

12-2018

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CASES OF CONTINGENT STEM FACULTY WHO PRACTICE CRITICAL
PEDAGOGIES WITH/IN THE NEOLIBERAL UNIVERSITY

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Educational Leadership

by
Jeffrey Michael Kenney
December 2018

Accepted by:
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ABSTRACT

An increasingly neoliberal university means diminishing resources and labor security for those located in the lowest echelon, particularly those engaged in critical/radical/activist projects. The purpose of this study was to generate knowledge in an effort to sustain and advance critical pedagogical practices in college teaching. This study focused principally on the knowledge and insights of contingent STEM faculty who practice critical pedagogies in the neoliberal conditions of public universities. Utilizing critical and pragmatic perspectives, I explored both the ingenuity and practicality of the participants' praxis as well as examined the structural machinations of neoliberal capitalism within their teaching and learning environments.

I utilized a collective case study design to complete this study. The data sources were interviews, classroom observations, artifacts, and a questionnaire. The participants were four contingent STEM faculty at public universities in the state of Oregon. The results of the study are organized into four case reports, which are synthesized into recommendations for practice and future research. Practice recommendations consider the interests and goals of institutional leaders, faculty developers, and critical pedagogues. Research recommendations consider next steps for innovation in critical pedagogical practice and organizational change

DEDICATION

I dedicate this dissertation to Harold “Hal” Stevens, my friend and mentor. Thank you for your love and leadership in pursuit of social justice. Our relationship is one of this life’s greatest gifts.

I also dedicate this dissertation to my parents, who exemplify the many practices that made this journey possible:

- Nancy Kava, for your honesty, rigor, and fortitude.
- Bernie Kenney, for your curiosity, optimism, and creativity.
- John Kava, for your patience, collaboration, and generosity.
- Laura Kenney, for your love of community, celebration, and joy.

ACKNOWLEDGMENTS

To my advisor, mentor, and friend Dr. Tony Cawthon, thank you for your extraordinary wisdom, love, and support throughout this process. I have been transformed through your commitment, faith, and generosity. It has been an honor to share this journey with you.

To Dr. Robin Phelps-Ward, our relationship has been an unwavering site of motivation and affirmation. Your guidance elicited deep reflection, high scholarly standards, and creativity. Thank you for pushing me further than I thought I could go.

To Dr. Jane Clark Lindle, thank you for your time, energy, and wisdom during long conversations through which much of the focus and design of my study emerged. Thank you for your enthusiasm and critical insights.

To Dr. Larry Roper, thank you for sharing your knowledge and experience, as well as your assurance. I am so happy that this process became an extension of your professional mentorship. I admire you so much, and am humbled that you joined me in this process.

Many faculty members outside my committee have supported me directly, and indirectly, in the realization of this dissertation. Thank you, Dr. Jennie Farmer, Dr. Cheryl Warner, Dr. Pam Havice, Dr. James Satterfield, and Elaine Hiott, for your support, encouragement, and wisdom throughout my graduate studies. Thank you as well to my undergraduate faculty who were formative role models of scholarly rigor, curiosity and creativity, including Elizabeth Kronfield, Karla Hackenmiller, Jake Jacobson, Michelle Lang, and Jack Karraker.

To my “cohort”, Dr. Aris Hall, Dr. Stacey Garrett, and (soon to be Drs.) Courtney Allen and Amber Lange, thank you for our community, love, and laughter. Your knowledge and encouragement pushed me across the finish line.

To my many professional mentors, foremost Dr. Allison Davis-White Eyes and Dr. Philipp Kneis, thank you for your loving and relentless encouragement without which

I would not have completed this process. Also, Altheia Richardson, thank you for your inspiring and nurturing leadership into the world of social justice education.

To my innumerable colleagues who have motivated me, thank you for your intellectual, emotional, and spiritual support as well as your inspiration, insight, and solidarity. While there are many, I am particularly grateful to Teresita Alvarez-Cortez, Luhui Whitebear, Brandi Douglas, Christopher Hughbanks, Charlene Martinez, Miguel Arellano, Kali Furman, Jessica Beck, Brenda McComb, Julie Greenwood, Mamta Accapadi, Allyson Dean, Emily Bowling, Clare Cady, Daniel Newhart, Becky Morgan, Pauline Matthey, Amanda Bonilla, Kate Radford, Carrie Tucker, Janet Greenlee, Trey Boynton, Josh Peipock, Patty Griffin, Taryn Petryk and Greg Merritt.

To my friends, whose gifts are many and impacts immeasurable. Thank you to Jessica Bullock, Allison Staulcup, Anthony Razor, Erica Ely, Jeni Olney, Kristine Hoke, and Rachel Eikenberry.

Also, to the Kenney, Kava, and Howard families. Thank you for your love and support. In particular, (soon to be Dr.) Christina Vejnovich, thank you for your 34 years of service as my *Big Sister On Call*.

To my partner, and the love of my life, Dr. Jimmy Lee Howard, Jr. What an absolute treasure that we were able to walk this road together. I am so proud of what we have done, and who we have become. This dissertation is an artifact of the happiest years of my life. As I attempt to put into words what your kindness, honesty, bravery, and brilliance has meant to me, my sincerest expression of gratitude is to say: I love you.

Lastly, I would be remiss if I did not acknowledge the irony of writing a large proportion of this dissertation on the properties of Starbucks® Incorporated. Thanks for the quality coffee at competitive prices.

TABLE OF CONTENTS

	Page
TITLE PAGE	i
ABSTRACT	ii
DEDICATION	iii
ACKNOWLEDGMENTS	iv
LIST OF TABLES	viii
CHAPTER	
I. INTRODUCTION	1
Chapter Introduction	1
Problem Overview	3
Inquiry Overview	13
Chapter Summary	21
II. LITERATURE REVIEW	22
Chapter Introduction	22
The Neoliberal University	22
Critical Pedagogy & College Teaching	37
Humanistic STEM Education	54
Chapter Summary	74
III. METHODS	75
Chapter Introduction	75
Research Approach	75
Data Collection	92
Data Analysis	98
Chapter Summary	105

Table of Contents (Continued)	Page
IV. FINDINGS	106
Chapter Introduction	106
Précis: Claire.....	111
Précis: Alicia.....	113
Précis: Ashley	115
Précis: Sela	117
Case Report: Claire	119
Case Report: Alicia	158
Case Report: Ashley.....	202
Case Report: Sela.....	239
V. DISCUSSION.....	280
Chapter Introduction	280
Implications for Practice	307
Future Research	317
Conclusion	319
APPENDICES	320
A: Clemson University: IRB Approval	321
B: Oregon State University: IRB Oversight Determination	322
C: Oregon HECC Affiliate Institutions	323
D: HECC Report: Part-Time Instructional Faculty Race/Ethnicity	324
E: HECC Report: Full-Time Instructional Faculty Race/Ethnicity	325
F: HECC Report: Student Race/Ethnicity.....	326
G: Participant Recruitment Card	327
H: Participant Recruitment Flyer.....	328
I: Participant Recruitment Video	329
J: Participant Informed Consent and Questionnaire.....	332
K: Participant Recruitment Follow-Up Email.....	337
L: Participant Recruitment Summary.....	338
M: Interview Protocols	339
N: List of Artifacts.....	340
O: Field Observation Protocol.....	342
P: Participant Member Check Emails	343
Q: Data Collection & Analysis Protocol.....	345
R: Data Collection Schedule.....	346
S: A Priori Coding Scheme	347
T: Coding Summary	348
U: Timeline of Major Study Activities.....	349
REFERENCES	350

LIST OF TABLES

Table	Page
4.1 Summary of Study Participants.....	108

CHAPTER ONE: INTRODUCTION

Chapter Introduction

Neoliberalism is a modified form of liberalism, a paradigm that privileges free-market capitalism (Harvey, 2005). An increasingly neoliberal university means diminishing resources and labor security for those located in the lowest echelon, particularly those engaged in critical/radical/activist projects. For those faculty, teaching controversial topics in the neoliberal university with contingent appointments is precarious. The number of contingent faculty is growing (National Center for Education Statistics, 2018), and the increasing contingent faculty labor class has openly discussed the ambivalence of negotiating their professional and economic security with an activist-scholar identity (Clausen & Swidler, 2013; Griffiths, 2017; Jorgensen, 2015; Kezar, Bertram Gallant, & Lester, 2011; Sullivan, 2015). These tensions are reflected in tumultuous labor negotiations, like the 6-year battle of contingent faculty in the CUNY system to expand their individual semester contracts to 3-year contracts (Flaherty, 2017a). The divestment of teacher labor is indicative of a larger ideological divestment from the notion of higher education as a function of the public good (Carlson, 2017; Kezar, 2005a; 2005b).

Neoconservative watch groups publish lists of professors purported to advance propaganda or a liberal agenda, and are reported in online publications to garner media attention and institutional reprimand. Such surveillance threatens academic freedom—particularly when administrations listen and respond to the noise of such watch groups (Mele, 2016). Such groups include the Professor Watch List (Watchlist USA, 2017), the Foundation for individual rights in education (FIRE, 2017), and campus reform (Campus Reform, 2017).

The reprimand of faculty by state or institutional actors—whether for failing to conform to corporatization (Hyatt, Shear, & Wright, 2015; Hyslop-Margison & Rochester, 2016) or for

advancing politicized thought that threatens neoconservative agendas (Flaherty, 2017b; Redden, 2018)—is well documented. The implications of resisting the neoliberal university were exemplified by the dismissal of a math instructor at UC Berkeley who eschewed traditional evaluation techniques and revised the institution’s approaches to grading and testing (Roll, 2017a). Another example of reprimand was the University of Georgia faculty who “obstructed” traditional modes of grading by proposing a system of self-grading in their syllabus, in an effort to practice outcomes-based rather than performance-based pedagogy (Roll, 2017b). Neoliberal rationality also manifests as state leaders advocating the repeal of funds from curriculum that do not have explicit and measurable connection to job placement and economic prosperity (Seltzer, 2017).

Other examples of educators reprimanded for their incongruence with neoconservative agendas include the numerous adjunct faculty members who have been antagonized or distanced by their administrations for sympathizing with Black Lives Matter or Antifa (Quintana, 2017); or the board of governors closing multiple academic centers in North Carolina because of their expressed commitments to eliminating poverty, cultivating civic engagement and social change, advancing bio diversity, and openly critiquing Republican leadership (Fausset, 2015a, 2015b). Neoconservative antagonism of activist scholarship also appears in the form of defunding. For example, the defunding of institutional diversity initiatives at the University of Tennessee, in particular an LGBTQ center targeted for its outreach education in support of trans and non-binary communities (Miller, 2016).

The call for neutrality and apoliticism from neoliberal and neoconservative stakeholders coincides with broiling political tensions at public universities. Of note are recent White supremacist movements like those agitating the University of Virginia (Bauer-Wolf, 2017). The

current machinations of alt-right groups on college campuses compounded with neoliberal and neoconservative demands leave students, faculty, and staff in discord, uncertain and incapacitated (SPLC, 2017). Contrary to neoliberal and neoconservative desires, White supremacist and alt-right campus actions call for a faculty response that is not neutral, but politically engaged through scholarship and leadership (Zamani-Gallaher, 2017).

The aforementioned incidents reflect the central concern of this study, how neoliberal capitalism and neoconservatism continues to shape the academy. Whether through the restriction of resources, withdrawal of labor protections, implementation of obstructive policies, or the reprimanding and expunging of practitioners, the neoliberal university is obstinate to the transformative potential of critical pedagogy. The following study is an exploration of the science, technology, engineering, and mathematics (STEM) teacher activists who persist in the neoliberal university, and an attempt to glean their wisdom and insights for replication and amplification.

Problem Overview

Background of the Study

The premier contextual consideration for this study is socio-economic. The era of global neoliberal capitalism, emanating from the West and the United States in particular since 1970, underpins the instabilities in higher education (Giroux, 2014a) which represent the study problem. This study takes place amidst a period of unprecedented institutional growth in tandem with skyrocketing costs of attendance, stagnant faculty wages, eroding shared governance and academic freedom, and increasing investment in disposable labor (Bok, 2009; Giroux, 2002, 2014a; Shumar, 1997; Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004; Washburn, 2008).

Generally, neoliberalism is an ideology of free market fundamentalism, or the belief that deregulation and laissez-faire economic policies are better suited to guide and improve society than public institutions (Kumashiro, 2008). Neoliberalism is recognizable as reductions in government spending, privatization, deregulation, open markets, and reduction in labor protections (Klees, 2008). The neoliberal viewpoint is one that conceptualizes all people and functions through a lens of market value (Brown, 2015). Neoliberalism is essentially the financialization of everything (Harvey, 2005).

However, neoliberalism is more than a governance philosophy; it is a cultural ideology with pervasive logics and values. The cultural common sense of neoliberalism manifests as commodification (Polyani, 2001), instrumentalism (Kincheloe, 2008), meritocracy (Kumashiro, 2008), and privatization (Slaughter & Rhoades, 2004). In addition to common logics, neoliberal values appear as competition, efficiency, profit (Aronowitz, 2000; Giroux, 2002; Saunders & Blanco Ramirez, 2016; Shumar, 2008), consumer development, flexible labor (Saunders & Blanco Ramirez, 2016), and quantification (Kvale, 2007).

General Problem

Much has been written about the impacts of neoliberalism in public education, in particular the detrimental impact of capitalist governance on schooling (Hursh, 2001; Lakes & Carter, 2011). Neoliberalism, in tandem with neoconservative policy agendas, threatens to imbue every facet of the educational system, influencing what is taught, how material is taught, who has access, who teaches, who does research, what counts as valid research, and the overarching goals of higher education (Apple, 2006; Giroux, 2002, 2014a; Hill, 2007).

The neoliberal conditions of public universities have adverse impacts on teaching faculty, the student body, the curriculum, teaching, and research (Giroux, 2002; 2014a; Slaughter &

Rhoads, 2004; Slaughter & Leslie, 1997). For contingent teaching faculty, particularly those who engage critical pedagogy, their relationship with the neoliberal university is particularly tenuous as many function without tenure, unionization or other formal labor protections. As a result, they are more susceptible to termination or discipline related to their critical pedagogical practices (Freire, 2018; Giroux & Giroux, 2006; Lawrence, 2015). Neoliberal and neoconservative criticisms of public higher education have resulted in a gradual decay of shared governance, academic freedom, and tenure protections (Schrecker, 2010). Teaching in the neoliberal university or the nearly perfect corporate university (Lincoln, 2011; Slaughter & Rhoades, 2004; Washburn, 2008) increasingly requires that practitioners persist without tenure, amidst destabilized academic freedom, encumbered by administration and audit practices, and beholden to the student as consumer (Lincoln, 2011).

The student-consumer is an influential agent in the neoliberal curriculum. Curriculum evolutions reflect shifts in the 21st century knowledge economy, which is pressed to produce laborers with the capacity to continually learn and adapt to new information. The demand for skilled and dynamically trained labor is so great that educational institutions increasingly integrated corporate interests and parallel their curriculum to reflect market demands (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004). Corporate investment in higher education curriculum has exacerbated long-standing curriculum hierarchies, and reified the conflation of STEM curricula with economic sustainability and global competitiveness.

Tandem with curricula, the neoliberal university narrows pedagogical imagination and sanctions teaching strategies, which maximize profit, minimize resources, avoid conflict, and affirm hyper-individualism (Martin, 2015). The pedagogical values of the corporate university

(scalability, efficiency, de-politicization, and autonomy) were regarded as antithetical to critical pedagogy (Martin, 2015).

Neoliberalism also shapes higher education research. Neoliberal ideology is incompatible with traditional norms of academic science, that inquiry be communal, universal, disinterested, original, and skeptical (Merton, 1973). Similar to teaching and learning, Aikenhead (2007) reported research has been socialized through neoliberalism, and organized into hierarchies governed by politicized funding structures (Martin, 1998). The current era of post-academic science privileges knowledge that fuels capitalist cycles of supply and demand, and subordinates research without clear, direct, and substantial market value (Bernal & Villalpando, 2002; Carey & Swanson, 2003; Hart & Metcalfe, 2010; Lincoln & Tierney, 2004; Lynch, 2006).

Study Focus

This study focuses principally on STEM educators who practice critical pedagogies and how they navigate the neoliberal conditions of public universities. Critical pedagogy is a conception of social justice in education that mutually commits to conscientization, critical literacy, and socio-political action (Freire, 1998; Greene, 1998; McLaren & Fischman, 1998; McLaren & Baltodano, 2000; Shor, 2000). Critical pedagogy is a broad theoretical and practical tradition that emerged in the 1980s as an umbrella for those engaged in academic work for social justice in education (Lather, 1998). Critical pedagogy regards teaching as a vehicle for liberation and social change (Ayers, Hunt, & Quinn, 1998; Freire, 2000; Greene, 1988; Payne & Strickland, 2008) and resists forces within mainstream education designed to normalize, marginalize, subjugate, silence, dehumanize, and de-culturalize historically marginalized groups (Darder, 1991; Giroux & McLaren, 1986; Macedo & Bartolomé, 1999; Nieto, 1999).

Critical pedagogy is antagonistic to Eurocentric and androcentric power relations in education and insists that education function to produce thoughtful, capable, and engaged citizens activated for social justice (McLaren, 1995). Critical pedagogy transforms education from a system of power and control to a practice of liberation (Freire, 2000). Critical pedagogy is concerned with policy, norms, language, and behaviors that shape our social, political, economic, and cultural contexts (Fischman, 2005). As such, critical pedagogy is concerned with neoliberalism (Smith, Ryoo, & McLaren, 2009). What underscores the tension of critical pedagogy with neoliberalism is that critical pedagogy does not merely seek to understand the contexts of power, privilege, and oppression, but seeks to scrutinize institutions and their policies, knowledges, and norms for their congruence with democracy (Giroux & Giroux, 2006), and further transform them through radical democratic action (Fischman, 2005).

Reflecting on Paulo Freire, a seminal practitioner and scholar of critical pedagogy, Giroux (2011b) asserted that “Freire rejected those regimes of educational degradation organized around the demands of the market, instrumentalized knowledge, and the priority of training over the pursuit of the imagination, critical thinking, and the teaching of freedom and social responsibility” (p. 156). Critical pedagogy is dangerous to neoliberalism because it resists “discourses of privatization, consumerism, the methodologies of standardization and accountability, and the new disciplinary techniques of surveillance” (Giroux & Giroux, 2006, p. 3). Conversely, the managerialism and audit culture of the neoliberal university serve to inhibit and constrain the possibilities of critical pedagogy (Blackmore, 2009; Martin & Brown, 2013).

The focus of this study is the practitioners of critical pedagogy, or teacher activists (Montaño, López-Torres, DeLissovoy, Pacheco, & Stillman, 2002), who engage the philosophy and movements of social justice through their curriculum and instruction. As practitioners who

consciously and actively politicize learning (Freire, 1998), critical pedagogues undertake the struggle (and risk) of educational injustice through their praxis (Montaño et al., 2002). For instance, such critical pedagogies explicitly honor and integrate multiple ways of knowing in the classroom (Dei, 2002; Wane, Shajahan & Wagner, 2004; Tejeda, Espinoza & Gutierrez, 2003), confront manifestations of oppression in the learning environment (Howard, 2006; Sue & Constantine, 2007; Sue, Torino, Capodilupo, Rivera & Lin, 2009; Sue, Lin, Torino, Capodilupo & Rivera, 2009), or utilize the curriculum to map and interrogate contemporary social justice issues (hooks, 1994; Lather, 1998; Kincheloe, 2004; Darder & Baltodano, 2003; Martin & Te Riele, 2011). For these reasons, and others, critical pedagogues are often (mis)represented in neoliberal and neoconservative discourses as dangerous (Horowitz, 2006) to the mission of higher education and its constituents: students, parents, and the greater public.

Study Purpose

As the future of higher education is one that will likely further entrench itself in neoliberal rationality (Giroux, 2014a; Lawrence, 2015), the purpose of this study is to understand the praxis of those critical pedagogues who do successfully negotiate and navigate STEM disciplines, amidst conditions of austerity and vulnerability. A principal goal of the inquiry is to make visible to higher education leaders, faculty developers, and like-minded pedagogues the practitioners who are engaging practices that are seemingly incompatible with the conditions of the neoliberal university. This study emphasizes STEM education, as STEM is a conglomerate of curricula that is sanctioned by neoliberal and neoconservative discourses and benefits from disproportionate access to funding and resources (Gonzalez & Kuenzi, 2012). At the same time, academic programs with established critical scholarly, curricular, and pedagogical foundations like those in the humanities are increasing under resourced, consolidated, or disbanded (Jay,

2014; Bérubé & Nelson, 1995). As a result, assuming consistent trends, sustainability of critical pedagogy in public higher education will require the adaptation to increasingly adverse teaching and learning contexts. I center contingent faculty in the study, as the proportion of non-tenured, short-term contract teaching labor is steadily increasing. The number of contingent faculty in the US have grown disproportionately in comparison to tenure-track faculty, and this trend is expected to continue (National Center for Education Statistics, 2018).

