Complementary Methods for Research in Education, 2nd Ed*. Richard *M*. Jaeger, Ed.

Sturgis, P. & Allum, N. (2004). Science in society: Re-evaluating the deficit model of public attitudes. *Public Understanding of Science*, *13*(1), 55-74.

Sudman, S., Bradburn, N.M., & Schawrz, N. (1996). *Thinking about answers: The application of cognitive processes to survey methodology*. San Francisco: Jossey-Bass Publishers.

Tabak, I. & Baumgartner, E. (2004). Teacher as partner: Exploring participant structures, symmetry, and identity work in scaffolding. *Cognition and Instruction*, *22*(4), 393-429.

Turner, S. (2006). School science and its controversies; or, whatever happened to scientific literacy? *Public Understanding of Science*, *17*(1), 55-72.

University of Missouri-St. Louis. (2008). *Science literacy through science journalism.* Retrieved from http://coe.umsl.edu/web/centers/scijourn/

U.S. Department of Education Institute of Education Sciences National Center for Education Statistics (2010). Percentage of public school teachers of grades 9 through 12, by field of main teaching assignment and selected demographic and educational characteristics, 2007-08. Digest of Education Statistics: 2010. Retrieved from: http://nces.ed.gov/programs/digest/d10/taes/dt10_074.asp?referrer = list

University of North Carolina, Greensboro School of Education (2009, Spring/Summer). Dr. Carlone interview. *Educare*. Retrieved from https://web.uncg.edu/soe/educare/carlone_interview.php

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wang, M. & Holcombe, R. (2010). Adolescents' perceptions of school environment, engagement, and academic achievement in middle school. *American Educational Research Journal, 47*(3), 633-662.

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

Wertsch, J.V. (1991). *Voices of the mind: A sociocultural approach to mediated learning.* Cambridge, MA: Harvard University Press.

Wortham, S. (2004). The interdependence of social identification and learning. *American Educational Research Journal*, *41*(3), 715–750.

Wortham, S. (2006). *Learning identity: The joint emergence of social identification and academic learning*. New York: Cambridge University Press.

Yore, L. D., Bisanz, G. L., & Hand, B. M. (2004). Examining the literacy component of science literacy: 25 years of language arts and science research. *International Journal of Science Education*, *25*(6), 689-725.

Zimmerman, H. Everyday science & science every day: Science-related talk & activities across settings. Ph.D. dissertation, University of Washington, United States -- Washington. Retrieved November 30, 2009, from Dissertations & Theses: A&I. (Publication No. AAT 3345569).

Zimmerman, H. T. & Bell, P. (2007, April). Seeing, doing, and describing everyday science: Mapping images of science across school, community, and home boundaries. Paper presented at the meeting of the National Association of Research in Science Teaching (NARST), New Orleans, LA.

Appendix A. SciJourn High School Classroom Research Participation

Teacher ID	Teacher Gender		School Setting			School Type		Courses Taught													# Participants (N=) Population/ Sample	Implementation Level**
	Male	Female	Rural	Suburban	Urban	Parochial	Public	Anatomy/Physio	Basic Bio/Chem	Biology	Chemistry	English	Environmental Sci	Journalism	Physical Science	Physics	Psychology/Socio.	Research	Science Elective	Vocational Ag.		
003*	X			X			X				X										59/25	High
005		X		X			X			X											83/0	Low
006*		X		X			X		X												50/24	High
007*	X			X			X			X			X								40/26	High
009	X			X			X								X						21/7	Med
010*		X	X				X				X					X					58/39	Med
015		X		X			X				X										44/0	High
019*		X			X		X				X										48/26	High
020*		X			X		X				X					X					33/26	High
021		X		X			X					X		X							44/0	High
023*		X	X				X			X											74/57	High
025*		X		X		X					X										141/53	High
026	X			X		X			X		X					X					69/0	Med
027	X				X		X	X		X											17/0	Low
029*		X	X				X			X											84/51	High
030	X			X			X							X							4/0	Med
031*	X			X			X				X										15/10	Med
033*	X				X		X										X				9/3	Low
034*	X				X		X				X					X					69/21	Low
035		X		X			X											X			26/0	High
037*		X			X		X												X		38/25	Comparison
038*		X			X		X								X						61/28	Comparison
039	X			X			X			X											99/0	Comparison
042		X			X		X			X											66/0	Comparison
043		X		X			X				X										55/0	Comparison
046*		X		X			X			X											11/5	Comparison
047*		X		X			X			X											38/15	Comparison
048*		X	X				X													X	33/28	Comparison
TotalPop	10	16	4	14	8	2	26	1	2	8	9	1	1	2	2	4	1	1	1	1	1303/469	
Sample	6	12	4	8	6	1	17	0	1	5	7	0	1	0	2	3	1	0	1	1		

* Teacher included in data analysis

** Implementation level determined as follows: High = students are expected to write and submit at least one article for SciJourn editing; Medium = students do some science news writing, but do not submit for editing; Low = SciJourn activities are part of class, but students are not engaged in science news writing

Appendix B. Youth Engagement with Science and Technology Survey

Participant Name: ________________________________ Date:________________________________

The following survey is designed to find out ways you are engaged with science and technology. It should take you 15 minutes or less. There are no right answers; we just want to know about your perspective and experience. Some questions may ask about memories that you cannot recall—if you can't remember quickly, just say so and go on to the next question.

I. Activities

1. What are the three main ways you spend your free time? (Check three.)

- ☐ Hanging out with Friends
- ☐ Playing Sports
- ☐ Playing Video Games
- ☐ Reading
- ☐ Talking or Texting on the Phone
- ☐ Using the Computer/Internet
- ☐ Watching TV/Movies
- ☐ Other: ____________________
- ☐ Other: ____________________
- ☐ Other: ____________________

2. Do you work outside of school? (Circle one.) YES NO

If yes, what is your job? ________________________________

3. How do you use science in your everyday life?

4. How important is science to your everyday life? (Circle one.)

1	2	3	4
Not at all important	Somewhat	Important	Very important

5. When you are looking for information about science, how often do you use each of the following resources? (Circle one answer for each resource.)

Teacher	Always	Sometimes	Never
Family member	Always	Sometimes	Never
Textbook	Always	Sometimes	Never
A different kind of book	Always	Sometimes	Never
Internet	Always	Sometimes	Never
Magazine/Newspaper	Always	Sometimes	Never
TV or Movie	Always	Sometimes	Never

6. How do you use technology in your everyday life?

7. How important is technology to your everyday life? (Circle one.)

1	2	3	4
Not at all important	Somewhat	Important	Very important

8. When you are looking for information about technology, how often do you use the following sources? (Circle one answer for each resource.)

Teacher	Always	Sometimes	Never
Family member	Always	Sometimes	Never
Textbook	Always	Sometimes	Never
A different kind of book	Always	Sometimes	Never
Internet	Always	Sometimes	Never
Magazine	Always	Sometimes	Never
TV or Movie	Always	Sometimes	Never

For the following items, please respond by checking the best description of how often you've done each of the activities, *within the last six months.* For any activity you have done, check all of the reasons why you did that activity.

How often have you…	Related to SCIENCE	Reason for doing	Related to TECHNOLOGY	Reason for doing
9. Read a **book**	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests
10. Read a **magazine or newspaper article(s)**	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests
11. Watched a **TV show(s) or movie(s)**	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests

For the following items, please respond by checking the best description of how often you've done each of the activities, *within the last six months.* For any activity you have done, check all of the reasons why you did that activity.

How often have you…	**Related to SCIENCE**	**Reason for doing**	**Related to TECHNOLOGY**	**Reason for doing**
12. Visited a **website**	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests
13. Taken part in a **club or other group activity** devoted to learning	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Find information to make a decision ☐ Related to future schooling or career interests
14. **Talked to a friend or family member** about a current topic	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Get or provide information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Get or provide information to make a decision ☐ Related to future schooling or career interests
15. **Provided an opinion** to someone else about a topic	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Provide information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Provide information to make a decision ☐ Related to future schooling or career interests
16. **Written, blogged, or texted** about something	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Provide information to make a decision ☐ Related to future schooling or career interests	☐ Not at all ☐ Once ☐ Monthly ☐ Every two weeks ☐ Weekly ☐ Daily	☐ Assigned for a class/related to a school project ☐ Required for work ☐ Fun or personal enjoyment ☐ Learn more about the topic ☐ Provide information to make a decision ☐ Related to future schooling or career interests

II. Interests

17. How interested are you in school? (Check one.)

- ☐ I am not interested in any subjects
- ☐ I am a little bit interested in a few subjects
- ☐ I am interested in some subjects, but not in others
- ☐ I am interested in most subjects
- ☐ I am very interested in school

18. How do you rate yourself as a student, in terms of grades? (Circle one.)

Poor   Fair   Average   Good   Excellent

19. How do you rate yourself as a student, in terms of learning? (Circle one.)

Poor   Fair   Average   Good   Excellent

20. How interested are you in learning science *in* school? (Check one.)

- ☐ I have no interest
- ☐ I rarely have interest
- ☐ I find science interesting sometimes
- ☐ I usually am interested
- ☐ Science is my favorite thing to learn about in school

21. How interested are you in learning about science *outside of* school? (Check one.)

- ☐ I have no interest
- ☐ I rarely have interest
- ☐ I find science interesting sometimes
- ☐ I usually am interested
- ☐ Science is my favorite thing to learn about outside of school

22. How interested are you in learning about technology *in* school? (Check one.)

- ☐ I have no interest
- ☐ I rarely have interest
- ☐ I find technology interesting sometimes
- ☐ I usually am interested
- ☐ Technology is my favorite thing to learn about in school

23. How interested are you in learning about technology *outside of* school? (Check one.)

- ☐ I have no interest
- ☐ I rarely have interest
- ☐ I find technology interesting sometimes
- ☐ I usually am interested
- ☐ Technology is my favorite thing to learn about outside of school

24. What, if any, specific aspects of science and technology do you find interesting?

25. Other people see me as a “science” person. (Circle one).

Strongly Disagree   Disagree   Not Sure   Agree   Strongly Agree

26. Other people see me as a “technology” person. (Circle one).

Strongly Disagree   Disagree   Not Sure   Agree   Strongly Agree

27. On a scale of 1 to 5 (where one indicates very low, three is average, and five very high) rate your knowledge of science compared with the "average high school student." (Circle one.)

