Advancing Functional Scientific Literacy to Socioscientific Literacy as a Cross Disciplinary Educational Goal: A Philosophical Analysis

Kory Bennett
*University of South Florida*

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Dedication

I dedicate this work to my family, the Killah B’s, Noah, Eve and Jenmarie.

Thank you for your patience, support, humor, and what must be unconditional love. You all give my life meaning, purpose, direction, hope and happiness - I could not have done this without you!
Acknowledgments

I want to acknowledge and extend my sincere thanks to all the students and teachers I have had the honor of working with over the years. Thank you all for helping me become the educator I am today.

I am truly thankful for the opportunity to collaborate with my committee members who are all exceptional thinkers, educators, and human beings. Dr. Robert Dedrick, thank you for your serenity, support, and thoughtful insights. Dr. Allan Feldman, thank you for your astute advice, encouragement, and the opportunities to collaborate. Dr. Sami Kahn thank you for your friendship, acumen, and your constant dedication to helping all students. Dr. Dana Zeidler, thank you dearly for refusing to judge by appearances, and offering this amazing opportunity to a brute like me. I am grateful for your friendship, guidance, compassion, and your dudesque way of being.

I would also like to thank all my parents, Georgia and Kent, Billy and Debbie, Bob and Judi, for your love and support, and for always striving to do the very best for your children and grandchildren. Matthew O’Brien thank you for your friendship and for sharing your inspiring ways of making sense of humanity. Alan Gonzalez thank you for being an amazing thinker, artist, friend, orator, and above all, a true teacher. Your students and colleagues are profoundly lucky to have known you. Thank you Tom Dolan for enriching the educational experiences we have shared, for your unrelenting friendship, and the work you do to improve the lives of your students on a daily basis.
Thank you to my daughter Eve and my son Noah, for your love, patience, and support.

Thank you for being creative, openminded, truly exceptional people who are always there for each other. I love and admire you both; continue being nice to people. Finally, to my colleague, wife, and best friend Jenmarie, thank you for your constant love and support. I learned more from you than you probably realize during our many hours discussing and working to improve the educational condition of our students. Thank you for all the years we shared teaching; you brought light, happiness, wisdom, and hope to students that many people had overlooked and forgotten. From all of those students and me, thank you for being the teacher and person you are, we are all better because of you.
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Abstract

Educational experiences built upon the Socioscientific Issues (SSI) framework provide opportunities for teachers and students to reflectively and reflexively address ill-defined complex scientific issues that affect human beings around the planet. Through the practice of Socioscientific Reasoning (SSR), while grappling with SSI, students have the potential to develop a SSI functional perspective of scientific literacy (SL); functional scientific literacy (FSL). Due to the multidimensional complexity of many human issues in and out of the science classroom, students are required to develop various skills, dispositions, and problem-solving strategies that expand from and connect with a SSI functional perspective of SL. The main focus of this philosophical endeavor is to provide a means to conceptualize the expansion of FSL toward a cross-curricular, student-shaped possibility called Socioscientific Literacy.

In order to open-up the topics under scrutiny, SL and Reflexivity, the notion of a deconstructive predicament is presented and explored. The recognition of this predicament allows for the analysis of tacit meanings and hegemonic influences concealed within concepts. Scientific literacy and reflexivity will be conceptually analyzed, personified, and rendered through the deconstructive use of literary and philosophical devices. Following from these analyses/narratives, through four deconstructive maneuvers, a bricolage version of SSR is formulated as a flexible means by which students can grapple with internal/external complexity.
Chapter One: The Problem

Introduction

My time as an educator in a K-12 public school system has been dedicated to working with groups of students that are underrepresented, marginalized, and disempowered. The subject of this philosophical inquiry, socioscientific literacy (SSSL), is meant to open up ways of conceptualizing the interconnectedness between classroom experiences, and how students individually and collaboratively, make sense of, affect, and are affected by their surroundings and themselves. SSSL will be framed as an expansion of functional scientific literacy (FSL), a SSI functional perspective of scientific literacy (SL), with a focus on the components and competencies that connect across disciplinary boundaries including reflection and reflexivity. However, it is also a fundamental ambition here to conceptualize SSSL as a student shaped goal, derived from personal particulars, yet connected to common human rootedness. While this work is philosophical in nature, it is inspired by my in-depth experiences with thousands of students, over 13 years of classroom practice. This requires a more direct and intimate form of reporting than is traditionally utilized by educational researchers.

The individual students I have known, each of whom directly influence my thinking here, transcend any labels society bestows upon them. As their teacher, labels of underrepresented, marginalized, high-needs, and disempowered, become academic shadows when juxtaposed with the actual everyday struggles each student is forced to negotiate and, in many cases, endure. The reason for all that follows, is not based solely on academic argument, but is also a genuine
attempt at providing practical ways for teachers to visualize and gain a deeper insight into their students’ educational condition. A first step is to conceptualize human beings, across space and time, as bound together by fundamental human habits of mind, modes of meaning-making, and problem solving. Simply put, our students, all of our students, are bound together and to us by our humanness. No matter how scattered student thinking seems on the outside, at the core, we find those commonalities that both connect us and that have the capacity to develop into countless permutations.

Statement of the Problem

My academic purposes for this study are to first, make visible the philosophical analyses of SL and reflexivity as they have been deconstructed within the socioscientific field of study. This required conceiving these concepts as deconstructive predicaments (see chapter four), which can be scrutinized for varying purposes including: revealing hegemonic, oppressive, influences of subordination and marginalization. I also connected and utilized these philosophical explorations to describe, analyze and advance Socioscientific Literacy as a cross-curricular, student centered, possibility for education.

Students from all walks of life in the US are alienated, confused, and intimidated by science (Furman, Barton & Muir, 2012; Shahn, 2002). Many adolescents in the United States are marginalized members of enclave communities, yet in the year 2020, they should have opportunities to be connected with social networks that can potentially span the globe. How do we ensure that we help students be well-informed, moral, compassionate and critical thinking citizens of the 21st century, instead of passive receptacles of information simply acting as the status quo dictates?
These questions, and their many corollaries, lead to a major problem for education; what should the goals be for (science) educators in the twenty-first century? Perhaps more importantly, what are the responsibilities of science educators working with students in ever fluctuating pluralistic societies?

As a group of science researchers and educators, attempting to make positive changes in our classrooms around the world, we must continue questioning those aspects of our practices and perspectives that we take for granted, such as our main goals, the systemic nature of our decision making, our responsibilities to our students, and ultimately, question if our choices are best for the students or best for society, and how might these two be in conflict. While empirical research may help to examine these issues, this paper argues for a more fundamental, analytical understanding of the constructs themselves on which empirical studies are situated. This required an analysis of key constructs, concepts, philosophies, and norms that, through a cloud of rhetoric, have been obscured and go unchecked. It has been pointed out that a lack of conceptual clarity can erode the validity of a concept and hinder theory development; a remedy to this, includes the use of more philosophical approaches such as conceptual analysis (Kahn & Zeidler, 2017).

**Background of Key Concepts**

Beyond being alienated from westernized science, students may not recognize the parallels between the types of thinking and acting they practice daily with those that are espoused and encouraged in scientific contexts (e.g., well-informed decision making, systematic testing, practice of certain habits of mind). Coupled with this is the question that if relatively few students enter the scientific community, what should be the goals of science education? The Socioscientific Issues movement addresses this concern in promoting the development of functional scientific literacy (FSL) (Zeidler, 2014), the practice of reflexivity (Green, 1999), and
presenting science as inextricably woven into the fabric of our sociocultural tapestries (Zeidler, Berkowitz & Bennett, 2014; Bencze et al, 2020).

These aspects of the SSI movement have the potential to move beyond the realm of school science, and connect educators of various fields. Kahn and Zeidler (2019) have recently posited in reference to promoting functional scientific literacy through the SSI framework:

While the SSI framework is positioned in science education, we suggest that other disciplines that frame pedagogy in a sociocultural context may benefit from this conceptual framework and the analytic approach we employ to uncover gaps in its relevant constructs. In many ways this philosophical endeavor is an examination of this possibility of expanding the SSI framework and functional scientific literacy outside of science education. (p. 608)

In the following sections, SL and Reflexivity, will be briefly introduced, and expounded upon in later chapters. In addition, the “rhetorical” nature and possible dehumanization of dominant science education objectives, will be discussed. Finally, an emerging Socioscientific Literacy will be introduced as a reimagining of educational objectives through the SSI framework.

Scientific Literacy

I previously posited the following question: What are our goals as science educators and what should they be? The debated concept of scientific literacy has been shaped and reshaped (Laugksch, 2000; Holbrook & Rannikmae, 2009; Roberts & Bybee, 2014) for many years, and is a contentious topic of discussion in the science education literature. However, it is often considered the uber goal for science educators.

There are many iterations of the concept; however, how “scientific literacy” influences the design and implementation of daily science pedagogical practice is not often discussed.
Douglas Roberts (2007) presented two visions, as opposed to definitions, of scientific/science literacy. The first vision (Vision I) is focused on the canonical nature of science, or the products and processes of science, that tend to guide the formulation of science benchmarks and standards (Robert, 2007 p. 730). Vision II is focused more on developing and understanding of science related situations that students may encounter as citizens (Roberts, 2007 p. 730). Aikenhead (2007) adds to this discussion by suggesting a Vision III promoting the pluralizing of scientific literacy to reflect the dehegemonizing of Euro-American science, to include indigenous and neo-indigenous sciences (Aikenhead & Ogawa, 2007). Holbrook and Rannikmae (2009) posited visions of scientific literacy that are related to functionality within society, and sides with those researchers that see scientific literacy as a means to cultivate interaction and decision-making skills (particularly when considering SSI) while also fostering personal development. Roberts and Bybee (2014) recently extended Roberts’s original work (2007) and made explicit the contribution of the SSI movement to vision II of scientific literacy.

Zeidler (2014) established the concept of functional scientific literacy (FSL) to underscore and rectify the disconnects among science education, moral growth, reflective reasoning, and the development of character. This suggests that functional scientific literacy is sensitive to alternative and normative views of SL, as well as contextually and culturally responsive to the need of the learner (Zeidler, 2014; Zeidler & Sadler, 2011). Functional scientific literacy has also been likened to the practice of Socioscientific reasoning (SSR), which represents the identified core competencies necessary for individuals to grapple with Socioscientific issues (Sadler, Barab & Scott, 2007; Zeidler, Herman & Sadler, 2019).
Through the practice of SSR, it is claimed that students may be prompted to cultivate functional scientific literacy, while practicing to become engaged productive citizens (Zeidler & Sadler, 2011).

**Reflexivity**

As will be discussed, “reflexivity” has many forms, and it has been deconstructed and displaced within numerous fields of research. While specific forms germane to this endeavor will be explored, ultimately the roots here can be traced back to the *Reflexive Turn* in the social sciences (Geertz, 1988; Emerson, 2001). This philosophical stance and approach required the researcher to no longer think of the collection, analyzing and interpreting of social realities to be a purely objective pursuit. Instead, researchers began to recognize the “reflexive” nature of reality; as they collect, analyze and interpret information from specific contexts, they are also influencing, shaping and being shaped by the “reality” they are researching (Emerson, 2001). In the present study, the same reflexive nature of social research, can be applied to the activities of learning and figuring out in the classroom; reminding teachers and students of their abilities to affect their own realities.

The SSI movement operates upon a theoretical framework influenced by psychological, sociological, and philosophical perspectives (Zeidler, Sadler, Simmons & Howes, 2005). The concept of “reflexivity,” borrowed from the social sciences and philosophy, is utilized in various forms within the SSI context. In the following chapters, “reflective” and “reflexive” will be contrasted, and framed in various ways, to illustrate their possible roles in the development of socioscientific literacy; however, the “reflexive” will be the main focus.

*Reflexive judgment* has been identified as a process which guides the decision-making of individuals grappling with SSI. Green (1999, p. 21) describes *conscience* as the practice of
reflexive judgment on those things that matter. Reflexive judgment can be described as the act of turning judgment upon oneself through the self-analysis and awareness of one’s own reflexive emotions (Green, 1999). Green connects conscience as reflexive judgement with Taylor’s (1985) work on the emotions: pride, guilt and shame, which we often structure as cues to the learned morality of a decision or behavior. The possible awareness and consideration of emotive dynamics of human thinking and acting, is one component of FSL which indicates an application/need beyond the science classroom.

Reflexive thinking is often defined as thinking about one’s own thinking, or turning one’s thinking back upon itself (Green, 1971). The concept of reflexive thinking as directly connected with analysis in general, as well as everyday thinking and acting will be contrasted with differing reflexive activities that help support the formation of FSL and SSSL. In addition, reflexive thinking will be juxtaposed with reflexive judgment in order to determine the interfaces of these two constructs, to better understand the role of reflexivity in the practice of Socioscientific Reasoning (Sadler, Barab & Scott, 2007; Zeidler, Herman & Sadler, 2019). Finally, reflexivity will be examined in relation to Green’s (1999) claim that the three features of conscience are, particularity, reflexivity and associated “moral emotions,” to better clarify the relationship between conscience and the development of FSL. While “conscience,” is not the specific topic under scrutiny, it will be used throughout this inquiry to contextualize reflexivity in relation to reflexive judgment.

**Science Education Goals**

Science education has been characterized as a filter, a sieve, or pipeline (Aikenhead, 2006a), which sorts our students into two monotone categories; those people that will be “scientists” and those that will be alienated from science. Inevitably, this sort of approach is
contrary to modern views of scientific literacy, or at the very least relies heavily on Robert’s Vision II to guide pedagogical practices. This type of implicit hegemony can be uncovered within the rhetoric that connects the westernized school science community, as well as reflexively evaluated as one’s own systemically influenced beliefs (Shume, 2015).

Consider the often-used slogan, “think like a scientist,” and while it can be interpreted in differing ways, within this slogan is an implication that all scientists think alike, or perhaps a bit more revealing, it suggests that all scientists should think alike. Slogans such as “think like a scientist” and in many cases, even the concept of “scientific literacy” (Holbrook & Rannikmae, 2007; Williams et al., 2004), may be utilized to dehumanize science, and act as rhetorically constructed boundaries (described below) which may keep students from recognizing that their own everyday personal epistemology is directly related to scientific thinking.

Consider, the basic process skills that scientists may conduct such as: observing, inferring, predicting, and hypothesizing. Activities regularly practiced by human beings around the planet, whether they identify the tasks with westernized scientific language or not. This is perhaps more evident in relatively broad sense-making strategies reflected by the science and engineering practices and cross-cutting concepts promoted by the three-dimensional learning approach to figuring out science disciplinary core ideas (NRC, 2012).

These include: Science and Engineering Practices 1. Asking questions (for science) and defining problems (for engineering); 2. Developing and using models; 3. Planning and carrying out investigations; 4. Analyzing and interpreting data; 5. Using mathematics and computational thinking; 6. Constructing explanations (for science) and designing solutions (for engineering); 7. Engaging in argument from evidence; and 8. Obtaining, evaluating, and communicating information. The Crosscutting Concepts entail: 1. Patterns; 2. Cause and effect- Mechanisms and

For all intents and purposes, this should be an opportunity to demonstrate the broad reaching skillsets that humans have been utilizing to survive and thrive on this planet for millions of years. Instead, through semiotic rhetoric, a debilitating boundary is constructed and reinforced by referring to these practices as belonging to scientists and engineers as opposed to also emphasizing, they belong to an array of human activities. Emphasizing the latter brings our students’ attention to the fact they are already utilizing similar practices and concepts to make sense of their everyday lives. While the rhetorical boundaries may not be physical, they can have the effect of making science seem inaccessible, and in many ways, irrelevant to everyday living.

For the uninitiated, science is often framed as a foreign and unfamiliar way of thinking. Even worse, teachers may convince themselves that some students simply can’t learn, much less practice scientific thinking. Educational systems, as are many social institutions, are wrought with *rhetoric* adopted and operationalized. A few examples of these rhetorical *boundaries* as they exist in the classroom include, multiple tracks for science studies (honors, gifted, regular, intensive), the labels utilized to mark students (emotionally and behaviorally disturbed, “special education,” “low” level, “high” level), and the segregation of school disciplines. Each of these labels are perpetuated by the transactional rhetoric that occurs within and between fields of study, practice, and differing aspects of our sociocultural contexts.

In many cases these “words” may flow from good intentions. However, when critically examined, these labels and boundaries can prevent students from realizing that they are already thinking and acting in a scientific manner when they are practicing everyday problem solving and decision making. Also, when we read against the text (Derrida, 1974), where we seek to
uncover and bring to light words that may conceal embedded contradictions, tacit meanings and hegemonic forces obscured by the text, these words (semiotic functions) can appear to be constructed so to maintain the structure and function of society as opposed to helping individuals recognize and meet their own potential. For instance, the skill-sets of many students, while often unrefined by formal scientific standards, are invisible to many current educational approaches to assessment, despite having a rooted connection with the practice of science.

A fundamental premise that will be unpacked and explored, and on which this study rests, is that thinking like a scientist is thinking like a human, and while this may appear as obvious or ordinary, we must make the ordinary strange (Green 1999, p. 151) in order to deeply and uniquely investigate that which we often take for granted without scrutiny. This is not to say that thinking like a human at all times, is thinking like a scientist, as it would be making narrow that which is broad. Instead, as will be explained below, concepts such as “thinking like a scientist” are colonizing moves, which claim for science, human capacities that are not monopolized by science. Moreover, by privileging scientific thinking (thinking like a scientist), over human thinking (thinking like a human), other aspects of humanity are obscured, made alien, or seemingly unacceptable or impossible in some contexts. In the classroom, this can also lead to alienating students, by framing the thinking of science to be both supreme and foreign. If there is any degree of merit in this claim, then it would compel us to reimagine the goals of present-day science education, reshape our approaches and contexts so that students may not just recognize, but forge their paths into science and life within our pluralistic societies.

Human beings have been and continue to practice modes of information collection, analysis, experimenting, debate, decision-making, and problem solving all over the globe; with or without formal westernized education. The roots of these activities are the same
modes of thinking and acting from which science has developed. While some researchers have claimed that it does not “help” to call various forms of thinking, “science,” (El-Hani & Bandeira, 2008) the purpose of this philosophical approach is not to solidify labels, but to instead problematize and peer through them to see the human connectivity they obscure. Humanistic connections can prompt all students to recognize that, as members of a global human community, science is not foreign to them.

It has been suggested that the STEM (Science, Technology, Engineering, and Mathematics) initiative is operating upon a deficit framework (Zeidler, 2014), which is indicated by portraying the major purpose of science education in terms of job preparation, economic growth and national security (Zeidler et al., 2016). This isolates science from the arts, humanities, various forms of human thinking/representation, and from many students. Because of this, science remains quarantined by antiquated and dogmatic views quelling student opportunities to become reflective, reflexive, critical, creative and open-minded human beings.

Recently, Zeidler and others (2016) have warned the science education community at large that sociocultural roots of education can no longer be ignored, and that current programs must lead teachers and students to recognize the crucial role of compassion, emotive reasoning, reflexive reasoning, perspective taking and conscience in the formation of scientifically literate citizens. In other words, we must make visible the connections between humanity and science. The following suggests that we, as educators and science education researchers, must continue to push the quest forward by “sifting-through” the humanistic soils in which sociocultural systems are rooted.
Reimagining Goals Through the SSI Framework: Socioscientific Literacy (SsL)

Socioscientific issues approaches can help connect learning in school with everyday living, as the topics are broad in scope, and relevant in differing degrees to the everyday lives of students. It has been argued that the same skillsets: habits of mind, modes of thinking, sense of conscience, weighing of evidence, problem solving, and decision making, that are required to be scientifically literate, should be practiced by students in the various contexts of which they are a part (Zeidler et al., 2013). Subsequently, the findings indicate that there are common elements of epistemological beliefs that connect social groups in terms of how people frame, justify and negotiate SSI (Zeidler, 2014).

Consider the aforementioned complement of practices employed by students conducting SSI learning, referred to as socioscientific reasoning (SSR): recognizing complexity, considering multiple perspectives, conducting on-going inquiries, being skeptical, and most recently affordances and limitation of science (Sadler, Barab & Scott, 2007; Zeidler, Herman & Sadler, 2019). These practices in relation to the history and continuity of humanity may be a priori to the negotiation of SSI in the classroom, in that they reflect common human practices employed throughout space and time. To one extent or another, human beings have long been analyzing the complexity of problems, attempting to consider the views of others, recognizing that they learn new things through exploration/trial-and-error, practicing some sense of skepticism and recognizing limitations of their problem-solving approaches.

The thinking and acting required of students grappling with SSI reach beyond the apparent realms of science; demonstrating the humanistic rootedness of the SSI movement and representing the potential to identify a common datum point for education in general. By rootedness, I am not only referring to the sociocultural attachments that each of us acquire
through enculturation (Green, 1999). I am also referring to humanistic “rootedness,” which is recognizing that all human modes of thinking and activity, even those considered innovative or unique, are connected because they have been constructed from the same mental raw materials that have helped human beings survive for millennia. The concept of human rootedness, as the basic commonalities of being human, is suggested here as a point at which all educators and students are connected, no matter where they may be in the educational-verse.

The research generated by the SSI movement in theory and practice, suggests that teachers and students are able to blur boundaries through awareness garnered while grappling with messy, multifaceted local and global issues. The progression of the SSI movement suggests that it does not have to be exclusive to science education, but instead can connect with and unite multiple disciplines of thought and inquiry. Here, S₃L is offered as a way to visualize the universal components of FSL, and how students might individually formulate coherent understandings and knowledge in relation to shifting contexts that are maintained by educational structure, function and dissemination.

**Research Questions**

Here, the concept of a “research question” is utilized as a rhetorical marker in order to bring some degree of focus to what can be characterized as a “messy” construct. The purpose of this philosophical endeavor is to scrutinize SL, and reflexivity, as they are formulated, conceptualized and deconstructed within the SSI movement. It will eventually be argued that through the analysis of these areas, one can trace the connectivity between FSL, reflexivity and the development of S₃L. This endeavor incites the formulation of many questions, however, the three essential questions I have selected for this inquiry and their rationale are as follows:
Research Question 1

What are the boundaries and overlaps of scientific literacy (SL) and functional scientific literacy (FSL) within the Socioscientific Issues Framework?

Rationale (RQ1). Scientific literacy has now become an obscuring concept for science researchers and educators (Feinstein, 2010). Furthermore, it is not clear that the varying forms of scientific literacy are recognizable by teachers practicing in various science disciplines. Given this mismatch between SL and our practice, there is an open question as to how closely SL connects to philosophy, research and the practice of science teaching. Here, it is suggested that science education researchers must question the appropriateness of SL, as it is often understood by practitioners, researchers, and policy makers as the major goal for science education (Roberts & Bybee, 2014).

Functional scientific literacy has been constructed in reaction to sterile conceptions of scientific literacy which dislocates science from a sociocultural context, moral and ethical decision-making, and disregards epistemological orientations. Functional scientific literacy, or a SSI functional perspective of SL, while well described (Zeidler & Keefer, 2003; Zeidler & Sadler, 2011), is not particularly well known by the science education practitioner community, and has not been readily distinguished from other forms of scientific/science literacy. FSL has been likened to the practice of SSR, and it will be argued that the core of FSL reaches beyond the domains of science. In more than one case, the construct of scientific literacy has been radically shifted toward a humanistic approach, emphasizing sociocultural aspects of science education that are not necessarily purely “scientific,” but are part and parcel to SL (Zeidler & Sadler 2011; Holbrook & Rannikmae, 2007). Socioscientific literacy will be shown to be a natural extension of FSL toward more inclusive science and social science classroom contexts.
Research Question 2

What are the major distinctions of the reflexive activities connected to the SSI framework?

Rationale (RQ2). Reflexive judgement, reflexive thinking, reflexive reasoning, and simply reflexivity are terms associated with SSI literature. In relation to research question one, reflexive judgment and reflective judgment are explored as practices that lead to the development of the moral context for Socioscientific Perspective Taking (Kahn & Zeidler, 2019), which is integral to the practice of SSR. Here, the suite of reflexive inquiries promoted by the SSI movement will be connected with reflexive awareness. Reflexive awareness (RA defined below), can be seen as the consistent use of general reflexivity to recognize and critically evaluate how information and evidence from our natural and fabricated environments interact with and influence us. This will result in students who are aware of the forces that shape them, and more importantly, how they themselves can shape their realities (also discussed below). Ultimately, the cultivation of reflexive approaches in our students and as aspects of SSI learning modules, can help them develop ways of thinking and acting that transcend classroom contexts. This in turn, suggests that current goals for science education may not fully represent the responsibility of educators in a pluralistic society.

Research Question 3

What aspects of functional scientific literacy (FSL) can lead to the conceptualization of socioscientific literacy (SSL) as a goal for education in general?

Rationale (RQ3). The conceptualization of SSL is influenced by pedagogical experiences and connections with current SSI research. In other words, SSL reflects the interconnectedness of overarching themes found in literature and practical educational pursuits,
which calls for a focus on the awareness of shifting contexts in relation to the nature of evidence. This will require not only the philosophical exploration of FSL and reflexivity, but also an analysis of how these aspects interact within differing contexts. The broad scope of SsL will be explored to identify the aspects that can aid educators in eliminating or assuaging the symptoms of the deficit frameworks that render science inaccessible and foreign to most students. Socioscientific literacy will be framed as an extension of FSL, opening up possibilities to connect with other school subject domains.

Reflexive Statement

Before reviewing the relevant literature, the following is a reflexive statement that will serve multiple purposes. First, the statement is used to clarify my positionality, which in general connect with varying aspects of my life and personal experiences that either implicitly or explicitly influence my work here and elsewhere. Second, through this statement I appeal to the intended “audience,” by modeling the sorts of reflexive honesty that is discussed in the later chapters, and the vignettes in these following sections can be seen in connection with the autoethnographic sketch in Chapter 6 (here, the intended audience are teachers, but more specifically, teachers’ personal philosophies of teaching). Third, it is an example of the literary devices that will be utilized throughout this paper, as a means of philosophical exploration. Finally, while the stories included in this statement are focused on “me,” the author to provide insight, they illustrate experiences that only became noticeable through my practice as a teacher, which required at the very least, a nascent, reflexive awareness.

Intended Audience. A reflexive statement requires an honesty, but not the sort that is directed toward convincing the reader. Instead, it requires the type of honesty that it used to cut deep within oneself, in a manner that can hurt, yet perhaps lead to transformation. This statement
serves multiple functions, yet the meaning which is ultimately drawn is not mine alone; just as the experiences themselves are not mine alone. While personal connections must be made for this sort of work, I limit most of it within the realm of education. The first function of these statements is to make known the intended audience. I imagine this audience as Teaching Philosophies; a teacher’s, theories, beliefs, values, and intentions pertaining to teaching/learning. These philosophies constantly affect the teacher’s thinking, acting, emotion and pedagogy as well as ways of negotiating and making sense of their educational condition.

I am not suggesting that this reflexive statement is such a philosophy, but it contains within it the constituent connections and origins of my own philosophies of teaching/learning. Therefore, above all, this contribution, if one chooses to see it as such, is directed at inciting a reflexive awakening through the constant process of formulating these philosophies of teaching/learning, as we (human beings) become teachers. This entails a scrutinizing awareness of the theories through which we see the world, so we can construct/extend them in the face of the classroom phenomena (Burawoy, 2009) that constitute the educational condition in which we find ourselves.

The next function, is to expose my own biases, pre-judgements, ethnocentrisms that are always, at least residual, in relation to what has been termed sociocultural rootedness. I am, as we humans often are, rooted from birth, and conditioned through particular enculturation processes, which are inevitably connected through overarching systems of control. I am from the foothills of the Appalachian Mountains of North Carolina, where I was educated in a rural school until grade three. At that time, I relocated to Florida where the remainder of my formal education unfolded, at other rural schools on the Western central coast.
I have two degrees in applied anthropology, both from the same department at the University of South Florida. My main focus was on anthropological archaeology, however, throughout my studies I continually drifted toward education; a fact that some in the department lamented. One professor proclaimed, “is this even research, I mean, anyone can teach.” The statement has grown in hilarity over the years. My interest in education eventually led me to teaching in a public school, specifically a renaissance, Title I, middle school within a fairly large city. In retrospect, I could speak of how teaching and I, at first, seemed at odds. For the first two years of teaching, many of my days ended with my face in hands, wondering, “what have gotten myself into, and what am I going to do?

Then, as if two opposed forces fell into agreement, I realized that teaching, and “being a teacher,” is more than what you see on TV, read about, study, or gleam from personal past educational experiences. It is obligation and meaning simultaneously. Once that shift is made, the very position of being a teacher is problematized. This is further exacerbated within higher stress schooling situations, that require the decentering of public-school objectives for those of personal and community healing. I began to think that many common practices, even those that are ostensibly empowering, can often become obstacles, burdens, and indelible psychological dispositions that our students must face, carry, and live with. Nevertheless, this did not become despair, but instead purpose.

**Personal History.** My own teaching experiences are brought to bear in various forms in all that follows; however, for this reflexive statement, I offer a tapestry of stories, which encapsulate the essence of my own educational past. Through the brief history of how I remember my education, I think that more than biases, prejudices, and even ethnocentrisms are exposed. These stories make apparent the origins and shaping of the deeper resentment that I
hold toward educational systems, and the ill-effects I believe they cause all of our students. It is from this resentment, that I have found inspiration and motivation toward trying to cause a positive change on some levels in those systems of which I have worked.

My history with education, and its systems, are suspect. The entire ordeal would seem trivial, if it were not for the fact that many of the experiences will later prove to be the reasons for the voices that echo through my head as I move from moment to moment. A reflexive statement in general would provide you with my basic academic, perhaps somewhat personal background. The following are narratives of my life, which seem to be connected to common threads of experiences and later points of reflexive evaluation. Of course, I will change or omit some details so to protect the actors in the stories. This is to respect the fact that just as these stories do not wholly define me as a student or teacher, the others involved, also, should not be wholly defined by their actions and words that took place within a snapshot of their/our lives. After all, these are interactions of our own personal deconstructive predicament.

**Pocket Full of Sunshine.** Her room always smelled of cotton and disinfectant, as far as I could define it from a brief moment in the infirmary at a summer day camp I had attended just before the school year. I recall the wooden blocks that littered the corner of my kindergarten class. I would gravitate toward them each day, and I remember thinking how amazing it was that Ms. D would let me build things, even when the others had to sit around the table and read aloud. “Pocket full of Sunshine” was the name of the book. I would listen to them struggle with the sounds of the words, they looked embarrassed, and I was glad that I wasn’t in their place. “You can learn to read this next year, now go and play with the blocks.” I remember being content, yet isolated and alone. Still, I felt lucky to have a teacher like Ms. D.
My mother worked at the school as a teacher’s aide, and one afternoon, I heard her raising her voice with one of the teachers in the backroom. She burst through the heavy wooden door; if it didn’t have hinges it would have exploded, and the sound it made probably made others elsewhere, think that it did. She had stacks of books, tucked under her arms, and she looked angry, to the point where I knew it best to say nothing. She just said, “let’s go.” I followed her, and we walked home, which at the time was my granny’s house; a warm comfort from the outside cool fall air. My mother talked with my granny for a while in the kitchen, she was upset with something that Ms. D had said, but I didn’t know exactly what. I did know it had something to do with those books. “He will learn, if we have to sit in there all afternoon every afternoon.” Soon, what that meant became a well routed routine; we would spend every afternoon reading, what I remember to be, boring books, about Dick and Jane, and their dog spot. It was tedious, but in time I was stating the words out loud, and it was obvious to me that it made my mother happy.