There are opportunities for critical pedagogy in STEM education, and the potential of critical pedagogy in STEM is congruent with the trajectory of humanistic STEM education reform (Dos Santos, 2009). For instance, critical pedagogy seems an apt approach in preparing STEM learners for an understanding of not just science, but at least three societal: implications including: (a) how science is done, (b) the implications of the context in which science is done, and (c) the implications of who is doing science (Kuhn, 1996). Such examination also prepares STEM learners for what Ziman (2002) referred to as post academic science. Post academic science is a recognition that science is produced through a confluence of industrial and academic interests, and that vestment from diverse funding structures also shapes the research enterprise (Ziman, 2002).

Bryce (2010) asserted the opportunity for STEM education to debunk scientific reasoning as a privileged way of knowing that is objective, and independent of its context. Rather, science may be taught reflexively, as an interaction between the knower and what is known, and revealed as a value-laden pursuit permeated by social interests. Ziman (2002) argued for a science education, which engages the multiple contexts of science, and cultivates learners' socio-political consciousness.

To best prepare learners for post-academic science contexts, curriculum can and should engage more complex and dynamic notions of knowledge, through more diverse ways of knowing (Tytler, 2007). Similarly, Kitcher (2001) argued for a democratic approach to science and active engagement with the moral and political dimensions of science. Such a transition, toward pluralism, politicization, and civic engagement, is congruent with the project of critical pedagogy. As with critical pedagogy, education for post academic science is met with resistance as historically, science education has emphatically espoused commitments to a dispassionate and apolitical science (Bryce, 2010).

Humanistic science education reforms aim to recognize science education as a human endeavor (Aikenhead, 2007; Donnelly, 2004). While these reforms are nuanced, they generally share concern for a narrow intellectually enculturation of science learners and strive to expand science education beyond purely technical and productive views (Bryce, 2010). Humanistic science considers the relationships between learning science, learning to do science, and learning about science (Bryce, 2010). Humanistic reforms include initiatives like Science Technology and Society (STS), Science Technology Society and the Environment (STSE), Science for Public Understanding, Citizen Science, and Bildung Science.

Aikenhead (2006) characterized humanistic science as challenging positivistic views of western science, addressing socio-scientific issues, and encouraging social responsibility and action. Ultimately, advocates of humanistic science education reform hope to re-conceptualize scientific literacy (Vesterinen, Manassero-Mas, & Vázquez-Alonso, 2014) to include socially responsible action (Hodson, 2003) and the production of informed, competent, and politically engaged citizens (Jenkins, 1999).

Illustrating the need for critical pedagogy in STEM, Garibay (2015) utilized a robust

survey design with a sample of 6,100 undergraduate students, drawn from the Cooperative Institutional Research Program (CIRP) Freshman Survey and College Senior Survey, to explore whether STEM is producing socially conscious and socially engaged students. Garibay's study indicated a disparity of outcomes for STEM students, both at the time of matriculation and graduation. Garibay (2015) ultimately confirmed a negative relationship with declaring a STEM major and measures of social agency. In short, students who pursued STEM had lower multicultural dispositions—as an example, working for social change is less important than one's personal career goals. Further, research on both STEM students and STEM professionals suggested lower outcomes on measures of social and civic values compared to their non-STEM peers (Garibay, 2015).

These findings are concerning, because while STEM is complicit in numerous global problems, STEM education largely ignores these issues in the standard curriculum. Rarely is there mention of or respect for social responsibility in the STEM curriculum (Garibay, 2015; Dos Santos, 2009; Beagan, 2003), but the scholarly discourse on STEM education is shifting and arguing for an integration of critical and scientific literacies (Gunckel & Tolbert, 2018; Olsen, 2016; Lasker, Mellor, Mullins, Nesmith & Simcox, 2017; Letizia, 2017).

Because higher education standards for STEM education emphasize outcomes almost exclusively pertaining to content learning, retention, and post-graduation employment, national calls to address inequity and injustice in STEM are growing (Garibay, 2015). STEM teachers seeking to engage anti-oppressive pedagogy in their classroom are not alone, as a number of leaders and advocacy groups in STEM education are advocating for an address of global inequality and social responsibility with STEM curriculum (Garibay, 2015).

Study Importance

While efforts for humanistic science education reform span more than 20 years, education scholars have called for more radical approaches to science education (Dos Santos, 2009; Hodson, 2003; Kumashiro, 2009; Santos, 2006). Progress in humanistic science education reform has fallen short of a radical reorientation, where the movement has advanced consciousness and critical literacy outcomes in STEM education, consistently humanistic science education fails to engage science learners in socio-political action (Hodson, 2003; Vesterinen et al., 2014). These critiques resonate with Freire's (2000) assertion that conscientization alone will not suffice, realizing humanity demands action.

Frameworks for radical practices in STEM education are emerging, and these practices may take the form of service learning, deliberation and civic action regarding socio-scientific issues, or perhaps immersive undergraduate research opportunities (Garibay, 2015). Some scholars advocate for a distinctly Freirean approach with explicit implementation of conscientization and socio-political action in science education (Santos, 2006; Seiler & Abraham, 2009).

Translating theories of anti-oppressive education into practice is not easy (Kumashiro, 2001). Challenges abound, and include issues of teacher reticence, teacher capacity, theoretical congruence, practicality, teacher efficacy, institutional resistance, and student resistance (Kumashiro, 2001). The implications for this study are connected directly to the challenges of implementing and sustaining a critical STEM pedagogy.

As neoliberal logics continue to expand throughout the higher education enterprise (Giroux, 2014a), it is essential to understand the praxis of those practitioners at the nexus of vulnerability and resistance. The beneficence of the proposed study has theoretical, social, and practical implications. By identifying and explicating the lives and success of critical pedagogues

in seemingly incompatible epistemological spaces, insights may serve to fortify, inspire, and endear educators and administrators to anti-oppressive pedagogy in STEM education and beyond. This study may further reveal strategies for faculty preparation, institutional navigation, and learner readiness. For instance, this study may have implications for faculty developers and educators charged with the preparation of new faculty. Graduate preparatory programs, college teaching certificates, and centers for teaching and learning may reconsider their role and opportunities in producing college educators who embody and advance critical pedagogy. Also, higher education administrators with oversight and influence with resources, policies, and processes that influence and enable the lives of critical pedagogues may reflect on the opportunities in their leadership. The stories of this study's participants may map critical impasses under the purview of administrators, who may have agency to eliminate or relieve unnecessary resistance to critical pedagogical practices. Or, the amplification of these stories may reaffirm the academy as a site of interruption, transgression, and subversion to cultural hegemony and reinvigorate collective understanding of higher education as a site and process of social transformation.

Inquiry Overview

This study is focused on how contingent faculty in STEM who practice critical pedagogies make meaning of their resilience in the neoliberal university. This study follows the qualitative tradition as my inquiry centers on issues of perception and meaning making (Jones, Torres, & Arminio, 2014). A qualitative design was selected to allow increased attention to the complexity of multiple contexts and perspectives (Jones et al., 2014) and consequentially case study research was selected for its contextual bandwidth.

Inquiry Framework

The core worldview, which guides this study, is emancipatory (Jones et al., 2014). This study is guided by an acceptance that the world is organized in systems of power and those systems are inherently oppressive. In tandem, this research aims to contribute to the dismantling of those systems. Epistemologically, I am approaching this study from a position of critical pragmatism. This perspective is a combination of two traditions, pragmatism and critical theory, which exist in dynamic tension (Frega, 2014; Shalin, 1992). To reconcile some of the tensions of critical pragmatism, I attempted to hold close West's (1989) recommendation that a sophisticated pragmatism considers the socio-historical context in which knowledge is produced and center dynamics of power and disequilibrium in knowledge production. Thus, my critical pragmatism attempts to hold simultaneously the pragmatic values of skepticism, practicality, plurality, democracy, and practice—with critical theory's concern for dismantling hegemonic systems and realizing emancipation.

To enable the incisiveness and transformative potential of my research, I have undertaken both critical and pragmatic theoretical perspectives. My use of critical bifocality (Weis & Fine, 2012) facilitated a dual focus on the perceptions of the participants and structural machinations of neoliberal capitalism in which they operate. My wielding two theoretical perspectives looked like holding and honoring the accounts and explanations of the participants' experiences while also examining and critiquing the logics, practices, and conditions of neoliberal capitalism that permeate all aspects of contemporary life. Cooperrider and Whitney's (2001) appreciative inquiry centered positive regard for what works and why the study participants succeeded, lending balance to the largely interrogative dispositions of critical bifocality, which required emphasizing the creativity, resilience, and experiential knowledge of the participants.

Inquiry Statement

The expanding neoliberal ethos of higher education imperils the essential work of critical pedagogues who attempt to mobilize the university as a site for cultural change and to advance democracy and liberty. Critical pedagogy is directly antagonistic with the capitalist and hyper-individualistic underpinnings of neoliberalism and as a result renders practitioners of critical pedagogy vulnerable to the surveillance and regulation of the neoliberal university. The incompatibility of critical pedagogy is exacerbated in fields of science, technology, engineering, and mathematics (STEM) as they, increasingly, are positioned as the principal economic forces of higher education. At the same time, tenure and other employment protections, which serve to maintain academic freedom, are being eroded slowly through neoliberal and neoconservative forces.

It is essential to understand the praxis of those critical pedagogues who do persist and thrive in STEM disciplines, amidst conditions of austerity and vulnerability. This study was guided by one primary research question, with two sub-questions:

- Primary Question: How do contingent teaching faculty in STEM who practice critical pedagogies navigate the neoliberal university?
- Secondary Questions:
 - How did their praxis develop?
 - What does their praxis look like?

Jones, Torres, and Arminio (2014) asserted that the overarching purposes of qualitative research are: (1) “to illuminate and understand in depth the richness in the lives of human beings and the world in which we live” and (2) “to use new understanding for emancipatory practices” (p. 11). To extend this potential, I chose a methodology, which accounts for multiple contexts including the temporal, spatial, historical, political, economic, cultural, social, and personal.

My particular design was an instrumental, collective, descriptive, and critical case study. The design is instrumental in that it is driven by a question external to the case (Stake, 1995), meaning the case was selected for its utility in answering the research question, not to explore the case in and of itself. My design choices affirm that I was not interested in a particular college teacher, but how college teachers navigate a particular issue in a specific context of interest. When several instrumental case studies are involved, Stake (2000) labeled the design a collective case study. In collective case study, multiple perspectives amplify the learning potential of the inquiry.

The study design is also critical, in that it is centrally concerned with issues of power. Case study is conducive to combination with a theoretical perspective (Jones et al., 2014). The centering of critical theory in the study design enables the inquiry by keeping “the spotlight on power relationships within society so as to expose the forces of hegemony and injustice” (Crotty, 1998, p. 157).

The study population is defined by four criteria. Participants are (1) contingent teaching faculty in (2) accredited public colleges and universities. Contingent faculty includes all teaching faculty who are not tenured or tenure line faculty and excludes graduate teaching assistants. Accredited public colleges and universities include institutions of all scales and locations within the United States including 2-year, 4-year, and doctoral granting institutions.

The study population also (3) held Science, Technology, Engineering, or Mathematics (STEM) teaching appointments, for example a part-time adjunct appointment as a geology and general science instructor at a 2-year public institution and a full-time mathematics instructor at a large 4-year public institution. STEM is a variably defined, and for the purpose of this study concerns applied science fields falling within the contemporary funding priorities of state and

federal governments. For inclusion, study participants must have taught a STEM course within either the last year, or plan to teach a STEM course within six months of study recruitment. Additionally, the study population's (4) praxis reflected core tenets of critical pedagogy. Specifically, the study population asserted intention to cultivate through their curriculum and instruction student outcomes related to conscientization, critical literacy, and/or sociopolitical action.

Consistent with Stake's (1995) guidance for instrumental case study, the sampling technique was purposive. The primary selection criteria were cases which maximized learning related to the research question (Stake, 1995). Inclusion also considered access and resources and remained flexible to the volatility of cases allowing from the dropping and adding of cases early in the research process (Stake, 1995).

Four data sources were used to triangulate the participants' experiences. My primary data sources were a questionnaire and individual interviews. My secondary data sources were via the collection of artifacts, and classroom observations. The primary data sources served to capture and describe the participants' experiences, where the secondary sources served to explore and build context for the participants' experience.

Analysis techniques included open initial coding, axial coding, and memo-writing. Open coding (Charmaz, 2006) entailed a close reading and accounting of all pieces of data. Subsequently, I engaged in data reduction, that is, axial techniques (Corbin & Strauss, 2008). My subsequent coding passes collapsed the open codes from my first pass, as well as explicitly sought power relations per critical bifocality (Weis & Fine, 2012).

I organized the findings for my study in a series of four case reports. I synthesized and organized the content of these reports into recommendations. Practice recommendations consider

the interests and goals of institutional leaders, faculty developers, and critical pedagogues.

Research recommendations consider next steps for innovation in critical pedagogical practice and organizational change.

Positionality

To extend the discussion of research paradigm, I offer insight into a number of social locations, which inform every dimension of my research activities. While I am experienced and thoroughly socialized as a higher education administrator and college educator, those experiences and insights do not eclipse my formative experiences as a white, Queer, cisgender, male, differently-abled, and suburban middle-class person. Moving through the world as white, male, cisgender, and middle-class affords perspective (assuming reflexivity) on the hegemonic systems through which privileged knowledge is constructed. My Queer and differently-abled experiences have uniquely illuminated the instability of privileged essential knowledge claims, the binaries produced by those claims, and the oppressive systems operating through the production of those binaries.

My experiences within my marginalized identities lead to an epistemological disposition, which recognizes the variability of knowledge between individuals across time, space, and culture. This pluralistic concept of knowledge troubles notions of objectivity, and secures that the knower is an intimate part of what is known (Green, Camilli, & Elmore, 2012). I elaborate on my position as a critical pragmatist in chapter three, and underscore that my commitment as a scholar practitioner centers inquiry that produces actionable solutions for social progress. My values of community, participation, dialogue, and utility are represented best in the tension of a critical pragmatism (Forester, 2013).

My inquiry is also shaped by my professional experiences in higher education. My career opportunities have included roles in housing and residence life, diversity and social justice education, advocacy with LGBTQ+ communities, and research and assessment for multicultural programs and services. Currently, my work focuses on the facilitation of intergroup dialogue and dialogic capacity building for students, faculty, and staff at a large, public, land-grant institution. I have been trained as an artist, counselor, educational administrator, and instructor. I have worked in rural, suburban, and carceral contexts. Each of these experiences continues to produce my worldview, my values, and my motivations in scholarship.

Terms

- Contingent Faculty — includes all teaching faculty who are not tenured or tenure line faculty and excludes graduate teaching assistants.
- Critical Pedagogy — an approach to teaching as a vehicle for liberation and social change (Ayers, Hunt, & Quinn, 1998; Freire, 2000; Greene, 1988; Payne & Strickland, 2008). Critical pedagogy regards mainstream education as marginalizing, subjugating, silencing, and de-culturizing to subaltern groups (Darder, 1991; Giroux & McLaren, 1986; Macedo & Bartolomé, 1999; Nieto, 1999). As such, action through critical pedagogy interrupts the Western Eurocentric and androcentric power dynamics, which reproduce the inequality of the status quo by reworking the power relations between teacher and student (McLaren, 1995). Through the creation of radical educational practices and spaces (Giroux & Giroux, 2006), critical pedagogy fosters (1) conscientization, (2) critical literacy, and (3) sociopolitical action – all towards liberation.
 - Conscientization — “an awareness of one’s socio-political location in a particular context” (Seiler & Abraham, 2009, p. 743) and the needed skills to critique one’s

social position and context (Ladson-Billings, 2006). Conscientization includes understanding how power relations embedded in societal and institutional structures reproduce inequality (Seiler & Abraham, 2009). Conscientization is analogous to scholarly notions of reflexivity (Door, 2014), in that conscientization demands self-awareness, and the interplay and influence of self in relation to knowledge, others, and the world.

- Critical Literacy — also called critical reading (Giroux & Giroux, 2006; Hemmings, 2000) is a literacy of not only the word, but the world. Critical reading comprehends what is said, what is not said, the context in which it is said, the mode with which it is conveyed, and how it is received (Kucukaydin & Cranton, 2013). Critical literacy includes a capacity often referred to as problematization, which is a competence to discern social, political, and economic contradictions (Hemmings, 2000).
- Sociopolitical Action — the attempt to resolve conflicts, following deep exploration of the contexts and conditions from which the issue manifested (Hodson, 1998). Sociopolitical action is the critical distinction between caring *about* and caring *for* an issue (Curtin, 1991). Building upon critical literacy, understanding the conditions of racism, sexism, classism, cis-heteronormativity, and other forms of discrimination in society, sociopolitical action is a political literacy of civic participation (Hodson, 1998).
- Humanistic STEM Education — a number of science education reforms seeking to recognize science as a human endeavor (Aikenhead, 2007; Donnelly, 2004).
- Neoconservatism — an aggressive moral-political philosophy that advances global

free market capitalism, nationalism, and militarism (Brown, 2006).

- Neoliberalism — an amoral-political philosophy (Brown, 2006) of government deregulation, and a constellation of policies that privileges the free market over public institutions to guide and improve society (Kumashiro, 2008). Typical policy manifestations of neoliberalism include reduction in government spending, privatization of government operations, dismantling of trade protections, enabling the flow of foreign capital, and reducing or eliminating worker protections (ex: trade unions) to realize a more flexible labor force (Klees, 2008).
- Science, Technology, Engineering & Mathematics (STEM) — a conglomerate of curricula that is sanctioned by neoliberal and neoconservative discourses and benefits from disproportionate access to funding and resources (Gonzalez & Kuenzi, 2012).

Chapter Summary

This study attempts to reveal and produce knowledge about the resilience and persistence of contingent STEM faculty who practice critical pedagogies in public universities. This area is researched minimally in post-secondary education, and the results may have immediate implications for practitioners and policy makers and suggest new pathways for scholars. In the following chapters I will: (a) synthesize the literature that foregrounds my study (Chapter 2); (b) construct an argument for my methodological approach (Chapter 3); (c) make meaning of the data collected (Chapter 4); and (d) share my findings and offer implications for future research (Chapter 5).

CHAPTER TWO: REVIEW OF THE LITERATURE

Chapter Introduction

This chapter presents three broad literatures concerning (1) the neoliberal university, (2) critical pedagogy and its contemporary practices, and (3) humanistic reforms in science education and the trajectory for critical pedagogic practices in STEM. These literatures serve to illustrate the context, problem, focus, and importance of the study, and foreground relevant knowledge to frame the lives and practices of social justice educators in STEM education.

The Neoliberal University

The review of the literature begins with a discussion of public higher education's context, and the social, economic, and ideological factors that shape it. From a broad and critical perspective, this study concerns how neoliberal capitalism has shaped the academy, influenced its actors and functions, and how critical pedagogues navigate whilst engaging in seemingly antithetical practices. Globalization and neoliberal ideology influence every function of life, and higher education is no exception (Lawrence, 2015). Because neoliberal ideology has penetrated all domains of social life, and operates as common sense, educators and scholars must necessarily adapt to, reflect in, and learn through the neoliberal university (Ball, 2012).

Neoliberalism

Neoliberalism is a broad and diffuse concept, which in social science can refer to a number of different meanings (Saunders, 2015). Generally, neoliberalism is an ideology of government deregulation, and a constellation of policies that privileges the free market over public institutions to guide and improve society (Kumashiro, 2008). Typical policy manifestations of neoliberalism include reduction in government spending, privatization of government operations, dismantling of trade protections, enabling the flow of foreign capital,

and reducing or eliminating worker protections (ex: trade unions) to realize a more flexible labor force (Klees, 2008). Together, these practices have been described as the neoliberal project of enclosure, through which public spaces are infiltrated and destabilized via privatization (De Lissovoy, Means, & Saltman, 2014; Saltman, 2006). In K-12 public education system, enclosure looks like voucher programs, charter schools, and privatizing public services related to curriculum and assessment (Lipman, 2005).

Neoliberalism is driven by market fundamentalism. Market fundamentalism is the belief that social problems can be resolved through a free-market economy (Apple, 2006; Giardina & Denzin, 2013); a presumption that extends beyond policy and into social, cultural, and political spheres (Bourdieu, 1998; Chomsky, 1999; Giroux, 2002; Mirowski, 2013; Olssen & Peters, 2005; Osei-Kofi, 2012; Robbins, 2005; Shumar, 2008; Sloan, 2008). Neoliberalism is not simply the privatization of formerly public spheres, as Neoliberalism re-conceptualizes everything, particularly humans, through a lens of capital investment and appreciation (Brown, 2015). In short, neoliberalism is the financialization of everything (Harvey, 2005).