1 2 3 4 5

III. Future

28. a. What do you see yourself doing 5 years from now?

b. 10 years from now?

29. Can you see yourself becoming a scientist? (Circle one.)

Definitely not Probably Not Maybe Probably Yes Definitely Yes

30. Can you see yourself majoring in a science or technology field in college? (Circle one.)

Definitely not Probably Not Maybe Probably Yes Definitely Yes

If yes, what field do you think that might be? ________________________________

31. Can you see yourself using science or technology in your career? (Circle one.)

Definitely not Probably Not Maybe Probably Yes Definitely Yes

If yes, how? ____

IV. Participant Information

32. Are you... Male or Female (Circle one.)

33. What grade are you in? (Circle one.) 6th 7th 8th 9th 10th 11th 12th

34. Is English the primary language spoken in your home? (Circle one.) YES NO

If no, what is the primary language spoken in your home? __________

35. Which of the following ethnic group or groups best describes you? (Check all that apply.)

- ☐ White or European American
- ☐ Black or African American
- ☐ Hispanic or Latino
- ☐ Asian American
- ☐ American Indian or Alaska Native
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ Other (Please specify: ______________)

36. What is the zip code at your home (the place where you live most of the time)? ________

37. What is the name of the class you are in while taking this survey? ____________________________

Appendix C. SciJourn Classroom Observation Protocol

I. General Information

Note: Observer should submit observation notes to Drop Box within 48 hours of the classroom visit.

Observation Date	
Observer's Name	
Observer's Role	observer only co-teaching leading instruction
Teacher (Use name and then change to code number before submitting)	
Grade Level	
Number of Students	
School (Use name and change to code number before submitting)	
Observation Time/Length	
Was Lesson Scheduled in EdPlans?	Yes No
Course Information	Science English Journalism Other:______________ Course Title and Period:
Is the classroom shared? (Traveling teacher)	

<u>II. Physical Setting/Classroom Context</u>

Snap a picture of the empty classroom if possible. (If not empty, try to shoot from an angle (i.e. the rear of the classroom) that would not identify individual students.) Alternately, sketch the layout of the classroom designating desk/work and writing spaces/tools (e.g. computers). If the arrangement changes during the class period or on subsequent visits, take another photo and describe the activity that precipitated the change.

From your observation, what technology was available/utilized during this class session by students or teacher?

Technology	**Available**	**Notes on utilization**
Computers in the classroom (#)		
Computer lab (#)		
Email		
World Wide Web		
Document camera		
LCD projector		
SmartBoard		
Overhead projector		

Describe or photograph what is on the walls/board in regards to SciJourn, science media, writing, or literacy. If you feel something is missing, describe what is also *not* there.

Describe how the teacher introduces the lesson. Is this clearly part of a series of lessons or a first-time introduction to the lesson?

Was there anything about this visit that might make the observation atypical (e.g. fire drill, spirit week, etc.)?

III. *Lesson Flow*

Please record the major events of the lesson. Cite evidence, examples, and direct quotations if possible. Please observe both the teacher's and the students' actions. The boxes expand when needed.

Raw Time (ie. 8:15)	**Observations (raw uninterpreted observation)**	**Comments (personal interpretation)**	**Materials**

IV. Pre-brief or Debrief

Note: When directing these questions to teachers, be sure to ask sufficient follow-up probes so as to point to specific instances, artifacts, etc.

Part A:

1. What was the purpose of this lesson? How do you see it fitting into the overall project goal of having students write science news? How will you follow up this lesson?

2. What successes are you experiencing as you implement the SciJourn model?

3. What difficulties are you encountering as you implemented the SciJourn model?

4. Do you feel your students' scientific literacy is changing? If so, how? Can you provide a specific example?

5. Have you overheard or had a direct conversation with a student specifically about either what it takes to get published or how it felt to be published in *SciJourner*? If so, describe the conversation.

Part B:

1. How would you characterize this class in terms of student academic level and curricular mandates?

2. What kinds of writing do you have your students do?

3. How important is publication of your students’ work in SciJourner to your implementation of SciJourn?

V. Observer Notes:

VI. Summary-

Please write a short summary (1-3 sentences) that gives and overview of the lesson you saw today. This will be used as the file descriptor in Nvivo.

Associated Files

	Filename
Video	
Audio	
Student Handouts	
Student Writing	

Appendix D. Phenomenological Interview Protocol

Interview One (life history):

How did the participant come to be a student in (or teacher of) this class? A review of the participant's engagement with science and technology up to the time he or she became a SciJourn participant.

Interview Two

- Part A (contemporary experience): What is it like for the participant to be involved with science and technology in SciJourn? What are the details of the participant's experience as related to science and technology engagement?
- Part B (meaning making): What does it mean to the participant to be involved with science and technology in SciJourn? Given what the participant has said in interview one and Part A of two, how does he or she make sense of his or her work as a SciJourn participant, especially as related to engagement with science and technology?

Appendix E. YEST Scoring & Coding Guide

Observations

Rationale: See and create a record of SciJourn activities in high-implementing SciJourn teachers' classrooms. Establish an understanding of the classroom culture and the teacher's overall teaching style. Document enactment of SciJourn-related activities.

Engagement: What invites or detracts from engagement? How do participants respond?
Invitations to engagement—teacher or activity structure foster engagement

Example:
One bulletin board is covered with issues of ChemMatters Journal. An area of another wall is papered with every print edition of *SciJourner* so far. The SciJourn poster "thinking like a science journalist" is posted in the center of the back of the room.

Detractors from engagement— teacher or activity structure hampers engagement with science, technology, or SciJourn
Example:
Student: Teacher, I can't find my article on concussions that I did. Do you have it? Teacher: I do. Student: Because he [editor] didn't have it either. Teacher: okay, what's your email? [Student's completed article, submitted for editing, has gotten lost in the email shuffle of documents, and never made it from teacher to editor. Student didn't realize until conversation with editor that the review wasn't in process. Now needs to start the process over again, presumably by submitting the article to the editor directly himself.]

Disengagement—students appear or state their lack of engagement with science, technology, or SciJourn
Example:
Teacher: I'm going to talk about that in a minute, okay, when everyone is finished. Teacher: (to two girls in the back of the room) You're finished, right? Girls nod. And you're downloading the chapter 7 outline? Girls nod. [Actually they are on Facebook.]

Context: Where and/or with whom is the engagement with science, technology and/or SciJourn happening?

School—For observations, the lessons are happening in the classroom, and should be coded as school.
If a reference is made to a science interest, action, or identification elsewhere, code as appropriate.
Home—Family or home life

Example:

Student's topic is electronic cigarettes. Has all the information, "and three quotes, one from the FDA, one from the [inaudible], and one from my mom's friend, like my godmother is a respiratory therapist, and she's been working with this lady who has been smoking, so she's been doing respiratory therapy and has been using electronic cigarettes." Teacher: that would be the sources that you're looking for. Much, much better than just fantastic . Fantastic. I'm pleased with your progress since yesterday. So any idea when that's going to come through? Student: Maybe later today or tomorrow, because I called yesterday when my mom told me I should call her, and she's going to call the patient and ask if she would mind being in the paper.

Social—At work, or in an out-of-school setting. With friends, in a social group

Example:

There is talk in the room about the mountain lions in MO topic. Student 1 and Student 2 discuss topics. Student 1 says his first two articles (on urbanization and wind energy) just really didn't have any news in them. "At least the cougar sis more relevant because there is actually newspaper articles about that as we speak." [indicates he has spent personal time keeping up with the issue on his own.]

Interest: Participant appears, acts, or states interest in science, technology, or SciJourn

Example:

Student 1: My topic is cloning, and if it's effecting the environment in a good way or a bad way. Student 2: Who clones? Student 1: They clone animals. Student 3: McDonald's sells cloned meat. [An argument breaks out about this.] Student 3: Drop your feelings, they sell cloned meat. Student 2: I'm going to read your piece. Oh my God! Cloning!?

Action: Participant does or talks about doing a science, technology, or SciJourn-related activity.

Example:

Teacher: I want to try this [going onto SciJourner.org; there was a problem with all of the students in an earlier class accessing the site at the same time]. We're going to go to www.scijourner.org. [students immediately start going to the site on their individual laptops.]

Identification: Participant aligns him/herself with science, technology, or SciJourn, through discourse (words and deeds), or is positioned that way by others (teacher, classmates, family).

Example:

Student 1 walks over to editor. Editor [visiting the classroom]: So you're the published guy. Congratulations. [They shake hands.] Student 1 asks a question about continuing with his second article. They discuss. Some students start to return their laptops to the cart [it is almost lunch time]. [Student 2 is swinging his light sticks on strings around his arms, kind of like nunchuks. Teacher releases a student from class. Editor continues talking with Student 1. Teacher releases students to lunch before bell rings, telling students, "If you get caught, whose class are you from?" and they say "Ms. Taylor!" [as though this is a routine occurrence]. Editor continues to conference with Student 1 after lunch dismissal. Editor then expounds on the student's brilliance to the Teacher after the student leaves the room.

Interviews

Rationale: Garner insight into participant backgrounds related to science and technology. Hear participant perspectives of their own experiences with SciJourn, and what they value about the experience.

Engagement: What invites or detracts from engagement? How do participants respond?

Invitations to engagement—teacher or activity structure foster engagement with science, technology, or SciJourn

Example:

Interviewer: Yeah. How'd you first get involved in that [after school robotics program]?
Student: A friend told me about it that was in there, and the teacher.

Detractors from engagement— teacher, other students, or activity structure hamper engagement with science, technology, or SciJourn

Example:

Student: Well, like they're just like, like he wants it to be 500 words, so it's like typing a page and a half. To some students that's like a lot…

Disengagement—students appear or state their lack of engagement with science, technology, or SciJourn

Example:

Interviewer: …So, what about all this writing that you've been doing in this class? Was that a surprise for you?...
Student: Yeah, I didn't know we'd be doing it, like a lot of my friends are like this is like English class. I'm just like I'm always pretty good in English so I don't mind it that much, like if we get the adequate time to do it, so I'm pretty OK with it, so…
Interviewer: He gives you adequate time in class you mean?
Student: Yeah, class time. I don't do it outside of class though.

Context: Where and/or with whom is the engagement with science, technology and/or SciJourn happening?

School—References to school events, experiences, teachers, etc.

Example:

Student: In middle school I actually liked it. I had some like some good teachers in science, it was one of the easiest ones, like the teachers made it way too easy but that's why I started liking it a lot.