It wasn’t until many years later that light was shed on Ms. D. When my mother observed, for the last time apparently, that I was playing with blocks during reading time, she asked Ms. D why. Ms. D told my mother that no one could teach me how to read, and once it got a bit heated, she told my mother that at best, I would grow up to be a “functioning retard.” I feel lucky that my mother channeled her anger into teaching me, as opposed to into Ms. D. Nevertheless, my entry into the systems of education, was paved with wooden blocks, and it was anything but, “A Pocket Full of Sunshine.” Later, I would recognize how this experience affected my way of being as an educator and once it was brought to light, it began my honest path toward teaching.
**Vincent and the Idiot.** The art room, actually smelled like a dry cleaner that I visited with my kindergarten class; it was both familiar and off-putting. My senior year of high school, I would not be classified as a good nor a bad student in most cases. The day was lingering, just as any day leading up to the last day of school might. There were only a couple of minutes in class remaining and at that time students were standing-up in groups, already discussing what they would be doing on the weekend. I stood in front of a reprint of Van Gogh’s, “Self-Portrait with Bandaged Ear,” thinking about the story that the teacher had previously told us. Luckily for me she was standing nearby. “Ms. P, I thought you said that he cut his left ear, it’s his right ear in the painting.” A slight smile, accompanied by an odd arrangement of her eyes and brows, struck me, as if I had said something wrong, and a feeling of near paralyzing awkwardness rushed through me. All I could think was, “I should have kept my mouth shut.” With a bit of a snicker she told me that he was looking into a mirror when he was painting. I asked her to explain, because the entire idea, which is common to me now, was not making the sense she thought it should. “Come on, he’s looking in a mirror, so he sees it on the other side.” I must have looked confused, because her smile had changed to a look of frustration, one that I had seen on more than one of my teacher’s faces. “It’s a mirror, you look in the mirror every day!” I just looked down, and my mouth would not function from the embarrassment, I said “yeah, yeah I know I know, it will make sense to me later- when I see it…”

She put her arm up to cut me off, as if she was directing traffic, and turned toward the class in one motion. I thought she was about to tell me not to worry about it. Instead, she exclaimed, “Class, class, give me your attention!” All of the students fell into silence. I remember that year Ms. P was the teacher of the year, and the students generally respected her, so they all gave her their full attention in that moment. She raised her hand above my head, so
she could extend her index finger to point down at me, and continued, “This, class, this is an example of an idiot!” Everyone, including me, looked stunned, as the bell sounded like thunder in the now uncomfortable silence. She looked at me with scorn as I quietly, without retort, left the class. The following day, was the final exam for that course, to which we only had to attend if our grades were low enough. As I approached the room to enter, something I was not looking forward to doing, she put her arm up to block the way. “You don’t need to be here.” Certainly, I looked puzzled, “but I’m pretty sure I have a low grade.” Without hesitation, she said, “no you don’t, you can go.” In retrospect, I am not certain if Ms. P excused me from the exam because she was scared, guilty, or fed-up with seeing me. I do know that I did not have to take the final exam, and I received a higher final grade than I previously had. I wish I would have taken the exam; I should have stayed, but as a senior in high school I welcomed the out.

**Bothering Unimpressively.** As I approached the office door, I remember thinking how it smelled like a basement, and then noticing, as if for the first time, that everything, all of the fixtures, furniture, even the ceiling tiles, were 20 years out-of-date. I wasn’t necessarily sure what would happen when I entered, I knew there had been a few “issues” here and there, but overall, I thought it had gone well. I was happy to finally complete my MA in applied anthropology. I knocked on the door, and as usual he opened it, stood to the side, and welcomed me in. I took the usual seat, and was prepared to ask, what I had come to ask.

He seemed fairly distraught, and I knew he had relatively recently suffered a family tragedy, so I was cognizant of my tone and approach, more so than usual. The general banter was forced; the weather, how’s your research going, and the like. I simply began to talk about moving on in the department, and the tone changed. In some ways it all became hazy and two
specific moments stood out ringing like bells that were enshrouding my head, and the speaker was using a baseball bat to drive home the point.

“You ask questions that bother people. They can seem disrespectful to others,” I let the words hang in a silent embrace, until he broke with more, “It doesn’t look good on me.” I tried to think of this in a judicious manner, holding myself accountable, “I really don’t ever mean to make you look bad, or to be disrespectful.” I really didn’t know what to say, the emotions were high, on both sides. “I just question things a lot, not always out loud, just to myself most of the time,” the words I spoke seemed not quite right, but nonetheless a reflection of how I was feeling. He responded, “You do, you question. Let me tell you though, if you keep doing that…” he looked away for the words, “well you can drive yourself crazy.” He was sincere with his words, which made the following almost sting. “Moving on is easier, if you impress someone, build a relationship.” During this pause, I was thinking, as you might expect, about what kind of relationship he and I had. It apparently wasn’t what I thought. Then he told me like a scratching record, “you… you just didn’t impress anybody.” I sat still, thinking of the blocks, of Vincent, of what this would look like through a mirror.

Not long after this encounter, I became an educator. At first, I was an ally of the educational system, but I soon realized the same issues that haunted me as a student, continued to negatively impact the people I was trying to help. The auto-archaeological sketch that begins Chapter 6 (See page 141) would serve best as the bridge to the next story, since that sketch tells the story of my own teaching epiphany during the first years of my career. However, those connections are made apparent later, here instead, is a story from my last year as a teacher. I have focused on a specific moment where my suspicions, which had become inflamed through the years, were sadly actualized.
The Professional Standard. The desk that sat between us seemed vast, as if we were separated by a continent. The room smelled institutional; a smell you might know from working in school system. As a teacher within a system, I understood the “reality” of standardized testing. I was not a proponent, and I often spoke out against the monopolization of time, technology, and efforts that these assessments consumed from a painfully, finite school year. In addition, these measures are not only connected with the pay teachers receive, I viewed teacher evaluations as tactics to bully educators into submission. Certainly, I may have been incorrect, but I had become sure of one thing as a teacher, within education, almost no one has a “voice.” Not students, teachers, perhaps not even administrators. There is but the illusion of having a voice achieved by setting and measuring goals within your own space.

She said, “I know you see these things as problems, but you are a teacher… so you need to stick to teaching.” I felt like the statement wasn’t meant to intentionally upset me, but either way it did just that. “I speak up because it’s part of being a teacher. To do that for the teachers and the students that don’t have a voice.” She was actively shaking her head in disagreement as I spoke, yet I continued “We should give voice to the voiceless. Seek out and try to stop injustice…” she put her hand up like a school crossing-guard directing traffic. “Let me stop you. It’s not your job to seek out injustice,” she gesticulated air quotes; “and isn’t to give voice to the voiceless,” still gesticulating. “It’s your job to teach, that’s it.” Leaving that office, I realized that my relationship with education and its systems is still suspect, to say the least.

Summary

One of the purposes for this study was to make visible, through varying textual devices and maneuvers, what I term throughout this paper, the deconstructive predicament of scientific literacy. Additionally, I explore the possibilities of opening up reflexivity and the other
competencies of SSR, in order to develop, characterize and present the (de)construction of SSL.

The philosophical queries are drawn from varying sources of text, information, and experiences including cases borrowed from my own student and teaching experiences as well as ethnographic sketches.

The socioscientific movement encourages students, educators, and researchers to recognize science as couched in the human condition (Zeidler, 2014). When exploring SSI, students are prompted to conceptualize science as being inextricably tied to the sociocultural contexts in which, and from which, they are being viewed. There is always the implicit intention of prompting students to explore the connections between science and their everyday lives, through the development of intersubjectivity and reflexivity. When students work together to grapple with SSI, they are provided the opportunity to examine their world and themselves from multiple perspectives (Kahn & Zeidler, 2019).

It has been shown that students demonstrate their abilities to be compassionate toward other human beings and conditions, yet they are often unable to see themselves as responsible global citizens when grappling with socioscientific issues (Lee et al., 2012; Lee et al., 2013). For example, students may recognize that people suffer because of the actions of others, yet they tend to prioritize economic profits of their own country as opposed to considering how their decisions may impact other peoples in various places in the world (Lee et al., 2012; Lee et al., 2013).

It has also been demonstrated that when students are negotiating SSI lessons, they tend to evoke their own views of right and wrong, their own personal moral/ethical/social values, and they rely on their personal beliefs (Lee et al., 2012). This can guide students to developing empathy for others, but may also prompt a student to strengthen the line between themselves,
and that which is “other.” Leading students and teachers toward the development of reflexivity can help each of them critically scrutinize their own situation while gaining a better understanding of the situations of their fellow humans in the process.

Humanistic progressive science education should not only instill scientific literacy (Roberts, 2007; Zeidler & Keefer, 2003; Holbrook & Rannikmae 2009; Zeidler & Sadler, 2011) nor make evident its necessity for empowerment in the twenty-first century (dos Santos & Mortimer, 2002; dos Santos, 2009), but also help students explore and connect skill-sets and modes of thinking and acting that transcend contexts. It is argued that educational prudence would entail that these forms of transcendent schema be buttressed by a general practice of reflexivity, including reflexive thinking, reflexive judgment (Green, 1999), reflexive reasoning, and other reflexive driven inquiries. “Students need to be educated as whole human beings in relation to the world they inhabit, who are not only intellectually competent but also sensitive to ongoing global SSIs that affect others in different regions of the world”(Lee et al., 2012, p. 927).

Finally, this philosophical work is not meant to serve strictly as an argument, clarifying agent, or generalized report. Instead, it is a way to tell a nearly ineffable story that has been formulating throughout my life as an educator and learner. It goes beyond questioning our practices as teachers; moving towards critically, honestly evaluating our teaching philosophies, and recognizing how these “philosophies” shape our instruction and interactions with others. An awareness of the reflexive relationship that teachers and students share with each other and their educational condition, is a step toward recognizing our abilities and obligations to positively influence our students and to problematize and change the systems of which we find ourselves at their mercy.
Chapter Two: Literature Review

Introduction

The socioscientific movement has led researchers from around the world, to develop various contributions to the field of science education. SSI are utilized as contexts in which skills valued by mainstream science can be practiced, while simultaneously promoting student comprehension of science concepts. SSI help to address Vision I scientific literacy, and at the same time foster Vision II. Nevertheless, SSI go beyond these visions and those skills valued by the scientific community, to tap into sociocultural thinking, acting, and interacting. It promotes student/teacher connections as human beings, and brings into question epistemological orientations, ethics/morals, and ultimately what it means to be a global citizen in the twenty-first century through functional scientific literacy (Zeidler, 2014; Zeidler & Sadler, 2011), which encapsulates these ideas.

Socioscientific literacy extends from FSL and other SSI constructs, and connects with several aspects of education related to a host of human interactivity. The focus of this literature review describes a possible path to SsL, while highlighting how the idea has been cultivated from the work of SSI researchers, social scientists and philosophers. In order to provide more context and connect with an underlying centrum of science education, the first section addresses notions of humanizing science education and humanistic science. The remainder of this chapter is comprised of brief sketches, focusing on the two main concepts under scrutiny: scientific literacy and reflexivity.
In the case of SL, the purpose is to focus on the connections between the SSI movement and the displacement of SL toward FSL. The concept of reflexivity, is connected with interpretations found in philosophical and social science literature. In addition, reflexivity is contextualized through the survey of practical applications, including those connected to SSI. In chapter five, reflexivity and reflection will be contrasted and connected with fields of practice, and framed in a more generalized manner.

**Humanizing Science and Science Education**

All of science is codified and transmitted through human communication, which while vastly expanding, is in itself a restraint. From the semantic surface to the intrinsic characteristics, everything about science is human. While the word itself, and its modern representations, may seem relatively young; as a human activity, it most assuredly is not. Notwithstanding the wealth of examples of high levels of human thinking that can be deemed *scientific*, the utilization of common problem-solving strategies can also be observed in the everyday actions of people around the globe.

Wade Davis (2009) provides several accounts of human groups and individuals around the planet that practice thinking and action that could be considered *scientific*. One example included the traditional Buddhists practice of self-reflection and self-examination. In many cases these practitioners employ the same strategies to gain self-awareness, that scientists might utilize to investigate varying aspects of their natural world. The anthropological and sociological literature is chockfull with examples of human beings negotiating their environments (and minds) to develop efficient modes of day-to-day survival.
Human beings, literate and illiterate, practice valuable scientific habits of mind, which allow them to collaborate to achieve both pedestrian and amazing goals (e.g., treehouse construction by the Kombai of Papua New Guinea). Enclave communities, aboriginal and indigenous groups, and varying other human beings, are often underestimated, generalized, and interpreted through an ethnocentric lens. This begs the questions; why is this important for modern science educators? Because the underestimation, generalization, and ethnocentric misinterpretation of indigenous knowledge and the like are negatively affecting science students and teachers. For science education, the dehumanization of science is particularly deleterious and is represented in many forms on varying levels.

Science education researchers (Donnelly, 2004; dos Santos & Mortimer, 2002; dos Santos 2009; Zeidler, 2014) have identified symptoms of the dehumanization of science; revealing it as isolated from other modes of human thinking and representation. Conceptualizing science as separated from and uninfluenced by humanity leads to the marginalization of science students from all walks of life (Gill & Levidow, 1987; Aikenhead, 1997). A recent example is highlighted by Zeidler (2014) who revealed that the STEM initiative is operating upon what he terms a deficit framework. Through the STEM lens, science is portrayed as fragmented disciplinary “silos,” characterized by the division of normative and non-normative components, and isolated from the arts, humanities and other forms of human thinking.

It has been suggested that educators should consider rehabilitating the educational acceptability of the natural sciences as knowledge that can serve humanistic purposes (Donnelly, 2004). Researches seeking to bridge the gap between science and the humanities, suggest that this merger would lead to a more accurate depiction of science in the science classroom (Yakman, 2008).
Eisner and Powell (2002) have explored the influence of art on the thoughts and behaviors of social scientists to expose the human personal side of scientific pursuits and reveal the innate connections between differing forms of human inquiry.

Other scholars have considered the implications of humanizing our approaches to science education and searching for ways to include all children in the scientific community (Aldous, Barnes & Clark 2008; Aikenhead, 1997, 2001, 2006b; Aikenhead & Jegede, 1999; Bryce, 2010; Donnelly, 2004; Ezeife, 2003; Newhouse, 2004; Snively & Corsiglia, 2000). These researchers, whether they directly proclaim it or not, seek to transform school science from an agent of assimilation (Aikenhead, 2006a) into an agent of empowerment.

This, of course, is a fine line and even progressive attempts at reimagining science can inadvertently exclude students. For instance, as mentioned above, some researchers/educators utilize an inflexible analogy characterizing science as a subculture that requires the uncovering of entry-points, bridges between one’s own culture into science, for our students to gain access (Aikenhead, 1996; Aikenhead & Jegede, 1999). While this perspective can be functional, it also draws and reinforces boundaries that will continue to obscure the relatable roots of human thinking that support scientific pursuits. In other words, rhetorical boundaries result from discourse, and in turn these words prevent teachers and students from recognizing their innate connections with scientific activity. The usage of “subculture” per se, is a rhetorical boundary that stifles creative pedagogical thinking. Consider that the concept of a “subculture” suggests that only a few people will ever gain entry despite our best efforts (Clarke, 1974).

Socio-culturally constructed borders can be useful in some contexts, but what is more important is the fact that only a few individuals construct these boundaries.
If these borders are built, deconstructed, and reconstructed by only a few, then science will always be disseminated as dogma through forces of coercion. Science education of the twenty-first century should seek to identify and eliminate the oppressive forces that affect both teachers and students (Emdin, 2008). I posit that two fundamental pursuits for practitioners of humanistic science education should be, 1) helping our students gain awareness of the mechanisms of thinking we develop through our personal experiences and situations, 2) helping students recognize how external situational, societal, cultural, and psychological influences mitigate our thinking and actions.

Before continuing, the term humanistic science must be operationalized for this study. Aikenhead (2006a) provided a fairly extensive description of a humanistic perspective of school science, which was juxtaposed with the pervasive pipeline model. He conceptualized:

a competition between two ideologies: a humanistic perspective that promotes practical utility, human values, and a connectedness with societal events to achieve inclusiveness and a student orientation, versus a traditional perspective that promotes professional science associations, the rigors of mental training, and academic screening to achieve exclusiveness and a scientist orientation. (Aikenhead, 2006a, p. 22)

Within certain school science contexts, the latter ideology is often exemplified by a “pedagogy of poverty”. This depicts science as a static body of knowledge, focuses on behavioral skills, and does not encourage students to develop analytical tools or any sort of deeper understanding (Furman et al., 2011, p. 155).
It has been suggested that:

The basic principle of humanistic education is to accept and believe in human existence and its capability to change its destiny toward the human values, in contrast with the current situation, in which these values are shaped by the technological systems. (dos Santos & Mortimer 2002, p. 4)

A humanistic science from this perspective obligates science educators to help their students become aware of forces that shape(d) them, while simultaneously allowing them to recognize their own abilities to shape their current and future situations. This must take place in relation to both local and global contexts through the practice of reflexivity and other habits of mind to prepare our students for life in a pluralistic society. This approach includes focusing on concepts such as: culture, worldviews, identities, and the many divisions that exist within science (Aikenhead, 1997; Gauch, 2009; Irzik & Nola, 2007; Zeidler, et al., 2013).

**Scientific Literacy**

In his tome, “The Myth of Scientific Literacy,” Morris Shamos (1995, p. 1) wrote that there have been three “major curriculum reform movements” in pre-college science education. The first movement relates to Dewey and others pursuit toward helping students cultivate scientific habits of mind. The second movement is identified with the modernization of science curricula and practice post Sputnik, with the final movement, beginning in the 1980’s, towards the era of scientific literacy (Shamos, 1995). In chapter one, a brief explanation of scientific literacy was provided and it should be noted that a great deal of writings pertaining to SL, in most cases, are literature reviews of the construct.

Many articles provide historical accounts of SL and links the use of language with education projects/agencies, such as the American Association of the Advancement of Science
(AAAS, 1993), and other international policy programs. Still, despite decades of debate, the answer to the question, “What is scientific literacy?” cannot be answered unequivocally. This literature review provides background of the SL construct including hegemonic distinctions, educational distinctions as well as the formulation of a functional perspective of scientific literacy within the SSI framework. Despite limited research on the matter, the possible problems with SL being misinterpreted as reading and writing in science will be briefly addressed within this paper.

**Scientific Literacy or Literacy in Science?** A body of literature connected with reading/writing literacy research programs, that could be categorized as “literal interpretations” of the concept of scientific literacy has been observed (Feinstein, 2010, p. 172). Therefore, researchers from other fields often conceptualize “scientific/science literacy,” as the ability to be able to read and write science content; resulting in these individuals exploring the benefits of being strong readers when it comes to science literature (Norris & Phillips, 2003). While this is a unique conceptualization of SL (Feinstein, 2010), it is a better example of how the slippery nature of the construct can lead to disconnected approaches unsuited to promote even the most basic vision of scientific literacy (Roberts, 2007; Roberts & Bybee, 2014). For this endeavor, the idea of “literacy” as reading and writing is not a focus, because a new definition of scientific or science literacy is not the goal here.

**Hegemonic Distinctions of Scientific Literacy.** Shamos’s (1995) divided scientific literacy into three categories: cultural, functional, and true. In this case, *cultural SL* refers to ones’ ability to possibly understand coded scientific information; *functional SL* suggests that an individual may be able to enter into a meaningful scientific conversation, and *true SL* requires an individual to understand scientific theories.
These types of divisions, while in some cases useful, can also be cast as mechanisms of exclusion. Consider Roy Ellen’s (2004) thoughts on the gatekeeping within the realm of science:

> At a distance, the potency of the sterile dichotomies being drawn here arise from a fusion of a general human cognitive impulse to simplify the processes by which we understand the world (reinforced by the socially-driven need of science to maintain an effective boundary (Nader 1996: xii-xiv, 3-4) around the practices which scientists engage in), and of the West’s mission to preserve its cultural preeminence. (p. 410)

As we approach the end of the first quarter of the 21st century, it is easy to convince oneself that this attitude, expressed eloquently by Ellen, is less influential than it has been in the past. However, there is a possibility that this sort of alienating attitude, perhaps considered assuaged by post-modernists, has become a phantom in our systems of education and thought.

If that is indeed the case, the effects of this residual attitude can be detected in the interplay, tension and division between differing visions of SL (Roberts, 2007; Roberts & Bybee, 2014). It should be noted, that while “empowerment” is implicitly suggested in modern versions of SL, it is only explicitly mentioned in a few cases, and seldomly in a critical sense.

**Scientific Literacy is not Science Literacy.** Roberts and Bybee (2014) recently revisited Roberts’ (2007) original visions of SL (See Chapter One), and in response to several years of debate, offered an overview of the evolution of SL along with new, possibly helpful, distinctions. Namely, the distinction between “science” and “scientific” literacy. In brief, Roberts and Bybee found that the literature reflects the development of this distinction over time and associates it with the changes in language utilized by science education policy organizations. Vision I is often associated with the concepts of “science literacy” and with those students that are hoping to continue on and become professional scientists.
However, Vision II is associated with “scientific literacy” and deals with the everyday use of
scientific thinking, the sociocultural, ethical and moral aspects of being a human being and
particularly within those contexts deemed scientific.

Roberts and Bybee (2014) also determined that SL, and its many iterations, are a matter
of discourse; prompting them to use an Aristotelian inspired distinction (theoria, techne, and
praxis). They list theoretical, technological, and practical as differing types of reasoning patterns

Theoretical reasoning in this sense, is said to be best for establishing warranted
knowledge. Technological reasoning is necessary when designing and building new ideas or
things. Finally, practical reasoning is applicable when making value-laden decisions that impact
other human beings (Roberts & Bybee, 2014). The two researchers suggest that practical
discourse is often overlooked within science program and suggest that SSI approaches are the
best examples of fostering this perspective.

Science Through Education or Education Through Science? Jack Holbrook and Miia
Rannikmae (2009), along with many other researchers, have tried to tackle the question, “what is
scientific literacy?” The two provided an extensive overview of the complicated history of SL
over the last forty years, which includes multiple definitions of SL resulting from various sources
and fields.

However, I highlight the opposition they provide and itemize, which they call “science
through education” compared to “education through science” (Holbrook & Rannikmae, 2009).
These binary opposites are borrowed from their own work (Holbrook & Rannikmae, 2007), and
serve to provide nuanced differences based in societal connections, reflecting a similar
dichotomy suggested by Roberts and Bybee (2014) when distinguishing “scientific” literacy from “science” literacy.

Instead of providing an exhaustive description, there are two ideas in particular that should be mentioned, because they epitomize the overarching theme and provide the relevant points of discussion for later chapters. First, the main ideas of science through education (STE), states that students should undertake the processes of science through inquiry learning as part of learning to be a scientist (Holbrook & Rannikmae, 2007, 2009). The second, education through science (ETS) suggests that students should conduct investigations and utilize scientific problem-solving strategies to better understand the science background related to socio-scientific issues within society.

The idea that students should be able to apply the uses of science to society and appreciate ethical issues faced by scientists is a STE statement. In response, the ETS statement posits that students should cultivate social values related to becoming a “responsible citizen” and undertaking science-related jobs (Holbrook & Rannikmae, 2007, 2009). The two researchers continue to develop a model of relevance in science education, yet this continues to be a difficult task.

**Should Scientific Literacy be Salvaged?** Feinstein (2010) referring to SL and “science literacy,” suggests that the idea of relevance is often overlooked when developing science education lessons; in terms of relevance in general and relevance to ones’ everyday life. This is also wrapped in the borrowed distinction of *insider vs outsider* (emic/etic) when it comes to science literacy.
Consider the following:

I propose that science literate people are competent outsiders with respect to science: people who have learned to recognize the moments when science has some bearing on their needs and interests and to interact with sources of scientific expertise in ways that help them achieve their own goals. It follows from this definition that the pursuit of science literacy is not incidentally, but fundamentally about identifying relevance: learning to see how science is or could be significant to the things you care about most.

(Feinstein, 2010, p. 180)

Even though Feinstein is in some ways imposing different boundaries, he is also suggesting a shift from a “gatekeeper” mentality, toward a more humanistic version of SL, whereby individuals are encouraged to utilize “science” in manners that they consider to be appropriate. This also relates to Aikenhead (2007) who considers this to be a Vision III of SL. Vision III includes, not only what can be termed Eurocentric science, but also various brands of SL, which are sometimes termed indigenous or neo-indigenous sciences. This vision is a good example of a well-meaning attempt to be inclusive of “other” human groups, yet it is ultimately being driven by intrinsic and unchecked political and societal motivations. While this may ultimately serve to assuage perceived “cultural” conflict, it still complicates and alienates; providing students with “bridges” and “entry-points” does not ensure they gain access to or will be included in the scientific community. Functional scientific literacy forged within the SSI movement is more concerned with the epistemological roots that unite us, as opposed to those ethnocentric political boundaries that continue to divide us.
**Functional Scientific Literacy (FSL) as Socioscientific Reasoning (SSR).** Zeidler and Sadler (2011) have offered an inclusive view of scientific literacy, that included the cultivation of informed members of society through the practice of socioscientific reasoning (SSR). Sadler Barab, and Scott (2007, p. 374) presented “socioscientific reasoning as a theoretical construct which subsumes aspects of practice associated with negotiation of SSI and addresses the citizenship goal.” The researchers suggest that FSL responds to the “continuum” of SL suggested by Roberts (2007), and includes what Vision I lacks, while also responding to Aikenhead’s (2007) Vision III of SL. Functional scientific literacy in this context is said to be “functional” because,

in the realm of SSI, functional SL means that experience with social justice, tolerance of dissenting voices, mutual respect of for cultural differences, making evidence-based decisions with consideration for how those actions may affect community and environment must be exercised for students to become functioning members of an informed democracy. (Zeidler & Sadler, 2011 p. 179)

FSL includes the exercise of ethical decision making along with the exercise of virtue (Zeidler & Sadler, 2008; Zeidler & Sadler, 2011). As with other cases, the researchers offer distinctions and categories in which to better understand the nature of SL, in this case, within a pluralistic society. It is suggested that FSL within SSI provides opportunities for the development of character, and is likened to the practice of SSR; which transcends the contextual nature of individual SSI (Zeidler & Sadler, 2011). The transcendent nature of FSL, as the practice of SSR, is directly connected to the conceptualization of S₃L.
Connective Aspects of Functional Scientific Literacy as Socioscientific Reasoning.

Sadler, Barab, and Scott (2007) identified the following essential aspects of SSR promoted through SSI experiences: recognizing the inherent complexity of SSI, examining issues from multiple perspectives, appreciating that SSI are subject to ongoing inquiry, exhibiting skepticism when presented potentially biased information. As mentioned above, a new aspect of SSR, affordances and limitations of science, has been added to this list (Zeidler, Herman & Sadler, 2019). These aspects of SSR engage with SSI as complex, open-ended, potentially contentious problems, which lack simple and straightforward solutions (Sadler, 2004).

One can argue, that while the SSI movement has been constructed and resides within the field of science education, many of the concepts, skills, and dispositions are interdisciplinary. Sadler (2009) has since pondered whether those processes practiced by students in the science classroom transcend that context. Recently, Dolan (2020) found that that informal reasoning skills associated with SSI did transfer between subject-areas when students grappled with issues in science and social studies classes. However, this is not necessarily because SSR and SSI have developed tools essential for the formation of a scientifically literate individual. Instead it is because the concepts, at their core, are manifestations of common and essential human experience and functioning practiced throughout time to one extent or another.

When thinking of SSI as complex messy issues, it should be noted that human problems of various ilk have long been complex, open-ended, potentially contentious problems lacking simple and straightforward solutions. From the same vein, the aspects of SSR, can be framed as representatives of the types of activities conducted by human beings, in differing times and contexts, to face and solve those problems.
In the latter chapters, SL will be examined, and scrutinized in differing and varying ways, in order to reveal the deeper motivations behind claiming that which is human in the name of science. For now, I will turn to the germane literature pertaining to the second construct under scrutiny, reflexivity.

**Reflexivity**

Reflexivity is equivocal and often carries baggage from differing contexts. The concept of reflexivity is utilized and illustrated in the literature of differing fields of philosophy and social science. However, it is not my intention here to provide a complete historical review of reflexivity. Instead, the focus is on the ties between reflexivity and the SSI movement, which could be considered rooted in the educational philosophy of Thomas F. Green. Connecting concepts such as reflexive judgment, reflexive reasoning, and reflexive thinking will be reviewed, in relation to SSI in Chapter Five.

In “The Activities of Teaching,” Green (1971) likened reflexive thinking to analysis while expounding upon the activity of wondering and curiosity. As a luxury of being an activity of the mind, reflexivity can be the tool and subject simultaneously; folding back upon itself in varying forms for an exhaustive number of recapitulations. However, reflexivity can be recognized as a practice of mind not often utilized, but essential for becoming critically aware human beings living within pluralistic societies.

**Reflexivity in the Social Sciences.** As mentioned above, the essence of reflexivity, whether marked by the word or not, has pervaded human thinking for countless years. The actual term *reflexivity*, is most often associated with the social sciences. As with the first topic, scientific literacy, many distinctions have been made when dealing with understanding the nature and practice of reflexivity. In some cases, the debates that take place within fields of study, such
as sociology, lead to enlightening academic discoveries that can prompt new directions in discourse. However, this often leads to the proliferation of terms, posited by researchers to fill some perceived void; ultimately obscuring the core of a concept as opposed to clarifying it.

It is not my intention to debate agency or structure, but instead present some basic concepts from the field, referred to as the sociology of knowledge, to provide context for current concepts of reflexivity within the social sciences. Sociologists offer differing distinctions and metaphors of reflexivity that can be useful, yet have many debatable aspects. For instance, Bourdieu and Wacquant (1992) have demonstrated that reflexivity can take on many forms, including ethnomethodological ethnography as text, social scientific studies of the natural world, critical phenomenology, as well as aspects of double hermeneutics (Alvesson & Skoldberg, 2000).

The works of Margaret Archer in particular, are considered to offer an understanding of reflexivity that is more suited for our current pluralistic societies. She has defined reflexivity as “the regular exercise of the mental ability, shared by all normal people, to consider themselves in relation to their contexts and vice versa” (Archer, 2012, p. 1). Her work is often contrary to the concepts of Bourdieu, particularly “habitus,” and she offers differing distinctions of reflexivity that are framed by her as features of everyday life: communicative reflexivity, autonomous reflexivity, meta-reflexivity, and fractured reflexivity (Archer, 2012, p. 13). Here, Archer is expressing the idea of “modes of reflexivity,” which represent the interaction between one’s inner methods of thinking with external sociocultural and environmental concerns (Archer, 2010, 2012). These modes of reflexivity are characterized as “inner conversations,” which is similar to Green’s (1999) voices of conscience.
Akram and Hogan (2015), while exploring the benefits and limitations of Archer’s (2012) work, succinctly describe these modes of reflexivity:

1. *Communicative reflexivity* is representative of our inner conversations which require confirmation through communication with others for us to act. In other words, a practitioner operating within this mode of reflexivity may be perceptive of others, and what is necessary to operate within a given system of acting.

2. *Autonomous reflexivity* is representative of the type of inner conversation that does not require confirmation from others and often leads to action.

3. *Meta reflexivity* is representative of subjecting our inner conversations to our own scrutiny. This mode of reflexivity is focused on self-evaluation and monitoring, which leads to thinking about how we think and act in relation to certain contexts.

4. *Fractured reflexivity* is representative of a type of inner conversation that can intensify disorientation and distress, leading one to inaction or expressive action.

The work of Archer (2012) is based on the utility of reflexivity in everyday life. Ultimately, it is her contention that as society becomes more pluralistic, flexible, and therefore less predictable; reflexivity must take the place of sociocultural guidelines that are generally passed through modes of enculturation that are no longer standardized. In other words, Archer sees reflexivity as an essential tool for negotiating the modern world.

**Academic Distinctions of Reflexivity.** Lynch (2000) does not think reflexivity is an academic virtue nor should it be considered a privileged source of knowledge. He is responding to and expanding upon Ashmore’s (1989) work with reflexivity. Lynch (2000), while also providing a mosaic of seemingly disconnected concepts, provides five major distinctions: mechanical reflexivity, substantive reflexivity, methodological reflexivity, meta-theoretical
reflexivity, interpretive reflexivity, and a sixth which he endorses, ethnomethodological reflexivity. Each of these distinctions are accompanied by “sub-distinctions” which serve to further illustrate the equivocal nature of reflexivity. Here, I am more focused on the overarching distinctions, not to entertain any one of them as a pure reflection of reflexivity, but instead to bring into relief some pitfalls that can be incited by thinking oneself to be reflexive in any sense.

Mechanical Reflexivity refers to the recursive process involving feedback within many conceptions of reflexivity (Lynch, 2000). In this case, the common parlance of reflexivity is brought into question, in that reflexivity is a not a reaction without thought, but instead requires awareness and choice. Substantive reflexivity refers to the tendency for researchers to consider reflexivity to be a “real” occurrence within the social world (Lynch, 2000). This concept is directly connected with Beck et al.’s (1994) notion of reflexive modernization indicating the formal meaning of reflexivity as the recursive turning of modernity upon itself.

Methodological reflexivity is most often defined by the methods that are employed, usually in the form of self-criticism, be it philosophical or methodological. Meta-theoretical reflexivity refers to a more general perspective or attitude, (Lynch, 2000), which can be thought of as stepping-away from one’s own sociocultural webs, to inspect that which is taken for granted. Interpretive reflexivity, often associated with making sense of texts, is referent to a style of interpretation that sets one imagining and identifying non-obvious substitutes for habitual ways of thinking and acting (Lynch, 2000).

Lynch attributes the final distinction, which he espouses, ethnomethodological reflexivity, to an ethnomethodological program, which represents an exemplary mixture of theoretical, substantive and methodological considerations. In this case, reflexivity is considered to be a part of the fabrics of everyday life, characterized by the practices in which humans either alone or
together produce accountable states of affairs (Lynch 2000, p. 32). The cross-cutting aspects of these distinctions of reflexivity, include a “turning back upon” of some sort, depending on the context and usually drive one to “root out” biases, and other aspects that constitute one’s own personal perspective (Lynch, 2000).