Neoliberalism should be distinguished from *globalization* and *neoconservativism*. Though often conflated, the term neoliberalism does not encompass the impacts of globalization; however, it does bring a politically necessary emphasis (Hall, Massey, & Rustin, 2013). Globalization refers to the free movement of resources, labor, and information and the resulting integration of diverse worldviews and cultures (Albrow & King, 1990). Similarly, it is useful to recognize the influence of neoconservativism apart from neoliberalism (Osei-Kofi, 2012). Neoconservativism is a value organization that defends the rights of the individual (Kumashiro, 2008), and advances individual responsibility, competition over cooperation, and the normalization of social inequality (Apple, 2006; Harvey, 2005; Hill, 2007; Osei-Kofi, 2012).

Apart from globalization and neoconservatism, neoliberalism is distinguished by a set of pervasive logics and values. Of the common logics, which underpin neoliberalism, foremost is *commodification*. Commodification is a process of objectification and financialization that considers all reducible units of life through a framework of consumption. In higher education, this means treating education as an object to be bought and sold within the capitalist market (Polyani, 2001). Other fundamental logics include instrumental rationality (Kincheloe, 2008), meritocracy (Kumashiro, 2008), and privatization (Slaughter & Rhoades, 2004).

In addition to logics, neoliberalism is distinguished by a number of values. In the global pursuit of capital, neoliberalism values competition, maximizing efficiency and profit (Aronowitz, 2000; Giroux, 2002; Saunders & Blanco Ramirez, 2016; Shumar, 2008), consumer development, and flexible labor (Saunders & Blanco Ramirez, 2016). Such values manifest in educational organizations, and contribute to the creation of the education object (Bok, 2009). Quantification is also a value. In education, quantification helps determine the commensurability of education as a commodity to inform the consumer of an educational object's market value (Kvale, 2007).

Neoliberal ideology imbibes all levels of social life, including higher education (Giroux 2002; 2014a). Neoliberal logics and values are accepted as everyday thinking and in turn regarded as natural and inevitable (Ball, 2012). Neoliberalism is itself a public pedagogy that inculcates itself across multiple institutions to transform neoliberal desires, needs, and values into a culturally internalized common sense (Giroux & King, 2016). Though neoliberalism is deeply critiqued, in particular following the 2008 financial collapse (Crotty, 2009; Duménil & Lévy, 2011; Kotz, 2009), neoliberal rationality and free-market fundamentalism persists as virtuous and common sense (Giroux, 2009a).

History. Neoliberalism is a global phenomenon, driven by a network of international organizations including the World Bank, Organization for Economic Co-operation and Development, and the International Monetary Fund, and not exclusive to the United States (Harvey, 2005). Neoliberalism is understood more effectively in the context of late capitalist history, as the present and dominant form of capitalism (Saunders & Blanco Ramirez, 2016). The ascent of neoliberalism is associated with 1980s era Reaganomics, and the subsequent blurring notions of public and private (Harvey, 2005). The time was marked by fierce advocacy for “unbridled entrepreneurial freedom, free markets, free trade, a radically reduced state, and vigorously promoted consumerism” (Smart, 2010, p. 19). The neoliberal transition of the American university also originated in the late 1970s, post democratization (Hachem, 2016). The 1980s marked similar major changes in American higher education (Cannella & Miller, 2008); notably, a boom of corporate partnerships and private giving (Washburn, 2008).

Societal impact. Critiques of neoliberalism are ubiquitous (Chomsky, 1999; Harvey, 2005; Klein, 2008; Polyani, 2001; Stiglitz, 2003) including critiques of neoliberalism in education (Bok, 2009; Donoghue, 2008; Giardina & Denzin, 2013; Kirp, 2004; Osei-Kofi, 2012; Shumar, 1997; Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004; Soley, 1995; Tuchman, 2009; Washburn, 2008). Across critiques of neoliberalism, a common theme resonates: neoliberalism is not natural nor inevitable. As previously asserted, neoliberalism is a formidable pedagogical force, “attempting to erase everything critical and emancipatory about history, justice, solidarity, freedom, and the meaning of democracy.” (Giroux, 2009b, p. 8). The insidiousness of neoliberalism is its reproduction as an educational project, which seeks to propel particular subjectivities, ways of knowing, and types of conduct (Giroux, 2009b). This transformation results in complex and a far-reaching impact on democratic public life (Giroux,

2004a). Broad impacts concern issues of (1) surveillance, (2) inequality, (3) community, and (4) imagination. Neoliberalism exacerbates surveillance of minorities, and disposes of unwanted or un-useful people in the neoliberal economy. The school-to-prison-pipeline illustrates the predominant forms of neoliberal surveillance in education is (Giroux, 2009b).

Systems of surveillance serve to reproduce inequality. Those deemed "deficient" by the system are discarded or even criminalized with little concern for their humanity (Darder, 2012). Inequality is exacerbated, which broadly results in the concentration of wealth and power with an elite class, and inflaming issues of income inequality, hunger, and homelessness. An example of growing inequality in education is student debt (Giroux, 2009b).

Neoliberalism has adverse effects on community as notions of public good are sacrificed for individual interests, and goodness is marginalized to issues of consumer satisfaction. The result is a dismantling of community and social bonds (Giroux, 2009a). Social problems are privatized and reduced to narrow solutions of self-reliance, which lends to individual blame – rather than critique of larger social structures (Giroux, 2009a).

Neoliberalism also limits the collective imagination. As the public sphere is eroded, the private sphere becomes the only space where young people can imagine “any sense of hope, pleasure, or possibility” (Giroux & Giroux, 2004, p. 222). Neoliberal ideology limits spaces for cultural work and opportunity for young people to shape their conditions through dialogue, civic engagement, and socio political action (Giroux, 2009b). In education, this looks like faculty and administrators failing to appreciate the role of education in the cultivation of engagement in democratic public life (Giroux, 2009b).

Educational impact. There is a rich and focused discourse addressing neoliberalism’s specific impact on public education. At center is the insidious and encoded language of

education reform (Hill, 2007; Shahjahan, 2012) which seeks to defund public schooling (Hursh, 2001; Lakes & Carter, 2011). A predominant critique of the neoliberal agenda in education is the posturing of schools as businesses (Hursh, 2001; Lakes & Carter, 2011), and how corporate logics and values imbue decision making about the who, the what, and the how of curriculum, teaching, and research as well as the overarching goals of higher education (Apple, 2006; Giroux, 2002, 2014a; Hill, 2007; Osei-Kofi, 2012). Critiques of neoliberalism in education particularly attend to issues of (1) commodification, (2) homogenization, (3) massification, and (4) dissociative identity.

The commodification of education is a central critique of neoliberalism (Saunders & Blanco Ramirez, 2016), specifically the transformation of education as a private good for individual consumption (Bok, 2009; Naidoo & Jamieson, 2005; Shumar, 1997). Commodification flattens education into a one-dimensional economic exchange. This reduces education to a transformation of a learner's market viability (Naidoo & Jamieson, 2005) with the tangible educational object being the degree (Saunders & Blanco Ramirez, 2016). A market orientation to education, which reduces the learning process into a transaction with an expected return on investment (Saunders & Blanco Ramirez, 2016), results in a market relationship that leaves students vulnerable to exploitation (Saunders, 2014). Neoliberal ideology also serves as a force of homogenization (Harvey, 2005; McDermott, 2007). In schooling, this looks like conformity driven by systems of competition, compliance and fear (Picower, 2011).

Higher education is amidst a period of massification driven by neoliberal demands for up-scaling and expansion of programs and services to maximize profit and efficiency (Clarke, Hyde, & Drennan, 2013; Hill & Kumar, 2012; Stromquist & Monkman, 2014). The massification of higher education, domestically and internationally, is a function of ensuring

institutional and state wellbeing, which is driven by the necessity to cultivate labor for the knowledge economy (Lawrence, 2015).

The aforementioned educational impacts result in dissociative identity. Where public higher education historically has been a more balanced site of holistic development, deep learning, and workforce preparation, increasingly higher education is being repositioned exclusively as an arm of commerce principally concerned with matters of economic productivity and production of citizens for the knowledge economy (Hachem, 2016). The imbalance results in a struggle for identity, and a public higher education system wrestling with ethical, political, ontological, epistemological, and aesthetic ambivalence (Hachem, 2016). The American University at once holds dissonant values, priorities, and paradigms, which creates confusion and consternation among its constituents.

The Faculty

Faculty are impacted by neoliberal and neoconservative forces, particularly those who practice critical pedagogies, through the compromise of academic freedom and labor protections. Higher education is amidst an onslaught of neoliberal and neoconservative criticisms. Such criticisms seek to erode academic freedom in an effort to advance the corporatization and privatization of American public universities (Schrecker, 2010). Lincoln (2011) described the nearly perfect corporate university (Slaughter & Rhoades, 2004; Washburn, 2008) as one that eliminates tenure, destabilizes academic freedom, encumbers personnel with audit practices, and aligns students and faculty in a consumerist relationship.

Practices of intellectual freedom (openness to diverse perspectives, rigorous analysis, and critique) are a relatively recent invention in U.S. higher education. Academic freedom was an ideological reform led under the creation of the American Association of University Professors

(AAUP) in 1915 to create legal protections for faculty engaged in controversial projects. Such protections established processes for faculty review and dismissal apart from the governance of trustees and donors (Hofstadter & Metzger, 1955).

John Dewey founded the AAUP 100 years ago, in response to corporatization, to establish a resistance to troubling practices in faculty hiring and labor conditions. Prior to the establishment of academic freedom, conflict with donors or trustees, or criticism of established norms or social orders made faculty vulnerable to dismissal (Cannella & Miller, 2008). The establishment of academic freedom, and the organization of faculty peer review, evaluation, and promotion structures, once, enabled scholarship in critical and often controversial arenas (Cannella & Miller, 2008). Particularly relevant to critical pedagogy, such protections are critical for inquiry that examines issues of equity, justice, diversity, and anti-oppression (Cannella & Miller, 2008). Despite developments in academic freedom, struggles of corporate control have persisted in higher education (Washburn, 2008). The last four decades in particular mark a sharp corporate turn in higher education (Cannella & Miller, 2008).

The resulting impacts of corporatization on college teaching are summarized here as issues of capacity, agency, and vulnerability. Regarding capacity, neoliberal logics of efficiency and profit result in the ballooning of faculty responsibilities. Faculty time, increasingly, is consumed by the demand to identify and compete for external revenue, including research grants and research consultancies (Winefield et al., 2003). Additionally, faculty are experiencing increases in managerial workloads, specifically audit exercises (Giri, 2000). Management tasks consume time critical to research, teaching, and any activism integrated with such tasks (Shore, 2010). Austerity measures like audit exercises have arguably outreached their intended purpose of sincere stewardship and have proliferated into an overgrown audit culture (Lincoln, 2011).

Related to issues of agency, Strathern (2000) defined audit culture as a neoliberal strategy to regulate behavior and induce conformity within a profession. Lincoln (2011) regarded such audit practices as a form of Foucauldian surveillance, a regulatory system of the state, which distrusts individual freedom and autonomy. Amit (2000) similarly invoked Foucauldian sentiments of power and control in referring to the surveillance state of contemporary audit practices as a panopticon of reporting. Audit culture inhibits control on curriculum, pedagogy, and assessment (Blackmore, 2009), growing restrictions on the freedom to teach (Lincoln, 2011). The increasingly inhibited teacher workforce struggles in the corporatized environment. Demand to produce more with less is incommensurable with the complexities of teaching and learning (Cannella & Miller, 2008). Classroom conditions, which center consumer satisfaction and incentivize streamlined and scalable instructional design, disincentivize rigor, complexity (Cannella & Miller, 2008) and other fertile learning conditions for critical pedagogy.

The college teachers who are over-capacity, and disempowered, are also more vulnerable. The commodification of education leads to the exploitation of academic labor, particularly contingent teaching faculty (Bousquet, 2008). Neoliberalism demands flexible labor to respond swiftly to market changes, a reliance on contingent faculty reduces institutional expenses and enables greater administrative control (Bousquet, 2008; Rhoades, 1998). The growing contingent workforce typically does not have tenure and is not expected to engage in research (Washburn, 2008).

According to the U.S. National Center for Education Statistics (2018) from fall 1999 to fall 2016, the total number of faculty at degree-granting postsecondary institutions increased from 1.0 to 1.5 million. In that same time period:

The number of full-time faculty increased by 38 percent over this period, while the number of part-time faculty increased by 74 percent between 1999 and 2011, and then decreased by 4 percent between 2011 and 2016 (para. 1).

Cannella & Miller (2008) suggested an even larger contingent workforce would emerge, with limited agency in curriculum and instruction. Increased demand for contingent labor has resulted in a deskilled class of college educators, who are focused on technical content, with limited control pedagogically or administratively (Giroux, 2014b).

The Student Body

Students and parents are viewed as consumers in the neoliberal university. As a result of public divestment, Connell (2013) stated the costs and responsibilities of education were exerted increasingly upon students. These conditions drive learners and their stakeholders to search the educational market for the best product at the lowest price (Dickeson, 2006). The neoliberal university, and the production of the student as consumer, cultivates a student neoliberal self – a self that is less interested in civic or public good, and more inclined toward self-interest (Fitzsimons, 2011).

Under neoliberalism, cultural notions of the good life have transitioned to a focus on individual wealth and economic superiority (Grant, 2012). Neoliberal schooling socializes student to conceptualize learning as a function of skill development for the purpose of job placement, individual wealth, and economic superiority (Etzkowitz, Webster, & Healey, 1998). As such, students pursue courses and curriculum, which they perceive to improve their employability (Brulé, 2004; Engell & Dangerfield, 2005). Student desires for employability and economic prosperity drive the production of curriculum that is profitable and marketable to students (Engell & Dangerfield, 2005).

In addition to curriculum, student consumption also drives pedagogy. Increasingly, teacher performance is measured via student evaluations, which exacerbate a consumer relationship between faculty and student (Brulé, 2004; Engell & Dangerfield, 2005; Giroux, 2002; Osei-Kofi, 2012). As a result, quality teaching and learning often are conflated with student happiness and satisfaction (Hill, 2007). An over-reliance on student evaluations undermines comprehensive measurement of learning. Student evaluations fail to capture student learning, including nuances of transformative learning indicative of social justice education (Bell, Morrow, & Tastsoglou, 1999; Titus, 2000; TuSmith & Reddy, 2002).

Curriculum

Curriculum in the neoliberal university is driven by the demands of the neoliberal economy. The 21st century knowledge economy marks a shift from blue-collar labor toward more specialized white-collar labor (Santos, 2006). The demand for more highly technically skilled labor has driven higher education to produce more laborers with the capacity to continually learn and adapt with the changing knowledge economy. Such demands are reflected in reforms like 21st century skills (Bybee & Fuchs, 2006).

Educational institutions increasingly integrate corporate interests so that curriculum parallels demand of labor and production (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004), and in preparing learners for the 21st century knowledge economy, there is debate over the value of the humanities and liberal arts in workforce development (Sigelman, 2016). The derision of the liberal arts has been exacerbated by the rising audit culture, as outcomes measurement serves to create reinforce curriculum hierarchies (Mayo, 2009) and further conflate STEM curricula with global competitiveness (Gordon & Shea, 2013).

Grant (2012) reported that the student as consumer paradigm shaped curriculum, reducing higher education to a function of employability and consumerism. The drift away from education for citizenship and public good, and towards economic, military, and vocational interests (Giroux, 2014a) has been reflected in the reduction of degree programs serving the public good (Hodkinson, 2009). Questions of curriculum and learning for commerce and economic viability are amplifying, where questions of learning for the purpose of engaged citizenship and public participation are waning (Aronowitz, 2015; Giroux, 2014a). Consequently, pressure to produce classes that are profitable and marketable to students (Brulé, 2004; Engell & Dangerfield, 2005), decreased exposure to alternative ways of thinking (Hodkinson, 2009).

Similarly, critical pedagogy is subjected to neoliberal commodification. The discourses, or scholarly and professional communications, related to diversity and multiculturalism have been co-opted (Darder, 2012; Hale, 2005; Melamed, 2006; Mitchell, 2003). Rather than undertaking emancipatory projects of reparation and decolonization, Atasay (2015) stated neoliberal “social justice” was concerned with equalizing success and preparing all learners for global competition.

Teaching

Neoliberal pedagogies are antithetical to critical pedagogies, as they privilege tools and strategies for teaching and learning which maximize profit and productivity, neutrality, and hyper-individualism. Teaching in the neoliberal academy is characterized by preoccupation with efficiency, de-politicization, and autonomy.

Foremost, college teaching has responded to the neoliberal demands for profit through pedagogical scaling. As a function of efficiency, scaled learning environments, such as massive open online courses (MOOCs) and hybridized classrooms, lend to homogenization (Church,

2008; Osei-Kofi, 2012; Packer, 2002), compounding the already narrowing effects of learning outcomes assessment on the curriculum (Blackmore, 2009; Lawrence, 2015). Scaled pedagogies have been in demand, and faculty have been incentivized heavily to engage online or in hybridized platforms (Tomei, 2006; Ukpokodu, 2008). As discussed previously, contingent faculty are limited in their agency, and are more likely to teach online classes (Association of Public and Land Grant Universities, 2009).

Neoliberal ideology also sanctions de-politicized teaching and learning. Conceptualized as Freire's (2000) notion of "banking", claiming a neutral transmission of knowledge, is a model of pedagogical violence. Practitioners of critical pedagogy however recognized that teaching is inherently political (Freire, 1998; Giroux & Giroux, 2006; Shor, 2000).

Neoliberalism also privileges autonomous learning, which numerous scholars have critiqued as the production of the 'neoliberal self' in education (Apple, 2006; Fitzsimons, 2011; Hursh, 2001; Gorlewski, Lalonde, & Gorlewski, 2017; Matusov, 2011). The neoliberal self includes preoccupation with self over civic interests, distorted sense of independence, preoccupation with consumption, and detachment from socio-historical context (Fitzsimons, 2011). Critiques of autonomy in neoliberal teaching have also addressed the rise in technocratic practices of self-directed learning (Bonnett & Cuypers, 2008).

Research

The neoliberal conditions of the American university shape knowledge production, analogous to the formation of labor, learners, curriculum, and pedagogy. Neoliberalism socializes and corporatizes higher education research, and establishes epistemological hegemony.

Science does not occur in a vacuum; rather knowledge production takes place within an elaborate network of socialized science (Aikenhead, 1994). For instance, traditional norms of science per Merton (1973) were those, which are communal, universal, disinterested, original, and skeptical. Conversely, Kincheloe (2008) stated that neoliberal market interests strove for science that increasingly becomes privatized and lucrative (Kincheloe, 2008). Because information operates in hierarchies and professional academic success is influenced by connecting to and appeasing existing funding structures, successful researchers were those who cultivate interpersonal connections to funding agencies and who engage research agendas that are distinct but aligned with existing systems of knowledge (Martin, 1998).

Ziman (2002) captured these mechanics of socialized science in his model of post academic science. Ziman's model differentiates industrial, academic, and post academic approaches to scientific inquiry (2002). The socialization of science in the neoliberal era, also, has been described as post-normal science (Funtowicz & Ravetz, 1993). Post normal science is "characterized by a focus on utility as defined by the patrons of science, the scientists' need to achieve funding, and the presence of vested interests. In consequence, the science–society interactions are more complex in post-academic science than in traditional academic science" (Kolstø, 2008, p. 981)

Neoliberalism privileges knowledge that fuels capitalist cycles of supply and demand. Research without clear, direct, and substantial market value is limited, whereas successful knowledge in the neoliberal market is that which, narrowly and succinctly, can be quantified for the purpose of accruing competitive external funding (Bernal & Villalpando, 2002; Carey & Swanson, 2003; Hart & Metcalfe, 2010; Lincoln & Tierney, 2004; Lynch, 2006; Osei-Kofi, 2012).

Science and higher education are being transformed by profiteering and fundamentalist power agendas (Cannella & Miller, 2008). Capitalist research is distinct from pure research, also referred to as basic research, which is the pursuit of new scientific knowledge, or understanding that does not have specific or immediate commercial objectives (National Science Foundation, 2018). Increasingly, inquiry is applied and developed with intent to produce commercializable results (Etzkowitz et al., 1998). While corporate influence in science is not new, Cannella and Swadener (2006) reported that science was increasingly submitting to hyper-capitalism. A growing culture of market academics is limiting the diversity of scholarship in the academy, privileging approaches to science that appeal to financialization, measurement, and control (Cannella & Miller, 2008). Other adverse implications of socialization and corporatization of science include the production of epistemological hegemony and undue narrowing of epistemological diversity (Cannella & Miller, 2008). Neoliberalism favors ways of knowing which Kincheloe (2008) summarized as an epistemology which is formal, intractable, decontextualized, universalistic, reductionistic, and one dimensional, conceptualized as the acronym, FIDUROD.