Interviewer: OK, and what did they do that was easy or fun?

Student: They like had a more like, like more labs, more experience, like less like textbook stuff.

Interviewer: Yeah.

Student: And that's always better.

Home—Family or home life

Example:

Student: My mom wants me to do engineering; it's like a good career field, like I know like I said I'd give it a try, like see if I do it. If I do good at it I'll stick with it but I can always change.

Social—At work, or in an out-of-school setting. With friends, in a social group

Example:

Interviewer: … Outside of school are there any science topics that interest you, or things that interest you at school that you pursue outside of school as well?

Student: Technology basically is probably one big one just because I'm kind of looking for careers in that. I think it's pretty neat how they figure out things and how to work it, so…

Interviewer: And how do you keep up to date on information about technology?

Student: Just on about like the latest thing about basically, you know, and how it works.

Interviewer: Do you research those sorts of things on the Internet or you just pay attention when it comes up?

Student: I tend to do an Internet search and pay attention a little bit more…

Student: And really, like I also have a part-time job, like I work in retailing also.

Interviewer: OK.

Student: So, we sell computers so that kind of helps me stay on top.

Interest: Participant appears, acts, or states interest in science, technology, or SciJourn

Example:

Student: In elementary school I don't think I really understood or cared too much about science. I don't think they really emphasized it too much in my opinion from what I remember, but I think as I got into middle school and high then it became pretty important and interesting.

Action: Participant does or talks about doing a science, technology, or SciJourn-related activity.

Example:

Student: I did like go to the science center and, like my older sister she was older than me and she had to do a science fair project so I kind of helped out with that and the family doing that.

Identification: Participant aligns him/herself with science, technology, or SciJourn, through discourse (words and deeds), or is positioned that way by others (teacher, classmates, family).

Example:

Student: And school wise as a career I'm thinking about going into business or engineering or math, one of those three, I haven't really decided which one, and…

Youth Engagement with Science & Technology Survey

Rationale: Gather self-reported engagement data from a large sample of students for the purposes of pre/post and intervention/non-intervention comparison

Data Entry:

1. Enter data from individual survey responses into a spreadsheet as described in the coding guide below. Leave blank illegible or blank items. (Alternatively, enter as 99 as place holder, and then use find and replace to blank those items prior to data analysis.)

	Data Entry Coding							
Item	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. What are the three main ways you spend your time?	Friends	Sports	Video Games	Reading	Phone/ Texting	Comput er	TV/Movi es	Input respons e
2. Do you work outside of school?	No	Yes						
3. & 6. How do you use science in your everyday life?	Input response							
4. & 7. How important is science/technology to your everyday life?	Not at all	Somewhat	Important	Very Important				
When looking for science/technology info how often do you use:								
5a. & 8a. teacher	Never	Sometimes	Always					
5b. & 8b. family member	Never	Sometimes	Always					
9c. & 8c. textbook	Never	Sometimes	Always					
5d. & 8d. different kind of book	Never	Sometimes	Always					
5e. & 8e. internet	Never	Sometimes	Always					
5f. & 8f. magazine/newspaper	Never	Sometimes	Always					
5g. & 8g. TV/movie	Never	Sometimes	Always					
9-16a. & 9-16c. How often have you… e.g. Read a science/ technology book?	Not at all	Once	Monthly	Every two weeks	Weekly	Daily		
9-16b. &9-16d. Assigned for class	Not Marked	Marked						
Required for work	Not Marked	Marked						
Fun or enjoyment	Not Marked	Marked						
Wanted to learn more	Not Marked	Marked						
Find info to make decision	Not Marked	Marked						
Related to future interests	Not Marked	Marked						
17. How interested are you in school?	Not interested	Little bit interested	Interested in some	Most subjects	Very interested			
18. How do you rate yourself as a student, grades?	Poor	Fair	Average	Good	Excellent			
19. How do you rate yourself as a student, learning?	Poor	Fair	Average	Good	Excellent			

	Data Entry Coding							
Item	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. How interested are you in learning science in school?	No interest	Rarely interested	Sometimes interested	Usually Interested	Favorite thing			
21. How interested are you in learning science outside of school?	No interest	Rarely interested	Sometimes interested	Usually Interested	Favorite thing			
22. How interested are you in learning technology in school?	No interest	Rarely interested	Sometimes interested	Usually Interested	Favorite thing			
23. How interested are you in learning technology outside of school?	No interest	Rarely interested	Sometimes interested	Usually Interested	Favorite thing			
24. What specific aspects of science and technology do you find interesting?	Input response							
25. Other people see me as a science person.	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree			
26. Other people see me as a technology person.	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree			
27. Knowledge of science compared to average high school student.	1	2	3	4	5			
28a. What do you see yourself doing 5 years from now?	Input response							
28b. What do you see yourself doing 10 years from now?	Input response							
29. Can you see yourself becoming a scientist?	Definitely Not	Probably Not	Maybe	Probably Yes	Definitely Yes			
30a. Can you see yourself majoring in a science or technology field?	Definitely Not	Probably Not	Maybe	Probably Yes	Definitely Yes			
30b. If yes, what field?	Input response							
31a. Can you see yourself using science or technology in your career?	Definitely Not	Probably Not	Maybe	Probably Yes	Definitely Yes			
31b. If yes, how?	Input response							
32. Name of teacher	Input response							

1. Review data entry by column and by row to ensure that coded responses are within range. Verify questionable responses with paper copies.
2. Save complete data set as is.

Data Analysis & Scoring of Selected Response Items:

1. Save another copy of the data set for analysis.

2. Delete any survey response that is less than 75% complete overall.
3. Average all columns to find mean score per item. For some items (such as sub-items of #s 5 & 8) these means will be used for comparison pre/post.
4. To find relative mean per item, divide each item mean by the maximum possible response for that item. Each score is now based on a range from zero to one, and more easily comparable with other items. For each student, six engagement sub-scores can be calculated on the zero to one scale in the same manner.
5. To consider selected response and likert-type items by aspect of the engagement framework, group as follows:

Aspect of Engagement	By Type	Item Numbers to Include
Action (16)	Science Action (8)	9a-16a
	Technology Action (8)	9c-16c
Interest (20)	Science Interest (10)	9b(3-5)-16b(3-5), 20, 21
	Technology Interest (10)	9d(3-5)-16d(3-5), 22, 23
Identification (24)	Science Identity (14)	4, 9b(6)-16b(6), 25, 27 29, 30, 31
	Technology Identity (12)	7, 9d(6)-16d(6), 26, 30, 31

6. Pre/post means for groups of questions are now comparable.
7. For questions 5 & 8 (not included in any aspect of the framework), look at trends and shifts in resources accessed from pre to post.
8. Scoring for items 9b-16b and 9d-16d is based on responses for 9a-16a and 9c-16c respectively, as follows. Scoring is different for interest and for identification for each item.

   Scoring for Interest: If in "a" section of the question, an item is designated as participated in at any frequency above "not at all," that frequency, multiplied by the sum of the number of reasons given for participating (other than assigned for class, required for work, or related to future schooling or career), is the *interest* score for that item.

Examples:

9a. How often have your read a science book in the last 3 months? Response: Not at all

Interest score: 0

9a. How often have you read a science book in the last 3 months? Response: Monthly (3); Reasons for doing: Assigned for Class (0)

Interest Score: 0

9a. How often have you read a science book in the last 3 months? Response: Monthly (3); Reasons for doing: Assigned for Class (0), Fun or Personal enjoyment(1), To learn more about the subject (1), relates to future schooling/career goals (1)

Interest score: 6 (3 x 2)

Scoring for Identification:

If in “a” section of the question, an item is designated as participated in at any frequency above “not at all,” that frequency, multiplied by the entry in the “related to schooling or career goals” (either 0 or 1 is the *identification* score for that item.

Examples:

9a. How often have your read a science book in the last 3 months? Response: Not at all

Identification score: 0

9a. How often have you read a science book in the last 3 months? Response: Monthly (3); Reasons for doing: Assigned for Class (0)

Identification Score: 0

9a. How often have you read a science book in the last 3 months? Response: Monthly (3); Reasons for doing: Assigned for Class (0), Fun or Personal enjoyment(1), To learn more about the subject (1), relates to future schooling/career goals (1)

Identification Score: 3 (3 x 1)

These calculations are easily made using a formula within the excel spreadsheet of data.

Data Analysis & Coding Open-Ended Items:

1. For open-ended items (1, 3, 6, 24, 28a & b, 30b and 31b), responses are coded using qualitative methods.

Item	Type of coding	Aspect coded	Sample response(s) (20)	Sample Coding
3. How do you use science in your everyday life?	Content analysis for emergent codes	Science Action	Computer none Most things I do. Graphite pencils, human anatomy, chemistry class none Not much, but I like science homework Hair color working on cars cooking work (cooking) I have vocal cord dysfunction, I recycle chemistry class, cooking medicine, texting chemistry class Building volcanoes with my cousin using a chemistry set Soccer is somewhat related to science in my	School or school work (4) Physical Activity/sports (4) Nothing (4) Health (3) Inventions/technology (3) Cooking (3) Personal care (1) Job activities (1) Everything (1) Explicit science activities (1) Automobiles (1)

			life Softball, soccer None everything Sports	
6. How do you use technology in your everyday life?	Content analysis for emergent codes	Technology action	computer, TV, phone the internet, my cellphone, my alarm clock and watch, my TV, basically everything watchin TV and playing on the computer TV Games my phone, my job texting watching TV driving My Guitar & Phones and other things TV, driving, 4 wheeler, video games, music, cell phone. Computer, phone, driving, Most things at work. TV remote any tool we Take and make into something useful and easier on daily life. Computer, texting Nearly all, my job, my phone, research. all	Computer/Internet (12) Phone/texting (12) TV (8) Vehicles/driving (4) Everything (4) Work activities (3) Video games (3) Music devices (2) School/school work (2) Instruments (1) Clock/watch (1) Research (1)

			computer, TV homework, Facebook, phone Everything My IPod, Phone. Laptop, Xbox 360, Internet Phone, pt. car. Comp. looking on the computer school work social networking	
24. What, if any, specific aspects of science and technology do you find interesting?	Categorize into broad fields (e.g. science/non-science, pragmatic/dreams & aspirations, occupational/social) with potential for additional and sub-codes based on emergence (Note: we may choose to revisit #28 in terms of extent/scaling)	Science and/or technology interest	I like ABC [current course] because you do a lot of labs I like science when its more hands on rather than book work The facts about how we are evolving as a nation and as a world. Just the fact that it’s so mysterious. How things work. There is always something new to learn about it. Marine Biology Pharmacy None 99 technology and how it advances so quickly &	Electronics/Technological developments (7) Inquiry/Nature of Science (3) Nothing/no response (3) Biology (2) Medicine (2) Hands-on activities (1) Social Sciences (1) How things work (1) Marine Biology (1) Chemistry (1) Anatomy (1) Nature (1)