**Reflexivity Within the SSI Movement**

The SSI movement is focused on empowering students to consider how decisions pertaining to science-based issues invoke and reflect the moral principles and qualities that encompass their own lives as well as their sociocultural environments (Zeidler & Sadler, 2008a). It has also been suggested that the SSI movement can and should be pushed farther in terms of scope and student engagement (Sadler, 2011), which is certainly one of the goals of this endeavor. Zeidler and Sadler’s (2008a) work on conscience, character and care, expose the philosophical roots of the SSI movement, directly connected with the concepts of reflexivity. When distinguishing between citizenship based on processes of normation, as *prescribed rules of behavior*, instead of normation as *thinking about what one ought to do, the two stated:*

While the former interpretation compels people to be compliant and obedient, the latter view is aimed at developing the formation of conscience through the exercise of reflexive judgment. Reflexive judgment, understood in this context, is primarily concerned with self-evaluation. (Zeidler & Sadler 2008a, p. 203)

This, as mentioned above, directly links to the educational philosophy of Thomas Green (1999), and his formulation of the voices of conscience. For Green, the context of this thinking takes place in the realm of moral education.
Zeidler and Sadler bridge this work with the moral/ethical aspects of being a scientifically literate citizen and how these aspects can be practiced within the contexts of SSI. However, it is suggested that before students engage in scientific reasoning, becoming scientifically literate, or even engaging in moral reasoning, students must be provided with opportunities to explore and exercise the reflexive nature of conscience (Zeidler & Sadler, 2011).

**Reflexive Judgment.** In some ways the model of reflexive judgment on the things that matter, is a key feature to Green’s educational philosophy, where reflexive judgment is inextricably connected with the formation of conscience. Green (1985) stated that it is a simple fact that each of us possesses the capacity to judge our own behavior and stand in judgment on what we discern to be the composition of our own affections. He also asserts, that the judgement each of us make in our own cases, is referred to as reflexive judgment and is always accompanied by emotions that can be associated with moral failings such as: guilt, shame, or embarrassment. This type of judgment is what Green meant by *conscience* in his 1985 paper and he suggests this can be extended to self-assessment of even the most banal of human tasks such as: washing cars, planting gardens, and even getting dressed.

Later, Green (1999, p. 23) offered a more robust explanation, stating “conscience is reflexive judgment on things that matter, and it is formed by the acquisition of norms… that take on the role of governance.” For Green, *governance* is the effective regulation of conduct of many types, and the acquisition of social norms, referred to as *normation*, is the how people acquire a contextual (particular) paradigmatic understanding of “ought” and “should.” The reflexive nature of conscience, allows for one to expand reflexive judgment to everyday life, more specifically to one’s own principles, socio-cultural memberships, and standards. Green (1999) renders what he sees to be the first two aspects of conscience as reflexive judgment; particularity and reflexivity.
He continues by positing a third aspect he refers to as *moral emotions*, which he later equates with reflexive emotions. This idea is linked with the past conceptions of John Stuart Mills, but more aptly with the work of Gabriele Taylor’s (1985) description of pride, guilt and shame as emotions of self-assessment (Green, 1999).

Ultimately, this conception of reflexive judgment describes both “inner” and “external” voices that work in concert with reflexive emotions in order to judge our internal integrity as well as how precisely we align with our socio-cultural situations. In other words, we have the capacity to judge our conduct in relation to our self-conceptions and our situatedness, through both a critical voice and the ways we emotionally “feel” in response to particular situations. Green (1999) was not focused on the content of norms, nor specific contexts, but instead on the underlying human capacity to develop conscience as reflexive judgment by practicing certain means of acquiring norms which leads to the structuring of our emotions. In Chapter 5, reflexive judgment will be examined and connected with other modes of thought.

**Reflexive Thinking.** Reflexive thinking can be succinctly described as thinking turned upon itself, or thinking about thinking (Green, 1999). The term *reflexive thinking* tends to be used in a general sense for reflexivity, which perhaps underscores the redundancy of the terms. In other words, reflexivity is often considered a cognitive process and therefore reflexive thinking can be considered another way of expressing the term in social science research. In this case, if one were to consider the simplest form of the term reflexivity, it is referring to the overlapping of the subject and object to the point they become one in the same (Emerson, 2001).

This stems from the reflexive turn in the social sciences, particularly sociological ethnography, whereby fieldworkers reacting to realist presuppositions, recognized the pluralistic nature of reality, as it was mitigated through the sociocultural and theoretical lenses of the
researcher (Geertz, 1988; Emerson, 2001). It is important to recognize the equivocal and contextual shifting of reflexivity as it is conceived and seemingly, shaped and reshaped, by agendas and temporal idiosyncrasies. For this particular section, reflexive thinking, then seems to be a special case of reflexivity, specifically geared toward focusing upon one’s own thinking processes (which is much more complex than appears at first glance).

Reflexive thinking, within the SSI framework, has not been described in terms other than those by Thomas Green mentioned above. A previously mentioned, Green (1971) also viewed reflexive thinking as the act of making distinctions, which ultimately includes the questioning and blurring of those distinctions already put in place. Perhaps a more important implication here for the following formulations of SsL, is that reflexive thinking is a “tool” of sorts utilized to make meaning of the multi-dimensional aspects of ourselves and our increasingly connected societies. Reflexivity has several interpreted meanings and that has been politicized, radicalized, and characterized as a privileged form of awareness (Lynch, 2000). Revealing the plural nature of reflexivity is essential before connecting with SsL. Moreover, here we are not concerned with the academic implications of research, but instead, on the everyday utilization of reflexivity, and the tacit influences of which an everyday reflexivity may reveal.

Summary

This brief review of literature connected with the key foci of the following philosophical inquires and analyses: humanistic science education, scientific literacy, reflexivity, and aspects of the SSI framework. From the review it is clear that: (1) a humanistic science, obligates science educators to help their students become aware of the reflexive relationship they have with their sociocultural and physical environments; (2) there are various ways to view the concepts of
scientific literacy and reflexivity depending on shifting contexts; (3) there is a potential for FSL to extend from science education into other classrooms as an educational goal.

In order to foster the development of SsL, the boundaries between SL in general and FSL must be examined. Philosophical explorations and analyses will help clarify and directly identify the characteristics of FSL that connect with education at large. In addition, the reflexive aspects of negotiating SSI, and practicing SSR, can be explored to reveal their distinctions as well as the commonalities that connect those activities. These concepts, through varying philosophical and literary means, will be probed for deeper tacit meanings, so to make clear those aspects taken for granted or blindly accepted, while also seeking out disconnects and hegemonic structures. For this, the deconstructive predicament (described in Chapter Four) of each of the concepts under scrutiny will be analyzed in varying ways.

The following chapter is a statement of the methodology which characterizes these philosophical explorations. A basic overview of deconstruction and conceptual analysis will be provided, and basic philosophical underpinnings and connections with education are highlighted. The selection of these methods or ways of exploring, was not arbitrary and in some cases reflect my personal thinking and acting as an educator. In other words, while the following, coded in writing, appears theoretical, these methods of thinking, questioning, and seeing things as new or different, have aided me as an educator in making sense of difficult educational situations and reacting in ways that benefit my students.
Chapter Three: Methodology Statement

Introduction

The main methods of philosophical inquiry utilized to examine scientific literacy, functional scientific literacy (a SSI functional perspective of SL), reflexivity, and the expansion of FSL into socioscientific literacy are generally aligned with deconstruction. In addition, forms of conceptual analyses were stretched and altered to focus upon varying levels of the concepts in question. These approaches were utilized in concert to trace the shifting of SL to FSL, as well as examine the nuanced nature of the reflexive activities within the SSI framework. Finally, the consideration of expanding FSL into SsL as a general educational goal was examined and discussed in later chapters. I aligned these differing ways of exploring and telling, by utilizing the concept of a deconstructive predicament (See Chapter Four), to open up alternative contexts and modes of investigation. More specifically, deconstruction is framed as a constant within discourse, which can help to dynamically contextualize the use of differing forms of conceptual analysis, while altering the traditional intentions of those analyses.

In addition, deconstructive readings/interrogations of concepts were implemented as a means of opening-up a multiplicity of meanings. The philosophical nature of these methods, was meant to inspire shifts in educational thinking that can directly and positively impact our students’ educational conditions. Additionally, the lenses employed here were meant to demonstrate the importance of helping our students gain awareness of the internal and external influences, which ultimately affect how they make sense of things. The project, while
unorthodox within the educational context, was a requirement for moving toward a reflexively aware pedagogy, which prompts students to formulate their own personal understandings of the universe, and rooted in human capacities, attitudes, and connectivity.

The division between conceptual analysis and deconstruction, attributed to a rift between analytic and continental philosophy, has been problematized and framed as a result of academic debate (Critchley, 1997). It was outside the scope of this inquiry to provide a map, genealogy, or pedigree of these codified camps of philosophy. However, the brief accounts of the two “modes of inquiry” provided below, highlight the contrast and search for awareness that make the methods complementary. Even though there were flaws, as there are with any language initiative, I used a scientific distinction as a metaphorical rendering of how conceptual analysis and deconstruction were used for this project.

Consider the analogy: conceptual analysis is to artificial selection as deconstruction is to natural selection. Artificial selection is generally thought of as a process in which humans actively select and manipulate the frequency of certain traits within organisms. Natural selection, conversely, is considered the process by which organisms that are better adapted to their environment at a specific time, tend to survive and produce more offspring that will carry-on their traits. Conceptual analysis is a method that can be conducted by anyone in a thoughtful and experimental way. Deconstruction is not a method at all, but instead something that naturally exists/occurs within any chain of signifiers and can only be deferred, displaced, reconstructed, described and/or observed.

Deconstruction is not something that we are actively cognizant of, it is being or occurring all the time, as an aspect of discourse and the revelation of dysmorphic views and discounted alternatives. Still, there are bloodlines that persist, that die out; there is a fossil record that may
not be logically ordered, but then again perhaps it is. Therefore, by carefully investigating, reading and interrogating the topics under scrutiny on how they have been shifted, redefined, and displaced within theory and practice, one can open up new contexts for exploration. Through analysis, we seek to wield seemingly logical and coherent understandings, in concert with imagination, creativity and curiosity; in order to actively make decisions that ultimately shape the final product. This is not to insinuate that the final product is in fact final, nor is it always known at the outset of analysis. Instead, the awareness of the decision making which leads to action sets the two approaches apart; yet they are still intricately related.

In addition, while they are not thought of here as specific methods of analysis used throughout, it should be noted that bricolage and what I refer to as auto-archeological, are utilized in Chapter 6. By auto-archeological, I am referring to the active and critical excavation of one’s own memories in order to connect with, and explain certain behaviors that manifest in one’s pedagogy. This is inspired by Foucault’s (2002) archaeological approach to knowledge; however, in this case it directed toward one’s own history. Bricolage, loosely translated as do-it-yourself, was famously used by Levi-Strauss (1966) to explain the recapitulation of myths over time.

Derrida (2017) problematized Levi-Strauss’s use of bricolage, suggesting that we are all bricoleurs in some sense when it comes to constructing knowledge and discourse, which in Chapter 6, inspires the student-driven process of the transmutation of SSR. While bricolage is not the main approach or strategy here, from some perspectives this entire project is, arguably, a bricolage. I fully embrace this by utilizing a wide range of available semiotic materials in order to create something that appears as new and different. This approach provides a rationale for using a variety of literary devices that employ allusions to “popular-culture,” connections to the
social sciences/arts, and borrowing from multiple pools of knowledge and approaches. It should be noted, that from my view, when a material is selected, it may be dislodged from its origins, and used for specific purposes. In other words, simply because it is used for the bricolage, it does not mean that I specifically prescribe to all of the rhetorical entailments and belief systems from which that material was generated. Ultimately, these devices aid in explaining the main frames of my methods, the coalescence of deconstruction and conceptual analysis.

Deconstruction and Conceptual Analysis

Before explaining how deconstruction and conceptual analysis were specifically utilized to address the proposed research questions, the following sections are meant to provide background information on the fundamental aspects and models of the two philosophical lenses employed.

Deconstruction. What is deconstruction? Derrida (1999) wrote that deconstruction is not a method, but something that is tied to an event; it is what happens. This is to underscore the idea that Deconstruction is something that has not been invented, but instead uncovered, and noticed. Derrida (1999) completes his thought by stating,

I think in every event, not only philosophical, in every cultural event there is some deconstruction at work, something which displaces and opens a structure, a set of actions, to singularity, to something other, to some alterity, to some unpredictable future. (p. 289)

Deconstruction is an innate state or mechanism of our signs and symbiotic/linguistic environments. Deconstruction, as a term, has been conveyed in multiple ways, and it can be seen as an attempt to make meaning where meaning struggles to be made. Despite this, the effects of deconstruction can go unnoticed, or be difficult to trace, and some concepts are able to persist longer than others under this pressure.
Consider that even Darwin’s way of describing natural selection, is centered from his own sociocultural rootedness, and is, and has always been deconstructing (Ryan, 1983). Nevertheless, the explanatory mechanism endures.

I do not wish to frame deconstruction as only a political, academic, or even personal reaction to experiences (idiosyncratic or generalized), but as a means of making meaning through consideration of the “other” and ulterior motives that hide within concepts. Deconstruction is bringing attention to our tendency as groups of humans to privilege one particular arrangement or concept over another. This often-unrecognized privileging is provoked by overarching and/or tacit underlying residue of influence that pervades our thinking and communicating. Within certain academic environments, those particular modes of thinking which survive to give rise to new syntheses, generally have the common trait of being connected with the dominant ways of knowing and “legitimized” knowledge.

In relation to deconstructive readings, Winter (2013) stated that deconstruction involves the close reading of texts, of any kind, that holds to the “tenets” of Derrida’s work. She states these tenets to be: 1) the meanings of words are insecure and never fully under our control; 2) the metaphysics of presence implies the existence of an underpinning unity of knowledge that needs to be upset to expose its internal inconsistencies and authority; and 3) deconstruction opens up a space for justice, from which something new and unforeseeable emerges (Winter, 2013, p. 185). This alludes to the deconstructionist’s “clues” (a tool-kit would be inaccurate) such as: 

différance, logocentrism, and the aspect of being under erasure.

Derrida utilized différance, to make the point, that language is not as fixed as one may think and verbal communication should not be prized above written communication as a more accurate form of thought (logocentrism). Intertextuality, the relatedness and dependency of text,
meaning must differ and always be deferred (difference), because it will never be possible for a word to illustrate the full “intended meaning” of the user. In that, a concept can never truly be everything it has the potential to be in one moment/space, and it can never fully represent all that it could represent, it is always under erasure. This device represents the ultimate inadequacy of any one symbol, or term in expressing singular meaning, while also illustrating the constant flux of meaning that occurs from human interaction.

Depending on one’s perspective, there can be many nuanced aspects of a deconstructive reading or interrogation. Here, however, I sought simplicity in the basic foci of deconstruction. In the following chapters, deconstructive readings, interrogations, and considerations of the deconstructive predicament adhered to the “tenets” outlined by Winter (2013) above, and were characterized with reading the text against itself, in order to expose the “textual subconscious.” This included seeking to uncover the disunity of the text where there was assumed unity, by highlighting seemingly imperceptible breaks or shifts in the textual connectivity. Ultimately, a deconstructive reading or framing of the topic included decontextualization, decentering, destabilizing and restructuring in order to fully expose the equivocal aspect of terms and their inner significance. This opened up the opportunity for a multiplicity of meanings that could be harnessed by philosophical analyses, as well as practical educational endeavors.

In Of Grammatology, Derrida explains that a deconstructive reading “must always aim at a certain relationship, unperceived by the writer, between what he commands and what he does not command of the patterns of language that he uses… It attempts to make the not-seen accessible to sight” (Derrida, 1974, p. 158). In the following section I briefly describe the basic aspects of conceptual analysis connected to this overall project. In the last three chapters, these analyses will be directed towards the deconstructive predicaments of the concepts in question.
Conceptual Analysis. Assuredly, conceptual analysis has long been thought of as a philosophical tool. These approaches generally spring from rationalistic and empirical groups of thinkers that search for patterns in language, meaning, and the tacit connections within the ostensibly real world. Kahn and Zeidler (2017) posit that conceptual analysis is a powerful and essential tool for science education researchers,

Conceptual analysis is both a creative and systematic methodology to explore and unpack constructs central to an area under investigation. It involves testing whether common usage of a word, that represents part of a larger construct, would be appropriate in various situations, or ‘cases.’ The data used when performing a conceptual analysis, therefore, are the cases in which one would use a term (‘model cases’), would not use a term (‘contrary cases’), or if appropriate usage of a term is unclear (“borderline cases”). Some analyses even develop cases that are beyond lived experiences (“invented cases”); such cases allow us to test the boundaries of concepts beyond the limits of a reality that is immediately apprehensible to us. (p. 542)

These case types can be approached utilizing differing types of conceptual analyses, specifically those types distinguished by Soltis (1978): generic, differentiation, and condition-type. A generic type conceptual analysis is focused toward discerning the basic and defining features of some concept. The differentiation-type of analysis is instead focused on determining the meaning of certain concepts as they are utilized within particular contexts. The condition-type of conceptual analysis is directed toward the conditions of the context which directly affect the meaning of a concept.
In addition to these three types, Kahn and Zeidler (2019) have also illustrated the use of conception development (see: Coombs & Daniels, 1991) through their conceptual analyses of various constructs in order to develop Socioscientific Perspective Taking (SSPT).

Coombs and Daniels (1991) describe three types of analytic inquiry geared toward providing useable, concrete interpretations of curricula development: concept interpretation, conception development, and conceptual structure analysis. For the purposes of this endeavor, the use of conception development came into play when working through SsL. Here, conception development was buttressed by the conceptual analysis of connected terms, to the overall concept or context. This connected directly with deconstruction.

Consider the following from Coombs and Daniels, “Conceptions are developed by modifying or reconstructing aspects of our existing conceptual structures, and new conceptions are developed to allow us to accomplish tasks for which our present concepts appear to be inadequate” (Coombs & Daniels, 1991, p. 33). This is occurring both because of deconstruction through discourse and can also be focused through the use of conceptual analysis. Even the very process of evaluating a concept as an educational goal, not only requires the use of types of conceptual analyses for clarification adjoining concepts, but also the questioning of the very standards and presuppositions on which that analysis is based.

**Study Design**

In the following chapters, I explore the deconstructive predicaments of scientific literacy and reflexivity in relation to the SSI framework. I was most interested in the idea that deconstruction ultimately is concerned with and seeks justice for “the other,” or that which may be generated by the other (Biesta, 2009).
Deconstruction is not necessarily a way of breaking things down, instead:

deconstruction rather provides a way to think again and afresh, more strictly and more 
radically, about the concern that has a central ‘project’ of education… a concern for 
precisely the incoming of the other, the coming of the other into the world. (Biesta, 2009, 
p. 16)

The deconstructive positioning of the research questions, and the corollary concepts 
under scrutiny, provides opportunity for analyses to be directed at previously unseen layers of 
meaning. These philosophical approaches will support the maneuvering of SSR and FSL (as a 
SSI functional perspective of SL) toward the development of socioscientific literacy. Ulmer 
reminds us of Derrida’s words that “one must simultaneously, by means of rigorous conceptual 
analyses… displace the framing, by philosophy, of its own types,” in order to write/see in a 
different way (Ulmer, 1983, p. 29). The following chapters represent this type of approach, 
although grounded in a more pragmatic conceptualization of education.

**Deconstruction and Conceptual Analysis of the Research Questions**

The following are brief descriptions of how the philosophical “methods” are directly 
related to each research question. Illustrations of how these methods were utilized begin at the 
outset of Chapter Four and the deconstructive devices that were employed to destabilize and 
read-against the text are most evident in Chapter 6. These methods will be made expressed 
through various forms of representation, from literary analogies, personification, practical 
educational approaches, to the merger of differing philosophical perspectives through the 
imagined juxtaposition of extant human existences.
**Research Question 1**: What are the boundaries and overlaps of scientific literacy (SL) and functional scientific literacy (FSL) within the SSI Framework? - The deconstructive opening-up of Research Question 1 began by evaluating the centralized position of scientific literacy as it is out of place, as both a goal for education and a manner of control. This included reading, or pushing, the text against itself, which in this case I mean upsetting or problematizing the ostensible purposes of scientific literacy. This led to uncovering ulterior motives that can alienate students from understanding science and how it connects to their lives. Through examination of the deconstructive predicaments, spaces for justice opened up, or at the very least spaces for something new. The development of functional scientific literacy was explored, emphasizing the connections with SL in general, but also with the practice of socioscientific reasoning (SSR). The conditions in which SL becomes functional, and the contexts in which this displacement can be most readily observed were highlighted.

**Research Question 2**: What are the major distinctions of the reflexive activities connected to the SSI framework? - The deconstructive opening-up of Research Question 2 started by exploring the reflexive aspects of SSR, specifically the moral context (reflexive and reflective judgment), to expose foundational connections. This allowed for the consideration of moving a more general and intentional reflexive/reflective, into a position to connect with all the competencies of SSR. This led to further investigation of aspects of the SSI movement in order to underscore the systems of reasoning, logic and purposes that connect them.

**Research Question 3**: What aspects of functional scientific literacy (FSL) can lead to the conceptualization of socioscientific literacy (SSL) as a goal for education in general? The deconstructive interrogation of Research Question 3 continued exploration of the spaces that were opened up through the exploration of the deconstructive predicaments of SL and
reflexivity. This included exposing fundamental aspects of FSL, as a SSI functional perspective of SL, in relation to SSR. The characteristics of SₜL, including constituent components/connections, the potential to cultivate reflexive awareness, and the abilities to recognize the shifting nature of evidence, were examined and evaluated.

Summary

The methodology begins with the noting and deblurring of the deconstructive predicament of Scientific Literacy. This will be illustrated by an analogical conceptual analysis of SL’s predicament as it is ex-loci. This approach will be utilized to reveal the tacit and hidden characteristics of scientific literacy, so that it can then be juxtaposed with FSL (used interchangeably with “a SSI functional view of scientific literacy”). As the boundaries between SL and FSL are recognized, the concept of “functional” is brought into question as a contextually dependent aberration, and an obscuring agent for concealed agreements of control. The role of SL as hero will be deprivileged, and cast in a new darkness so to highlight its disconnection from responsibility and obligation.

The deconstructive predicament of SSR is analyzed so to sort through sociocultural rootedness to uncover human rootedness, and tacit connections with power and control. From here overlaps of a SSI in the classroom, and those that comprise our pluralistic societies are framed together, and considered from an invented point of view. This leads an opening of SSPT and the moral context, where reflexive and reflective judgment, with a focus on judgment, are analyzed and considered as nodes for potential expansion. This entails the inspection of the foundations upon which these activities rest and are derived, on order to identify possible conflicts of interest, as well as unquestioned aspects of power that may influence the normation of our voice of conscience.
An auto-archaeological sketch, illustrating the reflexive turn toward my becoming a teacher, will illustrate the reflexive relationships of educational experiences, and the value of being aware of these relationships on a practical level as a teacher. In addition, hidden, unchecked, accepted as well-intentioned influences are framed as potential obstacles and agents of control which simplify, standardize, and dehumanize education. This is followed by the final development of socioscientific literacy (SSL), which will be described through the deconstructive maneuvering of SSR to a bricolage SSR (SSB). Following this transmutation, the characteristics of SSL will be explained, and a basic working “definition” of SSL posited. Table 1, illustrates the deconstructive typographical devices, that will be demonstrated in Chapter Four and utilized heavily in the final chapter, in order to convey the deconstructive maneuvering of the opening-up, of a SSI functional perspective of SL, toward a cross-curricular goal of SSL.

Table 1. Typography Devices

<table>
<thead>
<tr>
<th>Deconstructive Devices</th>
<th>Deconstructive Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>(/) Virgule</td>
<td>Contradictory instance of privilege; problematizing binary opposition</td>
</tr>
<tr>
<td>() Parentheses</td>
<td>Visually communicate the instability of an undecidable text</td>
</tr>
<tr>
<td>Strikethrough</td>
<td>Under erasure – The line is an incision, allowing us to open up the word to explore concealed meanings</td>
</tr>
<tr>
<td>Subscript Example</td>
<td>Decentering of the text</td>
</tr>
<tr>
<td>Superscript Example</td>
<td>Elevating, privileging the text</td>
</tr>
<tr>
<td>BOLD</td>
<td>Emphasis on what I think of commonly used phrases, which act as elements to textualize the two-dimensional representation. These are surface features uplifted by the unseen interworking of the text or artifacts that we have brushed clear of debris to reveal more detail.</td>
</tr>
<tr>
<td>Dictionary Entries</td>
<td>Used to locate deconstructive cracks, to problematize the representations, codification, slippage and privileging of meaning.</td>
</tr>
</tbody>
</table>
Chapter Four: The Deconstructive Predicament of Scientific Literacy

Introduction

What are the boundaries and overlaps of scientific literacy and functional scientific literacy within the SSI Framework? Within and throughout this research question are many tacit meanings, struggling with each other and ulterior motives that are made possible by those struggles. In the following chapter, scientific literacy is subjected to an interrogation, not through direct questioning, but through exploration of SL’s deconstructive predicament. At first this seems esoteric and meaningless to the everyday classroom, and perhaps on the surface this is true. However, when the realities of an educational condition are conceptualized as text, not in a trivial manner, but in a life-or-death sense, hidden stories begin to come out. I define, deconstructive predicament as follows:

\textbf{deconstructive predicament} \(\text{\textbackslash d\-\textbackslash k\-\textbackslash en\-\textbackslash tiv pri\-\textbackslash di\-k\-\textbackslash ə\-mənt}\) The difficult, enigmatic, demanding condition or state, in which concepts and constructs are suspended within as a consequence and contingency of their rhetorical existence.

For the most part, while it is not necessarily my claim, the primacy of scientific literacy springs from its deficit characteristics, one of which is few individuals will ever truly become scientifically literate. In an educational setting, this limitation might dissuade many professional educators from choosing SL as a goal for their prospective students. Surprisingly, however, this does not generally seem to be the case. This is notwithstanding, many science educators may not believe SL is unachievable and that it can be attained under the right conditions.
It would seem that SL needs to be clarified. However, doing this is much like two professional Tic-Tac-Toe players locked in a never-ending stalemate. No matter how the parts are arranged and rearranged, the outcome is always the same. This is not to say that SL is a constant or foregone inevitability. In fact, the shifting-aspect of the concept(s) adds to the problem of its clarification. Two decades ago, Laugksch (2000) stated, SL is contextually dependent, changing with the mouth it *exits* and the ears it *enters*. After reading this, a person may think, “How could what it means to be scientifically literate change from context to context, and year to year, if it is connected to something such as science?” The answer to which is as complicated as it is sinister.

One tenet of the nature of science, is that scientific knowledge is subject to change. It is tentative and open to adjustments, in order to incorporate new empirical information. This flexibility, which is grounded in a hopefulness of things to come, appears as a strength and weakness for science. This is an aspect of the deconstructive predicament of science and it seemingly points towards science, not SL, as the subject in need of interrogation. Scientific literacy could possibly be the equivalent of a smoke-screen, or worse yet, a press secretary for science. Looking at SL, entails seeing “science,” and therefore cannot be omitted. However, it is ostensibly obvious here, that SL *is not* science. Before asking SL to be more than it was imagined alone, I will borrow post-positivistic constructs to analogically analyze the SL concept in suspension of context; I call this *SL ex loco*.

Despite the removed analogies constituting the analysis, practical teaching experiences are interwoven indirectly. The purpose of the following is two-fold. First, general characteristics of SL will be revealed as SL is opened-up. This “operation” will allow the second purpose of this analysis; exposing the deconstructive predicament of SL. Here, I am using *deconstructive*
predicament in place of deconstruction as a noun. As I have elaborated and will continue to expound upon, I do not conceptualize deconstruction as a verb, in the sense that things are breaking apart. Instead, through a deconstructive lens, realities can be seen existing as text, and deconstruction is a constant of that existence. This constant promotes the aspect that is, “being possible.” By deconstructive predicament, I am also referring to the active exclusion of alterity; by leveraging the “impossible,” to make specific concepts possible. This predicament helps textual-rhetorical concepts maintain their shape within an ocean of text.

An Analogical Analysis of the Scientific Literacy Concept

To conceptually analyze SL ex loco, would be verification that SL is a concept. Perhaps, we think of it as a compound-concept. One that can be dissected and the parts scattered in orderly fashion about the floor. Like the arrangement of a jigsaw puzzle, we can begin to see pieces that may fit together, but struggle to get these parts to join seamlessly. If only SL were a male and female anglerfish (i.e., the fish with the light, that almost ate Marlin in Finding Nemo), we just pulled from the ocean’s depths. We could throw them up on the examination table in a specially pressurized workspace, to observe what had been elusive for so long. Here, what we can call in this one moment, the Angler Effect, causes onlookers to see SL as solid, known, and perhaps easy to measure, in this particular circumstance. However, for some time, scientists had no idea where the male anglerfish lived. It seemed as though only female specimens could be procured for observation. Interestingly at first, it seemed that many of the females were hosts to unidentified parasites. After closer investigation it was realized that the unidentified parasites fused to the female body, were in fact, male anglerfish.
If SL were an anglerfish and could be dissected as such, it would be a somewhat straightforward task to excise the scientific from the literacy, or the literacy from the scientific, to analyze both independently. We could wonder through this analogy and ask which is the male and which is the female, scientific or literacy? This reproductive practice has presumably occurred to be mutually beneficial to both sexes; in that it is so very difficult for male and female anglerfish to find each other in the depths of the ocean. When the male attaches to the female, it is able to release an enzyme that combines the two at a cellular level. After their fusion, they even begin to share blood vessels. In other words, it may become difficult to know where one starts and the other ends. At one time the boundaries may have been easy to observe, but biological processes have not just hidden those boundaries, in many ways it has erased them.

Instead of wondering whether scientific or literacy were the male or female, we could leave SL together and consider science as the other component. Has SL latched on to science and began to reduce itself, or has science latched on to SL? In either case, both need the other to survive. As signs, perhaps, they are able to change roles in differing contexts. After all, we are imposing terms like “male” and “female” to organize and make sense of/distinguish perceived differences. Still, looking at SL upon the table, primarily tells of its relationship with science. Scientific literacy is not simply a compound-concept, nor is it as easy to analyze as anglerfish specimens. If we were to relate SL to a sea creature, my first thought is of any abyssal organism that can only keep its shape at great depths, under immense pressure, and if you pull it to the surface for closer evaluation; it seemingly disintegrates and evades observation...slipping through your inquisitive perception.

As a former student stood in front of our class and reported about the Portuguese man-o-war, it occurred to me that it was a fitting analogy for SL. To many, the man-o-war is intriguing
to watch from afar and it is assumed that we are looking at one entity. However, after more in-depth scrutiny, it becomes known that the man-o-war is not simply a singular organism. It is instead a colony of organisms, connected for various purposes, operating in concert to give the illusion that it is singular. Within this, these fairly specialized organisms, while different, are connected directly or indirectly through which they find protection and purpose. From the standpoint of a teacher, SL may deleteriously seem as if it is one concept, but it is a Portuguese man-o-war of concepts. This brings us to the **first characteristic** of **SL ex loco**: **scientific literacy is beyond simply being equivocal; it is a colony of concepts.**

Over time, each iteration of scientific literacy, each bifurcation, conceptual inventory, shifting of contexts and interest, has both developed and taxed SL beyond its scope. SL as a concept or possible educational goal, emerged in the US as a response to the launch of Sputnik (Laugksch, 2000). It has, overtime, gone from something that would save the United States from Russia, to something that will save us from ourselves. Sometimes these iterations or visions, maintain existence by appearing as indispensable parts or simply by blending into the whole. Moreover, these iterations of SL have often taken on specialized functions; brought into relief by the context or purpose, for which SL is being wielded. While the works referenced in the literature review reveal a fraction of the dissociative disposition of scientific literacy; the flexible and octopi-camo characteristics that allow SL to be rearranged within differing contexts for various purposes, is seemingly the **second characteristic** of the **SL ex loco**: it reflects, refracts, and rearranges differing purposes, interests, agendas, biases, contextualization(s), and blends in or stands out depending on what it needs to do in order to survive.

It is tempting to formulate a taxonomy of SL, providing a genus and species of each **type** of scientific literacy, would be an interesting extension of this analogy. However, not all
characteristics of SL can be seen through the water, whether you are looking at it from outside or inside the medium. Here, the Portuguese man-o-war analogy illustrates a possible structural way of organizing the pluralistic concepts of SL, but there are weaknesses in this reasoning. Two major problems occur with this thinking: 1) the SL is not a finite, living organism and 2) it is too easy for us to accept the distinction between the man-o-war and the water in which they live.

What does this mean for SL ex loco? For the man-o-war to continue to work as SL, the ostensible tentacles would need to be imagined as endless chains, or at the very least with an “end” beyond our comprehension. Each organism of those chains would then also be comprised of seemingly endless chains of signifiers; like trying to track down the meaning of a word using a dictionary, following one word to the next for a lifetime. Scientific literacy is a specific colony of words, yet they exist in a sea of words and cannot take observable form outside of that sea. Because the man-o-war is comprised of the fluid in which it “floats,” it would be like trying to separate an actual man-o-war from the water it is in, but while only able to see the atomic level. The limitations of this analogy reflect the deconstructive predicament of scientific literacy. Here again, deconstruction is not the breaking apart of objects or ideas; it is, among other things, actively relying upon the binary opposition of possible versus impossible; rendering the manifestation of “the other,” impossible.