Epistemologically, FIDUROD promotes Cartesian dualism, or the mind-body divide – a binary that has long underpinned Western paradigms. Cartesian dualism insists on distinction between the mind and body and divorces inquiry from non-cognitive domains of feeling, imagination, intuition, and dreams (Kincheloe, 2004). Synthesis of multiple ways of knowing, transcending the divide, is necessary for fuller more transformative understanding of the world (Kincheloe, 2004), but neoliberal and neoconservative values advance epistemological hegemony by discrediting epistemological perspectives which fall outside rigid notions of objectivity, meritocracy, and individuality (Bernal & Villalpando, 2002). The climate shaped by

neoliberal and neoconservative forces in higher education functioned to reinforce the canon of traditional knowledge, and marginalize non-dominant knowledges and ways of knowing (Bernal & Villalpando, 2002).

Critical Pedagogy and College Teaching

The following is a collection of literatures from the histories, theories, and practices which may inform critical pedagogies in STEM. The work of the practitioners included in this study is likely to be reflected in the following discourses. This literature also attempts to locate their work in socio-historical context.

Critical Pedagogy

Critical pedagogy (CP) is a conception of social justice in education that mutually commits to conscientization, critical literacy, and socio-political action (Freire, 1998; Greene, 1998; McLaren & Fischman, 1998; McLaren & Baltodano, 2000; Shor, 2000). CP reimagines the relationship between curriculum and lived experience, problematizing assumptions about knowledge and practices of knowledge production (Martin & Te Riele, 2011). Critical pedagogy manifested in the 1980s as a diffuse ideological constellation for those engaged in academic work for social justice in education (Lather, 1998). CP is broad and dynamic with numerous contributing theorists; however, the tradition is unified in an emphasis on socio-political action (Montaño et al., 2002).

Critical pedagogy regards teaching as a vehicle for liberation and social change (Ayers, Hunt, & Quinn, 1998; Freire, 2000; Greene, 1988; Payne & Strickland, 2008). Critical pedagogy regards mainstream education as marginalizing, subjugating, silencing, and de-culturizing to subaltern groups (Darder, 1991; Giroux & McLaren, 1986; Macedo & Bartolomé, 1999; Nieto, 1999). As such, action through critical pedagogy interrupts the Western Eurocentric and

androcentric power dynamics which reproduce the inequality of the status quo by reworking the power relations between teacher and student (McLaren, 1995). Critical pedagogy realizes John Dewey's distinction between education as a function of society and society as a function of education, and is concerned with producing thoughtful, engaged, and capable citizens in pursuit of justice (McLaren, 1995). Critical pedagogy imparts in learners the critical tools to realize a more socially just world (Giroux & Giroux, 2006) transforming the function of education from power and control, to liberation (Freire, 2000).

Darder, Baltodano, and Torres (2003) summarized major theoretical foundations of critical pedagogy emphasizing Dewey's (1916) human agency as well as Gramsci's (1971) criticality, counter hegemony, and historicity of knowledge. As such, critical pedagogy "embraces a dialectical, relational view of knowledge" (Denzin, 2009, p. 382). Truth is understood in structures of power, and critical pedagogy seeks to dismantle hegemonic truth regimes to establish new truth regimes centered in kindness, hope, and love (Darder, 2002).

Paulo Freire. Paulo Freire is perhaps the most recognizable, and among the most influential social justice educators (McGee & Hostetler, 2014). Generally, Freire considered pedagogy "not a method or an a priori technique to be imposed on all students but a political and moral practice that provides the knowledge, skills, and social relations that enable students to explore the possibilities of what it means to be critical citizens while deepening their participation in the promise of a substantive democracy" (as cited in Giroux, 2014b, p. 716). For Freire, critical thinking was not a performative tool, but an essential skill for freedom and democracy. Critical thinking was about the interrogation of the past and present, it was an engagement with history and the status quo to imagine new futures (Giroux, 2014b). While Freire is a significant figure, often critical pedagogy is reduced, inaccurately, to his seminal

works, overlooking the contributions of many other theorists and practitioners (Burbules, 2000). Among Freire's major contributions to critical pedagogy, (1) praxis, (2) banking, and (3) dialogic and problem posing education are significant to this study.

Hemmings (2000) offers a useful definition of praxis, asserting that "educational praxis is the process of synthesizing theory and practice in school contexts in a manner that improves the lives of students and their communities" (p. 68). Praxis distinguishes and synthesizes thinking, saying, and doing to establish that one process without the other is incomplete (Derman-Sparks & Phillips, 1997). According to Giroux (2014b), Freire's elaboration of praxis emphasized action:

Freire believed that critical pedagogy involves both the recognition that human life is conditioned, not determined, and the crucial necessity of not only reading the world critically but also intervening in the larger social order as part of the responsibility of an informed citizenry. (p. 716)

Freire also coined the term "banking" which is useful to name and examine how neoliberal education seeks to commodify knowledge and facilitate a one-way transaction between the teacher (provider) and the learner (consumer). Banking is a linear and passive framework for teaching and learning. Giroux and King (2016) succinctly summarized the distinctions of banking and critical pedagogies: "Critical pedagogy rejects the notion of students as passive containers who simply imbibe dead knowledge. Instead, it embraces forms of teaching that offer students the challenge to transform knowledge, rather than simply processing received knowledges" (p. 495). Students are not empty and predictable vessels, to be filled with a standardized curriculum. Such practices are oppressive, and re-inscribe social hierarchies. An

alternative and liberatory pedagogy negotiates with and invites active participation from all members of the learning community (Freire, 2000).

In problem posing education, dialogue engages learner's histories, knowledges, and literacies to facilitate learning (Freire, 2000). For learners, a shift occurs in seeing self not as an object but as the subject of their lives (Freire, 2000). Frameworks and practices for dialogue abound, and conflate easily. Hemmings' (2000) synthesis of the literature on dialogic practice in schooling makes distinct two dialogic trends relevant to this study: liberal-progressive (Deweyan) and radical (Freirean). The liberal-progressive tradition is about individual liberty, recognition that individual notions of goodness conflict, and that conflicts should be deliberated in the public sphere. Dewey specifically championed deliberative dialogue as a necessary function of democracy, and a critical practice of public schooling. The liberal framework centers the preparation of young people for participation in representative public institutions (Hemmings, 2000). Distinguishing features of the liberal tradition include mirroring public democratic institutions, focusing on competition of ideas and intellectual authority, being disinterested and socially detached, and valuing civility. Language is power, and particular ways of speaking are placed in hierarchy. Knowledge is also organized in hierarchies. Knowledge is expert and technical (Hemmings, 2000).

Radical practices in dialogue are in many ways distinct from the liberal-progressive tradition. Foremost, the radical framework is grounded in social transformation theory (Gramsci, 1971; Freire, 1998, Freire & Shor, 1987) and is principally interested in liberating historically marginalized groups. The radical framework positions educators to approach dialogue as a means of consciousness raising and to incite political action. The tradition also advances notions of critical literacy, or the ability to read the world and explore the influence of privileged

paradigms (Hemmings, 2000). A radical approach to dialogue creates space to share stories and engage in autobiography to dispel oppressive attitudes and imagine new and more just futures – and does so by centering care, community, and connection (Hemmings, 2000). In the radical framework, multiple languages and ways of communicating are invited alongside multiple ways of knowing. In this process, there is an effort to find, raise, and listen to unique and historically marginalized voices (Hemmings, 2000). In the radical framework, it is necessary to balance power relations. The praxis serves to diffuse authority and dismantle social and intellectual hierarchies (Hemmings, 2000).

Assumptions. Critical pedagogy is an expansive liberatory educational tradition, with innumerable theoretical and practical contributions, but a number of key assumptions thread various approaches to critical pedagogy. Foremost, schooling is regarded as a contested cultural site (Freire, 2000) which is inherently political (Bartolomé & Trueba, 2004; Cochran-Smith, 1997; Freire, 1998; Giroux & Giroux, 2006; Shor, 2000; Zeichner, 1993), where every dimension of education is influenced by power and ideology education (Giroux & King, 2016).

Critical pedagogy recognizes that realities “are constructed through linguistic, cultural, social and behavioral interactions which both shape and are shaped by social, political, economic, and cultural forces (Fischman & McLaren, 2005, p. 425). Critical pedagogy does not seek to merely understand these various dimensions and realities, but to scrutinize structures, knowledges, and practices for their congruence with democracy (Giroux & Giroux, 2006) and to transform them through radical democratic participation (Fischman & McLaren, 2005). As such, critical pedagogy requires engagement with neoliberalism (Smith et al., 2009).

Conditions. Several social, political, cognitive, emotional, and spiritual conditions are conducive to critical pedagogy. Apt conditions for critical pedagogy have been widely theorized,

and include access and entry to (a) contact zones, participation in (b) border crossing, facilitation of (c) discomfort, cultivation of (d) hope, and the release of (e) imagination.

Contact zones are an intersection of disparate cultures, marked by dissonance and negotiation, often formed in asymmetrical power relations (Pratt, 1991). The contact zone framework conceptualizes the pedagogical and curricular possibilities at the point of convergence (Pratt, 1991). Convergence, or proximity, can imply a broad range of encounters (Giroux, 1992). Critical pedagogy engages the classroom's potential as a contact zone, and facilitates the potential for cognitive, cultural, and epistemic dissonance within the space (Giroux, 1992).

Analogous to contact zones, border crossing is a spatial geographic conception of education in which students are positioned as cartographers, where they re-author physical, cultural, and epistemic borders (Giroux, 1992). Otherness is understood through border crossing. By extension, border pedagogy bridges the curriculum and storied lives of students and teachers across otherness (Giroux, 2011a).

Contact zones and border crossing are indicative of discomfort. Critical pedagogies facilitate discomfort (Zembylas & Boler, 2002) by juxtaposing Western knowledge and paradigms with indigenous and non-Western worldviews. The subsequent dissonance is fertile for learning and transformation.

Hope is ubiquitous in discourses of critical pedagogy (Denzin, 2009). Hope is an essential panacea to the despair and fear that accompanies critical pedagogic work. Hope takes many forms, and may look both aggressive and nurturing. Ultimately, a pedagogy of hope aims to realize a progressive politics that rejects "conservative, neoliberal postmodernity" (Freire, 2014, p. 10). Hope is also a verb, and is connected intimately to socio-political action.

Hope is ethical. Hope is moral. Hope is peaceful and nonviolent. Hope seeks the truth of life's sufferings. Hope gives meaning to the struggles to change the world. Hope is grounded in concrete performative practices, in struggles and interventions that espouse the sacred values of love, care, community, trust, and well-being. (Freire, 2014, p. 9)

In addition to hope, critical pedagogy cultivates imagination, in opposition to neoliberal dis-imagination (Giroux & King, 2016). Imagination is the conglomerate of critical pedagogy (Giroux & King, 2016), a space of radical futurity—or a space of radical thinking and activism to challenge the oppressive operations of power (McNeilly, 2017). Denzin (2009) summarized four practices of imagination indicative of critical pedagogy: (a) instruction that fosters critical, historical, and sociological thinking; (b) exposing pedagogies, which reproduce oppression; (c) cultivating reflexivity and ethical self-consciousness; and (d) a more refined critical racial self-awareness.

Outcomes. The outcomes of critical pedagogy reflect its practices. Giroux and King (2016) summarize the goals of critical pedagogy broadly and succinctly:

Providing students with the skills, ideas, values and authority necessary for them to nourish a substantive democracy, recognize anti-democratic forms of power, and fight deeply rooted injustices in a society and world founded on systemic economic, racial and gendered inequalities (p. 496)

Through the creation of radical educational practices and spaces (Giroux & Giroux, 2006), critical pedagogy fosters (1) conscientization, (2) critical literacy, and (3) sociopolitical action – all towards liberation. While these outcomes of critical pedagogy have been itemized, they are not mutually exclusive. Many scholars infuse one concept in the definition of the other.

For the purpose of this dissertation, the following three outcomes have been made distinct for emphasis and comprehension.

Conscientization. Critical pedagogical work begins with consciousness, for teachers and students (Duncan-Andrade, 2005; Freire, 2000; Greene, 1988). Conscientization describes the phenomena of transformation of oppressed people when their experiences are seen within socio-political-historical context (McGee & Hostetler, 2014). Conscientization as a process often occurs in contact zones, and is a “recursive process of reflection and action toward individual and social transformation” (Seiler & Abraham, 2009, p. 739). Broadly, conscientization is “an awareness of one’s socio-political location in a particular context” (Seiler & Abraham, 2009, p. 743) and the needed skills to critique one’s social position and context (Ladson-Billings, 2006). Conscientization includes understanding power relations and how societal and institutional structures reproduce inequality (Seiler & Abraham, 2009). Conscientization is analogous to scholarly notions of reflexivity (Door, 2014), in that conscientization demands self-awareness, and the interplay and influence of self in relation to knowledge, others, and the world.

Critical literacy. Critical literacy, also called critical reading (Giroux & Giroux, 2006; Hemmings, 2000) is a literacy of not only the word, but the world. Critical reading comprehends what is said, what is not said, the context in which it is said, the mode with which it is conveyed, and how it is received (Kucukaydin & Cranton, 2013). Critical literacy includes a capacity often referred to as problematization, which is a competence to discern social, political, and economic contradictions (Hemmings, 2000).

Sociopolitical action. Sociopolitical action is the attempt to resolve conflicts, following deep exploration of the contexts and conditions from which the issue manifested (Hodson, 1998). Sociopolitical action is the critical distinction between caring *about* and caring *for* an issue

(Curtin, 1991). Building upon critical literacy, understanding the conditions of racism, sexism, classism, cis-heteronormativity, and other forms of discrimination in society, sociopolitical action is a political literacy of civic participation (Hodson, 1998).

Challenges. Giroux and King (2016) asserted:

The fundamental challenge facing educators within the current age of neo-liberalism, militarism and religious fundamentalism is to provide the conditions for students to address how knowledge is related to the power of both self-definition and social agency (p. 496).

Creating such conditions requires innovative, dynamic and novel spaces and practices. As such, critical pedagogy is difficult, messy, and risky (hooks, 1994; Martin, 2015; Martin & Brown, 2013; Sharma, 2010). While difficult and messy, students are resilient and inventive in conflict (Pratt, 1991) and the outcomes are worth the risk, potentially transformative, and joyful (Hooks, 1994).

Critical pedagogy is antithetical and dangerous to neoliberalism and neoconservatism (Giroux & Giroux, 2006). Giroux (2011b) stated that “Freire rejected those regimes of educational degradation organized around the demands of the market, instrumentalized knowledge, and the priority of training over the pursuit of the imagination, critical thinking, and the teaching of freedom and social responsibility” (p. 156). Critical pedagogy is dangerous because it actively rejects the detached transaction of teaching for the test, and implores reflection, dialogue, and action for individual rights and social justice (Giroux & King, 2016).

Critical pedagogy is dangerous to neoliberalism because it resists “discourses of privatization, consumerism, the methodologies of standardization and accountability, and the new disciplinary techniques of surveillance” (Giroux & Giroux, 2006, p. 3). Denzin (2007)

reported that “critical pedagogy provides the tools for understanding how cultural and educational practices contribute to the construction of neoliberal conceptions of identity, citizenship, and agency” (p. 381). Teaching, understood as a performative act, is a practice of invention and spontaneity that does not lend to reduction and mechanical replication (hooks, 1994). Neoliberal managerialism and audit culture however serve to inhibit and constrain the creativities of critical pedagogy (Blackmore, 2009; Martin & Brown, 2013).

Critical pedagogy is also dangerous to ideological fundamentalism (Freire, 2000; Giroux, 2014a), in that it establishes space for learners to realize their own power, critically question, and to engage civically (Giroux, 2014a). Critical pedagogy reinforces unconditional free and open inquiry (Giroux, 2014a), and problematizes established histories by revealing their multiplicity and complexity (Said, 2001).

Critique. Critical pedagogy has been heavily critiqued, most consistently for its inaccessibility (Ellsworth, 1989; Lawrence, 2015), penchant with grand theory over theorizing local contexts (Lawrence, 2015) and preoccupation with critical Marxism and class analysis (Hamilton & McWilliam, 2001). Some argue that critical pedagogy is waning in energy and relevance, and that the significance of critical pedagogy has run its course (Pinar, 2009). In defense, others have asserted that critical pedagogy is evolving and incomplete and needing of constant testing and theorizing (Darder et al., 2003; Kincheloe, 2008). Proponents counter that critical pedagogy is dynamic and serves as a point of inspiration for further theorizing and practice (Martin & Te Riele, 2011). In acknowledgement of critiques of accessibility and relevance, Lawrence (2015) cautioned about paths forward that may run the risk of oversimplification.

Critical pedagogy is critiqued as a political vehicle for indoctrination (Giroux, 2014a). Critical pedagogues have been (mis)represented and (mis)identified as dangerous (Horowitz, 2006). In particular, critical pedagogues have been (mis)characterized in neoconservative outcry as activist faculty with radical political agendas (Horowitz, 2006). Proponents have argued that education is not neutral, nor is critical pedagogy indoctrination (Giroux, 2014a). All pedagogy is political, and presumes particular understandings of society and possibilities for and commitments to the future (Freire, 2000). Critical pedagogy is distinct in that it directs all teaching activities to the realization of a more socially just world (Giroux, 2014a). To suggest such a commitment is indoctrination is erroneous. Critical pedagogy's distinction is not indoctrination, but its commitment to connect learning to criticality and democratic action (Gutman, 1999).

Because interpretations and practices abound, scholars have fashioned frameworks for implementing social justice education in institutional settings (Bialystok, 2014; Carlisle, Jackson, & George, 2006). One such framework is Bialystok's (2014) guidance for defensible social justice practices in schools. Bialystok's (2014) guidance serves as a useful response to neo-conservative critiques of critical pedagogy, as well as provides concrete parameters for practitioners and educational leaders looking to implement critical pedagogical practices.

Specifically, Bialystok (2014) proposed that effective and responsible practices will:

1. Have legislative backing in the form of such precedents as the Charter, human rights codes, and current policy;
2. Be compatible with reasonable pluralism;
3. Not engage in partisan politics or political activism that students do not choose;
4. Be connected with developing skills for democratic engagement; and

5. Respect students' freedom to abstain from activities that contravene their own (emerging or tentative) comprehensive doctrines. (p. 415)

Practitioners. Montañó et al. (2002) provide a useful framework to understand practitioners of critical pedagogy, which they refer to as teacher activists. Montañó et al. (2002) refer to individuals who engage social movements and enacts social justice philosophy by inviting students to challenge inequality in their schools and communities through their curriculum as teacher activists. Teacher activists, or social justice educators, are actively engaged in politicization, owning their role as subject and maker of history (Freire, 1998). Social justice educators also undertake the struggle against educational injustice through their praxis (reflection, dialogue, and action) (Montañó et al., 2002).

Practitioners of critical pedagogy reflect the intended outcomes of critical pedagogy, in that they model conscientization, critical literacy, and socio-political action. To challenge the educational status quo (Macedo & Bartolomé, 1999) a practitioner of critical pedagogy needs political and ideological clarity (Ayers, 2001; Bartolomé & Trueba, 2004; Freire, 1998; McLaren & Farahmandpur, 2001; Sleeter, 2012) as well as the ability to name and see problems within themselves and the educational system (Montañó et al., 2002). Critical pedagogues are not simply facilitators (Roberts, 2000), they are active architects (leaders) developing social and spatial conditions for dialogue and sociopolitical action. Both Darder (1991) and Ayers (2001) underscored that political and ideological clarity in practitioners of critical pedagogy are not enough, there must be action.

Analogous Movements

The history and practice of critical pedagogy is not distinguished easily from other educational movements. The lineage and distinction of critical pedagogy is illuminated when

juxtaposed to analogous pedagogical movements including progressive education, citizenship education, adult education, and social justice education.

Progressive education. Progressive education expanded rapidly in the 60s and 70s, during a peak period of democratization (Gumpert, Iannozzi, Shaman, & Zemsky, 1997). Emboldened by civil rights, critical pedagogies thrived in this period of democratization and progressive democratic discourse solidified in higher education (Hachem, 2016). Like critical pedagogy itself, there are numerous contradictions of progressive liberal education and neoliberalism (Hachem, 2016)

Citizenship education. Citizenship in education, much like critical pedagogy, is broad and heterogeneous. While it is in some ways unanimously agreed upon, there is much ideological diversity spread along a continuum of conservative to progressive political spectrum (Westheimer & Kahne, 2004). Westheimer and Kahne (2004) assessed 10 education programs, aimed at cultivating citizenship, and discerned their various political dispositions towards citizenship and considered their effects. Three general dispositions were identified, and included personally responsible, participatory, and justice-oriented citizenship.

Westheimer and Kahne's (2004) citizenship dispositions spanned from a notion of individual goodness, to working within systems, to transforming systems. The authors asserted that justice-oriented citizenship education is not about indoctrination, nor imparting perspectives, but rather cultivating critical capacity to analyze structures (Westheimer & Kahne, 2004).

Adult education. Adult education's legacy is viewed as a confluence of workforce development, democracy, and social activism (Kreber, 2015). Where early practices included radical Marxist agendas such as cultivating labor capacity in anticipation of political revolution

(Crowther & Martin, 2010), Kreber (2015) asserted that adult vocational education has drifted, and contemporary scholarship is reluctant to engage in its community and activist roots.