			what it will be like in the future	
			How it makes life easier.	
			electronics	
			any medically related science or technology is interesting to me	
			That both keep evolving so quickly!!	
			the outdoors	
			computers	
			biology, anatomy	
			99	
			biology aspects, chemistry, I hate technology w/ a passion, I can rarely get my iPod to work, I only find it interesting how society relies so heavily on it get off your butt and go outside	
			cell phones, mpg in new cars	
28a. What do you see yourself doing 5 years from now?	Categorize	Science and/or technology identification	college/close to graduating	College non-sci/technology (13)
			not sure	Unsure (2)
			in college	College science (1)
			business or engineering	College technology
			finding a job	Work non-
			college	

			finishing engineer degree at Mizzou sewing costumes for various theatre programs graduating from college paramedic In college/graduating from college & pursuing a career I love. graduating college college going to college or starting a career going to college for architecture Being almost done with college college going to college finishing college	science/technology (2) Work-science/med (1) No response (1)
28b. What do you see yourself doing 5 years from now?	Categorize	Science and/or technology identification	working working at a job I love with a family a good paying job and family same [as prior question response: nurse or performing musician] same [as prior question response: mechanic or engineer]	Family (8) Work-science/med (6) Work non-specific or non-science/technology (7) Unsure (3) Prosperous (3) Business owner (2)

			Getting out of college. don’t know Being a nurse still and having a family but a little early then 10 years. making video games Becoming a writer Music not sure Have a family, a nice house and good job working part time married with children Being a Nurse practitioner with a family Physical therapist Some of doctor Managing my own bakery and coffee shop. Having my own business Married, have a good job, and have a kid not for sure	College non-sci/technology (1)
30. If yes [you can see yourself majoring in a science or technology field in college], what field	Categorize	Science and/or technology identification	psychology Veterinarian Astronomy not sure I do not know technology	N/A (11) Unsure (2) Medicine (2) Veterinarian (2) Astronomy (2) Technology (1)

do you think that might be?			Engineering space Photography, if that counts	Engineering (1)
31b. If yes [you see yourself using science or technology in your career], how?	Content analysis for emergent codes	Science/technology identification	being a veterinarian to become a doctor majoring in chemistry; becoming a chemist machines related to the cardiovascular system Computers etc. a lot of things everything now & days deal w/both of them medical related I don't know	N/A (11) Science or technology-related career (4) Everything (2) Computers (1) Technical tools (1) Unsure(1)

Appendix F. Sample Interview Transcript

Interviewee:	Teacher 020
Site:	TCH020's home
Date:	7/06/2011
Interviewer:	JH
Purpose:	First of two phenomenological interviews exploring engagement
Submitted by:	JH

JH: And then any details you have would be great. So, let me just make sure this is recording, looks like it is, we have 17 hours and I'm going to put it there so they can hear us, and so let's just start and I'm going to do this the same way with the students, and tell me the story of you. How did you get into teaching?

Teacher 020: Well, it's funny because I was not going to be a teacher. I was going to be a physical therapist from high school on up.

JH: OK.

Teacher 020: And I'd always taught swimming, I always coached, I taught, you know at the Y, summer and delve into outdoor pool, swam, and so I enjoyed the coaching aspect and the interaction, and when your physical therapist all of the sudden I went to college and I thought this is not for me, you know the classes, and so I majored in biology and I was going to work in a lab. I worked at [a local well-known] Chemical Company for a short while and that was not for me because there's no interaction, and while I was in college my mom was in college. My mom had a two year degree from a small school and made a D in algebra so she had to re-, she just took one course at a time to, she was an activity director and so she got close to a degree and they said all you need is this algebra, A, B, and C, from [local land grant University] as a matter of fact, that's where I got my degree from is [local land grant University], and one day I come home from work and she's crying and she's so upset. She did imaginary numbers and the quadratic formula and all that, and my dad, you know, can't understand why she can't get it and so he raises his voice a little bit because of impatience. So, I'd sit her down and I had to calm her down and then I taught her algebra which floored me back, and she graduated May of

89', I graduated August 89' and I said crap I don't want to do this. So, I went back for two years to get certified to teach, and my first year I taught at [a rural school district north of the current city] up in rural in 91'-92', it was the year before the flood, and I didn't like it up there, couldn't, I'm not rural, yeah, but it was a total culture shock. So, I came back and was looking for another job, I mean I was in tears every night up there and thought I never was going to teach again. So, I'm interviewing in the summer and I'm working on my masters in secondary school administration, not finding a job, you know it's obvious, not finding a job, panicked, same Chemical Company and [current School District] both offered me a job at the same time, and I kind of sat back and thought about it and dad said to me, you know he's an educator, and my aunts and uncles are educators, you know it's in the family, and he said to me just give it another shot; you can always go to [Chemical Company] next year just give it another shot. [Chemical Company] even counter-offered; they offered me more money which they don't do, and but [School District] still was paying a little bit more and I thought well, I just had experience so I went to [Current District] and I've been there now going on 20 years. I have coached, so I've been coach, matter of fact when I was hired they said are you going to coach and I said yes if you want me to. So, I started that year coaching and, God I did something, I did some committees or something; I mean I started right away two feet in the door. I had a great mentor for chemistry. I taught chemistry my first year, just all chemistry, had a great mentor, Stan Moore who we still keep in touch. His birthday's the same day as my dad's which is why I never forget. Great sense of humor, gave me everything I needed helped me out, so that's where I've been. Then next year I taught physics and had absolutely no help except for I finally got a hold of the teacher from [another high school in the same district] and she helped me out, so you know, but from there I just kind of did this committee, that committee, this class, that. So, I did teach biology one semester. They gave me biology three days in the second semester one year and took the chemistry away from me, and then they let the teachers choose what kids they gave me so you can imagine the kids I got. They were doing cartwheels and that was the year I was told the first time to F off.

JH: Oh.

Teacher 020: Yeah, that was an interesting year. I went really and just started writing him up. He's like you can give me the whole staff and I'm like OK, and about 20 quit, so yeah we had to kind of learn to just give your authority and say hey I'm not messing with you, so that was an interesting, it was a very interesting year but I stayed through the whole move to a different classroom for six years every hour. You know you just kind of, you realize the kids are good and you have to realize that the other stuff it's not, you know, important. Matter of fact two of my little kiddos friended me, well three of them who've already graduated way down the road friended me on Facebook. The one has my same birthday and he has a son, and I'm like you're not old enough to have a son and he's like I graduated in 2000, yes I am. I'm like crap.

JH: Yeah.

Teacher 020: He was in the military, when he was in the Navy he would write me letters, hand write me, and so then we kind of lost touch and he's living in Arizona, so it was interesting to, you know to keep in touch, they keep in touch with me so that's the good thing, I mean it makes you feel good that they're on the right track and succeeding. You know [meteorologist on a local news channel] he was one of my kids.

JH: Oh yeah?

Teacher 020: Yeah, and he's come to the school a couple times, and so you know. I have a girl that came by, she works at the brewery. She goes I never realized I needed that chemistry stuff you taught me. So, yeah so I stick with it for some reason good and bad and ugly.

JH: Yeah.

Teacher 020: Yeah.

JH: So, let's go back to you growing up. I know your family's really important to you. You said your dad's an educator?

Teacher 020: Yeah.

JH: Tell me about you growing up. Are you from St. Louis?

Teacher 020: No, I was born in Massachusetts.

JH: Oh, OK.

Teacher 020: And then they moved to Indiana, my dad was finishing his PhD up there.

JH: Oh, OK.

Teacher 020: He did post-doctoral work in Notre Dame so he lived there for three years, and then he did a second post-doctoral work in New Jersey at Roach Institute of Molecular Biology which doesn't exist anymore up there, and then we moved here in 76', so I was nine. My brother was like three or four months old but I was nine, so I spent most of my life here but I wasn't born here; I'm not originally from St. Louis.

JH: OK, gotcha. So, you remember living there?

Teacher 020: I remember Indiana.

JH: Alright, and then…

Teacher 020: But I don't remember Massachusetts except the visits we took. I definitely remember New Jersey, in fact my best friend I still write after 35 years, we hand write letters.

JH: Yeah.

Teacher 020: We don't even Facebook or anything, we hand write, yeah.

JH: Yeah.

Teacher 020: The old school.

JH: So, your dad what did he do after he finished school?

Teacher 020: He did his post-doctoral work.

JH: Right, and then what?

Teacher 020: Oh, he came to UMSL. When we moved here he was at [local land grant university].

JH: OK.

Teacher 020: Biology, professor of biology. Yeah, he worked with Dr. [science and education professor we both know]?

JH: Oh really?

Teacher 020: Dr. [Familiar] was department chair at the time. I've known [him] since I was nine years old.

JH: Oh my.

Teacher 020: Yeah, and he still looks the same.

JH: Yeah. So, when you, so tell me about what kinds of things that you did. When did you start swimming?

Teacher 020: 4th or 5th grade. Well, I was, when we lived in New Jersey my parents on Saturdays we went to the YWCA, OK, and they would drop me off Saturday morning and I'd swim, gymnastics, get a dollar for a hotdog and soda and chips, and then I'd do ballet. So, I was really swimming back then, but competitive I did summer leagues when we first moved here when I was nine, and then all year round it 5th grade I started doing all year round swimming with [local town] USS Swim Club. It wasn't connected to the school but we swam at the school and was mostly the [local town] area involved, so yeah I started there and it was late because a lot of kids start when they're four and five.

JH: Right, yeah.

Teacher 020: So, yeah, so I was about 10 I think when I started year round.

JH: And did you go to [current district] schools then?

Teacher 020: No, I went to [adjacent district]. I live probably less than two miles from where I grew up.

JH: OK.

Teacher 020: So, I don't know, you probably, I don't know which you came, but…

JH: Up, I don't know, Washington.

Teacher 020: OK and [high school she attended] is just .7 miles from there. I lived right behind the corner; I walked across the football field every day.

JH: Wow.