The man-o-war can help with this problem. How, does the man-o-war maintain its shape; how is it possible? The possible is only made as such, because of the perceived relationship between the possible and the impossible. The signifier “impossible” has a chain of meanings reflected and reinforced by other signifiers such as: unnatural and irrational. For instance, unnatural and irrational have been injected into discourse, and their pervading meanings act as
forces to repel, exclude and be set apart from other modes of thinking and acting, while also excluding the “other” which is cast as impossible by circumstance.

The reason why the man-o-war can maintain its shape in the water, is dependent upon the scale on which we are formulating and looking for answers. The reason can also change dependent of the goggles we are using to view the man-o-war, as well as with our own known and ulterior motives for viewing the colony. Perhaps, we can conceive of a group of human beings that do not see a distinction between the actual man-o-war and the water it is in. The actual man-o-war, if it does exist, is also in a deconstructive predicament, it is only not the water, because we decide that it would be impossible, on our plane of observation, for the man-o-war and the water to be the same things. However, on more than one of the levels we claim to know, they are just that, the same thing. Still, the man-o-war can be observed, and we would not knowingly serve it in a glass to a thirsty friend.

Unseen forces hold together the fundamental particles of that which is observed in specific arrangements. We then use these arrangements as reference points to begin dividing, rearranging, and ascribing meaning until, in this case, we have something that we call liquid water and a man-o-war. It may seem straightforward and entirely logical or reasonable to recognize these patterns, name them, define them, compare them, and even go as far as to say there is indirect empirical evidence of atomic phenomena. Nonetheless, from other spatial-temporal perspectives, it is not entirely different than the practical, creative and predictive use of constellations to help us make sense of our existence in the universe.

Here, I highlight the elemental human necessity for all empirical information to be coded in some form of language so to convey meaning. Therefore, knowledge is situated in a deconstructive existence, which is generally rectified by post-positivists with the notion of a
tentative nature, and by post-structuralists with the endless chain of signifiers. This is a
reminder that the man-o-war may keep its shape for a multitude of physiological, bio-chemical,
cellular, quantum, and other explanatory reasons/causes. However, the man-o-war takes and
maintains its shape through our collaborative language (semiotic systems), without which the
shape of the man-o-war does not exist in a meaningful way. Perhaps, there is an outside referent,
a thing we have covered with symbols so to make it visible. Perhaps this thing does “exist,” with
or without humans. However, this thing does not “exist” in a meaningful way without us.

The argument could go another way, towards dispelling “existence” as another linguistic
construct to describe the unobserved. However, accepting that the man-o-war goes on without us,
whether it does or not, only serves to highlight the holographic situation of SL. Scientific
Literacy is a rhetorical apparition, maintaining its flexible shape through discourse, which is
knowingly or unknowingly maintained by providing the same points of argument to SL the man-
o-war as you would to the actual man-o-war (I say actual, because it is the organism of which if
you touch the right area, you will feel physical pain- the type that prevents you from debating
whether or not pain is real or an illusion). For example, there is no reason to think that SL, like
the actual man-o-war, will continue on without us humans. This is a basic yet diminished third
characteristic of SL ex loco; it is human-dependent and without us, it will not continue on.

This is not simply a game of semantics, this has a major impact on the classroom, where
teachers and students are interacting. Consider that SL, through rhetoric and research, is afforded
the same qualifications as the actual man-o-war. The very notion of being able to “measure” SL,
indirectly suggests that SL has some sort of outside-of-human referents to which we are trying to
ascribe meaning, just as with the actual man-o-war. However, there are none in the same sense as
the actual man-o-war, when we keep in mind that human cognition, skill-sets, practices, habits of

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mind, and knowledge, do not exist anywhere…except within and between humans. Still, thinking that SL receives the same concessions as the actual man-o-war, gives the illusion that SL is something outside of human existence. Thus, we have the **fourth characteristic of SL ex loco; it is dehumanized - so it can be captured and studied, in order to formulate an understanding.**

SL is not only dehumanized, but as Shamos (1995) somewhat mocks, mythologized. Why does this matter to a teacher? Ask a teacher in Arkansas about the likelihood of their students seeing a Portuguese man-o-war in-person, much less capturing one on their own, particularly if it stings. Then ask them how likely they are to catch a leviathan, dragon, or unicorn outside of a video game or virtual reality. I suggest that SL is not necessarily “a myth,” as much as the role of being a myth is a part of its deconstructive predicament. This type of existence almost invites mythologizing and mystification by researchers and teachers. I use the term mythologize, to refer to its secondary form, that SL is open to exaggeration, facilitating the creation of romanticized and idealized forms. This is unfortunately, the **fifth characteristic of SL ex loco; it is open to mythologizing and mystification.**

When contemplating the complexities of the Portuguese man-o-war, we are reminded that it is a single colony comprised of many very similar, yet different organisms. A dehumanized, mythologized SL also appears as a singular object, that is illusive, misunderstood, possibly dangerous, and isolated to very few people. Imagine that instead of a population of man-o-wars, there was only one. An individual colony, roaming the vastness of our finite oceans. Now imagine that one group of human beings claim to have captured and contained the man-o-war. In this situation, very few human beings in our finite, yet vast human populations, will ever “actually” see the man-o-war. Instead, what everyone else knows and learns of the man-o-war
must come through only a select few individuals, within the original human group that allegedly captured it.

This enclave community eventually claims that they have captured something that explains what a human must do, be, act, and yield to, in order to make sense of and cope with the “natural” world. The group claims that the man-o-war can be interpreted as a mode of human conduct that helps answer questions, solve problems, make decisions, unlock other perceived mysteries, provide you with differing ways of living, and it could help you make money. This conglomerate, being altruistic and all, decided they will teach everyone the ways of the man-o-war. Of course, since they are the only privileged members of this order to have ever actually been in contact with the man-o-war, it is their responsibility to craft the curricula-o-war. This board of directors is then able to craft many documents, codes, policies, and begin enculturating or acculturating all other groups it deems fit. Consider that within anthropology, acculturation is often thought of as one group leveraging their power over another to force assimilation (see SL and Human Contact section).

This is a simplistic, analogically problematic telling of the man-o-war. And, while this analogy can be carried on as a quality of the deconstructive predicament of the man-o-war, it exposes the sixth characteristic of SL ex loco; scientific literacy is imbued with power. This power affords the founders, a position of elitism, through which the founding members can claim that only they can understand, and therefore interpret for everyone else, the Portuguese man-o-war. We can stand outside of this metaphor and see that “science” or scientific literacy could be the man-o-war. I do not believe this is solely because of a semantic or analogical flaw, but because “science” is one of SL’s sources of power; and ultimately through some visions at just the right angle of refraction, SL may be difficult, if not impossible to separate from “science.”
Through the alteration of text, six characteristics of *SL ex loco* have emerged, and a
description of this entity could be offered as:

*SL ex loco* – scientific literacy is a “colony” of concepts (i.e., poly-conceptual) that is
plastic to particular interests, purposes and biases, it is human-dependent, while
simultaneously trying to be dehumanized, open to mythologizing and mystification and
imbued with *power* beyond the scope of a single individual.

These characteristics, when compared, are at conflict on differing levels, yet also co-
dependent. This again, is the deconstructive predicament of SL; it remains possible, because of
the perceived conflicts and rearrangements that must occur in imperceptible time, which actively
casts otherness as impossible. Consider that one common component of SL is to understand the
“nature” of science (Singh & Singh, 2016). Notwithstanding the problems associated with NOS
and the feigning of “naturality”; the internal characteristics of science, also act as defenders of its
shape and position of power (i.e., “the nature of” is less about what is and more about what is not
or cannot/should-not be).

In some forms, scientific literacy can be cast as a mechanism of preservation and
gatekeeping for westernized science; helping science maintain its shape. In a practical sense (as
has been pointed out), it can act as a labeling system, a sieve, or a “pipeline” that can sort, filter,
and direct those who closely follow the lead of the “original” group toward a livelihood
connected with science. This highlights characteristics that SL does not phenotypically express,
yet are genotypically implied, and from this point a “functional view” of scientific literacy can be
recognized and explored. If we examine the “nature of science,” as it is framed within the NGSS,
through the incision of the tenets, one can observe possible shape holding properties that are
often implicit. (See Figure 1, p. 72).
A Deconstructive Reading of the NGSS Framework NOS

Appendix H of the NGSS Lists 8 Basic Understandings of the (Nature) of Science:

- **Scientific (Investigations) Use a Variety of** (collected, vetted, and altered) **Methods**, that have been claimed from cited and uncited human sources around the world, and may not be innately scientific. As westernized science expands, colonizes, and integrates, in must also change in response. Claiming broad categories of manipulated practices as scientific help science appeal to more individuals and communities.

- **Scientific Knowledge/knowledge is Based on Certified “Empirical” Evidence**, which implies that certain experiences, under specific conditions, following **rigorous** guidelines, presenting presumed transparency, with the possibility of **supervised repetition**, may be coded and packaged as “legitimate” knowledge.

- **Scientific Knowledge/knowledge is Open to Revision in Light of New Evidence**, which excludes the possibility of culpability, providing the constant caveat, “the decision was made in light of the evidence we had at the time.”

- **Scientific Models, Laws, Mechanisms, and Theories Explain (Natural) Phenomena**, in a way that must be mastered through directed study and training toward the realization, and therefore, verification of these explanatory tools. In the eventual likelihood that you cannot master these, a **select few** who can, will interpret them for you.

- **Science is a/the Way of (Knowing) how to be a good 21st century citizen.**

- **Scientific Knowledge Assumes an (Order) and (Consistency) in (Natural) Systems**, which is imposed upon the universe by human beings, not “discovered”.

- **Science is a Human Endeavor**, for relatively few humans; majority are spectators

- **Science Addresses Questions About the (Natural) and Material World**, because this is generally the confluence where wealth (power) is amassed.

Figure 1. A Deconstructive Reading of the NGSS Framework NOS. Note. Original text taken from: (NRC, 2013, Appendix H). Modified by the researcher to highlight the deconstructive predicament of scientific literacy. All views expressed are those of the researcher alone and do not reflect the opinions of the original authors.
This deconstructive reading of the NOS tenets (NRC, 2013), is not meant to tear them down, nor to show them to be wanting, unnecessary or not useful in certain contexts. Instead, this sort of reading brings our attention to the possible conflicts, contradictions, and hidden agendas that a list of tenets may hold. The continuation of the textual sentences, from that of the original, are mere possibilities, that cannot be falsified in a meaningful way. The words in bold reflect statements I think of as most easily seen, and used as either simplifiers, or a way to obscure tacit meanings. Those words under erasure, or struck-through, while present/absent, may not necessarily be as beneficial as they seem on the surface. In response, they have been opened-up so as to inspect their metaphorical genotype. Finally, those words that are elevated, such as “law” and “theory,” do not represent a problem with their development, but instead represents their often-dogmatic primacy over all other things within science, but also within the science classroom.

**Looking for a Functional View**

It can be argued that scientific literacy has no intrinsic, ethical, or moral domain. This presents a boundary between SL and a SSI functional view of scientific literacy. A SSI functional perspective of SL, FSL, attempts to purposefully and responsibly connect with globalized and localized ethical/moral realms, while SL has no such purpose. I suggest that thinking of SL as having no connection to ethics and morals, while called-for, can mask the deleterious and residual effects of *SL ex loco* - Characteristic 2: SL is plastic to particular interests, purposes, and biases. In other words, scientific literacy is not detached or non-influential in the formulation of moral/ethical decisions, but instead SL uncritically reflects the personal, temporal, and spatial moral/ethical parameters of the context and operator in which it is functioning. If this were not the case, when considering scientists that have committed what we
see in hind-sight as unethical or immoral acts under the guise of science, we would not need to say, “they were the product of their times…” and/or “the ends justified the means.”

For example, the atrocities committed by Nazi biologists, where “…prejudice found a faithful servant in science,” and the explanatory frameworks and arguments of science were used to justify the conception of inferiority of differing races (Weigmann, 2001, p. 871). Consider J. Marion Sims, the often titled, founder of modern surgical gynecology. Despite having made more than one contribution to gynecological medicine, many of his breakthroughs were formulated through his experimental surgery on the African slaves he owned at the time (Spettle & White, 2011). Just hearing his honorary title, one would conjecture that J. Marion Sims was a scientifically literate human being, despite living before the term “scientific literacy” was presumably coined in the late 1950’s (Laugksch, 2000).

Certainly, I would concede that these are extreme examples and in the case of Marion Sims, some still attempt to frame him as a “man of his time.” This, however, is a deconstructive opening and fundamental flaw. It is not well hidden, often overlooked, and a view that pervades science and the accomplice…scientific literacy. That is to say, SL is as science, not just amoral or a-ethical, they are both, moral cuttlefish, able to shift texture and nuanced colors, and in some cases supporting, the moral disposition of the brandisher, helping them blend into the in-place dominate regime. Moreover, on differing levels of special interests, such as experimental genetic research, energy consumption, and environmental justice, scientific literacy in particular, can easily change to blend in and support special agendas (i.e., explicit or implicit). This ability to take the moral-shape, not only acts as a survival mechanism for science and SL, it protects them from ever being tried or interrogated. When connected to the terrible acts that being a scientifically literate human being can help one, or many, commit, power and pain are obscured.
If you could ask SL and science, “Where were you when these scientists were conducting torturous experiments, formulating “scientific ideas” that became biological weapons, leveraging power over other humans, and building bombs that were destined to end millions of lives;” imagine how you would you react if they could only tell you, “Ok… we were there, but there was nothing we could do about it.” Some would say, “Of course, science can’t be blamed!” Here is a boundary between scientific literacy and the SSI functional perspective of scientific literacy. However, this is more of a move towards decentering scientific literacy, to reduce its primacy. The role of SL *ex loco* is rarely reversed, and perhaps a reversal, can reveal a shadow of the sixth aspect of SL; with power comes, or really should come with, great responsibility. The question remains how responsible is SL, and what is it really responsible for?

Through a historical excavation of SL, it is obvious that it has changed responsibility definition, purpose, utility, and in a civil sense as well (Laugksch, 2000; Anelli, 2011). At the confluence of hundreds of articles, thousands of web entries, seemingly simple organizational proclamations, it seems that SL is more than a colony of concepts, it is also a “colonizer,” or at the very least a tool for colonizers. SL extending its reach through discourse, staking claim to human skills as if they were first discovered, can also be an indication of another deleterious possibility that may lurk within SL. Although ostensibly unlikely, but even in its more congenial, idealistic, and open form, scientific literacy may help science maintain its shape and reach, by excluding human beings from being influential actors within the scientific enterprise. In other words, scientific literacy may be a villain.

**villain** /ˈvi-lən/ 1: a character in a story or play who opposes the hero (Merriam-Webster, n.d.)
Shamos (1995) shouts out Characteristic 5 of *SL ex loco*, positing that it would be a mythological feat for SL to become a goal that all members of society can achieve. Of course, this may be an easier position for a physicist to take. In some ways, it is calling out the impossibilities of setting a universal goal for what it means to be “of science.” On the other hand, it is also saying that science is really only for a few “special-ized” human beings. In response, SL continues to be morphed to meet differing purposes and to become something that seems, possible or accessible. Mythologizing and mystification, obscure this power and control. At this point, the characteristics of *SL ex loco* can serve as a heuristic to help educators examine and visualize the deconstruction predicament of SL, allowing them to open-up their own conceptions of scientific literacy. In what follows, this heuristic will help expose the boundaries between SL and a SSI functional perspective of SL, while also exposing the villainous characteristics of SL’s deconstructive predicament.

As an example of how a conception of SL can be approached this way, consider how it is seemingly convenient that many pedagogical goals align with what could be considered maintenance mechanisms for society. Contemplate the following artifact of SL: scientific literacy is "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity” (NRC, 1996). Despite this definition being connected with now defunct science educational standards; it encapsulates many of the aspects that educators attach to scientific literacy. This is the first definition that appears on a computer monitor after a Google search of scientific literacy (2020), which in this age, is a fairly reliable indicator of the widespread exposure to this
definition. SL in this way may be vaguely accessible, but at the expense of exposing the colonizing power that it, and its benefactor science, can maintain together.

The deconstructive predicament of the definition considers the sentence as is, but it is not a gestalt; in fact, it is quite the opposite. Knowledge and understanding (of scientific concepts and processes) are left unchecked, as if both logos are innocent bystanders.

science \ˈsᵻ-ən(t)ən\ 1: the state of knowing: knowledge as distinguished from ignorance or misunderstanding (Merriam-Webster, n.d.).

Knowledge has a shared pedigree with science and ultimately is the original source of Characteristic 6 of SL ex loco. The implication should be glaring, science is not only equated with knowledge, but casts all possible “other” modes of knowing as ignorance or lacking understanding. Multiple definitions help maintain shape, while some entries serve to claim territory. Due to all the aspects named above (and some remaining hidden), scientific literacy is a useful tool to obscure, moralize, and champion many agendas and special interests. It does this, while also staking claim over territories that would not necessarily be considered “scientific” (e.g., everyday decision making, civic duties, cultural affairs, and economic productivity). On the surface, this appears reasonable, in that each of these domains seem to intersect(act) with science in some way. However, here “science” and “knowledge” may be interchangeable, thus allowing for the monopolizing and leveraging of a position of feigned essentiality (i.e., making science “required”).

This is but only one of the guised problems of scientific literacy’s positionality within education…colonizing through acculturation as an act of exclusion. Claiming certain practices that are distinctly human (e.g., asking questions, communicating ideas, conducting investigations, etc.) as “scientific,” is a dehumanizing act of colonization. This is also evident, in
the claiming common ways of making sense of things (e.g., patterns, cause and effect, stability and change), or even habits of mind (e.g., curiosity, observation, skepticism, etc.). Scientific literacy keeps its shape by excluding alterity, but also by absorbing common threads and weaving them as foreign (SL and science, don’t always seem like distinct constructs).

**understand** /ən-ˈdər-ˈstænd/ 2: to accept as a fact or truth or regard as plausible without utter certainty (Merriam-Webster, n.d.).

Not only must the scientifically literate “know,” they must also “understand” scientific concepts and processes within this definition. Dr. Who proclaimed, “I try not to understand, it’s called an open mind” (Macdonald, 2015). Nonetheless, the definition above (2) is a crack in the concept of *understanding*; to accept as *fact* or *truth*, or at minimum entertain as plausible without utter (i.e., complete and total) certainty. This is, after all, the (nature of) *deconstructive predicament* of science and scientific literacy. Deep within, beyond the overlaps with *faith*, there is the other exclusionary, diabolical plan which SL as a villain knowingly exacts.

Scientific literacy is not asking for understanding, but instead acceptance. This acceptance does not ensure the construction, addition, or any say at all about “the knowledge” (science) being referenced. Still, that knowledge and acceptance are “required” for personal decision making, participation in civic and cultural affairs, and economic productivity. This could seem like a nice trade-off…just accept this and you will be able to be included, maybe, in some way. On the other hand, SL implies nothing about being a member of the “scientific community.” Instead, it hides the exclusionary power of science. Here we see the unfortunate flipside of Characteristic 6 of *SL ex loco* - it is imbued with power but has no connection to responsibility.
The question, “Do students have the knowledge and understanding of scientific concepts and processes required for personal decision-making and participation in social systems?” (NCREL, 2003); could be read back: Do students have the right knowledge and acceptance/understanding of scientific concepts and processes that will direct their personal decisions so they can contribute to the maintenance of socio-economic systems? (See: Bourdieu & Passeron, 1990). This is akin to the power of “literacy” alone, in that it is framed as an essential skill of empowerment. However, being literate is also what (our) society needs at large to maintain the current leveling, structure, and work force. Nonetheless, straddling the line between liberator and oppressor, is not the villainous act of SL in and of itself.

Scientific literacy is a missionary for science, enlisting all of “our” youth as citizens, that will accept science without guaranteed representation. Here, is the diabolical plan, SL enlists students into science, not as active participants, but as spectators. This is disguised by “making connections” with everyday life and science, yet those connections to everyday life were already there as human constructs; SL claims it for science. It (SL) has been identified as an important characteristic that every citizen in a modern society should possess (Turiman et al., 2012). From the characteristics above, it is apparent that SL can help forge “good citizens,” but there is no reason to think SL can influence students to be “good.”

citizen ˈsi-tə-zən  also -sən 2. b: a native or naturalized person who owes allegiance to a government and is entitled to protection from it. (Merriam-Webster, n.d.)
good ˈgud 1 f (2): conforming to a standard  2 a (1): Virtuous, Right, Commendable a good person good conduct (2): Kind, Benevolent good intentions. (Merriam-Webster, n.d.)
From the six characteristics of *SL* *ex loco*, SL can help forge “good citizens,” but there is no reason to think SL can influence students to be “good.” Do you have to be good, to be a good citizen? Were Nazi doctors, charged with crimes against humanity, *good citizens* within a particular spatial-temporal context? Were they good human beings? Certainly, good and bad are human binary oppositions, in which good is privileged. Yet good is often twisted, disguised and overlapping with bad. Nevertheless, there are cases where good and bad are made fairly distinct. The same can be said for the relativity of “good.” Admittedly, SL is not necessarily a villain, nor is it good or bad, but rhetorically it has the potential to act against “otherness,” and therefore can exclude, marginalize, and dehumanize individuals and groups.

Here is another distinction between SL and FSL (a SSI functional perspective of scientific literacy), the decentering allows for the possibility of the impossible or attempts to do justice for the *other*. A functional view of SL, beyond its definition, seeks to humanize science, not through colonization, but through interaction, transaction, and awareness. The SSI functional view of scientific literacy is equated with the practice of SSR, which exposes the *affordances and limitations of science*. Through these competencies, SL can take on differing shapes, as it is decentered and reconnected by human beings grappling with multi-dimensional problems.

In the next section, a functional scientific view of SL is explored further, with a focus on SSR. Table 2 (See page 81), lists the characteristics of *SL* *ex loco*, and compares them with the implications identified in this section, which will be referred to as *SL the villain*. While they are listed in connection with the characteristics, they can and do connect in different ways beyond this limited scope. As mentioned at the outset of this section, I will continue to use, these now joined characteristics of the deconstructive predicament of SL, to detect the boundaries between SL and a SSI functional perspective of SL. These characteristics of *ex loco* and *the villain*,


represent conditions that a functional view of SL must account for, adapt, absorb, or discard as it displaces other forms of SL (see Krupnick, 1983). These characteristics of the deconstructive predicament of SL can continue to be adapted as a heuristic, against which other formulations of SL can be compared, much like the SL definitional artifact treated above (NRC, 1996).

Continuing with this in mind, in order to make visible a shift toward a functional view of scientific literacy, I imagine placing SL in the same awkward and daunting position as our students, when being asked to cultivate scientific literacy. What if scientific literacy had to be a functioning human being?

Table 2. SL ex loco vs. SL the villain (A comparison view)

<table>
<thead>
<tr>
<th></th>
<th>SL ex loco</th>
<th>SL the villain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SL is a “colony” of concepts (polyconceptual)</td>
<td>A centralized SL is also a colonizer</td>
</tr>
<tr>
<td>2</td>
<td>SL is plastic to particular interests, purposes, and biases</td>
<td>SL carries influence from science and other westernized systems</td>
</tr>
<tr>
<td>3</td>
<td>SL is human-dependent</td>
<td>SL depends on humans for purpose and direction</td>
</tr>
<tr>
<td>4</td>
<td>SL is dehumanized</td>
<td>SL has no outside referents</td>
</tr>
<tr>
<td>5</td>
<td>SL is open to mythologizing and mystification</td>
<td>SL is cast as the hero and the villain</td>
</tr>
<tr>
<td>6</td>
<td>SL is imbued with <em>power</em></td>
<td>SL has no obligation or responsibilities</td>
</tr>
</tbody>
</table>

SL and Human Contact

It is silly to anthropomorphize a concept such as scientific literacy, a term keyed by slamming two seemingly, unrelated words together. It is not as though scientific literacy is human. Most certainly, scientific literacy is not a living person at all, yet the six characteristics identified above suggest it does not exist beyond human beings. However, what if scientific literacy were a person? That question asks for a description which can gloss over flaws guised as
strengths. Moreover, I may also be susceptible to a romanticized view of science brought on by Mr. Wizard and another science guy, keeping me company through my youth. I could easily paint a positive picture of scientific literacy, that would look like an android, trekking aboard a starship, with instant access to countless funds of knowledge, and endlessly, and amusingly, trying to mimic human emotion and behavior. The question, “What if SL were human” asks nothing difficult of SL.

Instead, ask the question that scientific literacy would probably fear, if it could…“What if scientific literacy had to be a human being?” What if, instead of human beings having to learn to be scientifically literate, SL had to learn to be human? Would the voices of scientific literacy be able to live a fully functional life of a human being on an everyday basis, given the varying contexts and environments that occur throughout its existence? The characteristics of SL ex loco, suggest that the answers are “no.” That may mean that many of its characteristics must be reversed or diminished, in order to function within a social context. Perhaps this is an unfair, or far too broad a request. After all, we humans are still scattered around the globe, engaged in varied lifestyles and conditions from day to day, comprised of pluralistic families, communities, and societies.

Consider that there are still groups of human beings living in the Amazon Rainforest that have very limited contact, if any contact at all, with the “outside” world. Could SL be a member of one of these human groups? Admittedly, in that they are “uncontacted,” it would be difficult to say with certainty what they do on a day-to-day basis. Yet, when viewed from afar, it is obvious that they can transform environments, cultivate plants, domesticate animals, and assuredly educate their youth. The members of these groups are seemingly, successfully intelligent. This is made evident by the fact they are surviving in a difficult physical
environment, without the technological supports many of us in the “privileged” western world may be able to access. Successful intelligence has been defined as:

**successful intelligence** \(\text{sək-ˈsēz-fəl}\ in-ˈte-lə-jən(t)s\ the ability to achieve success in life according to one’s personal standards within one’s sociocultural context. (Sternberg et al., 2009, p. 76)

Even though it can be difficult to truly grasp the view of the uncontacted, even after contact, we can contemplate a slippery term; “culture.” Could SL be a member a culture? On a practical level, the first two visions (Roberts, 2007) possessed by SL may help them (SL) survive the Amazon. Having access to the entire pool of westernized, empirically-based knowledge and an awareness of scientific methods and approaches may also aid its survival. One may also think that a person with a degree in electrical engineering from a prestigious university would be able to create a simple electrical system with a single wire, battery and bulb (which is sadly, not always the case). The uncontacted groups and even those that have been contacted, have lived in these areas, without any connection to the scientific enterprise. Ultimately, by suggesting that these groups are connected by culture is a “privileged” western perspective, using a “privileged” western term.

Angrosino’s (2004, p. 6) distillation: “culture is a system of learned and shared material productions, interpersonal relations, and ideas about what those productions and relations mean.” If these groups, living and thriving in the Amazon, have a system in which they produce “stuff”, teach others, practice learned and shared relationships, and understand the interconnected relationship of these concepts; then we can begrudgingly use the western term “culture” for a generalization. Perhaps, with this distillation, we are tempted to think the cuttlefish villain could easily slip within the group, and at least blend in; here, the cuttlefish is out of its waters.
Ponder this expressive thought on “culture” as non-trivial:

It is a blanket of comfort that gives meaning to lives. It is a body of knowledge that allows the individual to make sense out of the infinite sensations of consciousness, to find meaning and order in a universe that ultimately has neither. Culture is a body of laws and traditions, a moral and ethical code that insulates a people from the barbaric heart that history suggests lies just beneath the surface of all human societies and indeed all human beings. (Davis, 2009, p. 198)

Such an eloquent and romantic notion. Culture is also a perilous mechanism of oppression by which human societies cling together through the codifying and diminishing of behaviors, leveling and labeling of human groups, leveraging certain oppositions, and constructing barriers that insulate people from change (Wolf, 1984; Wolf et al., 1994). Add to this, the guise in which it operates, giving comfort by cloaking awareness, limiting choice, and making the other, the “other.” With the same privilege, science has been framed as a “culture,” a mechanism of the deconstructive predicament of science. If SL is removed from its “culture” and transplanted in another, its shape is forced to bend beyond comfort, while also revealing possibilities of otherness that otherwise seemed impossible. Disconnected from science, SL has far less, if any power, and is amorphous; without science it cannot colonize, it must be acculturated or reimagined to survive. In this case, we will consider SL as acculturated:

**acculturation** /əˌkɒlCHəˈræSH(ə)n/ changes that transpire due to the meeting of cultures.

This may apply to an individual or a group who moves from one sociocultural context to another… generally related to the context of immigration, whereby immigrants must take on the cultural norms of the **majority** culture. (Jacob, 2020)
**enculturation** /ənˈkʌltʃərəˈreɪʃən/ the process of acquiring culture that begins with children and influences and reflects a person's concept of what is **normal** or **acceptable** when considering such things as, living conditions, education, values, and beliefs. (Jacob, 2020)

Assuredly, if SL had undergone the enculturation process from birth, within the De-Nigami tribe of the Amazon, it would not appear to us in a form that we readily recognize. If SL were a human that could be acculturated by this group, they could leverage their dominant position. Any notion of scientific literacy must learn to ingratiate other perspectives, since any missteps could mean an unraveling of a way of life. When SL (pronouns: they, them, they’re) is disoriented, withdrawn, and possibly feeling betrayed and alone; I think of our students in the science classroom.

**SL of the De-Nigami**

To leave science behind, SL would also need to leave their colony of concepts that are well situated within the realm of science, as there will no longer be a “community,” or an “enterprise” for SL to lean on. SL must leave behind the special interests, reworked purposes, and perhaps luckily, the biases implicit within science. They will not ascend on these human groups as a god, nor as a mythical entity that changes the universe; they are still human-dependent. Without science, SL can no longer be dehumanized, as a human living amongst a group, they could no longer afford to be separated from humanity. SL is powerless, subject to shaping by the surrounding “cultural” forces, in which some will remain invisible to SL.

**Scientific literacy** would have a difficult time feeling at home here. They would struggle to connect with the people on a personal level, and to grasp the day-to-day lives of the De-Nigami. At first, uttering in a pattern-based noise, SL tries to convince the others in the group to
They try to make them second-guess their reasoning, to wonder why they believe this or that, to conduct rituals and question why they carry-out seemingly inane traditions. This is an indication of a yet to be named consequence of Characteristic 2 of SL ex loco, that is, scientific literacy is ethnocentric. Ethnocentrism, is defined as:

ethnocentrism \ˌeth-nō-'sen-trəm \ the technical name for this view of things in which one’s own group is the center of everything, and all others are scaled and rated with reference to it (Sumner, 1940, p. 13); the attitude that one's own group, ethnicity, or nationality is superior to others (Merriam-Webster, n.d.).

Here we see that SL has dual(ing)/duel(ing) cultural affiliations; it is directly connected to a conglomeration of socio-cultural iterations (science). As SL journeyed far from the science they had known, they maintained some connection with the westernized, pluralistic societies of science. SL’s allegiance to both science and other constituents of the westernized hemisphere, waned in the sweltering heat of the rainforest. Walking into the cleared living area, SL felt something ineffable; a moment, in which they previously guarded against and denied with their life.

There is no cure for ethnocentrism. However, immersion within a group for prolonged amounts of time, under what can be stressful situations, can act as motivation, a catalyst for change. Deep within the Amazon rainforest, SL is no longer the hero, nor the villain. They are not privileged or prized. Instead, at first, SL is a liability living with the uncontacted De-Nigami, they are foreign, an outsider…they have become the “other.” Here, SL struggles to make meaning of the phonemic, and can only barely ascertain the phonetic.
What could make SL functional within an uncontacted group and what would that mean? Before, looking more closely at SL of the De-Nigami, consider the consequences and lessons of artifactual cases of westernized education, meeting with traditional ways of thinking.

**The Real Function.** I am tempted to take SL toward a “real” human case, yet the colonizing effects of westernized education on human lifeways, is similar to throwing a bowling ball through an intricately woven spider web; then blaming the spider for the destruction. The people creating and navigating those lifeways, are often left like fell trees, after the wake of a westernized logging company. When Davis (2009) spoke with an Italian Priest that originally set up a relief camp for nomadic Rendille herders, he lamented the affect that the sedentary lifestyle and opportunities for western education had on the Rendille. Father George, critiquing his own complicity said:

> Schooling has not changed the people for the better. This is the pain in my heart. Those educated want nothing to do with their animals. They just want to leave. Education should not be a reason to go away. It’s an obligation to come back. (Davis, 2009, p. 191)

In this case, the nomads would acquire basic skills of literacy and numeracy, just enough to enter into “modernized” Nairobi at relatively menial levels of employment, when employment was available. Westernized education, particularly those components that are ostensibly empowering (e.g. literacy), may be functional within specific sociocultural contexts. However, depending on the conditions of that function, the empowering effects can be nothing more than empty promises, or acts of entrapment, coercion, and control. In some cases, it can rob humans of a viable, rewarding ways of life, by inviting them to ill-conceived hives that enlist them for societal maintenance. It is possible to imagine teaching someone to read, as an act of oppression.
The Huaorani. Rival (2000) provided an insightful telling of the Ecuadorian Amazonian hunter-and-gathers called the Huaorani, which brings into question the empowering effects of western education. Interestingly, the Huaorani conceptualized the education of their youth as an integral part of growing through experience and participation; kids become functioning members of the groups experientially/experimentally. Westernized education was provided/imposed upon some groups of Huaoranis and school villages subsequently were formed. This new mode of education was decontextualized, and diametrically juxtaposed with the traditional life in the forest longhouses.