Kreber (2015) described adult education's characteristic features as (1) inward looking, concerned more with the mechanics of teaching and learning for adults than the meaning and value of the work they do, and (2) instrumentally rational, preoccupied with measuring how teaching strategies produce knowledge and skills necessary for the labor market (Kreber, 2015). In these ways, contemporary vocational education succumbed to neoliberal technocratic rationality (Kreber, 2015).

Transformative learning. Transformative learning refers to “processes that result in significant and irreversible changes in the way a person experiences, conceptualizes, and interacts with the world” (Hoggan, 2016, p. 71). Transformative learning is among the most rigorously and comprehensively researched theories in adult education (Hoggan, Mälkki, & Finnegan, 2016; Taylor, 2005, 2008; Taylor & Snyder, 2012), and since its inception has transitioned from foundational theory to meta theory (Hoggan, 2016).

Transformative learning came to prominence with the work of Mezirow (Kucukaydin & Cranton, 2013), and while transformative learning is a broad educational discourse the significance of Mezirow in the formation of contemporary theory and practice of transformative learning is demonstrable (Hoggan, Mälkki, & Finnegan, 2016). Mezirow's work has been engaged by numerous traditions and elaborated in innumerable scholarly directions (Dirkx, 1998).

Mezirow's major premises of knowledge, learning, and action are grounded in emancipatory theories of praxis (Hoggan et al., 2016), and Mezirow's theory connects to major

works by Marx (1888), Freire (2000) and Habermas (1984). Mezirow's work is also influenced by Dewey's notions of experience, critical thinking, and democracy (Hoggan et al., 2016).

Transformative learning and critical pedagogy parallel and intersect in numerous locations. Foremost, both traditions regard praxis as the creative implementation of purpose (Mezirow, 1991). Similarly, dialogue and reflection are regarded as means for transcending and transforming epistemic, psychological, and sociolinguistic distortions (Hoggan et al., 2016). Hoggan et al. (2016) argued that Mezirow's praxis is a synthesis of Freire's radical collectivist ideals inherent in conscientization and the scholarship of critical thought and adult development. Hoggan et al (2016) also argued that Mezirow extends Freire's notion of conscientization by integrating Habermas's and Dewey's ethical commitments to participatory democracy.

However, Mezirow is distinct from Freire. For instance, Mezirow (1989, 1990) asserted that perspective transformation may not be explicitly connected to sociopolitical or liberatory action (Hoggan et al., 2016) where Freire's (2000) praxis implored connection between transformative learning and social change (Hoggan et al., 2016) —linking critical literacy with socio-political action. Freire's critical pedagogy insisted upon individual transformation as a function of social transformation (Freire, 2000).

Notable critiques of Mezirow include those related to issues of continuity, intersubjectivity, and emancipatory practice (Hoggan et al., 2016). Debate exists as to whether perspective transformation is an emancipatory form of adult education (Collard & Law, 1989; Hart, 1990; Hoggan et al., 2016; Inglis, 1997; Murray, 2013; Newman, 1994). Mezirow (1990) defended the emancipatory potential of perspective transformation, claiming commitments to counter-hegemony and democratic action, but Mezirow continues to be critiqued for insufficiently addressing issues of power (Murray, 2013; Newman, 2012).

Social justice education. Particularly relevant to critical pedagogy in higher education is the field of social justice education. Social justice education (SJE) is a widely defined and debated field (Bull, 2008; Carlisle et al., 2006; Hackman, 2005; Sensoy & DiAngelo, 2012; Zajda, Majhanovich, & Rust, 2006). McGee and Hostetler (2014) synthesized the goal of social justice in education, asserting that:

Social justice in U.S. education has focused on striving for educational excellence via the examination of social and historical issues and, therefore, giving voice to the marginalized, and recognizing inequities in order to empower marginalized and privileged students alike so that they can empower those around them to promote diversity and inclusiveness for all persons. (p. 209-210)

SJE is particularly concerned with challenging hegemonic points of view, specifically Eurocentric, patriarchal, and mono-cultural points of views (Ayers, Quinn, & Stovall, 2009; Cochran-Smith, 2004, 2010; Kumashiro, 2009; Leonard, Brooks, Barnes-Johnson, & Berry, 2010), deficit perspectives (Gay, 2018; Ladson-Billings, 2006; Frankenberg, Taylor, & Merseth, 2010; Sleeter & Milner, 2011; Villegas & Davis, 2008). Such SJE criticism also problematizes the mythical norm of the white, male, heterosexual, Christian, able-bodied, and so forth individual (Lorde, 2007). SJE is also interested in the cultivation of socio-political consciousness and action (McGee & Hostetler, 2014).

Trajectories for Critical Pedagogy

Heeding critiques of critical pedagogy's relevance, scholars have called for re-politicization and re-engagement with the deceptively neutral political arena of schooling (Hursh, 2007; Kumashiro, 2008). The importance of organizing and action, specifically "challenging

neoliberalism and neoconservatism and vigilantly upholding and advancing concrete socially just practices in everyday life in the academy, is essential” (Osei-Kofi, 2012, p. 240).

Critical pedagogy has been called to advance intersectional and solidarity efforts and join broader SJE movements to fight inequality (Cochran-Smith, 2004; Oakes, Rogers, & Lipton, 2006). It is essential to the sustainability and success of critical pedagogy to reimagine, form coalitions, and organize in more tangible ways to effect change (Gur-Ze’ev, 2005).

The traditional scope of critical pedagogy is also amidst pressure to transform. Neoliberal values of scale complicate scholar activists’ ability to translate their work into higher education contexts (Martin, 2015; Morris & Hjort, 2012). Critical pedagogy must be adaptive to new contexts (Martin, 2015), including new media (Stommel, 2014).

Atasay (2015) argued that to sustain the integrity of critical pedagogy, scholars, and practitioners must reclaim discourses and practices of critical pedagogy from neoliberal. Atasay (2015) asserted the immense challenge of a reclamation as the neoliberal university will only accept and integrate diversity and social justice to the extent that such values and practices advance profit agendas. For instance, neoliberalism has transformed the notion of critical thought from that of scholarliness and consciousness to a tool of employability. Critical thought is now a skill set to be cultivated in a well-qualified workforce, in service to employers and the economy (Wilson & Howitt, 2016).

Some scholars suggest a compromise, beyond the binary of neoliberal and critical pedagogy. Where Marxist and Freirean notions of criticality may be joined in a comprehensive model with critical thought for employability, Wilson and Howitt (2016) point out that though critical thought for employability and critical thought for liberation are markedly different, they share similar processes in their cultivation.

Resisting the neoliberal university and reclaiming diversity and social justice can take many forms (Shahjahan, 2014). Heyman (2007) highlighted teaching in particular is underutilized as an activist space and needs to be re-engaged. Unfortunately, neoliberal higher education is eroding unorthodox and critical pedagogies for "safe" pedagogies (Hill, 2003; Leonardo & Porter, 2010). The importance of faculty action against neoliberal inculcation is paramount (Saunders & Blanco Ramirez, 2016). Such resistance requires renewed resolve to critical pedagogical work in the university. Hodkinson (2009) warned of the growing perception that activism has moved beyond the university, that meaningful social justice work exists exclusively in grassroots organizing and community-based action. As such, activist scholars need to re-activate inside their institutions (Castree, 2002).

Humanistic STEM Education

The following is a collection of literatures that frame the history and trajectory of humanistic science education reform. Humanistic reform efforts guide science education toward high context learning in response to contemporary practices of academic and corporate science. This section culminates in an overview of more radical science education practices, germane to the participants of this study, which implore the cultivation of socio-political action in STEM learners.

Education for Post Academic Science

Science is an inherently human endeavor (Kuhn, 1996). Kuhn (1996), in the structure of scientific revolutions, revealed science as a human enterprise composed of self-reproducing organizations with particular paradigms. Kuhn (1996) implored that we understand not only science, but how we do science, the context in which it was constructed, and what were the characteristics of the people who constructed it.

Traditional understandings of science, like those characterized by Merton (1973) failed to represent the academic and industrial confluence of the contemporary scientific enterprise. Ziman's (2002) model of post academic science differentiated between industrial, academic, and post academic approaches to scientific inquiry. Post academic science acknowledges the complicated science-society interactions that take place, as multiple interests enter and are vested in the scientific enterprise through funding structures.

Kincheloe (2008) described the scientific logics reinforced within the neoliberal university. As previously described, Kincheloe's (2008) notion of FIDUROD is a neoliberal epistemological framework which privileges knowledges which are formal, intractable, decontextualized, universalistic, reductionist, and one-dimensional. FIDUROD is a persistent and prevailing logic that shapes the practice of science and science education.

Socialization of science learners, which reifies FIDUROD, is of concern to science educators. Reflecting on the conditions of post-academic science and the implications for science education, Bryce (2010) asserted:

Contrary to the traditional caricature of how science works, ... science is not a uniquely privileged way of understanding things, superior to all others. It is not based on firmer or deeper foundations than any other mode of human cognition. Scientific knowledge is not a universal 'metanarrative' from which one might eventually expect to be able to deduce a reliable answer to every meaningful question about the world. It is not objective but reflexive: the interaction between the knower and what is to be known is an essential element of the knowledge. And like any other human product, it is not value-free, but permeated with social interests. (p. 327)

Ziman (2002) argued that to prepare science learners for post academic science contexts, science learning should reflect those contexts. Specifically, Ziman (2002) encouraged sensitivity to the following socio-political factors:

- The ways in which funding bodies now tend to operate
- The typical succession patterns of funded projects
- The growth of application-driven research
- The scale of finance typically required for research programs
- The now common pattern of teamwork and interdisciplinarity among researchers.

To best prepare learners for post-academic science contexts, curriculum should engage more complex and dynamic notions of knowledge, through more diverse ways of knowing (Tytler, 2007). Such transition would challenge scientific dogmatism, as historically hard science has resolved focus on dispassionate or apolitical science (Bryce, 2010). To the contrary, Kitcher (2001) argued for a democratic framework for science, calling for an integration of moral and political values.

Bryce (2010) identified necessary skills for post academic science, including reflexivity, communication, and deliberation. Bryce shared particular concern for the dearth in reflexivity among scientists, and the resulting ill preparation to engage in matters of public policy. Bryce asserted that a gap exists between the hard sciences and those who take the time to question the process and impacts of science in context. Bryce (2010) quipped that scientists are good at making progress, and less talented at questioning such progress.

Humanistic Science Education

A number of science education reforms sought to recognize science as a human endeavor (Aikenhead, 2007; Donnelly, 2004). While these efforts were nuanced, they generally shared

concern for how young people are nurtured and enculturated intellectually and affectually and regard purely technical and productive views of science education as unhelpfully narrow and harmful to all those involved (Bryce, 2010).

The trifecta of humanistic science “considers the relationships between learning science, learning to do science, and learning about science” (Bryce, 2010, p. 591). Aikenhead (2006) used the term “humanistic” to describe the diverse portfolio of scientific approaches that counter mainstream science education. There exists a plurality of approaches and perspectives that include but are not limited to Science Technology and Society (STS), Science Technology Society and the Environment (STSE), Science for Public Understanding, Citizen Science, and Bildung Science.

The aforementioned reforms reflect Hodson’s (1998) and Aikenhead’s (2006) broad conceptualizations of the theory, practice, and goals of humanistic science education. Hodson’s (1998) framework emphasized a balance of content, process, and context. Science learning included learning what it is, how to do it, and the circumstances that surrounding it – all requiring students to see, do, and understand science in a modern context. Hodson (1998) argued that this approach is achieved in relevant problem posing education, but Hodson’s framework has been critiqued as not easy to follow or implement (Bryce, 2010).

Aikenhead (2006) characterized humanistic science as challenging positivistic views of Western science, addressing socio-scientific issues, and encouraging social responsibility and action. Aikenhead emphasized the importance of interrogating positivism and its remnants as they are dismissed too readily. He asserted, much like Kincheloe and Tobin (2009) that positivism lives in our consciousness and discourses and it should be rooted out and tested.

The various reform projects of humanistic science education were also characterized by a shared advocacy for the integration of science with moral, character, and citizenship education (Bencze & Sperling, 2010; Berkowitz & Simmons, 2003; Hodson, 2003; Lee, Chang, Choi, Kim, & Zeidler, 2012; Zeidler & Sadler, 2008; Zeidler, Sadler, Simmons, & Howes, 2005). Science education needs to go beyond transmission of content knowledge and reasoning skills, and must commit to the cultivation of character and civic action (Choi, Lee, Shin, Kim, & Krajcik, 2011; Zeidler & Sadler, 2008; Zeidler et al., 2005).

While integration of science with moral, character, and citizenship education has broad appeal, fewer humanistic science education reforms specifically advocated the cultivation of sociopolitical action. There were however a number of advocates for sociopolitical action in science education (Bencze & Sperling, 2010; Hodson, 1998, 2003; Roth, 2003; Roth & Lee, 2004; Roth, 2009). Dos Santos (2009) argued that most educators can generally agree on the base significance of skill development for necessary action on socio scientific issues, but regard or even dismiss sociopolitical action as a radical interpretation of scientific literacy. For example, Hodson (2003) called for a science education that will “produce activists: people who will fight for what is right, good and just; people who will work to re-fashion society along more socially-just lines; people who will work vigorously in the best interest of the biosphere” (p. 660).

Scientific Literacy

A scientifically literate person is “able to combine science knowledge with the ability to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity” (OECD, 2003). Scientific literacy is a diffuse concept, but often regarded as a measure of understanding science as a social activity, the ability to contextualize knowledge, and the application of knowledge in social,

cultural, and political domains (Dillon, 2016). Scientific literacy is a broad reference to the majority of goals in science education, and generally, has been accepted in science education worldwide (Deboer, 2000; Dillon, 2016; Hurd, 1998). Scientific literacy has been argued to promote cognitive and moral development (Zeidler et al., 2005).

Advocates of humanistic science education reforms have critiqued and expanded widely-accepted notions of scientific literacy (Vesterinen, Manassero-Mas, & Vázquez-Alonso, 2014), and have made steady progress articulating a scientific literacy that includes socially responsible action (Hodson, 2003). Such reformers asserted that scientific literacy should realize informed, competent, and politically engaged citizens (Jenkins, 1999).

Hodson (1998, 2003) established a formative and popular framework for scientific literacy. Hodson's four levels of scientific literacy were structured in graduated levels of sophistication:

- Level 1: Appreciating the impact of scientific and technological changes on society while recognizing that science and technology are culturally embedded
- Level 2: Recognizing that decisions about scientific and technological development are taken in pursuit of particular interests and linked to the distribution of wealth and power
- Level 3: Formulating one's particular views and creating corresponding value positions
- Level 4: Anticipating and preparing to take action. It is important to note that levels 3 and 4 are prerequisites for sociopolitical action (Lee et al., 2013).

Hodson's (2003) levels of sophistication were considered in four domains of scientific literacy: (1) learning science and technology, (2) learning about science and technology, (3)

doing science and technology, and (4) engaging in sociopolitical action. Some scholars argued that student sociopolitical action is a premier goal (Dos Santos, 2009; Hodson, 2003).

Socio Scientific Issues

Humanistic science education reforms, and interventions that pursue the moral and behavioral outcomes associated with scientific literacy, often center socio scientific issues in curriculum and instruction. Socio scientific issues (SSIs) are based in science with importance for society (Zeidler et al., 2005). SSIs are authentic, current, researchable through media, and involve local, regional, and global perspectives. SSIs engage ethical dimensions that require reflection upon knowledge and values, and are contentious enough for different parties to come to different conclusions reasonably with the same information (Zeidler et al., 2005). SSIs are distinguished by their moral and ethical concerns, and regard these dimensions as inseparable from good science (Sadler, 2004b). SSIs concern political, personal, and social domains often related to issues of the environment and public health (Sadler, 2004a).

A core feature of SSIs is the inclusion of narratives. To explore the moral and ethical dimensions of science, SSIs draw upon multiple contexts and experiential knowledge. SSIs engage narratives in active, embodied, and dialogic manners. Levinson (2008) argued that such practices are long established in the humanities but with few exceptions are absent in the sciences. Personal narratives are contentious with science's episteme, but arguments for the foregrounding of personal narratives in the teaching of SSIs and their epistemological justification have been established (Levinson, 2008; Michael & Brown, 2005; Rose & Novas, 2004) and interdisciplinary approaches have been proposed (Levinson, 2008).

Levinson (2008) argued that the inclusion of the personal narrative in SSI curriculum bridges the gap between experiential knowledge and emerging science, and serves to reveal

controversy and contradiction, and advance deliberative and critical thought. Levinson (2008) stated “whereas argument, the logico-scientific mode, operates on the formal level of generalisation, narratives supply those local contexts and particularities that reinforce or problematise warrants and supply rebuttals.” (p. 861). Zeidler and Sadler (2008) argued that SSI learning is unique and effective in that it allows learners to structure their understandings with personal experience and social discourse.

Kolstø (2008) argued that teaching science history is a practice of SSI learning, which contextualizes and humanizes science. Teaching science history also cultivates democratic engagement (Holton, 2000; Millar & Osborne, 1998; Shamos, 1995) particularly when issues highlight politically sensitive science and society interactions (Kolstø, 2008).

SSIs are also defined by controversy (Zeidler & Sadler, 2008). Socio-scientific knowledge is non-consensual, as is the history of science (Kolstø, 2008). The heart of SSIs is conflict. Bryce (2010) stated that common and relevant topics for SSIs include contentious issues like hunger, poverty, infectious diseases, and global warming. Other documented examples of SSI application in STEM classrooms include nuclear power, genetic engineering, nanotechnology, environmental pollution, and depletion of natural resources (Lee et al., 2013).

The controversy of SSIs is not unlike other curricular and instructional strategies in STEM education, for example controversial issues and ill structured problems (Zeidler & Sadler, 2008). SSIs are controversial and ill structured, but controversial issues and ill structured problems are not necessarily designated as SSIs. SSIs are markedly more demanding in their moral and ethical reasoning and character development. Ill structured problems specifically, while common in science, are not necessarily controversial nor necessarily contain ethical and moral tensions (Zeidler & Sadler, 2008).

Zeidler and Sadler (2008) stated SSIs are unique and powerful tools for situating social and ethical issues in science education. SSIs invited multiple modes of thinking and meaning making, and welcome socio-cultural, historical, emotional, and personal dimensions in addition to logical mathematical exploration (Zeidler & Sadler, 2008). As such, the learning and developmental outcomes of SSIs were robust. Numerous researchers have asserted SSIs's potential for cultivating personal, moral (Levinson, 2008; Sadler, 2004; Zeidler, 2003; Zeidler & Keefer, 2003; Zeidler & Schafer, 1984), and cognitive (Bryce, 2010) development. One mixed methods study confirmed increases in students' empathy, ethical and moral reasoning, and increased feelings of social responsibility (Lee et al., 2013). Numerous arguments have been made for the effectiveness of SSIs in the cultivation of character and global citizenship (Fowler, Zeidler, & Sadler, 2009; Levinson, 2008; Kolsto, 2001b; Mueller & Zeidler, 2010; Sadler, 2004). In secondary education contexts, SSIs have been empirically validated as an effective teaching approach to cultivate character, instilled global perspectives, and fostered sociopolitical action (Bencze & Sperling, 2010; Fowler et al., 2009; Lee et al., 2012; Mueller & Zeidler, 2010; Roth, 2009; Roth & Désautels, 2004). SSI's have also been demonstrated to increase content learning (Bell & Lederman, 2003; Colucci-Gray, Camino, Barbiero, & Gray, 2006; Kolstø, 2004; Simonneaux, 2001; Zeidler et al., 2005a; Zeidler, Walker, Ackett, & Simmons, 2002), more complex thinking and critical analysis (Dawson & Venville, 2010; Zohar & Nemet, 2002), and collaboration (Bryce, 2010).

SSIs have been demonstrated to be an engaging STEM pedagogy (Murray & Reiss, 2005; Osborne & Collins, 2000). Student were more likely to engage (Zeidler et al., 2002) and experience increased engagement by participating in SSIs (Aikenhead, 2006; Ratcliffe & Grace,

2003). SSI engagement included increased self-efficacy and collaboration in inquiry (Ekborg, Ottander, Silfver, & Simon, 2013).

SSIs present a number of pedagogical, practical, and capacity challenges. Zeidler's (2003) framework for SSIs identifies four interdependent pedagogical issues: (1) nature of science issues, (2) classroom discourse issues, (3) cultural issues, and (4) case-based issues.

Nature of science issues. SSIs are an exemplar of the challenges of teaching for post academic science. Kolstø (2008) argued problems of post academic science tend to be more nuanced, requiring more actors, institutions, and moving parts, and are technically more complex. SSIs are also epistemologically challenging, and confront the logics of FIDUROD. Levinson (2008) argued the plurality of knowledge sources that are welcomed in the deliberation of SSIs are incompatible with Cartesian logics. The latent argument in this resistance to SSIs was that humanizing science is epistemologically misguided (Donnelly, 2004; Hall, 2004).