Teacher 020: Well, I went to [catholic school] for 4th-8th grade but high school I went [to nearby high school].

JH: Saint what?

Teacher 020: [repeats name], it doesn't exist anymore.

JH: Is that a Catholic school?

Teacher 020: Yeah.

JH: Alright.

Teacher 020: It's now Rose, Phillip, something like that.

JH: Oh, gotcha. Alright, so tell me what it was like growing up with a biologist as your dad.

Teacher 020: Well, let's see I won a lot of science fairs when I was at [catholic school] because I would go to his lab. Now, he kept it age level appropriate; you know you did the acid/base labs where you made the cabbage and everything in like 4th and 5th grade, did all that to test acids and bases. So, he made it so I grew up basically living, breathing biology, I mean it was the dinner table talk. He did research; he did a lot of research. I remember one of his first research projects was with aging, and he did a, and I used to watch him do his slides and it was projected slides and it ran timed and he did it to When You're Sixty-Four, and I still remember that over all the years that one just kind of stuck in my mind, and then he got into pilot disease, and that was when I was in college I worked in his lab for a course with [another teacher we both know].

JH: Oh, yeah.

Teacher 020: And that was, I got published with that one.

JH: Oh.

Teacher 020: And did researches, you know the research class there, and I had a great time with it. I did statistics because she taught us; it was called biometry at the time which is biological statistics.

JH: Yeah.

Teacher 020: I did that with her and then I did the research and it was interesting because pilot disease is still big because that', Japan is infested with it and that's their big product, and of course if you watch the Olympics they had that all over the Olympics when they built the stadium and stuff, so he was right on with that, and now he's doing something with soybeans.

JH: So, is he still at [local land grant university]?

Teacher 020: No, he just retired from Bradley. He went to [local land grant university]?

, then he went to [LOCAL PRIVATE JESUIT UNIVERSITY], he was at [local land grant university]?

about 10-12 years, he went to Japan for about a year at sabbatical, and then he went to [LOCAL PRIVATE JESUIT UNIVERSITY] for about 10 years as biology department chair, then he went to Youngstown, Ohio for three years as Dean of College of Arts & Science, and then he was at Bradley and he started his associate provost and dean the graduate school, then they put him as interim provost for like a couple years, three years, and then he went back to the graduate school dean this past year and he retired May 31st, except he's interviewing for a job this week with NSF in Washington, D.C., and a college at a university up there, so I don't know which one of the two if it's either one, or if he'll take them because, you know he has grandkids and he's been playing with the grandkids since they moved back here, and so I don't know what he, he's going to be 68 so I don't know what he's going to do, I'm like…

JH: Anything he needs.

Teacher 020: He loves to work, so I mean he's been studying for these interviews, he literally, he does, he interviews, well he studies and I'm like OK I wish I had that drive, but OK.

JH: Where is Bradley?

Teacher 020: Bradley is in Peoria, Illinois, it's three hours exactly.

JH: OK, I knew I had heard of that.

Teacher 020: It was just on the news yesterday if you saw Channel 2 at 11 they were talking about the new dorms they have, these real expensive, because it's private.

JH: Oh, right.

Teacher 020: It's like [LOCAL PRIVATE JESUIT UNIVERSITY], it's private.

JH: Right.

Teacher 020: And yeah, expensive, expensive dorms and they said they're already filled and I'm like it's 600 and some dollars a month or something and I'm going that's like, I mean how could kids afford that?

JH: So, you lived and breathed science at your house.

Teacher 020: Oh yeah, oh yeah.

JH: Now, you said you have a younger brother?

Teacher 020: Yeah, he's nine years younger, eight years and 10 months, but yeah. He's a lawyer.

JH: And he's here in St. Louis?

Teacher 020: Yeah, yeah, Chesterfield.

JH: Right and he's got your nieces and nephews?

Teacher 020: Yeah, one niece and one nephew, that's it, only one brother. He majored in biology too.

JH: He did?

Teacher 020: Yeah.

JH: I was going to say how did you end up in science, but he did major in biology.

Teacher 020: And then he's a lawyer. He was a swimmer too.

JH: So, how did you know about physical therapy, your first career aspiration; at what point did you think that would be a good idea?

Teacher 020: When I went to the physical therapist all the time when I hurt my shoulder in high school.

JH: OK.

Teacher 020: Yeah, yeah, and I kind of, yeah.

JH: So, as a kid did you see yourself, what did you think you wanted to be when you grew up do you remember?

Teacher 020: Physical therapist.

JH: Before that.

Teacher 020: Before that, nah not a clue.

JH: Not a clue?

Teacher 020: Not a clue. I always knew I was going to college, that was in the family; you're going to college, you're going to get A's and B's and you're going to college, except D's in art.

JH: So, you always knew you were going to college but you weren't sure what you would study?

Teacher 020: Right, not until I was in high school; when I was in high school it was physical therapy, and I don't know why, I mean it just, yeah.

JH: And then you said the classes you had to take for that turned you off.

Teacher 020: Yeah.

JH: What kinds of stuff turned you off?

Teacher 020: You know honestly I don't remember it just, I was swimming at the time too so it was a lot of time and energy and just very intense, so I just…

JH: Because a lot of people get turned off of physical therapy because of the science they have to take, but I'm guessing that wasn't you.

Teacher 020: Yeah, I don't remember particularly. I just all the sudden was like nah I don't want to do it. I got accepted to [LOCAL PRIVATE JESUIT UNIVERSITY]'s physical therapy program and turned it down.

JH: OK.

Teacher 020: Because I just said what if I change my mind, so it was still kind of an if and there so I just, yeah, started taking my first, you know, two years. First year and a half I was at Louisville, Kentucky, University of Louisville because I was swimming for them.

JH: Oh, oh OK.

Teacher 020: Division one, division one and that's when I really hurt my shoulder after a semester and was done, tore the rotator cuff, I was done, toast.

JH: OK.

Teacher 020: And I was working on a biology degree and then thought I was going to get my masters in physical therapy because by then you need to get, I mean that was, but I just decided I don't want to do it. I think it really was, well probably was when I had to dissect a cadaver, that probably did it.

JH: I was wondering if you did it that far.

Teacher 020: Yeah, because I was at UMSL when I did, but they took us to what's that chiropractic place, or the Logan, and it was one of the classes at UMSL and they took us to Logan and there was the cadavers out there and I remember coming home because I was living at home, and my parents had just had chicken for dinner and the bones were there, I was done; it was like I couldn't even eat, I had, I'll take cornbread and vegetables, I couldn't even touch meat for like three days.

JH: So, just so I am sure here you went to [local] High School and then you shopped around colleges for a swimming scholarship?

Teacher 020: Yes.

JH: And decided to go to Louisville?

Teacher 020: Yeah, for a year and I ended up being there a year and a half.

JH: A year and a half.

Teacher 020: And then I came back here and I was only going to be at [the local land-grant university] for a semester. That was in 80's, let's see. I went to college 85'-86', it was 87', January of 87' I was at [the local land-grant university]. I still remember my student ID# too.

JH: Oh my.

Teacher 020: I do remember, and I graduated in 89'.

JH: OK.

Teacher 020: So, I did the full, and I had to go an extra semester because of the way courses were offered, I mean and that's just summer, but…

JH: So, you came back thinking a semester and then you ended up going back and forth?

Teacher 020: Oh, and I was going to go to [one of the branches of the state university located in a rural region of the state known for its education program]. I was going to; well no I was going to go to [to that particular university].

JH: To teach?

Teacher 020: Yeah, I was kind of leaning that way and, but I got a job, I was back at the Y, matter of fact I was working at two Y's. I was working at Mid County Y down in Brentwood, and I was working at the Y in North County, which I don't know if it was [Corporate sponsored] Family or North County; somewhere it changed its name to one or the other, and I was coaching the swimming which I think is what really got me to be a teacher because I knew I could coach.

JH: OK. So, the coaching swimming and then the teaching your mom the math you were like…

Teacher 020: Yeah, that really, yeah that really kind of, yeah. And I like interaction with people; I don't like to be in a lab by yourself kind of in your little cubby hole and you're going ah.

JH: Right. OK and we talked about your first years of teaching. Now, you were a biology major.

Teacher 020: Yeah.

JH: And then you did the two year program.

Teacher 020: Well, yeah it was you had to take courses to satisfy the state, you know, and Dr. Granger wanted me to take a, I still remember this one, a theatre class because I needed to learn to project my voice, and the kids can hear me underwater.

JH: No kidding?

Teacher 020: Yeah, so I stood in his office and I still remember, and not even yelling just projecting my voice and I said do you really think I need to learn and he went no. I said I'm going to take the state courses, I'm going to get certified, and that's just the way it's going to be, I'm not taking anything extra, and he went OK. Yeah, so he's the one that approved it so I was afraid he wasn't, but when I stood there and said oh no we're not doing that, we're not taking extra I don't care, already have a degree, I can go somewhere else, he went OK. So, yeah Granger and I went toe to toe a couple of times. But then I…

JH: So, you were working at the Y and teaching there while you were doing…?

Teacher 020: And I was working at [university] too at the library.

JH: OK.

Teacher 020: The [Name of Specific] education library, yeah. I picked up a part-time job there. I was working three jobs during those two years, and Granger got mad at me because he didn't want us working that second semester when we were student teaching, but too bad I had to pay for things.

JH: Right, and then so you graduated in 87' with your biology degree.

Teacher 020: No, 89'.

JH: 89', sorry.

Teacher 020: Yeah, 87's when I went to [the local land-grant university], yeah.

JH: And then, so 91' you graduated with your teaching certificate?

Teacher 020: Right, May of 91', and I had some classes towards my masters because I had to stay fulltime to stay under my parents insurance, so I had already started that. I took some general courses, you know the philosophy ones and education, you know teaching/education ones, that kind of thing, the statistics one that you had to always take as your, and then I was also working on my chemistry certification because at that time you basically had to have a minor, you had to have a minor so I was shy two classes for a minor, so I was shy two classes from what the state wanted so I took one at night, and I was working at [a specific well-known] chemical company at the time too.

JH: Goodness gracious.

Teacher 020: Yeah, I was working second shift right after I got out in 89'. The summer of 91' I was working at Sigma and I was in the packaging and labeling and I worked from 2:00 PM – 1:00 AM, and I took a class at [local Private Jesuit University] in the morning to finish up, and then somewhere in there I took one at [[the local land-grant university] too; I think when I was doing my certification I took a night one so I could get certified.