The power of “modernization” through westernized education could be easily observed. The Huaorani, with a “modern education,” lacking the empirical knowledge that would have been afforded to them through a traditional Huaorani approach to pedagogy, did not cultivate their groups’ usual dispositions and norms, specifically in terms of personal autonomy and the sharing of natural abundance (Rival, 2000, p. 117). The division between adult and child, also had to be demarcated, so that children could understand their place in the modern classroom. As experienced educators might expect, the Huaorani youth receiving a westernized education, were ingesting more than decontextualized facts, (just as were those youth living in the forest longhouses), but also undisclosed hidden norms and agreements. I use this to frame the deconstructive predicament of “functional.” The term “functional” has been defined as:

**functional** /fənˈk(ə)nl-/ 2: used to contribute to the development or maintenance of a larger whole 3: performing or able to perform a regular function. (Merriam-Webster, n.d.)

The “larger whole” is the context of “functional,” whereby it is weighed and measured. We, as educators, must question what that “larger whole” actually is, should be and could be. We could imagine that the Huaorani, in the school villages, would have been better served by an
education that promotes alignment with, as opposed to dislocation from their traditional ways of life. However, the underlying hidden agendas of a dominant force, through acculturation, dictate the functionality of scientific literacy, within the Huaorani. SL ex loco may be aligned with the promotion of dogmatic norms or ulterior motives of a particular group. In this case, the function is to isolate, marginalize, disempower, dislocate, and create rhetorical obstacles through the promotion of SL. Scientific literacy is functional for some other whole, be it science or the western world in general.

However, can there be a functional view of SL for the Huaorani, living their traditional lives in the forest? A functional view of SL for the Huaorani would embrace their modes of learning (a term of which they have no direct translation), and it would help them continue to survive in their physical and socio-cultural environments. Let’s leave the potential of this concept for a moment and turn back to where SL was left behind. When last we saw SL the human, they were in the forest, acculturated, without power and a science-dependent shape. SL had been forsaken by the whole they once served and now, from the chrysalis of the Amazon Rainforest, we see the emergence of SL of the De-Nigami

A Functional Perspective of Scientific Literacy

Viewed through a telephotographic lens from above, we can observe these uncontacted communities (e.g., the De-Nigami) are able to harness and redesign their surrounding environments and the layout of their dwelling spaces appear (to us) to have order and distinct designs. Still, outside the artifactual results of a community, it would be difficult to ascertain the deep hidden descriptions and meanings that transfer and mutate between the group. From an optimistic perspective, over time, perhaps SL of De-Nigami, immersed within this group, reconnected with their humanity. This helped them see some mechanisms of being human (habits
of mind, meaning-making, questioning and problem-solving practices, interpersonal communications, connectivity, design and construction, etc.) are not realms discovered by science, any more than the Americas are realms discovered by Christopher Columbus.

From this recognition and acceptance, SL is no longer scientific literacy. They are something more foundational to humans. Basic habits of mind (i.e., being observant, creative, curious, open-minded, and skeptical) may take some sort of form as a member of a group forging a living in the Rainforest. Of course, Aikenhead (2006), borrowing from Ogawa, reminds us that western educators are often unable to escape their Eurocentric Cartesian habits of mind and therefore they unconsciously attribute their own ontology and epistemology to people of differing cultures. Perhaps then, we would find fundamental mental activities, exhibited by humans around the world throughout time. These metacomponents may include higher order executive processes, which control the planning, monitoring and evaluating of thinking and action. Behaviors such as recognizing the existence of a problem, defining the nature of the problem, and mentally representing information about the problem (Sternberg, 2003).

After their time with the De-Nigami, SL now expresses mainly characteristics 2 and 3 from their life as SL ex loco. They accept on differing levels what it means to be human-dependent, decentering science as the dominant culture. And SL remains plastic and carries the unrecognized biases of the group with which they interact, even without science. This is one of the ways SL is able to maintain any shape at all. Through this deep immersive process, SL was resistant to being mythologized or mystified and was able to plainly see the limitations of science. SL may seem to be a formulation, sparked by competition and fueled by high ideas. However, deep beneath those agendas may be a call for something more humanly profound.
SL of the De-Nigami, is a fundamentally human idea of what SL could be if they were detached from their spatial-temporal origins. While working and living with the De-Nigami, SL confronted many problems that had to be defined and solved on the physical, psychological, and sociocultural levels. Each of these required an openness to alternative views of norms. For instance, the De-Nigami, have no distinction between themselves and the other life forces that live in the forest. Therefore, construction in this case, is much more like the people of Meghalaya India redirecting (and maintaining) the roots of living trees into bridges and other needed living structures. This in turn causes SL to rethink science norms generally attached with westernized, agricultural sciences.

It would be difficult to ascertain if SL ever reached the status of “functional” in the eyes of their hosts, but through survival they were able to be functional in some capacity on a day-to-day basis. Being a participant, meant entering into decision-making, SL was often tied to the immediate experiences, yet they became dedicated to helping develop the quality of the De-Nigami’s condition by arguing for choices to be made. SL’s transformative immersive experience, aided SL in seeing that the enculturation of the De-Nigami (i.e., learning to hunt specific prey, gather specific materials, enact certain rituals, and seek counsel when in need) was more than learning to be efficient and good at hunting or gathering. SL came to find that the De-Nigami pedagogy, much like the Huaorani, was focused on making one a “good De-Nigami,” which the De-Nigami judge by their own agreed upon standards.

Naturally, during day-to-day living, there were times when meaning slipped by, explanations remained incomplete, and certain obligations and expectations were not fully met. Nonetheless, SL was transformed by the prolonged interactions, whereby they began to develop a familiar/familial sense of appreciation, respect and love for the De-Nigami. As a result, SL was
repositioned with a new sense of humility, prompting introspection and the reimaging of existence. SL was positioned in a manner, that to make sense of *themselves, they* had to see *themselves* in the De-Nigami, catalyzing an epiphany; SL is wonderfully humanly ordinary. The De-Nigami and others helped SL reflect upon many of its SL *ex loco* characteristics, exposing the possible boundaries of a rooted functionality, and a kinship to the aspects that also give shape to a SSI functional view of scientific literacy.

Table 3 (See page 93) presents a deconstructive opportunity, the decentering of science within the SSI framework and to connect with varying human capacities. It is an attempt to help make SL a functional part of being human in varying contexts. This can be realized through the identified fundamental competencies of socioscientific reasoning. While SSR is situated within its own deconstructive predicament, it is in essence a reflection of common human ways of negotiating the murkiness of the known universe. Furthermore, within the competencies, couched within perspective taking, we find the reflexive turnings of the SSI framework.

*SL*, now hungry to continue their humanistic quest, must leave the Rainforest, for another point of light and dark; where making a living and surviving, requires a genius often undetectable by western eyes. Near the top of our world, SL will find another complex existence, requiring an encyclopedic knowledge of the environment coupled with an observant, creative, incredulous approach to living. Here, the everyday struggle is exacerbated by the weight of colonization and lack of global representation. To explore the practice of SSR as a fundamentally human representation, *SL of De-Nigami*, will need a *natsiq* coat; they’re traveling to a region where it is the aboriginals against the rest of the world. At these gruesome, cold, cross-roads of cultural, ethical and personal norms (Zeidler, 2014), the functionality of scientific literacy can be tested.
### Table 3. Detected Boundaries Between SL and a SSI Functional Perspective of SL

<table>
<thead>
<tr>
<th>Characteristics of SL ex loco and the Villain</th>
<th>Detected Boundaries Between SL and a SSI functional perspective of SL</th>
<th>SSI Functional view of Scientific Literacy (Zeidler, 2014)</th>
</tr>
</thead>
</table>
| 1. SL is a “colony” of concepts (poly-conceptual)  
SL is plastic to particular interests, purposes, and biases  
SL carries influence from science and other westernized systems | A functional view of SL extends from the “visions” of SL. | Emphasis on moral growth, reflective reasoning and the formation of character |
| 2. SL is human-dependent  
SL depends on humans for purpose and direction | A functional view of SL attempts to connect directly with globalized and localized ethical/moral realms. | Sociocultural “prioritizes enculturation and practice” (Sadler, 2007 p. 4). |
| 3. SL is dehumanized  
SL has no outside referents | A functional view of SL suggests that scientific literacy is decentered. | SSI may develop both SL and character through experiences that maximize opportunities for citizenship |
| 4. SL is open to mythologizing and mystification  
SL is cast as the Hero and the Villain | A functional view of SL, humanizes science, not through colonization, but through interaction, transaction, and awareness. | Pedagogy is deliberately directed toward issues embedded in the crossroads of cultural, ethical, and personal norms. |
| 5. SL is imbued with power  
SL has no obligation or responsibilities | Through SSR, the affordances and limitations of science are exposed. | Context and culturally sensitive to the needs of the learner. |
| 6. | A functional view of SL allows for the possibility of the impossible or attempts to do justice for the other. | Sensitive to both dominant and alternative normative views of SL. |
Chapter Five: The Reflexive Transformation of Es-el

Introduction of the Angry Inuk

Entering the house, the smells would most likely be unfamiliar to SL, yet the warmth offered by the western layout and modern heating systems, would be a welcome contrast to the arctic air. The first room was centered around a stove, topped with unique cooking vessels made of varying materials. Water vapor was visibly rising into what appeared to be an oven exhaust hood. The kitchen is inviting, full of life and energy. People smiling, talking, and a small group welcomes SL with open arms. They speak in unknown patterns, yet this dialect is made clearer with familiar demonstrations of emotion. Others simply smile and act reserved, or perhaps shy with the new visitor. All the hosts, even those that seem to be visiting this particular home from the surrounding area, invite SL in with great zealoussness. SL, curiously and with a sense of developing humility, walks through the narrow quarters. It is a tight squeeze and SL finds themselves bumping into visitors carrying bags, looking like they may be meeting together to paint the interior of the house red.

As SL, approaches the next room, they quickly observe a group of individuals. Some of the people are standing, but many are crouched down, concentrated on the center of the floor. They are all seemingly busy at work, yet their bodies obscure the center of attention and as SL approaches, the far faces of the human formation become visible. SL sees two children sucking on their hands, which are dripping in a rich, red, glistening syrup, that is also generously painted around their mouths. SL’s disposition changes from curious, to skeptical, to uneasy as they
continue to approach, taking in new sensory information; *their* formulating inference of the environment, growing in complexity. *SL* knows, before the words form… the red syrup is blood. *SL* looks to *their* side, startled by the image of a woman, with a young baby that has the deepest, brightest red ring around its’ mouth. The baby smiles kindly and waves innocently at *SL*, after which she turns her attention to excitedly take a bloody bit of flesh offered by her proud mother.

*SL* steps closer still and begins to peer inward. Standing around the group, plastic sheets are plainly lining the floor, with strategically carved portions of flesh, well organized in stacks. The woven entrails and unidentified, freshly removed skeletal remains are arranged neatly on the plastic protected floor. Everyone was eating and dissecting. They were packing this part and that part into their bags, while smuggling a bit into their mouths with great enjoyment. *SL* mesmerized, looked up as a calm faced man, holding a grey bag with a scarlet bottom (surely full of flesh) speaks with the home’s host and easily and plainly says, “thank you.” He then turns and slips out the door into the cold artic air. An elderly lady, continues to welcome *SL* to the group, saying (although not translated), “Please join us. Grab a bag of food to take with you!” *SL*, steps forward and begins to consider the prospect and possibilities. Then, curiously looking up again, *SL* witnesses one of the more intriguing scenarios seen to this point in *their* human existence.

An elderly man, sitting in a large rolling office chair, was positioned on the periphery of this crowded, active, living, eating, and working area. He was not looking on at the group of people. They moved around him, often stopping to thank him. He acknowledged them with a quick nod of his head, but then retuned his intent gaze back to what *SL* thought was an older computer monitor.
SL began to look over the man’s shoulder and was struck with a surprised intrigue. The juxtaposition of a group of people eating raw, bloody meat together, in an otherwise westernized living space, was only made stranger by the fact that the man was posting pictures of the feast, on his Facebook page.

**Earlier that morning.** Joannie and his grandson, Isuaqtuq, sat together, motionless, peering across what seemed to be an endless expanse of water and ice. H$_2$O was mingling together in various forms, showing off to the point of the sublime. It was quiet…only the gentle lapping of the water against the ice and the occasional high-pitch whistle of the wind, disturbed the tranquil serenity. Joannie, panning through the icy haze with the scope of a modern rifle, almost without warning, pulls the trigger. In an instant, the shallow gunshot blast is swallowed and made seemingly insignificant by the vastness of the atmosphere, brought into relief against the barren landscape. The duo rose from the snowy ground and made their way to a rowboat, half-perched on the ice’s edge. Isuaqtuq rowed them out with a purpose and direction. As they approached the distant suspected spot, which seemed so far away from the origin of the gunshot; a globular shape with a slicked black and grey surface, breached the surface tension. A viscous red syrup slowly diffused throughout the murky waters. Joannie grasped the body and pulled it on to the boat. The two men hastily made their way back to shore.

They gingerly moved the natsiq from the boat to the ice. Joannie began to surgically remove the outer skin of the natsiq, taking great care to keep it complete and whole. Once removed, he hands it to his grandson, asking him to submerge it in the water. “Careful…don’t drop it” he says to the young one (in a dialect unfamiliar to most). Then Joannie begins the meticulous dissection of the fallen organism with great precision and care. It was evident that specific parts were harvested and carefully curated in such a way, that they must have an
intended purpose. The natsiq, with all its possible resulting utilities, is a source of protein; rich in minerals and nutrients that are not easy to come by in the colonized circle. After they procure and prepare specific portions of the natsiq (including the harvested skin), the proud grandfather and grandson, bundle together all the remaining parts, a majority of which were large fatty chunks of meat. They secure everything to a large sled attached to their skimobile and with a revving of the engine; they head in a direction that looks like all the others, destined for the house that is now familiar to SL.

With great happiness the two return home, knowing that in their small community, the invites are already being sent out. Just before SL walked into the house, Joannie’s daughter, was on the phone with members of the community; inviting them to join them for food at her mother’s house. This is the story that Joannie tells SL, as they gather their portion of natsiq. Realizing SL has been in other unusual times with the De-Nigami and in order to be functional here; they must be open to other norms. Judgment should not only be reserved for more information, but also for intense reflexive scrutiny. SL is having difficulty here, outside of the De-Nigami. Within the contained culture of conjecture, SL faces complex, culturally contingent conundrums, in a mental vacuum. Here, in a warm house nestled in an arctic community, the benefits of that isolation have quickly faded away.

SL ties the bag closed with a knot taught to him by a De-Nigami woman, and once again watches Joannie post pictures and nonchalantly sift through the internet fodder. Joannie begins to tell SL of the ridicule, judgement, and threatening social-media reactions against his practice of hunting natsiq. “They say I am barbaric, heinous, and cruel.” He holds up a picture of what seems to be a white stuffed animal. “They show people this image, yet this is not the natsiq we hunt!” Joannie tells SL of how he and his people have long been living with, revering, and
sustainably hunting these respected creatures. Now, even though they live in an area relatively isolated from most other groups of humans, they suffer the negative impacts of many westernized powers. Joannie’s people are told their way of life is affecting the rest of the world negatively. As the many dimensions of the story are told by Joannie, SL realizes that this was far more complex a problem, than initially thought.

Through a now diminished ethnocentric lens, SL assumed that Joannie and his Inuk community could not understand the complexity of this issue; yet they still had respect for their norms. However, SL will come to find in time, that Joannie and other Inuit (plural of Inuk) recognize the complexity of this problem on a deeper level than the dominant groups (i.e., scientifically literate individuals) that claim to know better. SL, may find itself that being functional for the Inuit, will require competencies similar to those evoked through socioscientific issues. These people of the North, despite differing colonial influences, spread around the arctic, remain bound by a common language and way of life. They interface with the western spheres, just as they have for hundreds of years. However, Inuit voices are still swallowed and made seemingly insignificant by the vastness of the pluralistic atmosphere, brought into relief by the remoteness of the arctic circle.

**Socioscientific Reasoning**

Before further exploring the complexities of the Inuit *scientific* issue, a reminder of the role of socioscientific reasoning (SSR) in the context of harnessing a SSI functional perspective of SL is appropriate. The identified “competencies” of reasoning are associated with the negotiation and resolution of socioscientific issues (Zeidler, Herman & Sadler, 2019).
Table 4 (See page 100), contrasts the components of SSR with selected entries of an endless chain of signs. This is meant to clarify by pushing against components of SSR with varying meanings, from generalized contexts, to both draw and make problematic rhetorical boundaries.

The connectedness of the SSR competencies, aid students in cultivating a means to deal with complex issues, keeping in mind that complexity is both contextual and obviously, subjective. Sadler et al. (2007), claim that advanced SSR practice should include the ability and habit of conceptualizing the inherent complexity of SSI, to avoid simplifying the issues by ignoring broader, contextual significance. SSR must also be examined for the residual biases’ SL carries from their life ex loco, so that complexity is not grounded into a misinformed, or perhaps misguided functionality. Why can the Inuit, from their limited, marginalized position see the complexity of the natsiq problem, while a majority of a multi-national parliament members cannot?

**Inuit vs. the European Union (EU).** The scene in which SL found themselves placed in the above story, was adapted from Alethea Arnaquq-Baril’s (2016) ethnographic film, *Angry Inuk*. The filmmaker, a native Inuit from Iqaluit, Nunavut, opens a window into the world of the Inuit. Through this window we see a clarification of the Inuit modern existence that has been forged in response to hundreds of years of acculturation and colonization. Despite this, the general image of the Inuit, in most western minds (many of which are presumably scientifically literate in some sense) is akin to a museum exhibit (Davis, 2009). This less than complex picture is perpetuated by images drawn from limited information, without regard for information that has been left-out or is seemingly unknown. In other words, not only is the image of the Inuit simple in the minds of many; it is also false, inaccurate and incomplete. This only worsens the ill-effects of the assumption.
### Table 4. Socioscientific Reasoning vs. Generalized Meanings

<table>
<thead>
<tr>
<th>Socioscientific Reasoning</th>
<th>Merriam-Webster, n.d.</th>
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<tbody>
<tr>
<td><strong>Complexity</strong>: the ability to perceive and reason through the complexity inherent to SSI.</td>
<td><em>Complex</em> \kām-kam-ˌpleks \c: a group of <em>obviously</em> related units of which the degree and nature of the relationship is <em>imperfectly known</em> (\text{\textit{complex}})</td>
</tr>
<tr>
<td><strong>Inquiry</strong>: the ability to recognize information that is not available regarding an issue as well as the ability to consider ways in which that information may be generated.</td>
<td><em>Inquiry</em> \in-\textit{'}kwī(ə)-rē (\text{\textit{inquiry}}) 2: a <em>systematic</em> investigation often of a matter of <em>public</em> interest (\text{\textit{inquiry}})</td>
</tr>
<tr>
<td><strong>Perspective-taking</strong>: the ability to analyze an issue and potential solutions from the perspectives of different stakeholders.</td>
<td><em>Perspective</em> \pər-\textit{'}spek-tiv (\text{\textit{perspective}}) 2a: the interrelation in which a subject or its parts are mentally viewed places the <em>issues</em> in <em>proper perspective</em> b: the capacity to view things in their <em>true</em> relations or relative <em>importance</em> (\text{\textit{perspective}})</td>
</tr>
<tr>
<td><strong>Skepticism</strong>: the ability to identify potential sources of bias that may influence information or the presentation of information about an issue or potential solutions.</td>
<td><em>Skepticism</em> 'skēp-tə-,si-zəm\ 2 a: the <em>doctrine</em> that <em>true</em> knowledge or knowledge in a particular area is uncertain b: the method of suspended <em>judgment</em>, systematic doubt, or criticism characteristic of skeptics (\text{\textit{skepticism}})</td>
</tr>
<tr>
<td><strong>Affordances &amp; Limitations of Science</strong>: the ability to determine how scientific knowledge and processes may contribute to the resolution of a SSI and to recognize dimensions of the issue that cannot be addressed by science.</td>
<td><em>Affordance</em> \ə-\textit{'}fər-dən(t)(\text{\textit{affordance}}) 2: the quality or <em>property</em> of an object that defines its possible uses or makes clear how it can or <em>should</em> be used (\text{\textit{affordance}})</td>
</tr>
<tr>
<td></td>
<td><em>Limitation</em> \ˌli-mə-\textit{'}tā-shən\ 2: the quality or state of being limited 3: <em>something that limits</em> (\text{\textit{limitation}})</td>
</tr>
</tbody>
</table>
The Inuit have been members of the global economy for over a hundred years and while they continue “traditional” lifeways, it is also recognizably modern. This can be seen by their assimilation of Facebook and Twitter (#sealfie) into their lives. Inuit hunt natsiq for their meat and various other products they can render, including the skins. For millennia the Inuit have lived in these areas, hunting the natsiq. It was only upon contact with the western world that their reliance on a distant monetary income became a crippling feature of their everyday lives. It became apparent to the Inuit that the natsiq skins were prized by others in the world, so as an acculturated group might, they slowly adapted their economy to be a part of global community. The Inuit were forced to adapt. They began moving into modern homes, in modernized communities, with westernized schools. They became members of our pluralistic societies. Nonetheless, they are still conceptualized in the same mistaken vein as the De-Nigami...isolated, simple, and disconnected.

The Inuit only hunt the natsiq they need. Along with having limited amounts of money, Inuit have restricted access to nutritious, affordable food, thus the natsiq continue to be a main source of their diets. The carefully harvested skins are sold to the dominant governing group and then auctioned off to the rest of the world, on behalf of the Inuit. The relatively small amounts of money gained through this are used to buy fuel to support the continued hunt for nutritious food, not to gain a wealth. Despite this relatively low impact, sustainable hunting of the natsiq (an abundant sea creature), the Inuit continue to be villainized by global reactions to commercial natsiq hunting.

The *Angry Inuk* (Arnaquq-Baril, 2016) is not just a window into the lives of the Inuit; it showcases members of the westernized world, unable or unwilling, to grasp the complexity of the issue. The unfortunate irony is that the people failing to grasp the complexity, are those
people sitting in privileged positions in relation to the Inuit…it may even be us. In 1983, the EU decided to ban the trade of products from a specific natsiq (Fakhri, 2017), which Inuit do not actively hunt. The world market in the trade of the skins plummeted and despite there being an exemption for the Inuit to hunt for their own communities, it was their community impacted most negatively by the ban (economically and psychologically).

In 2009, by an overwhelming majority (550 in favor to 49 against), the EU passed a second, broader ban of the trade and sell of all natsiq products (on trade in seal products Regulation 1007/2009); once again, they provided an exemption for Inuit to hunt for their own communities (Arnaquq-Baril, 2016; Fakhri, 2017). In this case, members of the EU not only fell victim to unchecked propaganda, designed to raise awareness/funds to the level of profit (skippy10, 2008); they failed to conceptualize the nuanced complexities of the issues and even worse, the complexity of the modern, now 21st century Inuit. Sadly, at a very basic level, the EU members seem to think that that the Inuit live a hunter-gatherer subsistence and do not need or rely on money (Arnaquq-Baril, 2016).

The parliament of the EU, constantly embroiled in the grappling and resolving of this SSI, failed to grasp the complexity of this global issue, directly harming an entire population of human beings (Complexity). These decisions not only made evident that EU members failed to grasp, or reason through, the complexity of the issue, but they were also unable to recognize that pertinent information about this issue was not available (i.e., information about the Inuit lifestyle, culture, modernization, effects of colonization etc.). Through their acceptance of inaccurate propaganda, they evidentially did not consider the ways in which that information was being generated (Inquiry). Moreover, it was obvious by their acceptance of inaccurate information (e.g., the use of natsiq pictures that had not been hunted by anyone since the 1983 ban, and
certainly not by the Inuit) they were unable or unwilling to identify potential sources of bias, that may influence the presentation of information or potential solutions (Skepticism).

Perhaps the EU members have a narrow view of how scientific knowledge and its processes contribute to the resolution of a SSI, and their view of science is similar to their view of the Inuit. This can be interpreted as serving a scientific agenda, in a way that makes the human beings effected seem secondary (Affordance and Limitations). These perceptions can be mitigated by belief systems, emotional attachments, and can be adjusted to suit certain desired outcomes. The EU framed the natsiq hunt as a “moral issue,” as such they contextualized their practice of SSR within their own ethnocentric bubble, shrouded in a façade of globalism and righteousness. As a result, in the EU and perhaps the world, the natsiq became more important than our fellow human beings (i.e., the Inuit).

We can also consider the most important aspect of SSR (Zeidler, Herman & Sadler, 2019), perspective taking. In Angry Inuk, one member of the EU tries to inform a protesting Inuit that “…you do know that there is an exception for Inuit personal hunting” (Arnaquq-Baril, 2016)? The EU members not only demonstrate their weaknesses with other competencies of SSR, but they also express that taking on a perspective, is as complex as the issue itself. Kahn and Zeidler (2019, p. 263) have suggest that perspective taking is “one’s ability to recognize and consider the diverse cognitive and emotional viewpoints of others within SSI.” In this case, it seems that the EU members are letting their perspective taking, inquiry, and skepticism be clouded by the emotional viewpoints contrived and exploited by activists.

By thinking of the Inuit as an enclave (i.e., a disconnected community frozen in time), the EU parliament members are unable to recognize the cognitive diversity of the Inuit, as well as their emotional viewpoints. The EU members are using the culture concept, knowingly or
unknowingly, as a dehumanizing lens, which removes consideration of the Inuit as a group of individuals and falsely makes the issue less complex. Before exploring further SSR, in the next section I continue to connect and problematize the culture concept.

**Deconstructive Reading of the Culture Concept.** As we look out at the faces that populate our classroom, no matter where or who they may be; what do we see? I suggest we often see a daunting barrage of differences bouncing-about a fluctuating context and this prompts us to seek explanation and meaning. I would like to think that the first inclination of a teacher is to search for commonalities they share with their students, and help students discover similarities they share with each other, on deeper, less obvious levels. Perhaps, this is what we think we do; but do concepts such as culture really aid us in this sense-making? While we think this concept provides explanation, it may also be shielding our view from that barrage of differences with skewed generalizations, built of unchecked biases, which obscure important commonalities.

Think of a group of teachers working in a low-income community and a majority of their students are from Cuba. While many teachers may build strong rapportts with their students, they may also still make sense of the students’ behaviors based on a shell of generalized knowledge labeled “Cubans.” This verges on merging stereotypes with the culture concept, which creates a method to make meaning, but it is based upon a static rending and understanding. Imagine a classic description of a semi-nomadic tribe living in the Kalahari Desert. There is a lengthy description of their communal ways of working, knowing, and general negotiation of everyday living. The narrator highlights shared and learned means of material productions, perhaps the occasional translated word appears on the page. The description includes pictures of matching clothing, dancing, and ways of behaving. It may be a wonderful story, one that provokes a strange nostalgia, or longing for the exotic or the other. One caption hangs as the deconstructive
predicament of culture, “And she sits looking over her land, a !Kung elder woman, mother, grandmother, bearer of her people’s history, a true representation of the San.”

As we look at her picture through a lens painted with the commonalities that were presented in such an artistic and supposedly accurate manner; do we really see her? Do we consider her unique experiences as a human being or do we assume she has had the same experiences as the rest of her kin? Intuitively, we may know that she is an individual and with more in-depth scrutiny, we can imagine that she has her own story and along with it, her own way of interpreting that story. It has been suggested that all cultures reflect the differing choices that have been made over time, making it clear that there is no universal progression in the lives and destiny of human beings (Davis, 2009). Consider Angrosino’s (2004) thoughts,

Culture is not destiny… because individuals vary in their capacities to learn, not all people who live in a given community know exactly the same things…There is thus a fair amount of variation within the community, even if by convention we say that the members of the community share a common culture. (p. 5)

Culture, ironically, provides us with a way of analyzing the ostensible commonalities shared within and between groups of human beings, thereby providing a humanistic perspective. On the other hand, the culture concept may serve to mask the common human quality of having unique experiences, which no matter how similar, shape us all in different ways. In this sense we use culture as dehumanizing. Despite all of its rhetorical iteration, culture can be conceptualized as a unit of analysis, by which social scientists, divide, organize, inventory, compare, and implicitly or explicitly, judge groups of people.

This predicament is made evident by the EU issue, whereby the parliament members see the Inuit as a monolithic, anachronistic, culture as their unit of analysis. Unfortunately, the many
members of the EU parliament demonstrate the formulation of an inference based on limited, sparse, and tainted information. The EU human beings are having a difficult time with the lynchpin of SSR; they are not able to make a mental *etic to emic shift* required for socioscientific perspective taking (Kahn & Zeidler, 2019).

**emic** \ˈē-mik\ and **etic** \ˈe-tik\ a distinction between formulating an understanding of cultural representations from the point of view of a native of the culture (emic), and formulating and understanding of cultural representations from the point of view of an outside observer of the culture (etic). (Barfield, 2000)

Marvin Harris (1976) reminded us that Pike’s stated purpose of coining emic and etic (from phonemic and phonetic), was to devise a single research project toward language and behavior in alignment with structural linguistics. Within the context of SSI, this shift has been conceptualized as a more manageable, yet difficult, mental shifting of the mind from an “outsider” to an imagined “insider” perspective based on the practice of empathy, intuition, and role taking, which is buttressed by reflective and reflexive judgement within a specific moral context (Kahn & Zeidler, 2019). This seems like an interesting analogical transposition, particularly in consideration that culture, in any iteration, is not a thing and is difficult to observe in action, no matter our feigned positionality.

When considering whether or not the EU parliament members were practicing SSPT while voting for the ban of natsiq products, it would be difficult to go beyond conjecture, considering there are several members, all with their own reasons and frames of reference. Nevertheless, if we consider the majority (550) that voted for the 2009 seal ban, as a representation of a common aspect of them all, perhaps we can imagine them as embodied by a singular human; similar to the treatment given SL, and the same treatment the EU afforded the
Inuit. The EU as a human, would also be far too flattering, what would be more difficult than having to be a parliament member? Let’s imagine EU the human, named Es-el (pronouns: them, they and their) as a new student, joining Dr. T’s grade five science class, in the middle of the year. Lucky for Es-el, they’ve arrived on a very exciting day! Today Dr. T’s class is starting a new SSI module; Es-el immediately has a sense of déjà vu.

The Harp Seal Hunt: A Global Socioscientific Issue

It is oh so difficult to be a new student in school, particularly when you join in the middle of the school year. The student is subject to any move their family makes (e.g., a corporate job, the military, family instability, etc.). Many of my students were children of migrant field workers and it was common for students to join our class for a few weeks…until the day they simply stopped coming to school. As a teacher I hoped for the best, as a human teacher my positivity was shrouded in worry. When a new student arrives, you help as much as you can, but you hope they are able to join-in, find friends, be happy, and start feeling like a member of the class.

Es-el walked into an active classroom, the students were not seated in desks as Es-el is accustomed, but were grouped together in different areas of the room. The first thing that caught Es-el’s attention was one student pacing around her group with a paper in her hand. Even though what she was saying was faint from Es-el’s perspective, it was obvious from the gesticulation, the student was emotional. “Welcome Es-el! We have been expecting you!” Dr. T had been anticipating the arrival of a new student. After reviewing some basic classroom procedures and helping Es-el get settled, he excitedly started telling Es-el about the socioscientific issue that the class was discussing.

Dr. T told Es-el that the students have been asked to work through the “issue,” of whether or not the hunting of harp seals should be reinstated in Canada. Now looking around the room
with Es-el, Dr. T explains that the students are all in different groups representing different stakeholders, or people that can be affected in the decision. Dr. T explained, directing attention to the groups, “One group represents the People for the Ethical Treatment of Animals (PETA), another represents Canadian government officials, the third group represents commercial fisheries, and the last group over there… well they represent the Inuit.” Es-el’s eyebrows flexed up. This was the group with the emotional student *they* originally noticed when entering the room. *They* had also heard *their* parents discussing “Inuit,” on more than one occasion.

Dr. T, then told Es-el that students had been reading pro and con articles about the harp seal hunt. He then handed *them* an informational paper with a brief description of the topic and each group’s perspective (See Figure 2, p. 109). “This is the basic information that all students received. Take a moment to look it over and then when you’re ready, join the group you want to represent.” Dr. T doesn’t generally assign students to various groups. He likes to learn about the perspectives of his students and in this case wanted to learn more about Es-el.