Classroom discourse issues. Effective facilitation of context-based classes requires dramatic overhaul to science learning (Bryce & MacMillan, 2009). Ekborg et al. (2013) argued that regarding time and resources, teachers are already deficient. It is difficult for science teachers to negotiate time devoted to cultivating scientific literacy beyond the time devoted to understanding content (Bartholomew, Osborne, & Ratcliffe, 2004)

Many teachers also struggle teaching beyond content. Where their content training is robust, many are unprepared to teach argumentation and decision making (Gray & Bryce, 2006; Newton, Driver, & Osborne, 1999). One large study found teachers appreciated the SSI approach, but they struggled with students' ability to formulate questions, critically examine arguments, or curate quality information (Ekborg et al., 2013). In the same study, science teachers' principal interest and appreciation for SSI integration was SSI's potential to deliver

course content, though participants began to consider goals beyond content delivery (Ekborg et al., 2013).

Cultural issues. Teachers and students may experience tension with the dialogic and cultural challenges latent in narrative approaches to science learning, particularly narratives which reverberate moral, ethical, and social issues (Bryce & Gray, 2004; Levinson et al., 2001; Levinson, 2008; Sadler, Amirshokoochi, Kazempour, & Allspaw, 2006). Aikenhead (2006) documented the factors that influence science teachers' ambivalence towards the teaching of SSIs, which included: (a) teacher values, (b) assumptions, (c) beliefs, (d) ideologies, (e) self-identities, (f) self-images, and (g) loyalties. In addition to teaching beyond content, some teachers felt unfamiliar and uncertain when facilitating value-laden discussion (Ekborg et al., 2013). Research has demonstrated that teachers have difficulty facilitating discussion on contentious issues, and engagement with SSIs requires stepping out of safe science (Aikenhead, 2006). Tension exists between teaching controversial issues and the desire for an amoral and apolitical curriculum (Cotton, 2006; Cross & Price, 1996; Lee & Witz, 2009).

High school teachers tend to favor the abstraction and decontextualization of pure science (Aikenhead, 2006), and a similar resistance to humanistic science education is common among university scientists (Bryce, 2010). Across the K-20 spectrum, teachers express insecurity about their roles in class discussion during the elicitation of anxiety and difficult emotions (Bryce & Gray, 2004).

Humanist Science Education Reform

Zeidler and Sadler (2008) reported that social and ethical issues are a growing area of research in science education, driven by the understanding that social and ethical issues cannot be resolved without science. Unfortunately, social and ethical issues are addressed marginally, if

at all, in the traditional science curriculum. That omission means students are socialized into science narrowly and amorally (Zeidler & Sadler, 2008).

Garibay (2015) utilized a large survey design to explore whether STEM was producing socially conscious and socially engaged students and their study indicated a disparity of outcomes for STEM students, both at the time of matriculation and graduation. Garibay (2015) ultimately confirmed a negative relationship with declaring a STEM major and measures of social agency. In short, students who pursued STEM had lower multicultural dispositions. Further Garibay's (2015) examination of both STEM students and STEM professionals reported lower outcomes on measures of social and civic values than their non-STEM peers.

Because higher education standards for STEM education emphasize outcomes almost exclusively pertaining to content learning, retention, and post-graduation employment, national calls to address inequity and injustice in STEM grew (Garibay, 2015). STEM teachers seeking to engage anti-oppressive pedagogy in their classroom are not alone, as a number of leaders and advocacy groups in STEM education called for the inclusion of issues of global inequality and social responsibility in STEM curriculum (Garibay, 2015).

Reform Currents. Pedretti and Nazir (2011) in their 40-year meta-analysis isolated six currents of humanistic science education – most of which place emphasis on socio-scientific issues and the cultivation of cognitive and moral development. In particular, the socio-ecojustice current implored the development of socio-political action and centered the realization of a more socially and environmentally just society as the premier goal of science education (Dos Santos, 2009; Hodson, 2003; Vesterinen, Tolppanen, & Aksela, 2016). Pedretti and Nazir's (2011) study accounted for a number of popular and high-profile reform efforts in the United States, many of which are in response to national imperatives. The Obama administration asserted that if the

United States wanted “to foster higher levels of scientific literacy, then it is essential to begin recognizing perspectives that includes science-related social issues and accept the importance of incorporating scientific literacy into standards, assessments and school programs for science” (Bybee, 2009, p. 10).

A review of the literature on science education reform reflected robust reform efforts including at least nine such projects known as the following: (a) Indigenous Science Education (McKinley, 1996); (b) Urban Science Education (Barton & Tobin, 2001), (c) Environmental Education (Colucci-Gray, Perazzone, Dodman, & Camino, 2013); (d) Multicultural Science Education (Seiler & Abraham, 2009); (e) Science Education for Citizenship (Vesterinen et al., 2016), Nature of Science (Kolstø, 2001b); (f) Science Technology and Society (STS) or Science Technology Society and the Environment (STSE) (Aikenhead, 2006); (g) Liberatory Science Education (Barton & Tobin, 2001), and (h) Bildung Science Education (Vásquez-Levy, 2002). The following is not a comprehensive review of these reform efforts, but a brief introduction to select reforms germane to the scope of this dissertation.

Science Education for Citizenship. In addition to the philosophical questions of what can be known, and how can we know it, science education for citizenship (SEC) asks – how should we live? SEC draws upon student capacity to discuss structural issues, and their social, political, and economic forces and engage questions of action whether individually, collectively, or in preparation for the future (Vesterinen et al., 2016). While SEC is grounded in a shared commitment to cultivating citizenship, there was little consensus of what citizenship actually includes, its priorities, or its goals (Vesterinen et al., 2016). Kiwan (2005, 2008) offered a model of citizenship science with four dimensions: (a) moral, (b) legal, (c) participatory and (d) identity

based, whereas Kahne's (2004b) model presented three visions for citizenship: (a) personal responsibility, (b) participation, and (c) justice orientation.

Science education for citizenship prepares students to engage with science issues critically, actively, and knowledgeably (Kolstø, 2001a), in service to democracy (Driver, Leach, & Millar, 1996; Millar, 1996). SEC exercises socio scientific issues to prepare learners for public dialogue concerning issues of justice and morality (Waghid, 2005). SEC also engages students in issues and problems relevant to them (Vesterinen et al., 2016). Kiwan (2007) asserted that identity-based science is important, if a concerted goal is to make a more inclusive citizenship science movement.

STS and STSE. A number of curriculum initiatives implore the infusion of Science and Technology in Society (STS) (DeBoer, 1991; Kolstø, 2008; Solomon & Aikenhead, 1994; Ziman, 1980). STS concerns science and society interactions and the exchange of resources, information, competence, and knowledge. Specifically, STS examined the mutual impacts of scientific knowledge in cultural, social, and political contexts (Kolstø, 2008). STS raised questions of what is to be researched and the trustworthiness of interpretation and communication of results (Kolstø, 2008). Science, Technology, Society, and Environment Education (STSE) extended STS by emphasizing “transformation (through sociopolitical action); decision-making; interdisciplinarity; uncertainty; multiple solutions; the coupling of science and ethics; and teacher as facilitator and guide” (Pedretti, Bencze, Hewitt, Romkey, & Jivraj, 2008, p. 955).

Liberatory Science Education. Liberatory Science Education (LSE) employed Feminist Theory as a conceptual framework to rethink the nature of science and science education (Calabrese Barton, 1997). LSE was about shifting focus from the deficiencies of minorities to the

deficiencies of STEM (Calabrese Barton, 1997). The tasks of realizing a liberatory science education include critiquing science, cultivating knowledge of one's own socio-political location, and constructing new language (Calabrese Barton, 1997). Calabrese Barton (1997) offered two paradigmatic questions that underpin LSE:

- Can a science and science education be constructed that is liberatory, rather than oppressive, to those students who historically have been marginalized by the science endeavor?
- Can we teach a science that is open to multiple ways of knowing in order to help all students value the contributions made by those traditionally silenced in science? (p. 146).

Calabrese Barton (1997) also summarized the essential critical questions that guide LSE:

- What is the purpose of teaching science to students, if the result is that they understand it, but remain oppressed by it?
- Can students be taught to understand the content, culture, and practice of science, including its hidden agenda?
- Do teachers teach a science that has been constructed within and that helps promote a limited ideology, or do they work to rebuild that science and include the perspective of women and minorities as one way to begin building a science of the future? (p. 145).

LSE also includes scholars and practitioners concerned with the social construction of science (Harding, 1991), specifically masculine (Bleier, 1986; Harding, 1986, 1991; Longino, 1989) and White middle-class constructions of science (Harding, 1991), and how such constructions resulted in an epistemological narrowing of science (Longino, 1989). LSE

recognized the danger of generalizability, and how generalizability was weaponized to normalize power relations through the construction of truth. LSE thus addressed the need for local and high context approaches to scientific inquiry (Harding, 1991).

Addressing local and high context approaches to scientific inquiry required a deeply trained educator, one that is antithetical to the "deprofessionalized" teacher (Calabrese Barton, 1997). LSE relies on teachers' capacity to trouble the foundations of science with their students. Beyond conceptual understanding, Liberatory Science educators recognized and considered the impact of content, culture, and discursive practice (Calabrese Barton, 1997).

Bildung Science Education. Bildung is a German word from the tradition of continental education with no exact English definition (Vásquez-Levy, 2002). The concept of Bildung is analogous to liberal education (Løvlie & Standish, 2002) and citizenship education (Elmose & Roth, 2017). Vásquez-Levy (2002) defined Bildung as “the process of developing critical consciousness and of character-formation, self-discovery, knowledge in the form of contemplation or insight, an engagement with questions of truth, value and meaning” (p. 118). Essentially, Bildung is what is left when what you have learned is gone. Bildung science emphasizes knowledge for daily life and societal issues, not merely rote memorization of facts and algorithms (Sjöström, 2013). Bildung includes cultural and ethical dimensions in teaching in an effort to develop conscious, intentional, and motivated citizens, comparable to contemporary notions of scientific literacy (Shwartz, Ben-Zvi, & Hofstein, 2005; Sjöström, 2013). For instance, in chemistry, Bildung is not just knowledge of chemistry, but also knowledge about chemistry and its interaction with society. In this framework curriculum is considered as a combination of the applied, socio-historical, and critical philosophic (Sjöström, 2013).

Resistance to Reform. Ziman (2002) stated that academic and industrial science were beginning to make room for ethical issues in science teaching, but reform required action by individual teachers and scholars (Kincheloe & Tobin, 2009). Initiating reform has been met with challenge. The impediments of pedagogical change are well established (Bryce, 2010) and rooted in a pipeline of teacher values, ideologies, and self-images connected to traditional science (Aikenhead, 2006). Gess-Newsome, Southerland, Johnston, and Woodbury (2003) described their experience initiating curricular and pedagogical reform in the stem classroom. The authors identify three factors in the paradox of change without difference: (a) structural and cultural contexts, (b) purposes of reform, and (c) teacher thinking. The authors elaborated on the literature of teaching thinking, and named Feldman's construct for personal practice theories as a useful framework from which to consider teacher thinking. Gess-Newsome et al. (2003) concluded that teacher development was designed and motivated intrinsically, yet, minimally influenced by administrative intervention. As such, successful humanist science education reform will account for a necessary and difficult shift in teacher identity (De Vos, Bulte, & Pilot, 2002). Reform must also account for challenges of capacity building, and prepare educators to engage knowledge from new ontological, epistemological, and ethical dimensions, as well as buttress their skills for dialogue and conflict resolution (Eriksen, 2002).

Scholarship exploring the effectiveness of humanistic science education reform revealed that in some cases, teachers' efforts to engage SSIs did not seem to be connected to any reform efforts (Lee & Witz, 2009). Teachers were motivated to teach outside of reform efforts, driven instead by personally rooted ethics and values (Lee & Witz, 2009). Unless otherwise driven by supra-educational or intrinsic factors, teachers followed traditional approaches to science

teaching (Aikenhead, 2006; Davis, 2002; Jenkins, 1992, 2002; Lee & Witz, 2009; McGinnis & Simmons, 1999).

Discipline Based Education Research. DBER “comprises related research fields that investigate learning and instruction within a discipline that are grounded in the priorities, worldview, knowledge, and practices of that discipline” (Singer & Smith, 2013, p. 469). Rapid advances have occurred in the last two decades in the focus and volume of STEM DBER, demarcated by a growing number of academic programs that are increasingly producing PhDs and scholarship on issues of teaching and learning in particular undergraduate STEM contexts (National Research Council, 2012). The Discipline Based Education Report (National Research Council, 2012) summarized trends and asserted directives for the future of educational research in physics, chemistry, biology, geosciences, astronomy, and engineering. The predominant influence of STEM DBER was seen in the momentum of the active learning movement, which includes teaching and learning strategies that actively engage learners in the construction of knowledge through cooperative and experiential activities (Singer & Smith, 2013). In addition to active learning, the DBER report targeted several additional undergraduate STEM education priorities including increasing student comprehension of fundamental concepts, attending to instructor “expert blind spots” through scaffolded curricular and pedagogical approaches, improving student visual and spatial reasoning, and metacognition (National Research Council, 2012).

Explicit priorities which reflect the goals of humanistic STEM education or critical pedagogy are virtually absent from the DBER Report. Nevertheless, the DBER Report’s positions on experiential learning and increased inquiry into students’ affective experiences with STEM learning (National Research Council, 2012) could be leveraged to pursue knowledge and

practice in domains with critical pedagogical potential such as community based participatory action research and affective pedagogies that resist the predominance of Cartesian dualism.

Radical Practices in STEM Education

For more than 20 years, calls have been made to push humanistic science education reform toward more radical approaches (Dos Santos, 2009; Hodson, 2003; Kumashiro, 2009; Santos, 2006). Vesterinen et al. (2014) argued that knowledge of and engagement with SSIs will not suffice, and recommended further action. Hodson (2003) conferred on the necessity for a radical reorientation of school science to include socio-political action. These calls are in line with Freire's (2000) assertion that conscientization is not enough, realizing humanity entails action and more activist educators. Kumashiro (2001) connected the urgency of radical practices in science education to STEM complicity in marginalization and oppression. Kumashiro (2001) emphasized STEM power relations that govern who can ask questions, what questions can be asked, what knowledge is publicized, and how knowledge is represented.

Frameworks for radical practices in STEM education are emerging. Consistent with reform efforts discussed earlier, radical practices may take the form of service learning, connecting science and social issues, and to a modest degree, immersive undergraduate research opportunities (Garibay, 2015). Select scholars advocated for a distinctly Freirean approach which infuses conscientization and socio-political action in science education (Santos, 2006; Seiler & Abraham, 2009).

Kumashiro (2001) stated that it is difficult to translate anti-oppressive education theories into practice. Teachers are reticent to engage anti-oppressive practices in their pedagogy for a multitude of reasons. They may interpret their role as principally teaching their subjects. They may also feel stifled by the complexity and difficulty of anti-oppressive education, which is

reasonable, as there are no clear strategies to address power and privilege in the classroom. Teachers may also regard curricular theorizing for anti-oppressive education as irrelevant or unduly activist (Kumashiro, 2001).

Challenges to radical approaches in STEM education reflect the adverse impacts of neoliberalism in higher education, discussed earlier in this chapter. Kumashiro (2001) asserted that anti-oppressive pedagogies require unique teacher efficacy and capacity and require additional resources and time. Anti-oppressive education is not easy, nor linear, and requires flexibility for conflict and crisis (Kumashiro, 2001). Anti-oppressive education is also difficult to measure and is dissonant with the standards culture of math and science. Accepting the unknowability of education creates tension with prevailing logic of measurability and outcomes (Kumashiro, 2001).

Kumashiro (2001) elaborated that anti-oppressive education also disrupts the larger curricular project of producing a passive, docile citizenry. In this aspect, learning math and science is not about conscientiousness of math and science, but the repetition of "doing" math and science. There is no time for anything but doing. Garibay (2015) argued that resounding logic in STEM education curriculum, reinforced in national standards, is the imperative of STEM to prepare a competitive workforce for global competition. Garibay (2015) stated that STEM education for global competition competes with critical views of the social justice potential of STEM to increase social consciousness, transform structural inequity, and advance democracy and the human good. Also as a significant obstacle, anti-oppressive pedagogies may meet resistance from students (Kumashiro, 2001). Kumashiro (2001) argued that the cognitive and emotional process of learning, and unlearning, one's complicity in oppression is difficult.

Chapter Summary

This chapter began with a discussion of the social, economic, and ideological factors that shape the public higher education context. Particular attention was given to the influence of neoliberal market rationality on the faculty, student body, curriculum, teaching, and research of colleges and universities. Following the inculcation of neoliberal ideology in higher education, this chapter reviewed the history, contemporary practice, and future of critical pedagogy in higher education. The chapter closed with a discussion of critical pedagogy in STEM education, addressing specifically humanistic STEM education its various K-16 reform movements and the prospect of a more radical STEM pedagogy.

CHAPTER THREE: METHODS

Chapter Introduction

This chapter presents the philosophy and rationale, guiding methodology and methods choices. An explicit detailing of my epistemology, theoretical frameworks, methodology, and methods is necessary as approaches to educational research are numerous and nuanced (Jones et al., 2014). This study is principally interested in how contingent teaching faculty in STEM who practice critical pedagogies navigate the neoliberal university. In the broadest scope, this study follows the qualitative tradition as my inquiry centers on perception and meaning making related to the human experience (Jones et al., 2014). A qualitative research design is also appropriate because the tradition attends to the complexity of multiple contexts and perspectives (Jones et al., 2014). I selected the qualitative approach for its ability to wield deep, diverse, and nuanced data, and subsequently selected case study research as my methodology for its contextual bandwidth.

Research Approach

Research Paradigm

The paradigm of the researcher explicitly and implicitly informs every aspect of inquiry (Jones et al., 2014). Crotty (1998) referred to the researcher paradigm as a “package of beliefs” (p. 35), and Creswell (2013) similarly asserted that paradigm is a “basic set of beliefs that guide action” (p. 35). Research scholars also discussed the researcher paradigm as worldview (Patton, 1990; Schwandt, 2007). Schwandt (2007) described paradigm as “a worldview or general perspective” (p. 217) and Patton (1990) “a worldview, a general perspective, a way of breaking down the complexity of the world” (p. 37). For this study, I operated from a hybrid paradigm, utilizing both critical and pragmatic perspectives to make sense of my participants, their praxis, and the contexts they navigate.

Declaration of the research paradigm makes clear for both the investigator and the study audience particular philosophies and intentions governing the ethos and mechanics of the study's purpose and design (Jones et al., 2014). Crotty (1998) argued that the researcher's paradigm has a cascading effect into subsequent dimensions of inquiry, from epistemology to theoretical frameworks, to methodology, and ultimately to individual methods. Denzin (2010) asserted that "the qualitative researcher is not an objective, politically neutral observer who stands outside and above the study of the social world. Rather, the researcher is historically and locally situated within the very processes being studied" (p. 23). Disclosure of the research paradigm in this regard is a first step in a practice of research congruence (Crotty, 1998; Jones et al., 2014). Numerous methodological decisions in this study trace back to my espoused research paradigm. The selection of my theoretical frameworks, the formation of my research questions, my utilization of both emergent and a priori analyses, and my approach in the discussion of my results all trace to my paradigm, namely my epistemological commitments as a critical pragmatist.

Except for ontology, the researcher's broadest consideration in the research approach is that of epistemology. Epistemology has been described as "the study of the nature of knowledge and justification" (Schwandt, 2007, p. 87) and the "assumptions that concern the origins of knowledge" (Morse & Richards, 2002, p. 3). An apt definition for the purpose of a critical qualitative study was Creswell's (2013) assertion of "what counts as knowledge and how knowledge claims are justified" (p. 20). A reveal of epistemology is ultimately a reveal of the researcher's philosophical assumptions about what constitutes knowledge (Jones et al., 2014). Often, these assumptions are articulated as a worldview, or how people conceptualize their

beliefs about the nature of humanity, time, and space (Hays & McLeod, 2010). As such, epistemology influences all dimensions of the research process (Jones et al., 2014).

Kezar (2004) asserted that researchers should know the philosophies that underpin their worldviews well enough to defend their choices. At core, my worldview is emancipatory (Jones et al., 2014), in that I view the world as organized in systems of power, said power systems are inherently oppressive, and the orientation of my research agenda is to contribute to the dismantling of those systems. Where Jones et al. (2014) uses the language of emancipation, the essential premise has also been described as subjectivism (Crotty, 1998), subjectivity (Pascale, 2011), critical science (Coomer & Hultgren, 1989), criticality (Steinberg, 2012), and critical theory (Lincoln, Lynham, & Guba, 2011).