JH: So, you're certified to teach biology and chemistry?

Teacher 020: Yes, and then I worked on the physics one. While I was teaching my first year I took a correspondence calculus based physics course.

JH: Oh my gosh.

Teacher 020: Through [State University]. Well, I was in [Small Rural Town located an hour and half north of the current city] so you know it was all…

JH: Right.

Teacher 020: Yeah, you had to watch the videos. We had the videos and then you'd take the test. I needed that one, because I only needed two there too; I needed that one and then I needed an astronomy course, and I took the astronomy one when I was at [current school] my first year and then I was done with that.

JH: OK.

Teacher 020: So, yeah I'm certified all three, and basically it's not on my diploma but I have a minor in chemistry and physics because those are the courses you needed.

JH: Right.

Teacher 020: I had the 20 hours, now I have more.

JH: Right. So, now however you teach mostly chemistry and physics, so how did that come to be?

Teacher 020: They needed chemistry and physics and they didn't need biology because you can find biology teachers almost anywhere because biology's an easy certification.

JH: So, why did you stay? I mean you liked it enough to stay there rather than find biology somewhere else?

Teacher 020: I love teaching chemistry, I don't want to teach biology, I really don't; I don't like teaching biology it's not as much fun. I love teaching physics but now they're pulling more of the physics away from me because they're putting me in chemistry because they know that chemistry state test is coming before the physics one and they want me in there because they know I can work with the kids and get the kids to do things other teachers can't get them to do.

JH: Right.

Teacher 020: And so that's, and I still do things like SciJourn.

JH: Right.

Teacher 020: So, I'm still trying new, you know I'm not the one that after 20 years is sitting in the corner going, handing out worksheets, so that's, yeah that's why they want me there.

JH: Got it.

Teacher 020: Except I'd rather do the physics, but yeah. Next year I have one physics and four chemistry.

JH: OK. You prefer the physics over both chemistry and biology.

Teacher 020: Yeah.

JH: Why do you think that is?

Teacher 020: I just think physics makes more sense to me, plus I love the math in physics. Well, as long as I'm teaching algebra based, and next year I have the freshmen pre-AP physics which is out of the, you know physics versus pre-AP it's a little higher and it's more math based and I love teaching the algebra. I just love the algebra because it makes sense to me. The physics makes math make sense, I tell the kids that: physics makes math make sense, and after a while they're like oh. Now, of course I have to teach them trig because they don't have trig by the time they're freshmen.

JH: Right.

Teacher 020: But I do the basic sign, tangent, cosign, just put it in your calculator, basic geometry, some of them are in geometry so, you know it helps later on because they'll come back to me and go we learned from you. Yeah, just the basics and they get it, I mean and you just tell them you're going to get it, it's going to work, because we do vectors and all that other stuff, so I love it. It makes sense, physics makes sense to me. Chemistry I say OK, yeah you know, and physics is more visual except when you get to electricity you have to imagine electrons, but you know you see the effects of the electricity, so yeah.

JH: Yeah, more tangible. Yeah.

Teacher 020: And I enjoy it, I do I enjoy. Just think if, I knew I was a physics nerd. I used to take the kids to Six Flags for physics day. I took them four times and after the fourth time when my name was on the intercom four times I said never again, but I was on the, it was the first year of the Batman.

JH: Yeah.

Teacher 020: OK, and I was on the Batman with another physics teacher, and this is what's funny, and we're sitting there in the front, I'm in the very first seat because you get the best torque in the first seat and you get the best g forces, so I'm in and look this is when I knew I was a nerd; we were sitting there the whole ride, I didn't even experience the ride, and we were talking about the motor and the mechanism and how the ride worked, and I went yeah we've got to do that ride again. I mean the whole time we talked physics and I went I'm not a real physics teacher, I mean that's when it really hit me that I got it and that was, yeah, that's when I realized that that's, I love it because it made sense to me. That was my weakest point of physics was electricity, magnetism, motors, electromagnetism, and now it's one of my strong points because I spent so much time, I've gone to other classes for it, I've gotten all the books to read, so I do a lot of that on my own, you know so these have to be right. Well, these are, some of these are, oh what's her, Paige Keeley's books.

JH: Oh yeah?

Teacher 020: Yeah, so I bought five of them, yeah, so I can use them next year. So, some of that's Paige Keeley's stuff.

JH: So, you are like this perpetual learner as well as teacher.

Teacher 020: So-so.

JH: So-so, and the truth of that is physics stuff, I avoid physics in high school.

Teacher 020: And now they're required to take it.

JH: Right, it was an elective and I didn't need a credit and I said nope.

Teacher 020: Yeah.

JH: And in college it was no risk class, and I was in the non-science physics with mostly all physical therapy majors, and that's what made me think it couldn't have been the physics that turned me off to physical therapy.

Teacher 020: I didn't take physics in high school, I was going to, I was signed up but I had mono and missed the first few weeks of my senior year. So, there was no way I was jumping into physics after that, I just couldn't do it, so I had that hour, the day off and went home because it was the end of the day. They let me because they knew I was still pretty sick, and I was an A student so they let me do what I needed to do. So, when I walked into college it was at UMSL and it was my I think junior year when I was taking the physics. I made a C first semester and I never worked harder for a C in my life. Now, what I didn't like about who I had first semester, and I can see his face can't remember his name, but he made us memorize the equations, he didn't give us any equations, which I thought I give the kids the equations and say you need to be able to manipulate it; I give them the basics, manipulate and use them. I think that's more, because you can look up anything, you can get online and look anything up now.

JH: Yeah.

Teacher 020: You just have to use it. My second semester I made a B and that was electricity/magnetism but he let us use equations, he let us. So, I think I would have done better if I was given the equations because I can do the math.

JH: Yeah.

Teacher 020: But yeah I never had it in high school either and now I teach it.

JH: Yeah.

Teacher 020: Yeah.

JH: That's interesting. My college professor would give us the equations and I had no idea what to do with them, the most ignorant I've ever felt in my life. I need to come take your class.

Teacher 020: I remember coming in to the room the first day for physics and I'm sitting in the front, I always sat in the front, in my science I always sat in the front, and even in my PhD I was in the front row, and very front seat because no one's going to mess with my education, and I remember I'm sitting around these people and they're like oh yeah we've read this four times, we're on our fifth time, this is our third time, and I'm going are you kidding me? I mean I'm sitting here panicking and I'm like when I finished I thought OK I worked hard, why did you flunk it if you, you know. Yeah, and it, you know classes aren't always easy, you know, that you'd have to work to get your.

JH: Right, right.

Teacher 020: Yeah.

JH: Yeah.

Teacher 020: And I don't think some people did.

JH: Right, exactly. OK I want to talk now about going forward. So, you started teaching, you had your certificate and this minor in chemistry and physics plus you already had some graduate classes and you were staying enrolled.

Teacher 020: Right, for the secondary school administration.

JH: Secondary school administration, so you…

Teacher 020: That's through UMSL, yeah, that started that, yeah.

JH: So, when you started that about how many years had you been teaching?

Teacher 020: Oh, I started that before I was teaching.

JH: OK.

Teacher 020: I started that when I was working on my certification so that I could stay under my parents insurance.

JH: OK.

Teacher 020: I only had I think eight or nine hours before I walked into my first year teaching, yeah, yeah.

JH: Oh, OK.

Teacher 020: My first year teaching I didn't take any courses towards my masters because I was at [Small rural town located an hour and half north of the current city] and I had like five different preps, yeah, and I had five different preps a day.

JH: Right.

Teacher 020: We had 45 minute classes and it was a nightmare.

JH: It was a nightmare?

Teacher 020: It was a nightmare.

JH: It was a nightmare because of the preps?

Teacher 020: The preps and the fact that being single they had the mindset, a female that you had to be a certain way, and I should have gotten a hint at the interview because they asked me at the interview if I drank and smoked. You can do that in a small town I guess, you know, remember this is, you know.

JH: It's not that long ago.

Teacher 020: 20-some years ago, and I still remember, and I sat there and went no, really, I mean I'm out when I drink but I don't smoke at all, and then I remember the principal would come out on the street and almost harass me about, you know I'm off duty don't, and they made me do the baseball clock, and you know there they don't have football so. I mean basketball not baseball, basketball, and you know that's the big thing. They made me go to barn warming and I have allergies.

JH: What's that?

Teacher 020: It's the fall dance, like you know they have homecoming, that's their fall barn warming

JH: Oh, OK.

Teacher 020: And they had hay all in there, and you had to go through a hay tunnel to get in and I was supposed to be there, I have a picture somewhere. I was supposed to be there monitoring it and I have allergies so bad; grass, mold, hay, oh my God my eyes swelled up, yeah, and I remember the one that got me because I believe in separation of church and state unless you're of course in a Catholic school or Lutheran or Baptist or whatever. He brought his minister in, pulled me out of class when I was teaching chemistry to talk to his minister so his minister could give me a bible. I always left on the weekends because I'd come home to my parents and friends because there was nothing to do. I'd watch the kids, I lived above the gift shop, and so if you go down 79 the gift shop, I lived right above the gift shop if you're facing it on the left side. It's got two apartments up there, I was on the left side, but the kids did this up and down Highway 7 up and down, up and down, that was it.

Teacher 020: Racing?

Teacher 020: That was the line and I said oh I can't be here on weekends because they didn't want me, because I was told I couldn't go to the bar.

JH: Right.

Teacher 020: Even though they had great sandwiches you couldn't go to drink, you know it's like if I go to Rizzo's up the street they have a bar area and then they have the regular, and I wouldn't be allowed to go in there because of how it looked. They wanted me to live down by the river, which allergies galore is bad enough where I live and I'm like no, in apartments which flooded all the time. I was like no I'm not living there. So, they wanted to control and since they couldn't he kind of made a removable and I said I'm out of here.

JH: Wow.

Teacher 020: I did science club, I did sophomore class sponsor at the, I knew I was doing science club, and then when I showed up they gave me sophomore class sponsor and I'm like, and we were supposed to raise the money for the junior-senior prom.

JH: Oh really?

Teacher 020: So, like here the junior class puts on the junior-senior prom at Hazelwood, but there the sophomores put on the junior-senior prom so that was a nightmare in and of itself; they wanted me to take them to the zoo so I brought them on a bus to the zoo, and yeah it just wasn't, it wasn't…

JH: They gave you the runaround it sounds like.