Es-el, still feeling a bit timid and displaced, was intrigued by the rambunctious discussion that continued to be fueled by the pacing student at the Inuit table. *They* approached the table cautiously. As the new student neared, the group representing the Inuit position immediately halted their discussion as if it were planned. “Hi, I’m Es-el,” *they* said nervously. “Can I join this group?” After a pause and a few looks of silent communication, the pacing student said, “Sure!” Es-el awkwardly moved toward a chair on the opposite side of the table, acknowledging each member with a closed smile and a quick look down; the group went right back to their discussion.
“They have been doing it for years…they should be able to take care of themselves and their families!” For the most part, Es-el had to take on the role of observer, since the group had only a few minutes left to prepare their recommendations from the Inuit point of view.

<table>
<thead>
<tr>
<th>The Canadian Harp Seal Hunt Information Sheet</th>
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**The Issue:** In Eastern Canada, newborn harp seals can no longer be killed for their pelts, although they typically lose their white coats and their protected status before they are two weeks old.

**People for the Ethical Treatment of Animals (PETA):** Animal rights groups view the seal hunt as pure barbarism. Some conservation groups fear that at current harvesting levels, the harp seal will become endangered.

**Canadian Fishers:** Some Canadian fishers view the harp seal as a competitor. Adult harp seals consume over 3 kg (7 pounds) of fish every day or 1.13 metric tons of fish each year.

**Canadian Government Officials:** The seal pup hunt also provides economic relief from the region’s decline in employment during winter months. In many cases, it makes up a third of a fisherman’s yearly income.

**The Inuit:** For centuries, the indigenous Inuit peoples have depended on seal blubber, meat, and fur for fuel, food, and clothing. Many also make a living through the trade of seal products.

*Figure 2.* The Canadian Harp Seal Hunt Information Sheet. Note. Figure created with information from “Using Socioscientific Issues in Primary Classrooms” by T.J. Dolan, B.H. Nichols, & D.L. Zeidler, 2009, *In Journal of Elementary Science Education, Volume 21, No. 3.*

All the groups had a few minutes to share their recommendations, and by that time many of them became emotionally tied to the groups they represented (Dolan, Nichols & Zeidler, 2009). As Es-el listened to the students explain their group’s perspective, they thought it was
interesting how some students would relate to the connections between the harp seals and the other animals that live in the area, how the fisherman were going to lose money if there were too many seals, and how sealing is a way of life for indigenous people (Dolan, Nichols & Zeidler, 2009). Admittedly, even in a short amount of time, Es-el had become invested in the lives of the Inuit; a commitment partly due to the passionate pleas of his new group members.

Dr. T, not wanting to put them on the spot, kindly asked, “I know you haven’t been here long Es-el, but would you like to add something?” The resulting quietness, weighed on Es-el, as if they could suddenly feel the weight of the surrounding air pressing down upon their shoulders. All of the students looked on with anticipation. Es-el, deciding not to stand, almost whispering added “I think the Inuit should be able to hunt, because that’s how they get food, and that’s how their families live.” Another student kindly asks, “What makes you think that?” One of Es-el’s new allies handed him the article they had been provided and Es-el explains how this is their source. Another student queries, “Do you think that everyone should be able hunt the harp seal then?” Es-el, feeling the heat on their neck timidly responds, “No… no… I don’t think it’s good to kill the harp seal, but the Inuit need to do it to live.”

The whole group, perhaps empathetically sensing Es-el’s uneasiness, moved the discussion on, however, the focus remained on the Inuit. Es-el was reminded again of their parents’ dinner table discussions. The debate continued and Es-el, sitting quietly, felt like they were going through an entire gambit of emotions, as students made their thinking on the Harp Seal hunt visible. By the end of the discussion, Dr. T listed the major aspects that the students all agreed upon.
The students agreed “… to allow limited hunting of the harp seal for the purpose of sustaining both the fishing and indigenous communities,” and also decided to “…allow PETA to monitor the number of seals hunted and the government to regulate the hunting methods of seals and establish humane trapping standards” (Dolan, Nichols & Zeidler, 2009, p. 8).

Es-el felt invigorated and excited at the prospect of being in Dr. T’s class for the next few months. They kept imagining the possible issues the class would be thinking about and the different populations they could think about helping next? Later in the evening, Es-el, sitting at the dinner table with their parents, was excited by the mention of the Inuit. “Hey, I know about the Inuit…we talked about them in class today.” Both parents smiled and listened to Es-el recount the day’s events. Describing the students with detail and emotion, they proudly stated that the class was able to come to a rational agreement together on what should and should not be allowed. “We even used evidence,” Es-el exclaimed!

Both parents were happy to hear this; one even excitedly stated during the story, “See that’s why we have to make sure we include an exemption for the Inuit…even fifth graders know it’s the right thing to do!” To which Es-el added, “Yes, we have to help the native people of Canada!” The other parent adding, “Yes and the native peoples of Greenland, Russia, and Alaska!” Es-el smiled, as anyone would after being praised and feeling accepted. With a motion of the fork, Es-el kept eating, feeling connected, but haunted by an unusual thought for a fifth grader. After hearing that last comment and thinking back to class, Es-el thought, “This issue is much more complex than I thought.”

**Returning Home.** Many months later, Es-el’s family returned home, as it was time for the vote; the banning of natsiq products for trade in the European Union. Walking along with their parents, they are all stopped by a man that seems familiar, but not. Joshua, head of the Inuit
hunter’s association, was there to plead the case of the Inuit on the world stage. He was hoping to sway a last-minute decision that could further oppress his family and communities. Joshua is with Aaju, an Inuit woman (fashion designer, activist, and lawyer), and they get the attention of Es-el’s parents. The two Inuit explain that the ban will have an indelible, negative impact on the global community of Inuit. One of Es-el’s parents smiles while listening, although it seemed less like listening and more like holding in what they wanted to say next, “Well don’t worry,” pausing to look proudly at Es-el, “there is an exemption for Inuit in the ban, that will allow them to continue their sustainable hunting of the natsiq.”

Joshua and Aaju try to explain that it will not help, as they are a part of the global trading market. Both parents, simply nod as if to say, “oh ok,” and moved along taking Es-el with them. Looking back, Es-el could see the same passion exemplified by the Inuit representatives that they saw when entering Dr. T’s class for the first time. Es-el wondered why the Inuit were so upset… “what are they missing?” Their parents walked in and voted for the ban of natsiq products in the European Union; they had reached a resolution of the global socioscientific seal/natsiq hunting issue.

The Reflexive Turning of Socioscientific Reasoning

What are the major distinctions of the reflexive activities connected to the SSI framework (RQ2)? In general, reflexivity that is associated with SSI can be lumped into two basic categories; reflexive thinking and reflexive judgment. Within SSPT, and therefore within SSR is where reflexive judgment has been positioned. It should be noted, there was no claim that the students in the story above, nor EU parliament members were practicing SSPT. Nonetheless, I choose to frame this experience with SSPT, because it is possible to conceptualize the students and parliament members as thinking they are practicing at least basic perspective taking. It is
difficult for the practice/habit of reflexive judgment to be visible to others. Still, it can be implied that this practice/habit is occurring on some level within a moral context; this is one of the deconstructive components of reflexive judgment that can also serve to obscure influences of power and control.

This is not a critique of SSPT, as I too believe this as the most important component to both SSPT and SSR, and as I explain below, the cultivation of a more general intentional reflexive position. Instead, consider the possibility that all competencies of SSR can work in concert and still fail to help individuals grasp important aspects of complexity. In turn, this affects the entire outcome of decision-making through SSR. Thinking back to Dr. T’s class, it seemed that the students were practicing, intuitive, emotive, and rationalistic reasoning (Dolan, Nichols & Zeidler, 2009). However, the mode by which the moral context was developed is hidden from view; a problem that may be hampering the EU parliament members as well. Let us consider Es-el’s relatively brief experience with the harp seal issue, using an envisioned school assessment instrument (i.e., parent/teacher conference form) for SSPT (See Figure 3, page 114).

Despite the contrived nature of the teacher notes, it is possible to imagine a student that expresses aspects of SSPT, yet still does not possess the ability to grasp the complexity of the issue on differing levels. In addition, their modes of inquiry and even their grounds for skepticism can go uninspected and be taken for granted. Since the processes of SSPT are connected with, not solely dependent on, the other competencies of SSR, perhaps it is a matter of extending the reflexive spirit of socioscientific perspective taking to the rest of SSR.

As can be seen in the re-rendering of a graphic representation of SSPT in relation to SSR (See Figure 4, page 115), the moral context is constituted by reflective and reflexive judgment and are supporting elements of the practice of SSR (Kahn & Zeidler, 2019).
SSPT PARENT / TEACHER CONFERENCE FORM

Teacher/Staff Name: Dr. T  Date Requested: 09/25/2020  Student: Es-el Nezitic  Student No: 8675309

School: Springfield Elementary  Grade Level: 5th Grade  Initial Date of Conference: 10/31/2020

Principal: Dr. Sami Khan  Assistant Principal: Dr. Dana Zeidler

Parent/Guardian: Mr. & Mrs. Nezitic  Language: Foul  Notified by: ☐ Phone  ☐ Mail  ☐ Email  ☐ Other

Present for Conference: Mr. & Mrs. Nezitic, Dr. T

Parent Signature: __________________________  Teacher Signature: __________________________

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Teacher Assessment Notes</th>
<th>Current Level of Performance</th>
</tr>
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<tbody>
<tr>
<td>☐ Engagement: Does the student</td>
<td>Es-el, seemed to have an immediate connection with the Inuit; even though they stated</td>
<td>Developing</td>
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<td>demonstrate engagement with the</td>
<td>that they didn’t think it was right to kill a seal, that the Inuit should be allowed to</td>
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<tr>
<td>issue and its stakeholders?</td>
<td>so they can take care of their family. They demonstrated intuition, with a strong</td>
<td></td>
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<tr>
<td>If so, what psychological domain</td>
<td>emotional connection.</td>
<td></td>
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<tr>
<td>is invoked?</td>
<td>In the group, Es-el continued to see the seal hunt as an everyday part of the Inuit way</td>
<td></td>
</tr>
<tr>
<td>☐ Etic/Emic Shift: Does the</td>
<td>of life. They mentioned seeing hunting from “their shoes.”</td>
<td></td>
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<tr>
<td>student express an etic/emic shift</td>
<td></td>
<td></td>
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<tr>
<td>from their viewpoint to others?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐ Reflective Judgment: Does the</td>
<td>Es-el seemed to be keenly aware of the impact a ban, or potential lifting of the ban,</td>
<td>Developing</td>
</tr>
<tr>
<td>student recognize potential</td>
<td>would have on the Inuit. Through consensus, they demonstrated an awareness of the</td>
<td></td>
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<tr>
<td>impacts of their decisions on</td>
<td>impact their decision could have on other groups.</td>
<td></td>
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<td>others?</td>
<td></td>
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<tr>
<td>☐ Reflective Judgment: Does the</td>
<td>Es-el, seemed very emotional during the final part of class,</td>
<td>Developing</td>
</tr>
<tr>
<td>student demonstrate a desire to</td>
<td>they were quiet, but noticeably responded during the finalizing of the decision about</td>
<td></td>
</tr>
<tr>
<td>“do what’s right?”</td>
<td>the Inuit. Which is right?</td>
<td></td>
</tr>
<tr>
<td>☐ Other: (e.g., organization,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>attendance, etc.)</td>
<td></td>
<td></td>
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</tbody>
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Figure 3. SSPT Parent/Teacher Conference Form. Note. “Objectives” in Figure 3 taken from “A Conceptual Analysis of Perspective Taking in Support of Socioscientific Reasoning” by S. Kahn, 2015, (Doctoral Dissertation). Information reprinted and modified with permission from S. Kahn.
Moral Context

The EU parliament members, much like our student Es-el, can be conceptualized as practicing SSR, which is hinged on a deconstructive, hegemonic platform. From afar, the members can be imagined as practicing a form of inquiry that they view as complete and verifiable. As members of a multi-nation parliament, they may view themselves as capable of negotiating a complex issue. It is conceivable, that at least some form of perspective taking is convincing them, they are viewing the manner from multiple-perspectives.
They may also utilize information from multiple-domains (including science) in reaction to specific interests, presuppositions, and limitations of the knowledge in relation to their purposes.

We could possibly consider the exemptions for the Inuit, although the “traditional” type, evidence that the EU members can conceive the impact of their decision-making, on groups of people living in remote locations. It may also be evident that they think providing the exemption, is the right thing to do. Still, their actions will continue to negatively impact the Inuit and, in some ways, the exemption in the ban is an exemption from further consideration; be it of the issue or the way in which it was resolved. The EU members, as a feature of their role, are engaged with issues and conceivably the resulting stakeholders. In relation to SSPT, the EU members are perhaps only capable of an “artifactual” (based-upon stereo-types or outdated sources of information) etic to emic shift and their decision-making continues to be from an ethnocentric perspective, which can be seen in their reply to Inuit legal action.

The Inuit, suffering greatly from the natsiq ban, sought justice by bringing lawsuits against the EU, asking for the ban to be overturned. As one might expect, the EU courts denied the lawsuits and perhaps provided a peek into the problem, by declaring that their decision was in the best interest of the Inuit. Even SL, having been with Joannie and his family for quite some time (hunting, living, learning, and being a part of the community), was caught off guard by this response. SL, now of the Inuit, wondered how the EU could not see the Inuit as they see themselves. I believe here is where the aspects of SSPT, the most well conceptualized components of SSR, are directing us toward a more intentional reflexive and reflective approach.
This is not to say, reflective judgment and reflexive judgment should be extended solely, since both reflective and reflexive are overshadowed and leveraged by judgment. Instead, both reflection and reflexivity should be balanced and extended as mental contexts to which SSR is connected.

**Reflexive Judgment.** Judgment, in and of itself, is a tricky construct. Within this term, perhaps not so hidden, are some of the most widely used and defined diametric oppositions that human beings wield in for differing purposes; good/bad and right/wrong. When considering these oppositions, some may take comfort in the supposition that groups of us on the planet can agree that there are at least some universals; however, not even “killing” is distinctly decided within shifting contexts (such as mercy and war). Nonetheless, the formulations of judgments can be prone to many imbalances in perspective(s), thinking, and power. The individual who actually makes the judgment is suspect and the influences on their decisions can be both invisible and insidious.

*Judgment* \ˈjä-jə-mənt\ 1a: the process of forming an opinion or evaluation by discerning and comparing 3a: a formal utterance of an authoritative opinion 6: a proposition stating something believed or asserted (Merriam-Webster, n.d.).

*reflexive* | \ri-ˈflek-siv\ 1a: directed or turned back on itself. 4: characterized by habitual and unthinking behavior (Merriam-Webster, n.d.)

It has been stated that Green’s concept called reflexive judgment was used to better explain, or perhaps modernize, the notion of conscience. In this sense, on one level, this is not reflexive judgment; in that this is not the judgment of Judgment (or judgment turned back on itself). Rather, it is judgment directed back toward the judge. To further distinguish, reflexive judgement, in this sense, is not specifically, although it could be included, a judgment of the
judge’s judging. Nor is this turning judgment on the actual process that influenced the formulation of the judgment. This is an interesting distinction (switch), if applied to reflexive thinking. For example: would thinking about thinking equate to thinking about the thinker?

Green’s voices of conscience (craft, membership, sacrifice, memory, and imagination) are well distinguished, broad reaching and they do pass numerous rulings. Conscience as the practice of reflexive judgment exposes a deconstructive paradox. The recognition that conscience can be extended “far beyond the boundaries of morality” (Green, 1999, p. 22), while allowing the moral and ethical to be extended unnoticed and unimpeded into everyday self-appraisal. This in turn, extends the power of the external influences on conscience as well. Most of those voices go unvetted, under scrutinized, overly influenced and perhaps, given too much power.

Consider the basis of the internal voices, or the reflexive judgments of oneself, is based on normation:

**normation** /ˈnôrəmôSH(ə)n/ is the structuring of the emotions of self-assessment—shame, guilt, embarrassment, pride and the like—both in our self-assessment and in our judgment of others. (Green, 1999, p. 41)

These voices are based upon conditioned ways of interpreting, responding to, and exhibiting the brain-body interactions/perturbations/reflexes, we call emotions. In this case, we are focused on those emotions that can be defined as reflexive, perhaps those that are best at (in)forming behavior (Green, 1999; Taylor 1985). Embarrassment, pride, shame, and guilt, combinations of base emotions, are states to which most human beings have traveled. These responses, along with others, are the players of reflexive judgement and in turn mitigate/evaluate certain behaviors, by building emotions around personal interpretations of social norms.
Awareness of the influencing external factors and the role one’s sociocultural rootedness has on this formulation, is not necessarily an aspect of reflexive judgment. In other words, a person may be aware of an external stimulus for feeling guilty, but not necessarily how that response of “guilt” was chosen/assigned to certain thoughts, actions, and/or reflections. Normation is also graduated on a scale of weak to strong, generally based upon associations rooted within and between “family, community and “society” (Green, 1999, p. 50; Tönnies & Harris, 2001). In either case, normation can be utilized to hide power, push agendas, to shape and hide another’s ability to shape, in order to promote desired behaviors, habits of mind, or general dispositions.

_Gesellschaft (Society)._ Consider the, Report Card that students receive in school. There are forms of this societal maintenance machinery, world-wide and they can seem like helpful representations of information. The grades are meant to inform students of their progress with “data,” yet those data are coded in simplified and to students often, nebulous ways. A “grade” is also a stimulus for emotion, through which acculturation or enculturation (depending on your perspective) is used to enforce and deter certain behaviors in children; directing the structure of their emotions in relation to societal, cultural, and/or other unseen hegemonic forces. These reflexive emotions can be used against human beings in many differing ways that can result in coercion. Carlo may understand why he feels shame for receiving a grade of “C,” on a project he diligently worked on for days. However, conscience as the practice of reflexive judgment, has no voice that either questions the appropriateness of shame, nor the deeper reason for it. Therefore, Carlo is destined to judge himself solely by the measures of others, as opposed to having some say in the parameters and criteria of his own self-judgment.
Gemeinschaft (Community). Ty’reen regularly demonstrated her leadership qualities while working with groups. I was often impressed by her abilities to see problems in different ways. I can remember a time Ty’reen said she felt embarrassed when I commended her for figuring out the problem her group was confronting. When I asked her why, she said she didn’t know. It could be that she was embarrassed as many humans would be. Of course, she often communicated, with me and others without reporting that she felt embarrassed. Later, when I asked her again, she acted shy and embarrassed saying, “I don’t know…it’s just not my thing.” Perhaps Ty’Reen was embarrassed because she didn’t want attention brought to her that day, in that moment. However, I can imagine, that she may have been practicing reflexive judgment as some voice of conscience, and it is possible that that voice was limiting her expressions and interactions. Still, why she felt embarrassed during this case may remain unknown or unspoken, to her and others; this is the deconstructive predicament of normation; or normation is the deconstructive predicament of reflexive judgment.

Reflective Judgement. Without cognitive support, reflexive judgment could be framed as a mechanism of oppression or control, of which education is intimately acquainted. Hidden within this realm of the moral is perhaps, if framed as such, a hidden moral question about awareness. In the framework of cultural, societal, or even personal norms, of which moral codes are derived, awareness can be both a contradiction and revolutionary. A reflective approach connected with reason, can also be replete with ulterior motives. These motives can be both unnoticed and unknowingly agreed upon, without intentional scrutiny.

Kant’s distinction of judgment is of interest as rhetorical anchors and historical influences, which are still attached to buried epistemic strata: determinative and reflective judgment. In essence, determinative judgement is generated from universals or generalities
toward particulars, while \textit{reflective judgment} requires the search for universals/generalities in which to frame particulars. Of course, this can be connected with the aesthetic, as well as ethics. However, in either case, these judgments are biased by being predicated upon privileged models of reasoning and interpreting (Zhenhua, 2004). This is not specifically the type of reflective judgment associated with SSI, but it extends the same influences and tacit power to that model of reflective judgment.

In constructing the moral context, reflexive judgement operates with reflective judgement. In this case reflective judgement is a progression/stage model of reflective reasoning, framed as an aspect of critical thinking; these stages are characterized by the recognition of how knowledge assumptions can affect judgement, and ultimately ends with \textit{reflective thinking} (King & Kitchener, 2004). This can prompt doubt, or the possible inspection of the shaping and \textit{nature} of knowledge. Nonetheless, this does not necessarily prompt the uncovering of hidden sources of power/influences accompanying knowledge, and favored methods of construction/verification. Reflective reasoners accept that they may not have all of the information, but use “reason” as best they can, in order to build explanations that guide decisions.

Reflective reasoners are open to reconsidering judgments based on the construction/revealing of new information or new ways to reframe reason (King & Kitchener, 2004). An openness and acceptance such as this, or even accepting the ambiguity of information, may deter one from considering the information that is missing or better inform their judgment. This could, in some ways, acts against socioscientific inquiry, an aspect of SSR, wherein one generally seeks to also recognize that which is not there.
The mode by which the reflective reasoner (reflective thinkers according to King and Kitchener), organizes, interprets, and connects, requires creativity, open-mindedness, skepticism, which is based on specific parameters of evidence, and other attitudes of mind often claimed as scientific. Of course, this makes sense, considering John Dewey (1997) played a role in the development of reflective judgement and attitudes of mind. Still, any conflation of the terms thinking and reason is an indication of the deconstructive predicament, as well as the colonizing reach, of this westernized form of thinking called reason.

thinking \ˈthin-kiŋ\ 1: the action of using your mind to produce ideas, decisions, memories, etc. : the activity of thinking about something (Merriam-Webster, n.d.).

reason \ˈrē-zən\ 2 a (1): the power of comprehending, inferring, or thinking especially in orderly rational ways. (2): proper exercise of the mind (3): SANITY (Merriam-Webster, n.d.).

We can imagine, that thinking encompasses a broad range of dimensions, while reason is tethered to, and in a formal sense, guided by logic.

logic \ˈlä-jik\ 1a(1): a science that deals with the principles and criteria of validity of inference and demonstration: the science of the formal principles of reasoning (Merriam-Webster, n.d.).

Reason, like a parasite or a male Angler fish, has slowly worked its way into common parlance to mean something roughly akin to thinking (i.e., good thinking). It is even to the point where reason has been aligned with developmental stages of learners/thinkers. Certainly, we can talk about poor reasoning, ill-informed reasoning, or faulty logic, but these are mechanisms by which reason maintains shape. Nascent to finely honed, reason has been superimposed back to its human roots to seem “natural.” Ultimately, it will be measured through the stock lens of logic,
from the domain of the rational, and carries with it that authority to limit or direct thinking (i.e., to accept or exclude knowledge). This is not to say that reason and logic are not useful human tools. However, they are not generally questioned and can be utilized to confuse, corrupt, con, or convince human beings to act, just not always in a positive sense.

Similar to the man-o-war scenario, if a group is in control of “reason,” then they have the ability to shape reason as they see fit, to meet their specific goals and interests. In order to create a heritage or a system by which information can be disseminated and passed from generation to generation, the group can construct a compulsory, enculturation system. This control is immeasurable and can lead to the development and applying of labels, diagnoses/prognoses, and systemic operations in order to guide individuals toward specific ways of thinking. Foucault (1994) archeologically excavated the epistemic strata of historical eras, in order to bring light to the contextuality of “knowledge,” and how the meaning of knowledge changes. It is not simply that knowledge is power; the verification, falsification, validation, and influence of knowledge is power to control.

Reflexive judgment, as the voices of conscience, acquired through the process of normation, and reflective judgment, as the practice of reasoning, in relation to presuppositions, are useful for the development of a moral context for perspective taking. I suggest the reflexive and reflective components to be expanded and applied to other aspects or SSR. However, this would not necessarily mean an expansion of judgement, per se. Reflexive judgment, without attention brought to the sociocultural rootedness (Green, 1985; 1999) of the reflexive as well as the judgment, creates a tool of repression. Green (1999, p. 11) wrote that culture is both the “presupposition and consequences, cause and result of repression.” The difference between the voices of conscience as liberators and voices of conscience as oppressors, is only a whisper.
Framing a SSI

Es-el, was reflecting back on their experiences in Dr. T’s class. They were thinking over everything said, or that which they remembered. For obvious reasons, Es-el could not stop thinking about the Inuit. Es-el decided to dig a bit deeper. They began to learn that the Inuit, while now a part of the global market, had suffered the negative effects caused by judicial and executive decisions and the colonizing westernized systems of economy and education. Suicide, once rare amongst the Inuit, is now at one of the highest frequencies of any human population. The original 1983 ban on seal hunting forced most of the Inuit to move from their normal territories into towns that are organized and overseen by the ruling government; “seven in ten Inuit children go to school hungry. Inuit communities have the highest poverty, unemployment rates and cost of living in North America” (Arnaquq-Baril, 2016).

Es-el, thought about bullies in school leveraging power, thought about how terrible it is that this was happening to the Inuit. Then, Es-el had a thought that made their heart sink and the reflexive emotions of embarrassment struck them. But why? Es-el remembered saying in class that they thought seal hunting was bad, and they still couldn’t shake the images of the seals being hunted, nor the feeling that killing seals is a “bad” thing to do. At first, Es-el was upset because they felt as though, they should be able to better see from the eyes of an Inuk, so to see that Inuit revere the natsiq, and do not view the hunting of natsiq as right or wrong; good or bad. Then a much more sinister question occurred to Es-el…why was natsiq hunting framed as a moral question in the first place? Certainly, the consideration of lifting the ban on seal hunting possesses moral aspects that deserve inspection; still, it occurred to Es-el, “If the Inuit do not think of natsiq hunting in a moral sense, why is seal hunting framed as moral and whose morals is doing the framing?”
We, just as Es-el, could question the motive toward centralizing the act of seal hunting as the focal, moral/ethical question within a SSI. Why is the focal question not directed toward how and why the physical and psychological health of an entire population of people is declining/suffering? From this perspective, the issue could be connected to the socio, the scientific, and with many of the same facets the students connect with when focusing on the natsiq. Moreover, the isolated, yet privileged issue of commercially mass-hunting seals could be addressed in a less centralized position. Es-el continued to reflect on their experiences in and out of the classroom. Holding up memories like imprecise pictures for inspection, which continued to evoke emotions. Es-el thought about everything they had learned. All of the discussions with their classmates. They thought about the other stakeholders in the issue, but again and again, their thoughts drifted away from humans and back to the killing of seals…with unassigned, confusing guilt.

**Reflexive Thinking.** Reflexive thinking (i.e., thinking turned back upon itself), is sometimes framed as thinking about thinking, just as metacognition is sometimes framed as thinking about thinking. Of course, “meta” also suggests going beyond thinking. However, this term is always constrained by one’s personal knowledge and it is sensible to question how anything at all can go beyond thinking. Metacognition is also presented as: knowing how you know, what you know in relation to content, and/or what you know about your own thinking.

**metacognition** /medəˌkäɡˈniSH(ə)n/ a person’s knowledge concerning their own cognitive processes or anything related to them (Flavell, 1976).

It can be viewed as a way for humans to keep track of their own learning and thinking. In some ways, this is turning thinking against thinking. However, this “turning…against” is a self-monitoring, control system of enculturation/acculturation. It is based upon measures that have
not been devised directly by the individual. A deconstructive aspect of western education in general, is a reduction of complexity accomplished through grouping students of similar age, ability, or achievement levels together; thus, exposing them to the identical content through the use of performed curricula and introducing systems of assessment and examination (Biesta, 2010). Metacognition, particularly in the backdrop of western education, can simply appear to provide ownership of learning to students; however, if the system of self-assessment is constructed in reaction to dominant systems, then metacognition becomes another mechanism to control behavior.

Green (1971), likened the coupling of reflexive thinking with reflection as the activity that is philosophy. In this case, it is western, analytical philosophy, with the activity of distinguishing in mind. This can be seen to have the same cyclical problems as does metacognition, when it comes to lacking a critical inspection and identifying hidden hegemonic influences. Though, in this case, reflexive thinking, does seem to focus more on “reason,” as opposed to “thinking” as a broader category of mental activity. Reflexive thinking in this manner, is reflexive reasoning, reasoning about reasoning, or tuning reasoning upon itself. Metacognition can include both thought and emotion, with more attention to monitoring through reflecting. This does not make, reflexive thinking and metacognition, the same; the point is that all of these iterations are influenced by the same unchecked currents of control.

Reflexivity. The deconstructive predicament of reflexive judgment (i.e., the redirection, shifting, and blurring of objects), can inform a more intentional reflexive path. If reflexive judgement, as the voices of conscience, can be cast as judgment turned back upon the judge; then reflexive thinking, often conceived as turning thinking back on itself, could be reconceptualized as, turning thinking back upon the thinker. This is not to promote an ego/ethnocentric datum
point, but instead clear up a distinction, which causes noticeable problems in the social (Latour, 2005); thinking and thinker. In some ways it seems reasonable to examine thinking as something other than the thinker, even if the thinker is performing the act. This distinction creates the illusion of division, which on the practical level, dilutes and distances responsibility, obligation, and connection. These illusions may have a hand in the characteristics of *SL ex loco*. It may also serve to make abstract, the empirical experiences that have shaped the thinker and their thinking, further obscuring and hiding them from scrutiny.

For example, in relation to “entering” the moral context through an etic/emic switch, I suggest a sort of relativistic positioning through introspection. Teachers and students should be encouraged to see from the eyes of other in action, as opposed to seeing others as if they were static artifacts featured in a museum exhibit. This is, of course, attached to my own biases as an applied anthropologist. However, I have found it to be an astonishingly effective/affective way to build rapport with middle school students, in what can be considered difficult and diverse circumstances. In turn, before entering into a SSI, the questioning of those aspects, that are considered ethical or moral, should be made strange and placed in a reflexive state, to expose the framing of the issue. Otherwise, I contend that competencies of SSR, will be generated from the dominant sociocultural rootedness, skewing toward the maintenance of the status quo; privileging, wittingly or unwittingly, the interests, purposes, agendas, belief-systems, and ways of knowing, emanating from unseen sources of power and control.

Reflexivity is not a singularity and therefore can be conceptually generalized and removed from some influences to be more flexible and encompassing. As a logos of western discourse, it will also contain residue from those displacements. However, for our purposes within education, by generalizing reflexive and reflective strategies, teachers and students can
begin to question their own sociocultural rootedness and the influences that are generated on that level, through diverse means. Moreover, when framed critically, students can recognize their ability to both shape and create their own measures of success, while recognizing deeper human connections of obligation. There are varied sources that describe reflexivity. Consider these demystifications, that educational practitioners may be more familiar with than traditional formulations:

reflexion \ ri-ˈfleks-ən \ is learning and developing through examining what we think happened on any occasion, and how we think others perceived the event and us, opening our practice to scrutiny by others, and studying data and texts from the wider sphere. (Bolton, 2010, p. 13)

reflexive \ ri-ˈfleks-əv \ is finding strategies to question our own attitudes, thought processes, values, assumptions, prejudices and habitual actions, to strive to understand our complex roles in relation to others. (Bolton, 2010, p. 13)

Bolton (2010) is writing from a perspective of “reflexive practice” and connecting with the activity of writing/journaling, in order to uncover truths about oneself and that self’s relations with others. It includes such frames as reflexive thinkers, reflexive-minded practitioner, reflective-minded. The reflective aspects are overtly connected to practice, and said to be reliving and re-rendering, so that one can be a reporter and fact-checker of one’s own accounts/experiences (Bolton, 2010). Moreover, the reflexive examine: our involvement in creating the social (Latour, 2005), that could possibly be counter to one’s own values and through the admission of the limitations of knowledge, we can begin to see how we may be involved in the exclusion or marginalization of humans (Bolton, 2010).
Here, I focus in on the “reflexive” component of the reflexive/reflective dyad, while suggesting that reflection in not a prerequisite for being reflexive. Instead it is a tool by which artifacts of memory are examined and used as objects, that could possibly be reflexively examined. By utilizing the term strategies, the link to logic and reason is brought into relief, but if interpreted broadly, leaves open the possibility of the emergence of something unforeseen (i.e. that which we cannot even imagine); this is a deconstructive crack in this brand of reflexivity. However, if viewed from another vantage, this crack becomes…opportunity.

From this opening, mechanisms for awareness can be fashioned by human beings individually, yet collaboratively. This can help make apparent the influences of ethnocentrism, and the effects of sociocultural rootedness. As it has been suggested, perhaps this would be a moment where a person can view themselves from an “etic” perspective (Kahn & Zeidler, 2019), or perhaps from a place where the emic/etic divide is examined and dissolved. Reflexivity is “making aspects of the self-strange, focusing close attention upon one’s own actions, thoughts, feelings, values, identity, and their effect upon others, situations, and professional and social structures” (Bolton 2010, p. 14). “Only when the ordinary becomes strange do we see it in fresh ways” (Green 1999, p. 151).

Through this general reflexivity, a more wholistic approach toward self-examination can be fostered. Rosenberg (1990) defines reflexivity broadly as an entity acting back upon itself. Through this sort of broader reflexive approach, reflexive judgement can be acted upon to dissolve a conflation: judge and that which shaped the judge. Entering into reflexive judgement through this reflexive awareness, informs agents and allows them the possibility of judging themselves. with an alertness of influences that may have shaped their judgement (normation), and them as well (i.e., the judge).
In relation to action, think of the reflexive social scientists being cognizant of the influence they have on their “research” and the influence the “research” has on them.