I approached this study from an epistemological position of critical pragmatism. This perspective is a combination of the two comprising traditions, pragmatism, and critical theory that in many ways are historically and paradigmatically opposed (Frega, 2014; Shalin, 1992). Most apparent are the tensions between pragmatism's anti foundationalism and the emancipatory commitment of critical theory (Kadlec, 2007). These tensions span almost 100 years, stemming from the Frankfurt School's' indictment of the American Pragmatists dangerous liaisons with the logical empiricists (Kadlec, 2007). Critical theorists have long accused pragmatism of failing to question the ontological structures within which they "solve problems" and as a result remain vulnerable to reproducing inequality and advancing systems of oppression (Kadlec, 2007). Conversely, Pragmatism's disregard for any inquiry not productive of tangible outcomes in service to democracy (or to the oppressed for that matter) has resulted in a mutual repugnancy (Kadlec, 2007). Nonetheless, I am committed to the reconciliation of these traditions and do so with four justifications (drawing from contemporary critical re-

conceptualizations of pragmatism as well as arguments and cautionary critiques of neo-pragmatist scholars).

Foremost, I am inspired by the critical reconceptualization of American Pragmatism (particularly Dewey) by scholars like Kadlec (2007) who asserted that Dewey made room for critical theory in emphasizing experience as an essential component of knowledge production, particularly the cultivation of critical thought, which is directly compatible with Freire's (2000) notion of conscientização or critical consciousness. Further, Dewey's commitment to democracy as a goal could be argued as a commitment to liberation and that Pragmatism could undertake the power analysis and concern for hegemony indicative of critical theory in service to realizing a liberatory democracy (Frega, 2014; Kadlec, 2007; Shalin, 1992). I am also encouraged by scholars who traversed the bifurcation of critical theory and pragmatism, most notably Jürgen Habermas (Fraser, 1992), whose broader writings I experience with great resonance. A third reconciliation is the postmodern turn of pragmatism, reflected in neo-pragmatists, namely Richard Rorty and Hilary Putnam. The somewhat post-structural uptake of the neo pragmatists and their concern for language disentangles some positivist affinities of the early American pragmatists (Bjørn, 2009). Lastly, I reconcile the divide by heeding the cautionary critiques of the neo pragmatists, specifically Cornel West. West (1989) admonished Rorty for his narrow historicism of knowledge, and implored consideration for the socio-historical context in which knowledge is produced. West asserted a possibility for a "sophisticated pragmatism" that centers concern for dynamics of power and disequilibrium in knowledge production, asserting:

The goal of a sophisticated neo-pragmatism is to think genealogically about specific practices in light of the best available social theories, cultural critiques, and

historiographical insights and to act politically to achieve certain moral consequences in light of effective strategies and tactics (p. 209).

In holding these critiques close, and integrating various re-workings and re-interpretations, my critical pragmatism attempts to mutually engage Pragmatism's complete skepticism, ethos of "good enough", concern for realizing change in people's lives, plurality, theoretical promiscuity, concern for democracy/liberation, and commitment to praxis of knowledge production. My adherence to critical theory maintains commitment to resisting hegemony, commitment to power analysis, vision of emancipation, and strive to map and dismantle white supremacist cis-hetero-patriarchy.

To further harmonize these epistemological traditions and amplify their unique potentials, I have selected two theoretical perspectives to inform my inquiry: (a) critical bifocality (Weiss & Fine, 2012) and (b) appreciative inquiry (Cooperrider & Whitney, 2001). Theoretical perspectives are philosophical dispositions, which inform methodological choices (Jones et al., 2014). Crotty (1998) described theoretical perspective as "the philosophical stance informing methodology and thus providing a context for the process and grounding its logic and criteria" (p. 3). Where Crotty (1998) refers to theoretical perspective, others make reference to movements (Pinar, Reynolds, Slattery, & Taubman, 1995), philosophical approaches (Bronner, 1999), interpretive frameworks (Creswell, 2013), and paradigmatic stances (Sipe & Constable, 1996). Theoretical frameworks influence how the researcher approaches the study topic and design (Jones et al., 2014). Broido and Manning (2002) implored that effective research the use of underlying theoretical perspectives and that thoughtful use can lead to greater complexity in understanding.

In particular, critical perspectives elicit complexity through questioning issues of power, identity, and social norms (Broido & Manning, 2002).

A critical perspective promotes a view of the human social life that takes into account the cultural, symbolic, economic, and political power that influences the lives of individuals oppressed by those in the majority, often times seen as those in power (Jones et al., 2014, p. 57).

Researchers undertake critical perspectives because they are interested in examining and transforming contemporary issues (Ingram, 1990). The uptake of critical perspectives in higher education research is popular, but often implemented without due diligence (Jones et al., 2014). As such, I have considered my study through Tierney and Rhoads' (2004) guidance, via five premises for adopting critical perspectives in higher education research:

1. "Research efforts need to be tied to analyses that investigate the structures in which the study exists;
2. Knowledge is not neutral. It is contested and political;
3. Difference and conflict, rather than similarity and consensus, are used as organizing concepts;
4. Research is praxis-oriented; and
5. All researchers/authors are intimately tied to their theoretical perspectives. We are all positioned subjects" (p. 327).

My study utilized one critical and one pragmatic perspective, in an effort to improve the incisiveness, nuance, and transformative potential of my research. Weis and Fine's (2012) critical bifocality afforded a dual focus on the local and the structural as well as accounted for the influence of neoliberal capitalism in the formation of institutions and the navigation of

individuals within those institutions. Weis and Fine's (2012) critical bifocality also attends to the call and obligation for education scholars to mind the role of structures in educational culture. I also applied Cooperrider and Whitney's (2001) Appreciative Inquiry to realize the pragmatic potential of the study by centering positive regard for what works and why people succeed. Appreciative inquiry lends balance to the largely critical dispositions of critical bifocality and brings focus to the wisdoms of the participants, and positions their reflections as rich sites for learning.

Research Questions

Jones, Torres, and Arminio (2014) cautioned researchers to discern whether their inquiry is driven by a question or an opinion. An opinion is a settled matter, where a question is unsettled and emergent from a compelling interest (Jones et al., 2014). To describe succinctly the compelling interest (or purpose and problem) of this study, the expanding neoliberal ethos of higher education imperils the essential work of critical pedagogues in mobilizing the university as a site for cultural change and the realization of democracy and liberty. Critical pedagogy is directly antagonistic with the capitalist and hyper-individualistic underpinnings of neoliberalism and as a result renders practitioners of critical pedagogy vulnerable to the surveillance and regulation of the neoliberal university. The incompatibility of critical pedagogy is exacerbated in fields of science, technology, engineering, and mathematics (STEM) as, increasingly, they are positioned as the principal economic forces of higher education. Coinciding with the neoliberal project, tenure and other employment protections once historically installed to maintain freedom of inquiry and provide labor stability, are now being eroded slowly through neoliberal and neo-conservative forces.

As the future of higher education will likely further entrench itself in neoliberal rationality (Giroux, 2014a; Lawrence, 2015), it is essential to understand the praxis of those critical pedagogues that successfully negotiate and navigate STEM disciplines, amidst conditions of austerity and vulnerability. This study was guided by one primary research question, with two sub-questions:

- Primary Question: How do contingent teaching faculty in STEM who practice critical pedagogies navigate the neoliberal university?
- Secondary Questions:
 - How did their praxis develop?
 - What does their praxis look like?

Stake (1995) asserted “good research questions are especially important for case studies because case and context are infinitely complex and the phenomena are fluid and elusive” (p. 33), but consistent with Stake’s (1995) guidance, I anticipated the research questions would grow and change with the study’s progress. Whereas the research questions manifested as a result of formative experience on my part as a practitioner, and were further shaped by the literature review, the data collection process produced new insights through which issues central to my study continued to “emerge, grow, and die” (Stake, 1995, p. 21). Two salient examples include my initial focus on the resilience of critical STEM pedagogues and my narrow construct for critical pedagogy. Through the course of investigation, most substantially through conversations with participants, I recognized that my focus on resilience was too narrow and did not capture participants’ experiences that were useful in relation to the research problem and purpose. Also, through in-depth conversations with participants, I was challenged to examine and reconsider my conceptualization of critical pedagogy to include dimensions of inclusive pedagogy, often

referred to as culturally relevant pedagogy (Ladson-Billings, 2006) or culturally responsive teaching (Gay, 2018). As a result of my inquiry, I now recognize the dynamic tension and overlap between inclusive and critical pedagogies and the short sightedness of my expectation that the research participants bifurcate these aspects of their praxis. In response to both of these realizations, I revised my conceptual frameworks and my research questions to maintain congruence.

Research Overview

Congruent with my aforementioned paradigm, the problem and purpose of my study called for a qualitative research approach. All qualitative research is naturalistic or occurs in real world settings (Patton, 2002). Qualitative studies are particularly useful for lines of inquiry, which center the perception and meaning making of human behavior and culture (Jones et al., 2014). Jones, Torres, and Arminio (2014) asserted that the overarching purposes of qualitative research are: (1) “to illuminate and understand in depth the richness in the lives of human beings and the world in which we live” and (2) “to use new understanding for emancipatory practices” (p. 11). Qualitative inquiry also lends to open exploration and the production of knowledge, rather than the testing and reduction of knowledge (Jones et al., 2014).

Qualitative inquiry is appropriate for my study because the conditions, which critical pedagogues negotiate and navigate in higher education STEM contexts, are in need of theorizing. The collection, curation, and amplification of human experiences are a necessary and foundational step to increasing inquiry that is more incisive. Also significant and essential to the design of this study was the potential for qualitative inquiry to engage and manage multiple intersecting social realities and contexts (Jones et al., 2014). My study required a holistic

methodology, which accounted for the temporal, spatial, historical, political, economic, cultural, social, and personal.

The requisites of open inquiry and managing multiples realities and contexts called for the interpretive methods characteristic of qualitative inquiry. Speaking to interpretation as method, Stake (1995) asserted that “in qualitative studies, research questions typically orient to cases or phenomena, seeking patterns of unanticipated as well as expected relationships” (p. 41). Qualitative inquiry is revelatory and aims to amplify learning for the investigator and the study’s readers by maximizing opportunities for naturalistic generalization (Stake, 1995). In qualitative inquiry, words such as illuminate, explore, discern, and meaning represent an openness to mutual construction and enlightenment (Arminio & Hultgren, 2002). Essentially, qualitative inquiry is experiential learning (Stake, 1995). Summarizing Denzin and Lincoln (1994), Stake asserted:

The function of research is not necessarily to map and conquer the world but to sophisticate the beholding of it. ‘Thick description,’ ‘experiential understanding,’ and ‘multiple realities’ are expected in qualitative case studies. Pursuit of complex meanings cannot be just designed in or caught retrospectively. (p. 43)

There are notable limitations and critiques of qualitative inquiry. Qualitative inquiry is derided for producing more puzzles than solutions (Stake, 1995). Qualitative inquiry is also vulnerable to the intellectual shortcomings of the investigator, as methodological weaknesses may fail to purge misinterpretations (Stake, 1995). As discussed later in this chapter, many limitations were accounted for through practices of triangulation. Further, the limitations of qualitative inquiry were far outweighed by the potential of a research design that is fundamentally holistic, empirical, interpretive, and empathic (Stake, 1995).

Case Study

Creswell (2013) described methodology as the “procedures of qualitative research” (p. 22). Methodology is the description of inquiry strategies, which will ultimately influence methods choices (Jones et al., 2014). Put another way, “a theory of how inquiry should proceed” (Schwandt, 2007, p. 193). The qualitative tradition is rich with diverse methodologies. Popular approaches in social sciences like education are ethnography, grounded theory, narrative inquiry, phenomenology, and case study (Jones et al., 2014). I considered a number of methodological approaches to pursue my research questions. Narrative inquiry, phenomenology, and emergent qualitative approaches like portraiture all invite rich and complex explorations of individual’s lives and the numerous contexts they inhabit. From the established traditions of qualitative inquiry, I determined case study to be the most manageable and congruent methodology to pursue my research questions. Foremost, I selected case study because the tradition centers and concerns the wholeness of the individual and the intersection of various contexts which inform their lives and work (Stake, 1995). While case study serves as the foundation for my methodology, my implementation was eclectic and drew upon practices and insights of other qualitative traditions like narrative inquiry.

Yin’s (2002) guidance also underscores my selection of case study, as my inquiry was concerned with the “how” and “why” of critical pedagogues persistence in STEM and the neoliberal conditions of their practice. The socio-political conditions of their practice are relevant as the boundaries between the neoliberal context and the phenomenon central to my study are not clear. To use Stake’s (1995) language, I am interested in the “particularity and complexity of a single case coming to understand its activity within important circumstances” (p xi).

Case study is a comprehensive research strategy that has a long history in social science (Yin, 2002). The popularity and prevalence of the design has ebbed and flowed, with renewed interest since the 1980s, particularly in the US and Europe (Stablein, 2006). Stake (2000) stated case studies are among the most common approaches to qualitative inquiry today. Case study is particularly popular in higher education, as much of our work environments and situations represent “cases” (Jones et al., 2014). In this study, the case is a person, an individual practitioner embedded in a specific environment during a specific era.

Flyvbjerg (2011) offers four succinct distinctions of case study. Case studies are:

- Defined by the demarcation of the unit’s boundaries;
- Intensive, that is, include more detail, richness, completeness, and depth;
- Influenced by developmental factors in that they evolve over time and in specific time and place; and
- Focused on the relation to environment or context (p. 301).

The design of my study is indicative of Flyvberg’s (2011) distinctions. My cases are bounded, demarcated by state and institutional affiliation, practitioner discipline and appointment type, and pedagogical disposition. My study design is also intensive, with numerous and thorough methods of data collection including four individual interviews with each participant. My study also attends to the highly contextual nature of the cases, and it aims to capture the distinctions and significance of their time and location and their numerous and dynamic ecological relationships (Bronfenbrenner, 1977).

An implicit assumption of case study is that something can be learned from a single case (Stake, 2000). The notion of a case can be diffuse, so I present multiple definitions to triangulate meaning. Stake (1995) emphasized the distinctiveness of a case defining it as “a specific, a

complex, functioning thing [...] an integrated system (which) has a boundary and working parts” (p. 2). Merriam (1998) also drew attention to delineation as a central feature, asserting that a case is “a thing, a single entity, a unit around which there are boundaries” (p. 27). In each interpretation of a case, the units may take many forms and may include but are not limited to a person, a relationship, a program, a group, an organization, and event, a process, a problem, or a policy (Merriam, 2009; Stake, 1995; Yin, 2008).

Case study is distinguished by an intensive focus on a bounded system (Jones et al., 2014). The bounded system is identified either for its uniqueness or its commonality (Jones et al., 2014; Stake, 1995). A case is bounded if it is clearly identifiable and limited in scope (Jones et al., 2014). Merriam (2009) offered guidance on assessing the boundedness of a case:

“One technique for assessing the boundedness of the topic is to ask how finite the data collection would be, that is, whether there is a limit to the number of people involved who could be interviewed or a finite time for observations. If there is no end, actually or theoretically ... then the phenomenon is not bounded enough to qualify as a case” (p. 41).

The boundedness of my cases meets Merriam’s (2009) criteria. My case selection was narrowed by numerous factors (region, institutional affiliation, institutional type, faculty appointment, faculty discipline, and pedagogical disposition), and the specificity of my design was affirmed by the results of my recruitment. After thorough solicitation through my networks, institutional listservs as well as through participant nominations, or snowballing, seven individuals consented to participate in the study. Four participants met the criteria.

Yin (2002) expanded on boundedness and considered the complicating features of context. Yin defined a case as “a contemporary phenomenon within its real life context, especially when the boundaries between a phenomenon and context are not clear” (p. 13). The

case in this study is bounded by the distinct social and psychological phenomena enveloping the experience of being a contingent STEM faculty member who implements critical pedagogies at a public university. Further, the study design invites participant reflection on and documents the numerous and nuanced contextual dimensions of participants' praxis including the influence of social and political climates at local, regional, national, and international levels.

Case study has a wide range of implementations and is easily adaptable. In fact, the innumerable interpretations and implementations of case study research have led to some consternation among scholars as to its essential methodological qualities (Ragin, 1992) but, case study research maintains legitimacy in social science research through the establishment of well-structured, transparent, and defensible protocols (Yin, 2002). As such, I have grounded my design choices in methodological precedents, which align with my research paradigm and questions. Further, I have made available the details of my data collection and analysis protocols (See Appendices G-R).

While interpretations and implementations abound, the essence of case study is the examination of at least one case, a case being a bounded system (Merriam, 2009; Stake, 1995; Yin, 2008). The essence of case study does not delineate any particular data collection techniques, as forms of data vary widely (Vaughan, 1992). Arguably, the use of multiple methods is a strength of case study research (Yin, 2002).

Case Study Perspectives

Approaches to case study are diverse and uniquely complement and/or inform all dimensions of the research design. For instance, the more prominent case study approaches in educational research harmonize more effectively with different epistemological perspectives. Case study research may be approached from a positivist perspective (Eisenhardt, 1989) or an

interpretive perspective (Lincoln & Guba, 1985), but many contemporary scholars of case study research locate their work in the constructivist paradigm (Merriam, 2009; Stake, 1995; Yin, 2008).

Constructivism is an epistemology of relativity and centers the premise that reality is socially constructed (Searle, 1995). Constructivism “recognizes the importance of the subjective human creation of meaning, but doesn’t reject outright some notion of objectivity. Pluralism, not relativism, is stressed with focus on the circular dynamic tension of subject and object” (Miller & Crabtree, 1999, p. 10).

This study utilizes Stake’s (1995) guidance for case study research. Appleton (2002) argues that while not explicitly stated, Stake’s approach to case study research is imbued by constructivism. Stake (1995) offers guidance on the facilitation, examination, and presentation for multiple levels of reality. Stake concedes however that while “there are multiple perspectives or views of the case that need to be represented, (there) is no way to establish, beyond contention, the best view” (p. 108). A dynamic tension exists in the relationship between the participant(s) and the investigator(s), as stories are collected, and the investigators attend to the representation of the participants’ reality (Jones et al., 2014; Stake, 1995).

In this study, a dynamic tension exists between the meaning participants made of their negotiations and navigations within the neoliberal university and the meaning I made as a result of my own lived experiences, my relationship with the participants, my observations of their work, and my observations of their institutional contexts. While the study is premised on the adverse socio-economic influences of neoliberal capitalism on public higher education, at times this perspective was not meaningful or salient to the participants. There were instances of interpersonal or institutional politics, issues of training, professional development, and

pedagogical capacity more so underpinned the meaning the participants made of their experience.

To attend to the value and validity of the participants' points of view and mine, the individual case reports are organized in an attempt to capture, honor, and juxtapose multiple points of view. First, each case report presents an illustrative narrative crafted from field observations and select aspects of the interview process. Second, oriented through appreciative inquiry (Cooperrider & Whitney, 2001), I present the results of the emergent analysis which attempts to reproduce the focus and emphasis of the participants' reflections. Lastly, oriented through critical bifocality (Weiss & Fine, 2012), I present the results of the a priori analysis which centers and interrogates the machinations of neoliberal capitalism in the accounts of the participants.

An Instrumental, Collective, Descriptive, and Critical Case Study

Utilizing Stake's (1995) guidance, I organized my study with an instrumental, collective, descriptive, and critical design. Stake (1995) draws upon diverse epistemological traditions, including naturalistic, ethnographic, and phenomenological methods for his guidance in instrumental design. An instrumental case study is driven by a question and need for understanding, which is not particular solely to the case, but to issues enveloping the case. Conversely, an intrinsic case study is concerned specifically with the case itself. An instrumental design is germane to my research question, as my study is not focused particularly on a sole college teacher, but more broadly and contextually on how college teachers navigate a particular issue, the systemic confines of the neoliberal university.

An instrumental case study appreciates the uniqueness and complexity of the case, with particular attention to "its embeddedness and interaction with its contexts" (Stake, 1995, p. 16).

For instrumental case studies, the issue is dominant. I am principally interested in “becoming familiar with (the case) by observing how it struggles against constraints, copes with problems” (Stake, 1995, p. 16). For instance, how do contingent STEM faculty who practice critical pedagogies navigate risk, manage workloads, acquire and make efficient use of resources, and reconcile their praxis with the mission, vision, and values of their institution?

When several instrumental case studies are involved, the design may be referred to as a collective case study (Stake, 2000). As a collective case study, multiple perspectives serve to enrich the potential for knowledge production, make the evidence more compelling, and the overall study more robust (Creswell, 1998; Stake, 1995; Yin, 2003). Together, an instrumental collective case study design enables inquiry that does not seek to generalize, but rather looks to reveal and amplify the perspectives and insights of the cases. While valid modification of generalization can occur in case study research, this study is concerned with particularization, not generalization (Stake, 1995). The charge of this study is to understand a particular case well, and not necessarily how it differentiates from others. The first priority is the understanding of the case itself. Tertiary to this is the pursuit of distinctions and comparisons with other cases (Stake, 1995). As such, multiple within-case analyses were performed, but cross-case analyses were not. For the purpose of this study, multiple cases serve to maximize learning relative to the research questions and provide unique perspectives within the bounded system to provide depth and nuance. This study does not attempt to build theory (Charmaz, 2014) or reveal the essence of a phenomenon (Van Manen, 2016).