Teacher 020: Yeah, well I remember I had a kid, now this is the one that just cracks me up; I think about it all the time. He had to go home during chemistry for five weeks because he had a sick pig, it was a prize pig, and he had to go give him his medicine in this chemistry, the last 10 minutes of chemistry. Even though it's only a 45 minute class he had to miss the last 10 minutes of chemistry every day, but that was allowed because he had a sick pig, a sick prize pig, and did you know that if you, it takes your nail, if you put a mark at the bottom of your nail, OK, by the time the mark gets to the top the piglets will be born, when you know they've been, and it takes three months for your nail to grow from the bottom to the top. I found that out from him.

JH: Wow.

Teacher 020: Yeah, so I took home something from the kids.

JH: That's interesting science.

Teacher 020: I went oh yeah! Yeah, I learned more in science there than I ever have, and then they used to drive to school in their trucks with the shotguns in the back, and then bow season when that started they weren't in school, hunting season when that started they weren't in school. Now, of course you're talking to a, I grew up a suburban kid, you know, not rural at all. My parents of course, you knew grew up in a small town.

JH: Right.

Teacher 020: And they got it, I didn't get that at all; I was like are you kidding me? So, that was not for me. It was culture shock and it just didn't work.

JH: Yeah.

Teacher 020: And they weren't very friendly, only the librarian was, and a couple of the other teachers that had been sub plants like me, and that was it; they were not friendly at all.

JH: Because you were an outsider?

Teacher 020: Oh yeah, yeah.

JH: Wow.

Teacher 020: The business teacher had been there four or five years and they weren't friendly to her at all. The librarian was the only one that'd been there for generations who was nice to everybody, so that kind of, yeah that did it.

JH: Interesting, wow.

Teacher 020: And I'm comfortable in North County, I mean I grew up here so it's…

JH: Yeah.

Teacher 020: My brother went to school at Hazelwood East, I taught him physics. He's nine years younger than me, remember?

JH: You taught your brother physics?

Teacher 020: Because I was the only physics teacher.

JH: Ah!

Teacher 020: He was like #5 in the class so of course he made an A.

JH: Oh, how awkward.

Teacher 020: Yeah, because he didn't, because all the kids knew because you know I'm not married so it's [the same last name as her brother], and he couldn't call me [by my first name] because that's what he called me because it's be like uh that's a first name, he couldn't call me Mrs. [Last name] because it was just not, you know it just didn't feel right, so he'd call me "Teach."

JH: Teach?

Teacher 020: Teach, and then I coached him for two years swimming too because it was my first two years I was there it was his junior and senior year.

JH: So, oh my goodness.

Teacher 020: So, if I would have got right out of college with my degree at 21 I could have had him, been there all four years, he would have had, yeah.

JH: Oh my gosh how funny.

Teacher 020: And my mom worked across the street at the time not at the hospital but at the nursing home that's across the street that's connected to the hospital, it's called Village North.

JH: Right, yeah.

Teacher 020: Yeah, that's where she worked, so she worked right across the street.

JH: Got it. I'm kind of running out of… But I wanted to ask you about your mom because you said she went to college when you did.

Teacher 020: Yeah, she had a two year degree from St. Aloysius in Pennsylvania.

JH: Yeah?

Teacher 020: Yeah, and…

JH: From when she was 18 or 20 or whatever.

Teacher 020: Right, yeah, yeah, so that was it, I mean that's what, you know I've seen pictures of her, yeah she's shown me pictures at the rock. They went back to visit and there's a big rock they all take pictures by and they've gone back to visit, she loved it, loved it, and then she worked when we were in Massachusetts at the VA hospital when she had me, and I don't think she worked when we were in New Jersey; I do not remember if she did or not. Indiana she didn't work. No, Indiana she didn't work. She didn't work here until my brother was in kindergarten and then there's a nursing home and I definitely can't remember the name of that one but it's right across from Bryant Library on Forrest Rd, and…

JH: So, is she a nurse?

Teacher 020: No, activity director.

JH: Oh, you said that.

Teacher 020: Yeah, they called it an activity therapist but it's basically an activity director. She ran a bed and breakfast for five years too after she retired from there.

JH: Here?

Teacher 020: Yeah, in Seward.

JH: Cool.

Teacher 020: Three, four, maybe four years, maybe about four years. She loved it; she always wanted to do that.

JH: Cool.

Teacher 020: And that's why I'm as heavy set as I am is because of her cooking; everything from scratch, oh no not just baker, cooking. My dad's really the baker.
JH: Really?
Teacher 020: He bakes bread, unbelievable, oh yeah, new homemade noodles.
JH: Nice.
Teacher 020: Oh, I can't stand cooking. I can, but I don't like to do it.
JH: Sounds like you don't love to, so your mom does good cooking.
Teacher 020: That's right.
JH: Alright, so when you get back to, so you started working at Hazelwood and then when did you pick back up your masters, or did you go to [LOCAL PRIVATE JESUIT UNIVERSITY]?
Teacher 020: No, I picked up my masters at UMSL. Let's see, I think I started, I don't think I started... I might have started right away. I know I got my masters in 96', and so I was in Hazelwood, the first year I was hired August 26, 1992. I had to find that out for something else that's why I remember the day, I wouldn't have told you that if I didn't know. Let me think, I don't think I started my masters the first semester I was there, I think I started it the second semester, so '93, and then finished in '96 taking one course at a time, two courses.
JH: Why?
Teacher 020: Because I wanted to be a principal but then I didn't get the certification at the time because then I didn't want to be a principal.
JH: What made you think you wanted to be a principal that early on in your teaching?
Teacher 020: I have no clue. At this point I really don't remember.
JH: No?
Teacher 020: Yeah, I really don't. It may be the fact that I have to be in charge.
JH: You didn't want to be in charge?
Teacher 020: I did, yeah.
JH: You did want to be in charge?
Teacher 020: Yeah, but then I think when they taught… When I got done it was the old test where you had to go to Jeff. City and pay $500 and sit through the whole, yeah, and that I think turned me off.

JH: To getting the certificate?

Teacher 020: Yeah, and then I took for years off, and then in January of 2000 I was at [LOCAL PRIVATE JESUIT UNIVERSITY]. Then I knew I wanted to be a principal at that point because I knew I could affect education in a different role as an administrator, because eventually my goal was to be superintendent but now that I hadn't been promoted I don't know where my goal has gone, I can't find a job anywhere.

JH: Right.

Teacher 020: I can't find a job anywhere, well right now if you notice District X cut out a lot of their, I mean they're not, yeah, and [my district] used to hire within but now they're hiring even out of state and out of, I mean it's, yeah. So, it's kind of been different lately so we'll see if changes occur.

JH: And you graduated last year, 2010?

Teacher 020: May, 2010. May 13th I think it was I was walking across that stage.

JH: That's awesome.

Teacher 020: With mom and dad there, and then dad had to go right back to Bradley University for their graduation because he had to sit on stage in the evening. So, mine was in the morning, they did it at the [inaudible], yeah, and then it rained, it was raining so we had to have those snacks they give us up at the center, the student center instead of out on the lawn. That's a really nice, I'd never been down there, it was a really nice landscaping they have.

JH: Yeah, I've only been down there one time.

Teacher 020: It was gorgeous, gorgeous, and it would have been nice to have it out in the middle, but yeah didn't work.

JH: Got it. Alright, so if you, what do you do in your free time? I know you have your doggies.

Teacher 020: Free time, it's free time.

JH: Well, since you graduated you had a year to sort of re-acclimate to life without school.

Teacher 020: Yeah, and I said I was going to do nothing. So, let's see I went back to coaching, oh I got teacher of the year so I had all that work to do, [science coordinator] nominated me for the presidential award in math and science, didn't get that, got the email on that one, but I just found out from someone I was with last Friday, she reviews the videos, usually people don't get it on the first time anyway, so I went OK.

JH: Right.

Teacher 020: Keri's like I'll nominate you next year. I said yeah because I'll know what to do better. So, she told me what I needed to do in the video and I'm like oh I can do that now.

JH: Yeah.

Teacher 020: You know the first time around too it's a learning curve. Let's see, what else did I do, oh my God committee, committee, committee, committee, committee, co-facilitated the discipline behavior guide committee with one of the assistant superintendents, I'm on the staff building facilities committee which is a meeting I had last Friday. So, even in the summer, you know did data assessment last summer and this summer for three days, so yeah I didn't.

JH: There's no free time.

Teacher 020: No, free time, yeah it doesn't exist. I do go every third week of September I leave, I miss swim practice, I leave Friday after work, come home, throw everything in the car including the dogs and I go to Dwight, Illinois for the basset waddle where we raise money for the rescue league that these guys came from.

JH: Cool.

Teacher 020: And right now they have seven bassets that are coming into the league that were from a horror.

JH: Oh.

Teacher 020: And they say it wasn't really a puppy mill because they were taken care of better than puppy, so I think it was more of a hoarder and they're looking for foster homes. I did foster one, so I'm like I don't know if I can do four even though it's similar to what we had for… Usually I had two, the only reason I got her is because Becky was blind and he needed a playmate.

JH: Right, she's so cute.

Teacher 020: Yeah.

JH: I have a problem with pets; I'm just not allowed to look at baby animals anymore.

Teacher 020: Yes.