**reflexive awareness** \( \text{ri-ˈflek-siv ə-ˈwer-nəs} \) is the view that a conscious mental event is not only directed at some object (or content), but that it is also directed at itself (Bernier, 2015 p. 125)

**Svasamvedana** (Sanskrit: स्वसमवेदन) roughly translated as reflexive awareness: a cognition’s being aware of itself simultaneously with its awareness of an object, and that this kind of self-awareness or reflexive awareness is nondual, that is, it does not involve any subject/object structure (Thompson, 2011 citing Sopa & Hopkins, 1976, p. 78).

The voices of conscience are rooted in us, yet they should be continually questioned. We must constantly assess their validity, biases, influences, motivations, and hidden agendas, that may be coercing these voices into speaking for the hidden hegemony, in the guise of the “greater good,” or perhaps allegiance of one’s ostensible sociocultural rootedness. After all, Green (1985) talked of “rootedness” giving judgment its sting through an insider’s voice, brought on through shared memories imposed against us so to reveal the great distances between the standards we promote and the realities we seem to actualize. However, reflexive judgement, reflexive thinking, and reflexive reasoning, do not offer a means to directly question the sociocultural rootedness of the activities (they are reflexively unaware), or the standards that we advocate. In addition, these activities do not necessarily bring our attention to the reflexive nature of our existence.

**Es-el’s Path.** Es-el could not stop thinking about saying that seal hunting was a bad thing. They found a video on YouTube (Enuaraq-Strauss, 2014) of a young Inuit girl posted as a response to a celebrity’s declaration that seal hunting is one of the “most atrocious and inhumane
acts” that any government can allow. The young girl seemed like someone that could have been in any of Es-el’s classes. She appeared very sad and asked what seemed to be reasonable questions. Es-el, still felt upset and wondered again; why is the hunting of seals the atrocious act allowed by a government as opposed to the condition of the Inuit? Why wasn’t there a vote on this condition? Sitting in their room, brooding over this complicated socioscientific experience, it was now more than just an issue to Es-el; their emotions and thoughts began to run together. The issue seemed so complicated, it is apparent that the way Es-el feels and thinks, is perhaps, even more complex than the issues themselves.

**SL the Ironic Bodhisattva**

Their bones were still frigid, from the arctic excursion with the Inuit. SL had a long, journey south, to arrive at an elevation offering air with similar kinetic features, to which they had now become a bit more accustomed. The traveling had been arduous, and SL felt lucky that they had brought a bag of natsiq meat for the trip. Along the way, memories of transformative experiences with the De-Nigami and Joannie and his family, made SL question their very existence. SL too, wondered why we would think of natsiq hunting as a moral act. Do we question the nanuq/polar-bear on ethics and morality; the jaguar, the stickleback, the blue whale? From the etic veranda, SL thought, it might seem as though this is likening the Inuiaq/Inuit with these lowered, non-civilized, beasts. However, from their assumed emic, SL recognized that this reflects what some might think of as wisdom, a non-formulation of anthropocentrism; humans are not above their environments, but members of it.

SL thought of (eco)justice’s struggles to attract attention in westernized countries. Systems were on SL’s mind. The very concept of “saving the environment,” raises human beings to a disconnected, falsely-elevated status. Consider the words of the comedic philosopher George
Carlin, “The planet will be here for a long, long, long time after we’re gone and it will heal itself. It will cleanse itself ’cuz that’s what it does. It’s a self-correcting system” (Carlin & Urbisci, 1993). SL, pondered all of the special interests it had supported in the past without question; without serious consideration of consequences. The reflexive emotions of guilt and shame surfaced once again. What were their motivations? Were they selfless or selfish? Were they self-serving or for the greater-good? How many people were overlooked, oppressed, marginalized, and made to feel invaluable, in the name of dehumanized interest; in the name of self-righteousness?

SL’s thoughts drifted toward a story they had once heard; of pride, of guilt, and of shame. The kind of story that is common in a Renaissance Middle School (i.e., an institution that has a large population of students living in poverty). Their thoughts were abruptly interrupted, when they saw a bustling metropolis, adorned by temples, rising over the horizon. After negotiating what seemed to be a labyrinth, SL now stood looking upward at a rocky path, leading to a Monastery tucked into a mountainside. SL had arrived in Katmandu. Upon their arrival at the monastery, SL sat with Matthieu Ricard, a Buddhist monk and ex-microbiologist, along with Wade Davis, a Canadian anthropologist, explorer, and author. SL was welcomed to sit and join them and they listened in on the conversation between the other two individuals.

Matthieu spoke at length, on the transformative work of the monks and nuns at the monastery, even reflecting on, “the science of the mind that is Tibetan Buddhism” (Davis, 2009, p. 183).
He continued on,

What is science… but the empirical pursuit of the truth? What is Buddhism but 2,500 years of direct observation as to the nature of the mind? A lama once told me that Western science and efficiency has made a major contribution to minor needs. We spend all our lifetimes trying to live to be a hundred without losing our hair or teeth. The Buddhist spends his lifetime trying to understand the nature of existence. (Davis, 2009, p. 183)

SL somewhat laughed and the mention of science caught their attention. Davis nodding in agreement added, “[Yes], the Buddhist speak not of justice, of good and evil, but only of ignorance and suffering, with all emphasis being on compassion” (Davis, 2009, p. 186).

Matthieu, nodding in agreement, continued to expound upon the four noble truths:

The first is the truth of suffering. The second is the truth of the causes of suffering—ignorance… [The third truth, is that this ignorance can be overcome.] The fourth truth is the path that turns that potential into a reality… The path is the process of using all available means to eliminate the fundamental causes of suffering. (Ricard, 2014, p. 18)

Davis was smiling and looked over at SL, who was startled by this sudden attention.

Davis said directly to SL, “at its core, it’s a wisdom philosophy, a set of contemplative practices, a spiritual path informed by 2,500 years of empirical observation and deduction that, if followed, offers the certain promise of a transformation of the human heart,” (Davis, 2009, p. 187).

ignorance ˈɪg-n(ə)rən(t)s/ [the error of perceiving,] under the influence of habitual tendencies…the exterior world as a series of distinct, autonomous entities to which we attribute characteristics that we believe belong inherently to them. (Ricard, 2014, p. 15)
SL, nodded in uninformed agreement, with a befuddled look on their face, as their mind drifted into contemplation, with a distracted ear on the gentlemen’s conversation. SL caught the last part of Matthieu saying, “…we imagine there being an independent self in the midst of the aggregates of the body and mind” (Ricard, 2014, p. 14). SL was struck with the thought of the differing voices of conscience. The discussion led to stories of travel and visiting differing communities, the deliberations of happiness, and proclamation that “our own happiness is intimately linked to that of others: most of our difficulties actually arise because we lack concern for others’ well-being,” (Ricard, 2014, p. 16). The discussion of visiting others around Nepal brought up talk of emotions and how the Buddhist think of emotion.

Matthieu (2014) stated:

the traditional languages of Buddhism do not have a word for emotion, Ekman and colleagues (2005) remind us that rather than distinguishing between emotions and thoughts, Buddhism is concerned with understanding which types of mental activities are conducive to one’s own and others’ well-being, and which types are harmful, especially in the long run. (Ricard, 2014, p. 19)

SL felt confused and the reflexive emotions were difficult to distinguish…it was a feeling without description. Matthieu and Wade, rose from where they were sitting and began to exit. As he left, Matthieu turned to SL, and perhaps sensing SL’s interests, reminded them; “every moment between birth and death, the body is engaged in a ceaseless process of transformation, and the mind is the theater of countless emotional and conceptual experiences… remember the Dalai Lama describes Buddhism as being, above all, a science of the mind” (Ricard, 2014, p. 22). With that, the two gentlemen left, continuing their conversation and laughing, seemingly in harmony, as they walked side by side.
Reflecting on the Matthieu’s words, SL couldn’t help but wonder if this science was the same science they had known not that long ago. Thoughts of a recent train ride flashed-back in SL’s mind.

**FLASHBACK.** SL almost missed the train all together. There was a snafu between the ticket taker and the gatekeeper and SL looked different from their original passport picture. Walking down the quaking aisle of the now moving train, SL paused to look at their ticket. Scanning the cabin, they located their empty seat next to a young person, who was seemingly deep in a trance, scrolling through windows on a computer tablet. Images of Joannie, sitting at his computer sprang to SL’s thoughts. They noticed a few white napkins on their assigned seat, “Are these yours,” SL asked the young person, who responded with a negative shake of the head. SL, shrugged their shoulders, said “ok,” picked up the scraps, and took a seat.

SL was extraordinarily curious and just couldn’t help asking, the seemingly distraught and perplexed young person, what they were so fixated on. SL’s voice interrupted the chugging of the train and the young person, who appeared to be a student, turned to stare at SL with a look of irreverence. Their expression was deliberate and clear, as if to say…”why are you bothering me?” Luckily, SL had become more personable over time and was able to convince the student that they were genuinely interested in their issue. The student began talking about traveling to the US, Brussels, France and other European countries. They talked about going to different schools, getting the chance to meet new people and experience their lifestyle and how they think about things.

SL continued to listen intently, reaching into their bag to fish out one of the last pieces of dried natsiq. “So, what was your favorite or most interesting experience, on this trip? You want some?” SL, asked the question with an extended arm to offer a morsel of the natsiq.
“No thank you…I know exactly what that is.” The student started to talk about an experience they had in Dr. T’s class working with a socioscientific issue about the Canadian Harp Seal Hunt. SL chewed a bit slower and despite the obvious connection, let the student keep talking without interruption.

It was obvious the student was emotionally invested in the issue and talked about it, as if they were having a frantic conversation with themselves. “There was an exemption for the Inuit! My class and parents decided that allowing an exemption was the right thing to do! But, even with that, the Inuit didn’t seem happy with the decision. I mean doesn’t that leave more seals for them?” SL, just nodded and continued to listen. Es-el, seemingly holding in tears exclaimed, “I mean…the Inuit…did you know they are all suffering? Things are really bad for them and I don’t know how to help, or if I should help. It’s one of those issues that makes you feel, well…you don’t know how to feel and you don’t know what to do; know what I mean?” SL, had been silent and bright eyed through the entire story. The student was animated, yet waited for the response in anticipation and the only response that surfaced was, “yeah…I know what you mean.”

The rest of the train ride was punctuated by discussion between SL and the young student. In the times of silence, SL would jot notes, inspired by the conversation, on the napkins they found on the seat. Once the opportunity was presented itself, SL told the student, about their diverse experiences. The student hung on every word as SL spoke about making a living, trying to be functional; from the foreboding, hot, humid rainforest to the natsiq hunts on the pure ice hidden away from the direct light of our nearest star. The student, started talking with hesitation, “well…” SL looked at the student with an expression, as if to say, just ask. “Did you think it was wrong?” SL looked puzzled. “Did you think that killing the natsiq was wrong?”
SL sat back with a strange look on their face. “At one time, I wouldn’t have cared one way or another…and when I was out on the ice, I never thought about it that way. I’m not sure I can give you the universal answer you’re looking for.”

The student with a concerned, yet understanding look on their face, looked away from SL contemplatively. SL could sense that the student needed more and began to speak of their time on the ice with Lasaloosie, when he told SL a story about of taking care of an elder member of the community. “He spoke of bringing water to an elderly widow in his community that no longer had anyone to take care of her. The elder woman would tell Lasaloosie, that she had nothing to give him in return, and instead offered him a blessing of sorts. She told Lasaloosie may you become a hunter, so that you can provide for your people (Arnaquq-Baril, 2016).” SL could see the student’s emotions were welling up in response to the story. SL added, “and that is how Lasaloosie thought about it.”

The student thought in silence for quite some time before responding, “I thought it was bad…I think, I think I might still think it’s bad.” SL asked, “What makes you think it’s bad?” The student paused, “The idea of it makes me feel sad and I would feel guilty if I did it.” SL asked, “Why does it make you feel sad or why do you think you would feel guilty?” The student, somewhat put-out, simply responded, “I don’t know, now…” and laid back in their seat. SL could sympathize and the reflexive emotions of compassion surfaced. They wondered how they could possibly help the student; a position, that many honest teachers find themselves. As SL was leaving, they wanted to say something comforting to the student and futilely searched for the right words., but the last thing SL said to the student before exiting the train was, “Hey…I don’t know how to make you feel better about any of this. The world in general is difficult, from what I can see.
But, if I have learned anything, it’s this; to be functional, you need to connect with others, to help them, as they help you… you have to remember that you are not the center of universe.”

Within the SSI framework, the promotion of certain modes of thinking, have been found helpful when grappling with multidimensional questions, that are murky and possibly unresolvable. Reflexive Judgment with or without SSI, is conscience, and conscience is multi-vocal. The voices of conscience are formed through a person’s individualized experiences with both the physical and sociocultural environment including, but not limited to, enculturation from family, community, and society. These voices can help us survive, negotiate, and blend in, depending on the situation. However, the voices also remind us of the implicit and explicit rules, laws, determinative judgments, and other tacit, hidden motivations and influences that are dictated by overreaching systems of power.

Reflective judgment within this context, through developmental stages, results in reflective reasoning. This is an indication of a command over information, a deep understanding of one’s language game, and a focused understanding of the nature of evidence and its relationship to the development and assessment of knowledge claims. Reflective judgment, as reflective reasoning, is a process that human beings can use to extend feigned “universals,” to make sense of, draw conclusions from, and colonize seemingly novel situations within that system. Reflective judgment as reflective reasoning, is a mechanism that can work in concert with reflexive judgment, to inform moral ethical decision-making.

Reflexive thinking, is thinking turned back upon itself, and within the SSI framework is often equated with reflexive reasoning, which could be considered a narrowing of the activity. Reflexive thinking then, becomes more akin to reflective and reflexive judgment, or at the very least somewhere along that jagged continuum. Reflexive thinking, becomes more like
metacognition, functioning more as a monitoring system. I previously suggested and it will be advanced below, that reflexive thinking can be conceptualized more holistically, as thinking turned back on the thinker. Moreover, removing reflexivity from privileged connections (e.g. in academia) can leave open opportunity to cultivate differing and varying reflexive positions and paths. Furthermore, reflexivity must be slowed and placed into a more intentional pose.

**END OF FLASHBACK.**  

*SL*, sitting in temporary repose, pondering intentional reflexivity, considered the possibility of transforming *themselves*. They started to meditate on the complexity of the mind, imagining tuning *their* inquires inward through introspection, interrogating shaping influences (e.g., overt, muddled or hidden), to better realize the influence *they* have on others. *SL*, thought about the quest for truth, and the empirical study of the mind. Could science aid one toward Svasamvedana? What would be the affordances and limitations of science in this inner-quest? *SL* was intrigued with the Buddhist. They are rooted, as *SL* has observed elsewhere, but also not rooted. This is evident in their open inquiry toward eliminating ignorance and developing compassion.

**compassion** \kəm-ˈpa-shən\ sympathetic consciousness of others' distresses together with a desire to alleviate it (Merriam-Webster, n.d.)

*SL*, pondering the possibilities, made their way back down the path, through the city, and set off home. Drawing a deep breath, *SL* exhaled and began to reflect; thinking of the rhetorical ocean from whence they came, their life as a human, the pride, embarrassment, guilt, shame, and happiness flooding to its memory. A differing sort of humility and awe has surfaced as a new characteristic of *SL*, which has been realized through a reconnection with *SL*’s human roots. The role of the “reflexive” has come to be less of a reflex and more of an intentionality. *SL*, thought of SSR, not of turning against or onto, but turning inward to find a beginning. As *SL* watched
Katmandu get engulfed by the horizon, *the same* memory of a renaissance middle school that had originally begun to surface just before visiting the monastery, retuned back into *their* minds eye. It was a fitting memory for the moment, resonating with the tumultuous conflict that is emotions and thinking blending together, in the crucible of a classroom.
Chapter Six: Auto-Archaeological Reflexion

Introduction

“Jason! For the last time, I need you to concentrate!” Every head in the class looked up abruptly, to see the two often featured characters, in their daily classroom drama. Jason was looking up as well, but with a bright smile headlined by lifted eyebrows and he was the only one not looking at me; he was looking at everyone else. “Mr. B, come on I’m concentrating. It’s just, you know…this is boring.” The entire class laughed, as they usually did, when Jason and I decided we would make our friendly struggle for Jason’s life visible to everyone else. The cruel summer weather was pressing in through the old classroom door and the forty students, sitting in the unmistaken standardize test formation, were feeling the effects. “I know this is boring Jason. We all think it’s boring, but we are all here dealing with it.”

Everyone laughed, but as usual, no one laughed more at my comment than Jason did. He smiled saying, “Ok Mr. B,” and repositioned himself in his desk. All of the other students were sitting at tables with dividers in between, but Jason sat in one of only two desks in the crowded, uncomfortably warm classroom. I continued to pace around the room, truly looking forward to the end of day bell; as the students finished up what would be, for most of them, their last science test in seventh grade. I decided to use some time to go through a stack of documents sitting on the front counter. I stopped on Jason’s file. It was a large, thick, overflowing folder, that I had become quite familiar with over the course of the year. I was reminded of the labels: emotionally disturbed, learning disabled, and the one that Jason used often for himself and his
classmates, “boom-boom.” A common response to an awkward break down of instruction in class might be something like, “come on now, you know we boom-boom.” Usually, this invoked laughter amongst the students, but not the sort that seemed out of happiness. These labels, along with the other school documentation, detailed Jason’s inability to “fit in,” and acted like excuses/reasons, for his failure in the classroom.

I looked up from the file, to see Jason turned around in his desk, posed as if in tableau. He was looking straight at me and smiling. Not because he knew I was looking at his file, but because…that was Jason. We both were on the stage, playing our parts. I remember feeling shame, when I could not help Jason do well on his tests, projects, and activities; which later, would turn to guilt. I was worried that Jason may never reach his full potential, but I knew that he must want more than he possessed and I had to figure out how to help him. It was my responsibility to teach him to do something, where others had failed and I did not question this motivation.

I shuffled the papers abruptly, as I was caught-off guard by the swift opening of the classroom door. It was our principal, making his rounds during these times of testing, seeing that everyone was staying in line and doing their best. “Everything ok in here, Mr. B?” I turned and responded, as any new teacher might to their boss, “Yes sir, everything is going ok.” He smiled and started to leave, yet the silence I had felt so proud of, was shattered by a familiar frequency. “Hey… hey, Mr. G,” Jason proclaimed standing from his desk. “Jason!” I loudly said his name from reflex, but Mr. G kindly held up his hand toward me, in a silent relay of meaning. “Yes Jason, we are testing, so maybe we can talk later. Take your seat for now.”
Jason, not deterred, moved his body back to his desk, while keeping his head fixed, continuing to stare directly at Mr. G., “But we can talk later, right?!” Mr. G said, “yes…please take your seat” and with that, he left the room.

I remember feeling so embarrassed that Jason spoke out of turn, as if it were a reflection that I wasn’t doing my job. Memories of other events, where I felt the same way, started flashing in my mind. There were snippets of classroom discussions where Jason would ask questions that just didn’t seem to fit the lesson or connect to anything the class was discussing. A recollection of him reading aloud in class, stirred my emotions. I couldn’t help, but wonder how the system could fail him and why I couldn’t help. With Jason, as I would with most of my students, I was compelled to gather as much information about him as possible. The information from his file wasn’t enough; I spoke with his other teachers (present and past) and tried to glean new information from building a rapport with Jason, by getting to know him. Still, at the end of the year, when I thought of Jason, I did so with guilt, shame, and the thought that I had missed an opportunity to help. I had no idea in that moment, how right I would be, which was only outweighed by how utterly wrong I was about the reasons why.

The entire time I was collecting the testing materials, Jason continued to want my attention. He wanted to show me something, so I let him know he could show me after class. He had been asking me for past week or so, to show me the “project” he was working on. I remember actively evading that time, thinking that Jason had no idea what a “project” entailed. In hindsight, I feel, guilt, shame, and embarrassment, for what I think are the right reasons, when I reflect on how I dismissed Jason’s pleas. The bell sounded and I dismissed the students from class. Jason approached me with such zeal. He asked if I had time to look over a few pictures of a project he was working on; he told me he wanted my opinion.
Jason was excited to show me pictures and tell me about his “project.” He had attempted to provide details about his project to me all week, but was shut down at every turn. “Ok Jason, let’s see what you have.” He placed a few pictures on the table in front of us. The pictures were of his adult-sized tricycle, which had two wooden boxes around the back wheels; it was curious to say the least.

I asked him if the boxes were for carrying stuff, but he informed me they were the speakers for the stereo system he had hooked up to the bike. “That’s why I’m showing you,” he said a bit surprised. I looked puzzled at first, wondering why anyone would do that. My expression must have tipped him off to my confusion. Jason explained it was so the “ladies” could hear him coming down the street, and about how he hooked the system to the bike. He explained the wiring he had to connect, how the amplifier worked, and he asked about the battery that was giving him trouble. “You said something about decreasing the resistance in the wire so that more electrons can flow through…could that make it louder?” That question is now only a faint representation of the complex questions that he actually asked.

As Jason was explaining the process, an inkling of pride was quickly doused by the feelings of shame and guilt. In the moment, for the first time in my brief career as a teacher, I saw myself reflected by Jason, by all of my students. A cacophony of negative voices from my past educational moments rang clearly in my mind and seemingly throughout my body. In reflection, I remembered the smells, faces, words, but more important the feelings I had as a student in those moments; helplessness, loneliness, worthlessness. It was apparent that I had let my own experiences as a student misinform and skew my teaching philosophies, while also preventing me from being critical of the educational system in relation to student treatment.
I let Jason’s difficulty with systemic aspects and expectations of the educational systems, which were enforced by me, make the possible seem impossible. Jason was a creative, practical, innovative thinker and doer. He possessed qualities that I had let become invisible to me, within the sea of educational rhetoric, that I unwittingly and uncritically let spill into the classroom. Jason practiced many habits of mind and was able to apply connected concepts that would be familiar to SL (See Feldman et al., 2018, for a version of this story focused on student labeling).

I felt as though I was using reflective and reflexive judgment, even during my earlier years as a teacher. The processes by which I was enculturated and acculturated and the resulting voices of conscience were taken as reliable. To exacerbate this situation, I had not questioned how my own sociocultural rootedness and experiences, had shaped my voices of conscience. In a practical sense, I did not question how my own negative experiences as a student in an educational system may have injected biases, incorrectly prompted the structuring of certain emotions, and cast differing, undetected hues of biases in the way I conceptualize education in general.

If I were to frame this as a SSI, and loosely connected it with the practice of SSR, in retrospect, I was still formulating my understanding of the complexities of working with diverse learners. To improve my understanding, I would conduct inquiries, collect information about instructional practices, read educational/social science research, and utilize alternative sources, so to broaden my problem solving and decision-making approaches. I would strive to build working rapports with students and try to understand their lives at home to better support them at school. Still, I don’t think that I ever really grasped the reflexive relationship between teachers, students, and all the other influential actors.
During this time, I was skeptical in a “scientific” sense, yet that did not extend to my learning to be a teacher, to how the educational system should function. I had become more accustomed to the daily routines of my position, constantly witnessing the ebbs and flows of odd behaviors acted out by students and teachers. Early in my teaching career, I felt as though I understood how the “business” of education was conducted. Looking back, I was allowing what I was taught through trainings, mainstream educational research, social science proclivities and discussions with other instructional professionals shaped the way I conducted my classes and simultaneously shaped the core of my educational philosophy. Sadly, I later discovered that I blindly accepted and employed the very structures that had impeded me as a young student.

This specific experience, was a moment that prompted more than shame, guilt, and embarrassment; it incited me to adopt a more critically reflexive position, questioning my thought processes, values, beliefs, assumptions, prejudices, and habits. Luckily, and thanks to Jason, in that moment, everything changed, not only how I saw myself as a teacher, but also as a human; and from there I began the reimagining of my being as a teacher (Feldman, 2002). A reflexive evaluation of my voices of conscience, also made me more aware of how and why I tend to emotionally respond to certain stimuli. This was coupled with a renewed awareness of the noticeable imbalances of power, along with insights into hidden power, that will generally lurk within any bureaucratic systems. It was here, that my sociocultural and personal psychological rootedness, stood in *my* way of seeing…in “my” way of judgment.

Reflexivity can be elusively defined, made to seem real as if “turning back upon” carries some sacred panacea, but this is how reflexivity has kept its shape; by remaining amorphous, malleable, and subject to the sociocultural rootedness from which it springs. This is the deconstructive predicament of reflexivity. However, when these roots are turned back upon
themselves, hidden influences become visible and a new view of humanistic rootedness can be considered. This does not necessarily entail a reflexive reflexivity, which may be similar to standing between two mirrors that reflect light endlessly between two fixed positions, but instead a more intentional, aware reflexivity which can be authored and generated from within. In the classroom, this requires the slowing down, or a change in reflexive velocity, so that students can begin to examine the influences and foundations of their thinking. In other words, reflexivity cannot become an involuntary reflex, but should be presented as an intentional, thoughtful mode of self-examination.

**Socioscientific Literacy (SsL)**

Which reflexive aspects of functional scientific literacy (SSI’s functional perspective of SL) can lead to the conceptualization of Socioscientific Literacy as a goal for education in general (RQ3)? In the following, I will continue to utilize the typographical devices listed in Table 1 (See page 60). It has been suggested that the SSI framework “offers entry points into science curricula that are of pedagogical importance,” to both communities of researchers and practitioners; promoting a focus on nature of science issues, cultural issues, discourse issues and case-based issues, as a way to develop a functional perspective of SL (Zeidler, 2014, p. 697). As has been illustrated somewhat problematically, the cultivation of a functional perspective of SL, is related to the practice of Socioscientific Reasoning (SSR). The competencies claimed by SSR, can be related to common human modes of sense-making, geared at coping with the complexity of the universe and our situation within in it, on differing scales. Therefore, the competencies may appear through our space and time as “particulars,” yet I contend that they are western representations that can be traced to our common human rootedness.
Of course, even on sociocultural levels we will find “universals,” otherwise as Kwasi Wiredu (1996, p. 21) posits, “intercultural communication would be impossible.” This is particularly precise in westernized classrooms, positioned at the interface of pluralistic sociocultural interactions. Moreover, these sociocultural commonalities support an underlying human rootedness. Still, I hesitate to call the competencies universals, since this is conflated on multiple levels, yet they can be conceived as refined manifestations of common cognitive activities of the human mind. This is made evident by human groups grappling with the complexity that is human existence and survival against the backdrops of dynamic physical and sociocultural environments.

If we were to debase literacy to mean simply, having knowledge or being competent, we could contend that most groups, from around the world and throughout time, depending on their particular situation, possessed certain forms of literacy; even though they may not call it that or have a word for its distinction. As humans we are genotypically, only a statistical shade away from being considered identical perhaps even “clones”. Our “literacies,” or “competencies,” the “stuff” that helps us survive, is generated from the same “basic materials.” It would seem that in these groups, there are differing literacies, although not necessarily separated as such, and these literacies may be in conflict with one another. The development of a functional view of SL, is the development of only one aspect of the tapestry of literacies necessary to be a human in varying pluralistic conditions. This is textually evident in the advent of neologisms such as: media literacy, critical literacy, media literacy, technological literacy, mathematic literacy, etc.

SSR, is geared toward developing a functional perspective of SL and is conceptualized as a way to approach ill-formed, complex problems; where science proper, is but one overlapping facet or stakeholder, within the complexity of the issue. Therefore, grappling with SSI, in or out
of the classroom, requires “literacies” that, while perhaps overlapping in variations, go beyond the sphere of SSI’s “functional scientific literacy.” The SSI functional view of SL, is rooted in research (i.e. Vision I and Vision II of SL), and by expanding to the ethical/moral and other sociocultural realms, it reaches out to include other “visions” as well. However, these interactions are only momentary and messy, which obscures the nuanced interplay of diverse competencies, knowledges, and other cognitive permutations.

Therefore, I visualize the development of a functional perspective of SL, as the development of only one aspect of the tapestry of literacies necessary to be a human in varying pluralistic conditions. This is textually evident in the advent of several “X” literacies. All of these literacies are artifacts of certain interests and contexts, and are all within their own deconstructive predicament.

Nonetheless, these rhetorical boxes are deconstructive cracks, suggesting that “other” human mental activities/literacies are interfacing, coalescing, displacing, mutating, and influencing humans as we negotiate continually negotiate our own ever-changing situations. I suggest that through the transmutation of SSR, we can reimagine a SSI’s functional perspective of SL, as one aspect of a more wholistic, connective ambition for the practice of SSR; socioscientific literacy (S$S_L$).

**Transmutation of SSR**

Before describing the deconstructive maneuvers towards the transmutation of SSR, a suspension of two-dimensionality is required for both the text and the textual images below. Imagine, instead of two-dimensional circles/shapes, you see three-dimensional spheres, which are dynamic, globularly imperfect, and all intersecting. These spheres, are always in motion, in indeterminable fluctuating directions and speeds, and are constantly, always interacting. These
interactions are creating kaleidoscopic combinations, mutations, transformations, and sometimes the unforeseen. Now imagine these spheres, while in motion, are tethered to one central mass comprised of two spheres, one nested within another. After the suggested maneuvering, this will be revealed as a reflexively aware, human rootedness, ensphered by a self-interpreted sociocultural “rootedness.”

On the surface, these two anchoring spheres appear as almost imperceptible concentric points. However, if we zoom in, we can imagine this as observing something similar to the tectonic deconstruction of Earth. The landscapes of this sociocultural sphere are a constantly changing landscape, in direct relation to the human inner core, and “psychological” mantle, of which we can only understand as far as our indirect observations allow. We also find here that the other interacting spheres are not simply tethered, but emanating from these human points. We pan out, and at a distance, these spheres are not only three-dimensional, but also positioned; and therefore, affected by the dimension of time, changing in relation to varying, diverse, unfolding experiences.

Here too, we can see the positioning of the reflexive/reflective spheres, which as opposed to simply ensphering the inner-spheres (like the fabric of space-time), the reflexive-reflective spheres are diaphanously solid, and is the fluid in which all the other spheres are interacting. As we move back toward these dynamically shifting spheres, we see that while they are four-dimensional; they are not perfect spheres and sometimes, they are not exactly spherical at all. Each of them constantly affects the shape of the other. The permutations become seemingly endless and unique at this scale, yet always rooted to the same central barycenter. Now, we imagine that not only do we see these multifarious interactions, but we can also see the
possibilities for “otherness.” These central points, are not human in a “general” sense alone, but potentially individually human; making the possibilities as diverse and rooted as our students.

**The Bricolage Maneuvering of SSR.** If the competencies of SSR are dislodged from the underpinning academic foundations, and considered instead as the dynamic representations of human roots revealed in situ, these competencies are reaffirmed as interconnected flexible “spherical” system(s) of meaning making. Furthermore, this provides varying degrees of overlaps, coalescences, and enrichments of and between these spherical competencies. These interactions allow the systems to be morphed into a myriad of idiosyncratic forms. This in turn elevates the potential for SSR competencies, to be more than what it was originally intended to be at its conception. For students, I suggest that this will possibly provide the personalization of SSR, in relation to an individual’s situation.

SSR, as a new sign, although harkening back to the original *significance*, is currently maintained as something that is already, always, under de/construction, and continues to be formulated/imagined. This is one aspect of its deconstructive predicament and makes SSR strong/weak enough to undergo an artificial transmutation; which, in this case, will not result in expunging the core, human-rooted features. Instead, they can be left reflexively intact, as sociocultural rootedness will become the subject of itself (See reflexive rootedness p. 165). This can lead to simultaneously exposing/assuaging the hegemonic, biased, acculturative, and ulterior influences/motivations, hidden within and between the competencies’ constituents.

An educational practitioner/researcher must often times be the bricoleur. If SSR were a bricolage, it would be more difficult to sense or imagine, than one might think. For example, within SSR it may seem as though all available materials are seen/known; however, many may remain, tacit, hidden, and in some cases, “impossible.” Therefore, this is a deconstructive
bricolage, in that, there is no project, no expectation, no need for anchors, blueprints, or strategic steps. There are no obligations, judgments, reservations, motivations, or an internal or external measure of completion or success.

The deconstructive maneuvers that follow, are my nascent conceptualizations of the releveling, rescaling, reflecting/reflexing, reimaging of SSR as a multi-purpose, spherically-interacting, cognitive opening. Most of this bricolage is unfamiliar, while at the same time stirring nostalgia. Ultimately, the bricolage is, and always has been, the bricoleur; we are our own projects.

**Deconstructive Maneuver 1: Reflexive Ensphering.** The expansion of the reflective and reflexive from the realm of the moral context, described in Chapter Five, provides a more relativistic positioning. Deconstructive Maneuver 1, entails positioning this spherical dyad in and around SSR, to be an intentional and unifying field (See Figure 5, p. 153). This does not suggest a specific reflexivity, but leaves open the opportunity for multiple strategies of reflexivity, depending on the particular purpose.

From this ensphering, we can imagine the development of multiple reflexive “strategies” (e.g., to expose, investigate and upend, hidden influences of power, control, and subordination). These spheres of interactions are reflexive with experience and therefore, while certain common experiences can be intentionally designed, the shape of the reflexive/reflective can and should be individual-dependent. Within the classroom, these spheres are spaces to develop reflexive awareness by making visible and intentional, the development of reflexive “strategies” directed at and through the practice of SSR within SSI.

Deconstructive Maneuver 2: Decenter and Destabilize. It is overt within the SSI Framework, that SSI within and beyond the classroom, are focused on inciting mental activities to connect with the moral/ethical facets of the problems or issues. As I have claimed above, this is a deliberate move toward decentering science, which is necessary for a functional perspective of SL. This move is not made by removing, nor the centralizing of moral/ethical realms. Instead, by introducing the concept from a science frame of reference, the conflation of science with moral/ethics is revealed, which can decenter both (See Figure 6, p. 154). This can serve to
obscure the privileging of science/knowledge and specific frameworks of moral/ethics, as well as the tacit influences of power and control that shape them. I suggest that to attempt to confront this directly, and to complete this maneuver, the decentering must continue toward destabilization. This in turn, problematizes the connections between the moral/ethical and science/knowledge, while making it possible to scrutinize hidden hegemonic influences. In the classroom, this would allow moments for teachers and students to be critical of explanatory frameworks, power structures, belief systems, and their own resulting biases in a collaborative, honest, and visible manner.

Deconstructive Maneuver 3: Evidence. Evidence, is not necessarily as stable as one might think; it has, historically been evidence. What is considered to be evidence, is always slipping under the pressure of discourse/power. Here you can find evidence of a deconstructive (insecurity) shift for science, towards colonized evidence.

empirical \im-ˈpir-i-kəl\ , em-\ˈir-i-kəl\ 1: originating in or based on observation or experience
2: relying on experience or observation alone often without due regard for system and theory an empirical basis for the theory 3: capable of being verified or disproved by observation or experiment (Merriam-Webster, n.d.)

empiric \im-ˈpir-ik\ , em-\ˈpir-ik\ 1: CHARLATAN sense 2: one who relies on practical experience (Merriam-Webster, n.d.)

The constant slipping of the meaning of evidence, as with all unstable features of the educational landscape, is a part of its feigned “nature” and of course, a demonstration of its deconstructive predicament. This does not apply simply across time, but also across space, disciplines, discourse, and society. The concept of empirical data has a similar, yet slightly different meaning to a historian than it does to a geologist; at the very least each have differing gradients of acceptance. In addition, what justifies/grants status to data as “empirical” has had to evolve through time, in order to generalize, codify, commodify and privilege certain experiences over others. Scientists, for instance, have many guidelines by which certain experiences are accepted and others excluded.

Evidence, generated within science, is sometimes a miniscule aspect of what is considered evidence in a broader human context. For instance, empirically derived DNA evidence may be used in a court of law. However, it will also be complimented with other sources of information considered evidence, which may not meet the scientific parameters of
“evidence.” Nonetheless, this would require an individual to be able to perceive more than just the evidence, but navigate the slippery motion of evidence. This slippage can be glossed over within SSI and therefore, affects the SSR system. Consider the possibility, that by introducing an issue from a science frame of reference, it automatically privileges the scientific parameters of evidence. Therefore, I see the activities of “inquiry” and “skepticism” being diminished in complexity and scope, and therefore affect the other competencies in a similar manner.

In addition, within a SSI, while certain “empirical activities” can be connected to the classroom modules, they are not necessarily a feature of “real” SSI. For example, a UN parliament member is most likely not going to conduct their own empirical studies as a part of their deliberation process. By privileging “empirical evidence,” the disembodied, dehumanized textual packaging of that evidence, removes participants from the generation or review or information, and as a result, accentuates the role of SL the villain. In the classroom, we may help students become familiar in determining the reliability of evidence; however, they are also removed from the process, by which the standards for evidence were created. In the case of the of UN parliament members that were grappling with a SSI, they must “trust” or “have “faith,” that the information is reliable by the standards of science, which may not reflect their own personal standards.

Here I suggest a radicalization of affordances and limitations of science, which fuels Deconstructive Maneuver 3: deprivileging “empirical evidence,” for a broader more reflexively aware, functional perspective of empirical evidence. This will, in turn, open skepticism and inquiry toward the possibility of something “other,” which in the classroom, can translate into justice for Jason (See Figure 7, p. 157).
In a practical sense, this means expanding the possibilities for our students beyond what we think, should, could, or ought to be possible/impossible. In addition, much like *SL ex loco* of the De-Nigami painfully learned, grappling with the complexity of everyday life, may require a less narrow understanding of (trans)substantiation.

Deconstructive Maneuver 4: Altered Velocity of SsR. The last deconstructive maneuver, is perhaps the most painful, for it is where we should begin, within the complexity of one’s self; the place of honest introspection/scrutiny. Deconstructive Maneuver 4, is not directed at the “shape” of SSR, although that is always subject to change. Instead this maneuver is a disruption in metaphorical “velocity” (See Figure 8, page 160). As I have alluded to, the intentional inspection of the mind can be conceptualized as grappling with a multidimensional, complicated, or vague, issue/problem.

Therefore, SSR reconceptualized, can be redirected inward, as self-exploration or a kind of socioscientific introspection. This velocity change is in direction and speed; reflexivity for example, should be slowed down, akin to watching a slow-motion film. While this may seem like an idealistic stretch, it can be conceptualized as a practical classroom approach, whereby the teacher and students take time to scrutinize inconsistencies, contradictions, imbalances and the generally unspoken influences that may be causing them on a social and personal level.

Indeed, it would be difficult to simply suggest students (of any age) conduct a self-evaluation, without providing suggestions for a path. SSR, as socioscientific introspection, can serve as an opening for the development of commonly rooted, yet individually diversified reflections of SSR. In other words, as student turn inward through SSR, the reflexive relationship is forged and therefore, not only does the student/teacher change through this practice, but so will SSR as a reflexive response. This also allows for the slowing down of reflexivity/reflection through various means (e.g., honest transactive discussion), as well as the movement of the other “interaction spheres.” From this relationship/awareness, students can redirect personally informed SSR outward, in a more holistically and reflexively deliberate manner.
In addition, it is here, within the personal context, that students, teachers, administrators, policy-makers and researchers, can/should confront the unknown hegemonic influences, that explicitly or implicitly shape them without their awareness. However, this also presents an opportunity for individuals to question their own reflexive judgment at the core of normation (which should be made visible), to root-out any hidden hegemony, that causes us to reinforce our own inner-oppression. With deliberate guidance and questioning from the teacher, a more active external view of the hidden hegemony can be developed. Internally, in relation to reflexive judgement, the possibility of intensifying and focusing a questioning voice of subversion can be developed; a hegemonic cricket if you will.

In the classroom, students can be asked to study themselves through multiple lenses such as grappling with complexity, conducting various inquiries, developing an awareness of skepticism, and figuring out the affordance and limitations of science. While this is also a time when students can attempt to see themselves as others do, and develop the “etic” of themselves, it should be more geared toward students developing a deeper awareness of their own “emic.” We often take for granted that students are already developing their “emic,” from the dominant etic. Think of Jason proclaiming himself and classmates as “boom-boom.” This reminds us of reflexive human situatedness and how we often see ourselves as outsiders. The suggestion here, is to make this human predicament clear, so that students not only recognize the importance of knowing how others define them, but also recognizing that those “views” do not define them in totality, if at all.

The once starkly recognizable concepts and competencies are now slightly less distinguishable. The strikethrough(s) are not to say these are now absent, obliterated, or altogether different. Instead, these are reflective incisions providing us openings to peer past the
phenotypical expression of the words, and to reminds us of their ever-slipping, unstable, meanings. Through these incisions, we can make visible the inner meanings and tacit attachments to power lurking within the linguistic genotypes of words and concepts. This, however, is not an indication of complete detachment from the intended meaning and purposes of SSR. Rather the maneuvers suggest that these attachments are made visible and deprivileged. In turn, this broadens the utility of all of the interacting spheres described above, while leaving open the possibility for novel rearrangements, variations, and creations. While the closed “system” of SSR was geared toward the development of a functional perspective of SL, a bricolage SSR (S₇R) is an open “system,” which is aimed toward the development of socioscientific literacy (S₇L); of which a functional perspective of SL is connected.

The Characteristics of Socioscientific Literacy

SSL, through the development and practice of bricolage SSR (SSR), is actualized through exploration of human rootedness, which becomes the barycenter for the interacting spheres, and is developed reflexively from that point, by/with the individual. This is the first characteristic of socioscientific literacy, it is not a universal goal. It springs from universal human roots, yet is cultivated, shaped, and reshaped through the interaction with particularities of the individual. These particularities are made even more varied, as they interact with one another, as well as the particularities of others. Hence, the second characteristic of SSL, which it shares with SL-ex loco, SSL is human dependent and potentially individually shaped.

The name, socioscientific literacy, can suggest a knowledge of and being competent in the application of SSR to grapple with and resolve socioscientific issues. This includes making SL functional, yet science is still centrally privileged and the critical approach (affordances and limitations) seems to come from within science. However, through the opened SSR, I suggest a further expansion, as the name SSL also signifies, to include a vast diversity of complex, ill-defined issues. This should also include the articulation, formulation and practice of a diverse array of literacies required to grapple with those issues. This does not occur within the spheres, as if they were disconnected silos, but instead are devised/invented at the intersections of these constantly interacting spheres. and can either become “permanent” interactors, or be as ephemeral as the issue of which it is focused and formulated. This is the third characteristic of SSL, in that socioscientific literacy is not representative of one “literacy,” or one specific domain or a single colony of monolithic skills and/or concepts. SSL reflects the reflexively aware and supported practice and cultivation of SSR, in relation to one’s own measures and parameters.
For students, this means, from a reflexively aware posture they can begin to gauge/define their personal success with measures they formulate in relation to their own personal situations.

The fourth characteristic of S₅L, has been an apparition throughout the text and is made visceral and intentional through Deconstructive Maneuver 4; S₅L indicates the transmutation of SSR to SₛR. This evolution makes it visible and subject to potential critical/reflexive scrutinization, hegemonic influences, tacit special interests, sociocultural rootedness, personal/cultural/familial/implicit biases, prejudices, mythological rhetorical/physical boundaries, and the potential for alterity. This does not indicate a detachment from sociocultural foundations, but instead exposes them so they too can be held accountable.

This can be seen as a potential opening for the fifth characteristic of SₛL, which is the potential to promote justice for the “other” analogically and incite the advocation of justice for and within the psychological (one’s self) and sociocultural (fellow humans). In other words, in the classroom, this brings human inequities (i.e., personal, local, global communities, etc.) and connectedness to a more centralized position; which is where global and local obligations can be suggested and framed as emancipatory paths (inner/outer). This characteristic of potential, as with all of the characteristics of SₛL, is actualized in differing ways depending on the shifting context.

An aspect of the deconstructive predicament of socioscientific literacy is it is now and always in a state of flux, responding to the human operator and the resulting movement through the four-dimensional “existence” represented by the interacting spheres of SₛR. Due to fluidity, reflexive awareness, the reflexive/reflective, and idiosyncratic variations, this fluctuation between impossible/possible should be kept constant, and therefore is the sixth characteristic of SₛL. In a practical sense, this is akin to broad-mindedness and open-mindedness, but goes
beyond those scopes, to a more reflexively relativistic-mindedness. This is an ability to recognize moments when taking on a relativistic position/perspective, which allows for a more open and honest evaluation. However, it is not anything goes, in that it the relativity is sustained within a sphere of reflexive/reflective.

Characteristic six, is also an indication, that there are always features and traits that may materialize through practice and on differing scales. These working characteristics of SsL, along with the deconstructive maneuvers of SsR, can be difficult to connect with the pragmatic universe of education. However, the final section of this chapter will be brief suggestions of the possible connections between SsL, pedagogical praxis, educational/social sciences research, and student/teacher interactions. I will also connect the possible ways that the practice of SsR as a means to cultivate SsL, can improve the educational conditions of all our students. Figure 9 (See page 164) features a checklist of the working characteristics and definitional entailments of socioscientific literacy.

**Research Questions and SsL in a Nutshell**

**Research Question 1** What are the boundaries and overlaps of scientific literacy (SL) and functional scientific literacy (FSL) within the Socioscientific Issues Framework? When functional scientific literacy is compared with the characteristics of SL *ex loco* and SL *the Villain*, it was suggested that the following six characteristics present a more robust and accurate functional view of SL: 1) extends from differing visions of SL; 2) attempts to connect directly with globalized and localized ethical/moral realms; 3) moves toward decentering SL; 4) humanizes science through interaction; 5) exposes the affordances and limitations of science; 6) attempts to do justice for the *other* (See Table 3 p. 93).
**Socioscientific Literacy (SsL) Checklist**

Name of School/Agency: Dr. Dedrick High School  
Observer: Dr. A. Feldman  
Date: 03/17/2021

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Yes</th>
<th>No</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SsL is not universal. It emanates from universal human roots, yet is cultivated, shaped, and reshaped through the interaction of particularities of the individual(s). Does this align with your teaching philosophy?</td>
<td>✓</td>
<td></td>
<td>None Required</td>
</tr>
<tr>
<td>2. SsL is not disconnected or subject to mythology or mystifying. It is human dependent and individually influenced. Does this align with your teaching philosophy?</td>
<td>✓</td>
<td></td>
<td>None Required</td>
</tr>
<tr>
<td>3. SsL is not representative of one “literacy,” specific domain or colony of monolithic skills and/or concepts. It reflects the reflexively aware and supports the practice and cultivation of SsR, in relation to one’s own measures and parameters. Does this align with your teaching philosophy?</td>
<td>✓</td>
<td></td>
<td>None Required</td>
</tr>
<tr>
<td>4. SsL does not obscure specific foundations, special interests, hidden ulterior motives, implicit biases or subordinating forces. It indicates the transmutation of SSR to SsR, in turn making it visible and subject to potential critical/reflexive scrutinization, hegemonic influences, tacit special interests, sociocultural rootedness, biases, prejudices, mythological/rhetorical physical boundaries and the potential for alterity. Does this align with your teaching philosophy?</td>
<td>✓</td>
<td></td>
<td>None Required</td>
</tr>
<tr>
<td>5. SsL is not a complacent, permanent, purely relativistic position. It includes the abilities and dispositions to recognize and incite the advocation of justice. Does this align with your teaching philosophy?</td>
<td>✓</td>
<td></td>
<td>None Required</td>
</tr>
<tr>
<td>6. SsL is not static or subject to external, disconnected measures and is not an absolute way of knowing or judging. It is in a constant state of flux in response to the operator and the four-dimensional moment and interactions of SsR. Does this align with your teaching philosophy?</td>
<td>✓</td>
<td></td>
<td>None Required</td>
</tr>
</tbody>
</table>

Figure 9. Socioscientific Literacy Checklist
These characteristics suggest that for SL to be functional for students, it must be open to scrutiny and connected with a broader realm of human activity than science alone (Zeidler, 2016). Moreover, for these characteristics to be actualized in practice they must emanate from an honest, flexible reflexive/reflective approach to design and implementation of educational experiences.

Research Question 2 What are the major distinctions of the reflexive activities connected to the SSI framework? This prompted the exploration of the moral context of SSPT, which is constituted by reflexive and reflective judgment. Reflexive judgment was shown to be intimately connected to the concept of conscience, particularly how it is shaped by the process of normation (Green, 1999). Through normation students structure their reflexive emotions to act as indicators when passing judgment on themselves and others, which can be conceptualized as voices of conscience (Green, 1999). Reflective judgement is also connected with the stage model of reflexive thinking (King & Kitchener, 2004), which is conceptualized as monitoring one’s own reasoning and assumptions. The concept of judgment and implied binaries (e.g. bad/good) were problematized, in order to dislodge and generalize the reflexive and reflective aspects of the moral context. It is recommended to extend this opened reflexive/reflective outward to ensphere and support the practice of SSR, toward the development of SsL. In addition, the encouragement of reflexive awareness, coupled with compassion, was argued as possible means by which teachers and students can gain a flexible understanding of their educational condition. This, along with the findings for research question 1, helped guide the formulation of SsL, and suggests many connections and implications for science education discussed in the next two sections.
Research Question 3: What aspects of functional scientific literacy (FSL) can lead to the conceptualization of socioscientific literacy (SSL) as a goal for education in general? The recognition of the humanizing aspects of FSL named above, including the decentering of science, inclusion of varying and diverse ways of thinking and acting, and the implied goal to seek justice for the other, helped guide the conceptualization of socioscientific literacy. The nascent S₃L, can be visualized as the reflexively aware, cultivation of abilities to holistically operate S₃R, in order to engage, grapple with, and seek solutions for a vast diversity of complex, ill-defined, issues. S₃L, also entails the abilities to imagine reflexive/reflective means of scrutinizing/supporting the operation of S₃R and the diverse array of literacies, dispositions, actions, and shifting modes of evidence that are momentarily called upon to grapple with those issues. The final entailment of S₃L is two-fold: it includes the abilities to 1) recognize hegemonic, colonizing, controlling, subordinating, oppressive influences, and 2) the ability to formulate and act justly in response to these influences/forces.

Research Implications and Connections to S₃L

As the openness and flexibility of S₃L through S₃R indicates, and as an intentional feature, there are a myriad of academic involvements, connections and possibilities that can be explored. The following are a few possible academic involvements, that could serve several purposes when considering the cultivation of S₃L in the classroom. For instance, there are many promising consequences of practicing a reflexive ethnographic process, which show potential as pedagogical tools (Goldman-Segall, 1998; Tynan & Loew, 2010). Therefore, differing forms of reflexive ethnography, including autoethnography, can add support to the practice of S₃R, toward the development of S₃L. In addition, the inclusion (and/or production) of ethnographic film in the classroom can promote the development of the reflexive/reflective through shared
experiences. For instance, holism (behavioral contextualization), through ethnographic films, can provide a context on which students can practice the reflexive construction of meaning connected to the behaviors they are observing (Heider, 2006). In this case the “meaning” they construct can reach beyond, yet connect to, their own everyday experiences. In order for students to develop an understanding of how the behaviors they observe are manifestations of human thinking, shaped by their sociocultural and physical environments, students must have a basic understanding of those environments. In addition, ethnographic film can aid students in opening up the complexity (Sadler, Barab, & Scott, 2007; Zeidler & Sadler, 2011) of any situation/issue on which they are focusing.

Reflexivity (The Ethnographer’s Presence), is a major component of ethnographic research and film (Heider, 2006). This can help with the development of reflexive awareness, via exploring and experiencing the ethnographer-ethnography reflexive relationship. If this is not made explicit in the film, it should be made so by the educator. In some cases, films that do not draw attention to the presences of the ethnographer, may provide opportunity for students to demonstrate the connections between biases, interpretations, and group meaning making. This attribute can also act as a “model” for students to cultivate their abilities within the reflexive/reflective.

The suggestion for Ethnography, can be aligned with the Humanities, ARTs, and Social Sciences (HARTSS) model; a model geared toward “pumping” differing methods and ways of making and representing meaning, into SSI classrooms, to promote functional scientific literacy (Kahn & Zeidler, 2016). However, this model can be reimagined to work in support of the development of SxL and will offer interdisciplinary possibilities, a means to explore humanness, and varying models to support the development of reflexive awareness. In addition, injecting
ethnography and autoethnography, as humanistic, artistic, reflexive/reflective, and modes of making meaning in the classroom, SSPT can become a focal point, while also being provide with a means to make a more authentic emic/etic switch.

Finally, I suggest a connection with a particular shifting perception of “intelligence” that has been cross-culturally and empirically substantiated, as well as conceptually analyzed and reconfigured in response to those data. Robert J. Sternberg (2020) has developed an interesting way of looking at human intelligence that he terms “successful intelligence.” While “successful intelligence” rests upon a sophisticated framework, it began with the basic definition cited above (Sternberg et al., 2009), and the more recent augmented definition of successful intelligence is one’s ability to set and accomplish personally meaningful goals in one’s life, given one’s cultural context (Sternberg, 2020).

Sternberg (2020) states that a successfully intelligent person accomplishes goals through figuring out his/her/their contextual strengths and weaknesses. Thus, allowing them to capitalize on their strengths and correct/compensate for their weaknesses. These “Strengths and weaknesses,” are relative to four variations of skills, derived from the same mental processes: analytical, creative, practical, and wisdom based (Sternberg et al., 2009, Sternberg, 2020). An individual 1) needs to be creative in order to generate novel and useful ideas, 2) is required to be analytical in order to establish that their ideas, as well as ideas of others, are “good ones,” 3) needs to be practical so to apply those ideas in order to convince others of their value, and 4) they must be wise in order to ensure that the application of the ideas will help ensure a common good through the facilitation of positive ethical principles (Sternberg, 2020).

Further connections between the cultivation of S3L and the work of Sternberg and colleagues, is with practical and adaptive intelligences. This entire project is focused on the
deconstructive predicament of the western notion of intelligence, and the mal-effects it can have on individuals and groups. Practical intelligence, roughly equated with common sense, is mainly focused upon tacit knowledge, or what one needs to know to succeed in a particular environment; even those things that go beyond the verbalized (Sternberg, 2020).

The most recent advent and reaction to years of research, adaptive intelligence, is based upon the realization that intelligence cannot be defined only as a quotient and represents the view that intelligence, broadly conceptualized, is and always has been about adapting to the environment (Sternberg, 2020).

These are ultimately research projects rooted in their own foundations, with their own tacit influences, hidden motivations, and spoken or unspoken goals. Nevertheless, this is a “deconstructive project,” which has led to the opening up of intelligence, intelligence. Nevertheless, there are many possibilities for acculturation. Consider that Sternberg states of their current adaptive intelligence model, that “these projects involve presenting students with real-world problems and asking them to define the problems, figure out ways of addressing these problems, and proposing possible solutions” (Sternberg, 2020, para. 2). Moving forward, there is a possibility of revealing deeper connections between this notion of intelligence and the cultivation of SsL through the practice of SsR.

**Implications for Science Teaching Practices and Philosophies**

As I stated at the outset, this philosophical work, as is obvious at this point, is not meant strictly as an argument, a clarifying agent, nor a generalized report. Instead, this is a way to tell an ineffable story, not simply of how an educator must question their practices, but more important, that educators must critically and reflexively evaluate their teaching philosophies and recognize how these “philosophies,” shape their being as a teacher (Feldman, 2002). One of the
many facets of this work, is the conceptualization of an individually shaped, reflexively positioned means for students to shape and negotiate our complex, pluralistic societies. However, the implications for teachers, are very much the same, as those for students.

One of the main implications of this philosophical study is that science teaching in any westernized context may be conceptualized as a socioscientific issue, perhaps on a daily basis, in and of itself. In my experience, a teacher must constantly grapple with difficult issues, requiring multiple forms of inquiry, varying degrees and shades of skepticism, react to the shifting of evidence, and there is no place like the classroom, to run headfirst into the limitations of science. Additionally, teachers in all situations, only benefit themselves and their students by honing abilities to build intersubjectivity and see from honestly-informed multiple-perspectives. Therefore, I suggest that the development of SsL, through the practice of SsR, can be a means by which pre-service and in-service teachers can (and should) reflexively and honestly evaluate their own sociocultural rootedness, and derive agency in relation to their teaching philosophies and resulting practices. Consider the following:

reflexive rootedness \(\text{ˈrɪ-ˈfleks-əv ˈrʊ-təd ənəs}\) the processes by which an individual recognizes and turns their sociocultural rootedness against itself making hidden aspects, and influences of their situation visible and open to scrutiny; exposing the underlying human roots.

This implies that the maneuvering of SsL can be incorporated into differing educational courses for pre-service teachers that may be only just formulating a teaching philosophy. I see potential in including this approach in action research conducted by educators on all levels of educational systems. The SsR conceived here, would provide educators a flexible approach for making sense of the seemingly enigmatic complexities of education. Moreover, this prompts
introspective consideration of the shaping that results from the reflexive relationship between themselves as teacher/learner, and their own educational experiences. This can be connected directly with reflective and reflexive practice (Bolton, 2010); however, it also encourages the possibilities found within the reflexive/reflective.

For science teachers, there are practical applications to consider. As I suggested in the previous section, there must be a broadening of scope and context when considering modes of making, interpreting, representing, and critiquing “meaning.” This responds to Zeidler and others (2016) call for bringing attention to the sociocultural aspects of science education. Through the inclusion and connections with other human dependent projects/pursuits, science is decentered, even within a science classroom. This decentering encourages an openness to other(s) and encourages co-realization of human rootedness, and the influences of power and control that may obscure them from view. This also prompts the reimaging of the science classroom as a place for interdisciplinary, practical, and creative experiences, making science functional, yet only as an aspect of each students shared humanness. Doing so can, in turn, counteract the effects of deficit frameworks that exist in science education policy and practice (Zeidler, 2016; Zeidler et al. 2016).

Through the exploration and opening-up of Research Question 1, ostensible boundaries between a SSI functional view of SL and scientific literacy were exposed (See Table 3, p. 93). The exploration of the deconstructive predicament of SL was made apparent in the form of SL ex loco and SL the Villain. The uncovered characteristics can be utilized heuristically by teachers, researchers, and other stakeholders to evaluate the brand of scientific literacy they are espousing, either implicitly or explicitly. Furthermore, the lens of the deconstructive predicament, along with these characteristics, can be extended to other concepts and constructs within education to
probe for hidden meanings, agendas, and disempowering forces. For teachers, this can help them identify aspects of their practices and philosophies that may hinder teacher-student interactions, while giving them a means to grapple with their own deconstructive predicament.

Through the exploration and opening-up of Research Question 2, it is implied that teachers should look for opportunities to practice and encourage the practice of SSPT in order to develop a deeper and broader perspective of their educational condition. It is also suggested that reflective and reflexive practices be developed and applied to all aspects of SsR and SSR, while identifying possible hidden influences that may affect those practices. From here, educators can help support students toward developing strategies to recognize how their interactions are shaping one another and their everyday situations (Lindahl, Folkesson, & Zeidler, 2019).

In relation to the development of SSI modules, the findings here suggested that teachers must begin with an honest and reflexive evaluation of their biases, belief systems, personal agendas, approaches, and teaching philosophies so to problematize the framing of moral/ethical questions related to the modules. This is also true of students engaging with SSI; they should be encouraged to cultivate introspective approaches buttressed by the practice of SsR so that they can begin to explore their own complexity before extending to murky aspects of the socioscientific issues with which they grapple. In addition, it has been implied that as students develop a sense of reflexive awareness, this should also be met with opportunities to develop compassion for others and to reimagine that compassion as an obligation to act. Teachers are encouraged to develop their own means of enacting the reflexive/reflective in their practices, while helping their students do the same. Through this active reflexive awareness, student-teacher interactions can be improved through a common search for intersubjectivity.
The exploration and opening-up of Research Question 3 directly implies that when students and teachers are grappling with SSI, they are required to utilize varying combinations and iterations of human thinking and acting that go beyond the scope of SL. This suggests that the development of a SSI functional view of SL, requires the acknowledgement of the other skills, literacies, habits of mind and modes of meaning making that interact with each student in similar yet particular ways. This means that teachers should support the personal defining of, while not set limits on, what being socioscientifically literate means. We must recognize that each individual student may cultivate SsL, based on their particular circumstances, interests, and ways of developing their own SsR. In other words, we must provide guidance, as well as choices, that are not tethered to particular means of assimilation or forceful acculturation.

It has also been implied that SsL through the practice of SsR, has the potential to be a metaphor for student learning/discovery in various classrooms focused on differing topics and issues (i.e., a cross-curricular goal). This does not imply that it is a goal that can be universally measured, but instead, owing to particularities of individual students, only facilitated and fostered. In some senses, this becomes heavily reliant on the rapports that teachers build with their students, which inform teachers in the types of guidance and support that is needed by each student. This also informs educators on how to help students develop in relation to measures of success they themselves set. This would also include helping students reflexively evaluate their selves and situations, making visible how their measures of success are shaped.

Finally, there are implications of pedagogical importance for science educators. We must begin to evaluate our own conceptions of SL, not only for clarity, but to uncover contradictions, tacit meanings/influences, and hidden motives and agendas. This suggests that a decentering of science is necessary, and while this seems like a literary trope, in the classroom the action is
relatively simple. It does not mean that science should be devalued, discarded, or rebuked, but instead simply revealed as not the most important thing in the science classroom. It requires opening science up as a human endeavor that has been formulating for centuries not only in scientific laboratories, but in the laboratories of human existence, as students inquire and make meaning of the world in which they dwell. We must view our students as human beings possessing the capacities to be far greater than simply scientifically literate.

As science teachers, we may advocate for causes driven by science, and even see such scientific progress as means to help all of humanity. In the classroom, when the door closes, and it is only you and the students, all of those things must be decentered, and the needs of the students must become central. Each student must be given the opportunity to be a bricoleur of their own ways of seeing themselves and universe around them. As teachers, we must provide our students with the “materials” and imperfect honest modeling of being human, to support, guide and share experiences that will shape both us and the students for a lifetime.

The final implication from this inquiry, a kind of prescriptive caveat, is that we, as science educators, must question what students actually need, as opposed to solely aligning their needs with what is prescribed by an external educational system. We may even find ourselves blaming that system for the many problems we and our students face, and perhaps even seeking ways to counteract or assuage the perceived negative effects those systems may cause. What is needed is to find a new point of departure predicated on the frequent and honest posing and grappling with the question, “How am I a part of the problem?” From there, we may find the real work of being a teacher, struggling with our own deconstructive predicament, revealing and fighting the coercive forces that knowingly or unknowingly affect our philosophies, pedagogies, and the ways we interact with our students. This is a formidable undertaking, that pales in
comparison to the everyday life of a teacher, yet it always already offers hope. Because even in
the midst of perceived failure, teachers that have taught bell-to-bell, day-to-day, year-to-year,
know that every moment on a school campus has the potential to be a new beginning, for our
students and for ourselves.

**Concluding (This Way to the Egress)**

The bellowing whistles, complimented the pillows of smoke from the engine, now
moving quickly and densely across the page. The faint aroma of burning coal, wafted through the
air, in which Es-el’s face felt fixed, as they gazed out through the window of the train. They were
watching the stranger, whom which they had shared a part of the journey and provocative
conversation. Es-el saw the stranger adjusting their backpack, looking down at their journal, and
finally heading on in a somewhat hesitant and what seemed to be a focused manner. Es-el, still
feeling perplexed from the stranger’s final comment, “center of the universe” Es-el questioned
indignantly; they made a clicking sound with their tongue and teeth, trying to brush it off, “I
know I’m not the center.” Nevertheless, this became a haunting and lingering thought for Es-el,
for years to come.

In that moment, the train moved, for a split-second Es-el thought it was the earth moving
outside. Their thoughts/emotions coalesced the comments of the stranger with the issues of the
Inuit. Es-el’s thoughts were like the colors in a shifting kaleidoscope, constantly changing in
shape and texture. Then, as Es-el looked out the window, viewing the bleak white plain, all the
colors were brought into focus by the one question, Es-el had yet to think or ask. They, had
indeed thought to ask, “how can I help,” many times. However, this new question, creeping ever
so slowly to forefront of their mind, actually frightened Es-el, which was a new characteristic of
questioning. They immediately wondered, “did my parents ask this question of themselves?”
Fright became sadness, then fear, then shame. Es-el, almost unwilling to form the thought into signs, finally, in an act of heroic bravery, asked *themself* the question, that perhaps *they* should have asked first, “How am *I* a part of the problem?”

Es-el, thought of the stranger’s final comments, and began to formulate excuses for why this can’t be true, “*I’m* not a part of the problem… *I can’t be…* *I’ve* never even heard of Inuit before.” Es-el now, for the first time on this journey, as *they* contemplated this thought of being a cause or part of the problem, began to cry. Thoughts of the declining, difficult, and defeating lives of the actual Inuit they had met or seen online raged in their minds. Es-el, put *their* face into *their* hands, and as the first tears reached the end of *their* human connection, one fell and splattered next to what seemed to be a scribbling on a white napkin. Es-el, bent down farther to pick it up, *they* wiped away the tears slowly to bring the lone words into focus.

It was but a question and a statement, the words stood out brightly for Es-el as if they were trying to escape the two-dimensional existence of the white napkin. It read, “Are we the issue, the problem, or at least a part? Maybe, just maybe, until we see ourselves as truly parts of the problem, we can never be a part of the truest solutions.” The words rushed through Es-el like a tsunami, leaving *them* confused, conflicted, yet somehow comforted; as if an answer and question, without words, occurred simultaneously. Es-el’s attention drifted back to the journey, as the train quieted and became still at the next stop. Es-el peering once again through the window, observed a platform bustling with human activity and in that moment a comforting transformative thought poured over *them*. For in that moment, Es-el did not see this as one stop of many. Instead, with a renewed vigor and happiness, as *their* tears faded into the vastness of the atmosphere, Es-el realized that *they* had only just arrived, at the beginning.
References


Appendix A: Copyright Licenses

Figures 4, 5, 6, 7, & 8

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