JH: The puppy, the kitty, what's next, you know?
Teacher 020: Yeah, and a fish. Fish will work, guinea pig, my brother had a guinea pig.
JH: Fish and the turtles, yeah.
Teacher 020: Yeah, so that's my third week and then we, it's a Friday night people are coming in because then Saturday morning you get up early, some of it kind of gets together a little bit Friday night, and Saturday we go to the part, they have a piece of a park that they bought and they have it all fenced in, they have vendors so you can buy stuff and there's raffles and I usually donate something for the raffle, and they're off leash and so they get to run around. There's a double gate so they're real careful about watching.
JH: It's a basset festival?
Teacher 020: Yes.
JH: Is that cute or what?
Teacher 020: Well, the next day, Sunday is the parade. We're the pre-parade for their fall festival down there in Dwight, and there are no hotels in Dwight so I stay like 20 minutes just outside of Lake Pontiac, and there were over 1,000 bassets the last two years I went.
JH: You're kidding me.
Teacher 020: No.
JH: Oh my God.
Teacher 020 And last year her being blind, I have a cart, a really good cart and I didn't know, I couldn't get the two of them and her, and people are so nice, they had extra hands so I had people help me with her and him, and I had her on the leash, so yeah it was over 1,000 bassets and people they love them on the street, and the bassets come by and they pet them and they're all oh come see me.
JH: Oh.
Teacher 020: Yeah, and they put water out and ice, they put ice out for the dogs to drink as they're going along the parade. It's about two miles, two and a half miles, you know, and yeah we've got to get in shape for it don't we; we've got to start walking.
JH: So, how did you get involved with the bassets?
Teacher 020: Well, my dad was at [LOCAL PRIVATE JESUIT UNIVERSITY] and [a professor friend] and his wife were giving a basset and they knew I was looking for a dog

because dad said, you know, my daughter’s looking for a dog, wants a laid back dog, and he called me, Dave, and said come on and meet this dog his name is Barney, big guy Barney. Well, the husband had to get rid of the dog because the wife didn’t want to give up her dog, so they had just gotten married and so he was giving up his basset but he ended up taking it back so I didn’t have a basset and I was all disappointed. So, then he said I’ve got a line on a dog from Arkansas, so Hope was a southern dog, he was very southern, very laid back, and I went and went down to the Lamberts in Arkansas and they drove up to meet us and they had two; they had Peter and Hawk and they didn’t tell me one of them had heart worm, they didn’t tell me which one because they wanted me to choose without. Well, I chose Hawk and he didn’t have heartworm.

JH: Yes.

Teacher 020: And he just had that square face that looks more like a basset to me. The other one had the long face that didn’t look like a basset to me. So, I picked him and came home with him and I had him for four days shy of 10 years.

JH: Wow.

Teacher 020: And about the fourth or fifth year I had him I got hurt. I was just looking for a buddy and I saw the rescue league and I met [someone], can’t pronounce his last name, and he was very involved with Guardian Angel, and we met somewhere through some basset thing that I… Oh, I know where we met, we met at [someone’s] house because [he] did basset parties and people would bring their bassets over; people with bassets would come over and bring their bassets and I met all these people, I mean I met more people because of my dogs. One of my best friends now is because I would walk in the neighborhood and she had a basset. Now they live in Godfrey but she comes running out of the house as I’m walking, huh, oh my God you have a basset! I’m thinking who is this crazy woman, she brings her basset Oscar out and that was it; we’ve been best friends for 14 years, 15 years now. It’s just so funny.

JH: Interesting.

Teacher 020: Yeah, so we met because of…

JH: Did your dad have dogs growing up?

Teacher 020: No, my dad did when he was little but my mom is not, yeah she doesn't want them in the house. Now, I guess my mom's older sister her and her husband raised Brittanies.

JH: Oh OK.

Teacher 020: But they were outside though, so my mom was not an inside dog person at all.

JH: Got it. So, you moved out and wanted a dog?

Teacher 020: Yeah, I always did. Now, my brother got a dog when he was a little after I went to college because dad said boys need dogs, and that was the first time he ever called my dad an [inaudible], and I did to his face. Now, that was Mandy and when he was out of town we had to put Mandy down. She was quite old, she was like 16 and she had lung, a tumor in her lung.

JH: 16 is old though.

Teacher 020: Yeah, she just had a tumor in her lung. She was a mix of Brittany spaniel, the black with I think beagle or something like that, she was a good dog, oh my God she was good, and then dad got, as a matter of fact I went with him to get the Brittany from Kansas City. We met the people and I drove him in my Ford Ranger, no it was my Ford Explorer at the time, I had the Explorer. I drove him and we met right outside at the rest stop in Mizzou, so we drove halfway and met them.

JH: Yeah, yeah.

Teacher 020: And that's where he got Spike, who we just…

JH: Right.

Teacher 020: We had him a long time.

JH: That's awesome.

Teacher 020: Yeah, and dad wants a boy, so now he has Molly which I'll be watching in September when they go to Czechoslovakia, no Poland; I think they're going to Poland. Yeah, they're going to Poland because he was asked to be a guest speaker.

JH: Oh my.

Teacher 020: Someone in the government, Tomas, I don't know, asked him to go speak about something. He knows everybody, I mean he's been to Poland before, he's been to Czechoslovakia, he's been to Russia.

JH: To talk about his research, something?

Teacher 020: Something, yeah I don't know what it is, I was like whatever dad, yeah.

JH: Awesome. So, last year you're graduating, you're finishing your dissertation, getting that over with; why in the world did you get involved with SciJourn at that point?

Teacher 020: [Science Coordinator] said to me, see I love [her]. I've known her from day one and I know she's innovative, and so there's certain people that when they say stuff to you it's like yeah I'll do it, yeah I'll do it. I mean I've had about four people I can say in my teaching career that I would do that for and two of them aren't in the building anymore, they're gone, they're retired. But she brought this up, and Alan came out, I remember Alan came out to talk to the chemistry data team.

JH: OK.

Teacher 020: And I don't remember exactly what he said, but I'm looking at it and I'm thinking well, you know, I mean I need to write and I knew that, and it kind of, I don't know, I didn't really click into it at first; I thought yeah, yeah, yeah, you know how they are, yeah, yeah, another program, and I thought about it and thought about it and thought about it and it kind of stuck with me, so I said yeah I want to apply for it, and then I talked to [Teacher 019, who also teaches Chemistry], I said to [Teacher 019] I want to apply for it and [Teacher 019] said I think I do too. I said OK if I do it will you do it and she said yes, and so that's how that came out.

JH: OK.

Teacher 020: And then we talked to [Teacher 032, a biology teacher in the same building], we were talking to [Teacher 032] about it and she's like yeah I kind of like that, and so she said if you guys did it.

JH: So, you were all on the data team?

Teacher 020: Well, she's not. I think she was on biology and I don't know if he talked to biology or not, I don't know how that, yeah, but she saw that…

JH: She saw when Alan came I guess?

Teacher 020: Yeah, yeah.

JH: OK.

Teacher 020: And that was like the seventh hour at the end of the day and we came in and he talked to us about it, and so we all three then decided to do it.

JH: At what point in the year was that, like how far before summer? Do you remember?

Teacher 020: It was second semester.

JH: Yeah, OK.

Teacher 020: I'm thinking it was even fourth quarter.

JH: Alright. Tell me about your experiences with writing.

Teacher 020: My writing?

JH: Not with SciJourn but before SciJourn, yourself as a writer.

Teacher 020: Well, I had to do the research and write that up, and then the dissertation of course. Other than that, you know your papers here and there, but no I really didn't do much writing beyond having the dissertation was another nightmare and I never wanted to write another thing again which is probably why I never finished, you know, the SciJourn article, you know, mine, I had no desire.

JH: I think it's interesting you took on a writing project because I can relate to not wanting to write.

Teacher 020: Well, first off I didn't think I was going to do any writing, you know.

JH: Right, OK.

Teacher 020: That was first off; I'm like I'm not writing crap, but I did I mean I went through the process which I think was more important than anything else. Even if I didn't get it published and whatever I went through a couple edits, so that was important to me, but it was also important because I know my kids cannot write; they don't want to write, they don't want to elaborate, and I know it is so important that they write. Well, they didn't do the performance event for the end of close this year but they need, it's going to come back and they need to be able to write down their thoughts, and I'll tell you what. Well, I'll tell you with Student 020-007, the first one I read I was like oh my God who was his English teacher and how the hell did he pass, I mean those were my thoughts completely; he had blogs in there, I mean it was just his writing was no sentences, no periods, or run-on sentences. I was just floored, and I knew, you know and I'm not really a writer because I like to say things in short sentences, bam, bam, bam I'm done because that's the science in me.

JH: Science writing, yeah.

Teacher 020: And even reading him he didn't even have bam, bam, bam, so I went you know he worked with me and worked. I was amazed he did it all, I was amazed because I really, but I think I did it in a nice way where I gave him encouragement because I said good start but let's go from here, you know.

JH: Yeah.

Teacher 020: Our kids need a lot of pats on the back, a lot of hugs, a lot of love, a lot of high fives, a lot of encouragement, and then when they're successful that's when they see everything come together, and that's, we've got to get them to that point where they are successful and getting them there, and you know it's not writing a 3-5 page paper which they want us to do research papers as part of our literacy plan which I think is crap.

JH: Right.

Teacher 020: Because they can do research papers in English. You don't always do research papers in science, you know you write up your lab report and I think this is a good way, writing journal articles is a good way to get them writing and get them involved in writing, because if I say they're doing a 3-5 page paper [inaudible], and the kids don't know how to do them, and it's like pulling teeth, and then they turn in whatever and 90% of its plagiarized. So, and I've done projects where they have to write. I've done the scientist project where they had to come up with the birth certificates, they have to do all the research and they have to create the birth, so I've done all that creative stuff in the past. I had them do a children's book before on an element which they had to have all the info in there and they created a children's story out of it, and so I've done the creative stuff where they're doing some fun little writing things and not necessarily, I don't want to do it, I don't want to do the research, I hate that.

JH: Yeah.

Teacher 020: You know me too. You can do it in your English class, you can do it in your AP courses; you don't need to do it in your lower level courses. So, I thought this would be of interest, and honestly when I went in I thought well if it works it works, if it doesn't it doesn't, but it really was the best PD I think I've had in my 20 years of teacher, the most productive even though Paige Keeley was good, I went to her April issue, she was good, I see a lot coming out of her stuff too. So, there's some stuff out there you've just got to be introduced to it.

JH: Alright. Let's stop there.

Teacher 020: Yeah, they're [dogs in the room] showing off for you now.

JH: I like it. Alright.

Appendix G. IRB Approval

OFFICE OF RESEARCH ADMINISTRATION

Interdepartmental Correspondence

The UM-St. Louis Human Subjects Committee reviewed the modification to the following protocol:

Name: Joseph Polman

Title: Science Literacy through Science Journalism

This modification was approved by the Human Subjects Committee for the term of this protocol. The Human Subjects Committee must be notified in writing prior to major changes in the approved protocol. Examples of major changes are the addition of research sites or research instruments.

An annual report must be filed with the committee. This report should indicate the starting date of the project and the number of subjects since the start of project, or since last annual report.

Any consent or assent forms must be signed in duplicate and a copy provided to the subject. The principal investigator is required to retain the other copy of the signed consent form for at least three years following the completion of the research activity and the forms must be available for inspection if there is an official review of the UM-St. Louis human subjects research proceedings by the U.S. Department of Health and Human Services Office for Protection from Research Risks.

This action is officially recorded in the minutes of the committee.

Protocol Number	Date	Signature - Chair
080718P	8/19/10	

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