In addition, case studies can be characterized by the nature of their final report, either descriptive, interpretive, or evaluative. The focus of this study was to describe how contingent STEM faculty navigate the neoliberal university. Therefore, this study can be characterized as

descriptive, since a detailed account of the issue and the participants' negotiations and solutions were presented (Merriam, 2015).

The proposed study design is also critical, in that it is centrally concerned with issues of power. Case study is conducive to combination with a theoretical perspective (Jones et al., 2014). The centering of critical theory in the study design enables the inquiry by keeping “the spotlight on power relationships within society so as to expose the forces of hegemony and injustice” (Crotty, 1998, p. 157). The examination of power is facilitated through the guidance of Weiss and Fine's (2012) critical bifocality, and it manifests in this study as a distinct a priori analysis in which a separate coding pass of the data examines neoliberal logics, practices, and outcomes present in the participants' praxis.

Data Collection

Study Population

The study population is constituted through four criteria, concerning issues of professional rank, location, professional identity, and practice. Foremost, the study population is delineated as (1) contingent teaching faculty in (2) accredited public colleges and universities in the state of Oregon. Contingent faculty includes all teaching faculty who are not tenured or tenure line faculty and excludes graduate teaching assistants. Contingent faculty are commonly, but not exclusively referred to as adjuncts, instructors, and clinical faculty (AAUP, 2014). Accredited public colleges and universities include institutions of all scales and locations within the purview of the Oregon Higher Education Coordinating Commission (HECC) including 2-year, 4-year, and doctoral granting institutions.

The study population also hold Science, Technology, Engineering, or Mathematics (STEM) teaching appointments. STEM is a broadly defined constellation of disciplines, and for

the purpose of this study concerns applied science fields falling within the contemporary funding priorities of state and federal governments. For inclusion, study participants must have taught a STEM course either within the last year or plan to teach a STEM course within six months of study recruitment.

In addition to having experience as a college teacher in STEM, the study population espouses goals indicative of critical pedagogy. Specifically, the study population asserts intention to cultivate through their curriculum and instruction student outcomes related to conscientization, critical literacy, and/or sociopolitical action.

Sampling Procedure

Purposive sampling was utilized in this study. Identification of cases was theoretically driven and then practically executed through the determination of specific sampling criteria (Jones et al., 2014). With Institutional Review Board (IRB) approval (Appendix A; Appendix B), participants were recruited with a purposive criterion sampling method, derived from group characteristics. Purposive sampling is consistent with the research design, as instrumental case study is driven by a question and need for understanding that is not particular to the case (Stake, 1995).

Case study research is not sampling research, and the principal concern of the design is not generalization but the intricacies of the case (Stake, 1995). This study did not aim to generalize its findings rather the study aimed to maximize learning (Stake, 1995) in pursuit of strategies to integrate critical pedagogical practices more fully in the neoliberal university. In this study, sampling was motivated by the concern for how contingent and critical STEM pedagogues navigate neoliberal contexts, and not the praxis of a particular college teacher.

Consistent with the guidance and precedent for collective case study in education, I planned to recruit between three and six participants (Bray, 2011; Charmaz, 2006; Jones et al., 2015; Mestemacher & Roberti, 2002; Stake, 1995; Scheib, 2003;). To solicit participation for my study, I designed multiple recruitment materials. I developed a postcard (See Appendix G) to share with cultural gatekeepers, to leave with participants and prospective participants for the purpose of snowballing, and to distribute in opportune moments as I encountered prospective participants or their constituents in my personal and professional life. I also developed a digital flyer (See Appendix H) which I distributed throughout social media networks including Facebook and LinkedIn. I also emailed this flyer to department chairs, colleagues, and other institutional gatekeepers at institutions throughout the Oregon HECC (See Appendix C) to distribute and post. Accompanying my post card and flyer was a video link to a narrated PowerPoint (See Appendix I) which detailed the study in a rich media format. Through my use of video, I intended to establish a sense of trust and interest with prospective participants, and share additional information which was too cumbersome for the postcard and flyer.

Active recruitment of participants took place over four weeks between February and March of 2018. A total of nine individuals accessed the study questionnaire (See Appendix J) and provided their consent to participate in the study. Seven individuals completed the questionnaire with the necessary contact information. I contacted the seven individuals, who completed the questionnaire via email (See Appendix K) to schedule and facilitate a first-round interview. Each of the seven individuals completed a first-round interview. Four individuals were selected for inclusion in the study. For a more detailed overview of the included and excluded participants see Appendix L.

Information Sources

A central tenet of qualitative research is the notion of researcher as instrument, the primary tool in the facilitation of meaning making (Jones et al., 2014). Drawing inquiry from one's life experiences is indicative of the researcher as instrument (Patton, 2002). Qualitative research often calls for an embeddedness in the research context, and it views a relationship between the researcher and the researched as a strength (Jones et al., 2014). Expanding on my positionality statement in chapter one, a principal qualification for qualitative research is experience (Jones et al., 2014). Germane to my research questions, I am approaching this study with 10 years of experience in higher education, in which time I have served as a college teacher, a practitioner, and a scholar of critical pedagogy, specifically, in the state of Oregon. These experiences inform a sensitivity and skepticism that leads to stronger understanding and recognition of good sources of data (Stake, 1995). As a lead investigator, I am conscious that the essential practice of qualitative research - the refining and replacing of impressions - begins long before the practicalities of data gathering (Stake, 1995).

When selecting data sources for case study research, the investigator should foremost consider the vicarious experience of the reader, and select sources that establish rich context. Context illustration, like all aspect of the research design, should align directly with the research questions. Stake (1995) highlighted the significant role of the qualitative researcher as curator of context. Stake cautioned in particular that contexts relevant to the issues of an instrumental case study may not reflect the contexts, which are important to the individuals at the center of a case (1995, p. 63). For instance, a participant may make meaning of their struggles through deficit narratives favoring explanations in which they are deficient as an individual rather than making meaning of their struggles through systems of institutional or structural oppression. While their

meaning making is significant in understanding their experience, relying exclusively on their narrative may not adequately address the research questions and the subsequent education of the reader.

The tools for context building in case study research are methods. Crotty (1998) referred to methods as the “techniques or procedures used to gather and analyze data” (p. 3). Methods choices enable the investigator to examine “selected issues in depth and detail” (Schwandt, 2007, p. 13). In case study research, preferred methods are commonly interviews, content analysis, and observations (Jones et al., 2014).

Four data sources were used to triangulate the participants’ experiences. My primary data sources were a questionnaire (Appendix J) and individual interviews (Appendix M). My secondary data sources were via the collection of artifacts (Appendix N), and classroom observations (See Appendix O). The primary data sources served to capture and describe the participants’ experiences, where the secondary sources served to explore and build context for the participants’ experience. The full sequence of my data collection and analysis protocol for each participant is outlined in Appendix Q. For details regarding my data collection schedule, see Appendix R.

The questionnaire (Appendix J) served to clarify the goals of the study, collect key demographic information to determine the efficacy of the case, and to administer informed consent. The questionnaire also served as the only record that directly linked the participants’ identities with the study data.

Following the submission of the questionnaire, I engaged participants in four individual interviews (See Appendix M). Individual interviews ranged from 17 to 72 minutes, with an average duration of 55 minutes. Total time in interviews per participant ranged from 186 to 236

minutes, with an average total duration of 218 minutes for four interviews. Interviews were audio recorded and later transcribed. The interviews were semi-structured, and the first meeting was guided by the constructs reflected in the participant interview protocol. Subsequent interviews were formative and drew upon the established interview protocol, the content of previous interviews, artifact analyses, and field observations.

At the end of the second interview, participants were invited to share artifacts they deemed relevant to the study (Appendix N). The artifacts that participants shared varied, and included course syllabi, curriculum, lesson plans, teaching materials, personal reflections, personally and professionally influential literature, professional development materials, and curricula vitae. I fully reviewed each artifact and included relevant artifacts in my analyses of the interview transcripts and observation field notes. The artifacts also informed the design of prompts in subsequent interviews.

I completed in-class observations (See Appendix O) for each case study participant. Observations ranged from 60 to 240 minutes, depending on the length of the participant's course. I asked participants to choose a class meeting, which they deemed relevant to our conversations and would afford insight into their pedagogical approach. I intended to complete one observation for each participant, but two participants invited me for multiple observations and argued that the additional observation would help me appreciate different aspects of their curriculum and pedagogy. Based on these invitations, I observed two participants (Alicia and Ashley) twice. The classroom observations were designed as a secondary data collection process in an effort to better understand the participants' practice, I sat in their lessons to gather data necessary for case contextualization. Observation foci are detailed in the participant observation protocol.

Data Security

Following data collection, all artifacts, interview transcripts, and field notes were de-identified and ascribed pseudonyms. Submissions included disclosure of distinctive traits of professional identity, institutional affiliation, age, race, socioeconomic status, sexual orientation, gender, and other demographics, which if fully reported, may enable the identification of a participant. To account for this, any results or anecdotes prepared for publication or presentation, will judiciously limit case information.

All data was secured in accordance with the policy standards of the Clemson University institutional review board (IRB), and stored for three years post-study termination. All data was hosted in password-protected files and stored on Clemson University's cloud. Any printed data, not destroyed following analysis, was kept in a locked filing cabinet in the student investigator's office.

Data Analysis

Interpretation Procedures

Stake (1995) asserted that “there is no particular moment when data analysis begins” (p. 71). The earliest stages of the research process engage the essential analytical processes of qualitative inquiry, including the emergence of issues, the finding of patterns, and the elimination of data (Stake, 1995). As a higher education practitioner with 10 years of experience in faculty and staff development related to issues of diversity, equity, inclusion, and social justice, I initiated this study with presuppositions about the nature of the university, the needs of faculty and students, and a vision for a more socially just higher education enterprise. The schemas formed by my personal and professional experiences were established before the launch of the study, and they were drawn upon when making study choices and making meaning of the data.

Data analysis should lead to a clear explication and understanding of the case (Merriam, 2009). Stake (2000) offered guidance for specific procedures of analysis: (a) categorical aggregation, (b) direct interpretation, (c) correspondence and patterns, and (d) naturalistic generalization. For an overview of my analysis protocol see Appendix Q.

Categorical aggregation is the collection and compiling of individual instances until an assertion can be made about a group of data (Stake, 1995). I practiced categorical aggregation through my emergent coding passes (See Appendix T) and my subsequent within-case analyses.

To the discern consistency with data in certain conditions (Stake, 1995), I practiced correspondence and patterns through my a priori coding pass (See Appendix S). During that analysis phase, I examined the participants' experiences for machinations of neoliberal logics, practices, and conditions.

Naturalistic generalization is a discovery process that results from meaningful engagement in the happenings of life, or through a rich vicarious experience (Stake, 1995). I practiced naturalistic generalization through my individual interviews as well as my classroom observations. In both encounters, I was afforded deep and complex exposure to the lives and practices of my participants and articulated these findings in the narrative summaries at the beginning of each case report.

Stake's (1995) procedures are both meticulous and intuitive. Case study analysis may balance coding, patterning, and extrapolation of data with more individualistic interpretation via direct observation. Stake (2000) argued that the more complex a case, the more individual interpretation is required. In any approach, case study research requires thoughtful and disciplined tabling of presuppositions, so learning may occur.

Stake (2000) elaborated on the nuanced practice of interpretation in his guidance for

analysis through instrumental case study. Interpretation is the essential distinction of qualitative inquiry, the fundamental practice being the documentation of happenings, and the examination of those happenings for meaning. The process is iterative and dynamic and exists, at least for the duration of the project timeline, in a constant state of becoming. The iterative relationship of documentation and meaning making may influence all aspects of the study, including the research questions (Stake, 1995).

Stake's (1995) notion of interpretation comes largely from within the investigator, and as such – what the investigator observes, and what the investigator asserts – do not necessarily need to be closely tied. This guidance however carries an important discipline on behalf of the writer/investigator to make clear for the reader what thoughts are speculation, conjecture, or theory (Stake, 1995). Throughout the data collection, analysis, and report writing process, I engaged in reflexive memo writing during which I bracketed my assumptions in an attempt to distinguish the participants' experiences from my own speculations and insinuations.

Good qualitative inquiry, including case study, is thoughtful, cautious, and deliberate in undertaking the perspectives of the case (Stake, 1995). The privilege and responsibility of interpretation often requires making assertions on a relatively small database. For this reason, I organized my report with strictly determined findings and loosely determined assertions (Stake, 1995). I attempted to make explicit my conjectures within the cases. I also tried to corral my assertions by organizing the case reports in three parts: (1) a narrative summary, (2) a summary of the emergent analysis, and (3) a summary of the a priori analysis. I reveal my interpretations more explicitly in the narrative and a priori sections, whereas I attempted to favor the participants' insights and words in the emergent analysis and subsume my interpretations.

I used this tripartite design to realize Stake's claims about case study research as “non

interventive and empathic” (Stake, 1995, p. 12). I intended for the case study to not intervene the case, and I attempted to capture data as discreetly as possible. In the process of data collection, analysis, and presentation, I attempted to preserve the multiple realities present within the case (Stake, 1995).

I synthesized Stake’s (1995) guidance for case study research and fortified it with additional analysis techniques, which include open initial coding, axial coding, a priori coding, and memo-writing (See Appendix Q). These analysis techniques facilitated the excavation of common or unusual ideas, phrases, or words and the relocation of those findings into broader meanings (Jones et al., 2014). As a first step, open coding (Charmaz, 2006) entailed a close reading and accounting of all pieces of data. Open coding is a brainstorming approach, denoted by its openness to all possible interpretations (Corbin & Strauss, 2008). Before engaging the data with the critical examination outlined in my theoretical frameworks, I sustained a period of open-mindedness and buttressed my preconceived notions (Corbin & Strauss, 2008). Subsequently, I engaged in data reduction techniques commonly referred to as axial (Corbin & Strauss, 2008) or focused (Charmaz, 2006) coding. These practices were informed by my commitment to appreciative inquiry (Cooperrider & Whitney, 2001), and manifest as a summary in the case report which attempts to reconstruct the accounts told by the participants while highlighting the wisdoms and successes as critical pedagogues navigating the neoliberal university.

In my subsequent a priori coding pass (See Appendix S), I reconsidered the entirety of the data by seeking to map neoliberal structures and power relations via critical bifocality (Weis & Fine, 2012). Discussion of these analyses is included in the last section of each case report. For an itemized summary of all analyses, see Appendix T.

Throughout the analysis process, I practiced memo writing to document my working

ruminations (Schwandt, 2007). Memo writing is a conceptual practice, written by and for the investigator and serves as a tool for ideation and reflexivity (Jones et al., 2014). The capturing of research memos, data organization, and data analysis were facilitated via computer aided qualitative data analysis software, specifically MAXQDA 2018 (VERBI Software, 2017).

Quality Control

In qualitative research, trustworthiness represents study rigor (Patton, 2002) and general confidence in the research findings (Jones et al., 2014). Trustworthiness includes domains of credibility, transferability, dependability, and confirmability (Morrow, 2005).

To strengthen the study design, and improve the trustworthiness of the study, I employed several triangulation protocols (Stake, 1995). Triangulation cultivates credibility by synthesizing multiple methods and perspectives (Patton, 2002). Triangulation efforts substantiate investigators assertions and make visible to readers the pathways of interpretation. Utilizing Stake's (1995) guidance, this study practiced (1) data source triangulation, (2) investigator triangulation, (3) theory triangulation, and (4) member checking. For data source triangulation, I drew upon multiple data sources including several individual interviews, classroom observations, participant artifacts, and a demographic questionnaire. For investigator triangulation I deliberated each aspect of the study process with two members of my dissertation committee, who reviewed by findings, draft manuscripts, and who engaged with me as I solidified my ideations and conclusions related to the data. For theory triangulation, I drew upon conceptual frameworks from several literatures including the scholarship of critical pedagogy, STEM education, and critical education studies. Also, I integrated two unique theoretical perspectives into my study design, appreciative inquiry (Cooperrider & Whitney, 2001) and critical bifocality (Weiss & Fine, 2012). Regarding member checking (See Appendix P), I facilitated a fourth interview with

each study participant prior to which I provided a complete draft of their case report and invited them to reflect and provide feedback on how they were represented, my curatorial decisions, and any other misinformation or oversights they could discern. I chose to share a copy of the case report but not copies of the transcripts or field notes from the classroom observation. The rationale for doing so was principally pragmatic, as I deemed the volume of transcription from the four interviews in addition to the observation field notes to be too cumbersome for the participant to review.

Limitations & Delimitations

Several limitations are expected and must be accepted for case study research design (Stake, 1995). First, the specificity of case selection in my study limits the boundedness to a particular group of practitioners and institutional contexts – limiting generalizability. Additionally, all of the respondents and subsequently the selected participants for the study identify as white women. As a result, this study is absent the experiences and perspectives of people of color and men. This limitation may reflect the structural barriers which impeded faculty of color from accessing STEM spaces in higher education or the precarity of scholars of color in STEM who are judicious about engaging or communicating their engagement with critical pedagogies. Turner, González, and Wood (2009) completed a comprehensive literature review and meta-analysis of 20 years of research by more than 300 authors on inquiry related to the status and experience of faculty of color in higher education. Their inquiry reasserted the underrepresentation of faculty of color, and underscored numerous departmental, institutional, and national contextual factors, which continue to impede faculty of color access and retention in STEM research and teaching (Turner, González, and Wood, 2009). Conversely, the absence of men - particularly white men - may reflect the over-representation of white men in the STEM

professoriate. As this study targets non-tenure and non-tenure track college educators, the privileged skew of white men in the upper echelons of the faculty ranks may be reflected in the sampling. Alternatively, my selection criteria and questionnaire may have included some biases that excluded people of color or men.

Regarding delimitations, this study did not explicitly engage the research participants in reflections on their race and gender nor did I uptake intersectionality (Crenshaw, 1991; Collins, 1999) as a central tenet of my research paradigm nor through my analyses. While race and gender may be salient aspects of the participants' experience and navigation of the neoliberal university, the interview protocols did not initiate reflections with the participants, but many participants chose to reflect of their own volition. Similarly, racist and sexist systems and their unique intersections were not targeted in the research questions, data collection protocols, or the a priori analyses of the data. As such, this study does not reveal the power relations of race and gender which underpin the experiences of the participants.

Reporting and Work Plan

Stake's (1995) guidance for synthesis and reporting of case study research findings suggests 10-60-page report format for each case. My curation of narrative, emergent coding results, and a priori coding results resulted in individual case reports ranging in length between 30 and 33 pages.

I intended to write the case reports illustratively and with detail in an effort to reconstruct the case contexts vividly. Setting context in case reporting is crucial (Jones et al., 2014). Case reports should describe what the context looks like, and offer rich descriptions that facilitate vicarious experience. "Language, precision, and accurate description are important, for social science is not only about subject matter, it is for an audience" (Bhaskar, 1979, p. 76). My

language choices were affirmed by the results of my member checks, during which each participant enthusiastically confirmed the accuracy and precision of their report.

Stake (1995) also asserted the imperative to write for a diverse audience; as such, I have attempted to represent the participants through case reports with accessible language but resisted unnecessary reduction or simplification. Stake (1995) asserted that “the important thing is to write for the understanding that ought to be, not to write down so as to minimize misinterpretation but to write up so as to maximize reader encounter with the complexity of the case” (p. 126).

All research activities, including data collection, analysis, and report writing, took place within a 35-week period in the 2018 calendar year. For an overview of the study timeline with corresponding research activities, see Appendix U.

Chapter Summary

The purpose of this chapter is to explain the methodological approach that guided data collection and analysis. An instrumental, collective, descriptive, and critical case study was selected for the study design, as the approach is epistemologically congruent and germane to the central research question: How do contingent teaching faculty in STEM who practice critical pedagogies navigate the neoliberal university? The chapter began with an introduction to the researcher paradigm, and subsequently discussed epistemological congruence with the proposed methodological approach. The chapter further detailed methods for data collection and analysis. Lastly, the chapter concluded with the researcher’s commitments to quality control and disclosure of study limitations and delimitations.

CHAPTER FOUR: FINDINGS

Chapter Introduction

The purpose of this chapter is to present a summary of findings from the analysis of data collected from four contingent STEM faculty who practice critical pedagogies in public universities in the state of Oregon. This chapter includes a brief overview of the study participants (See table 4.1) and the study site with core demographic information. I have also included a précis for each case, to provide a succinct summary with highlights from each case report to help orient and guide the reader. After the précis, I present each case report. Each case report is organized in three parts: (1) an illustrative narrative, (2) a summary of emergent themes, and (3) a summary of a priori themes.

The illustrative narratives in each case report were assembled from the data collected through classroom observations of the participants and through individual interviews. The narratives attempt to give the reader rich insight into the learning environment and pedagogical approach of the case, as well as bring shape to the conditions in which the participant navigates.

The following summary of emergent themes was generated through an open and axial coding process, and is constructed through a theoretical framework of appreciative inquiry (Cooperrider & Whitney, 2001). The summary of emergent themes aims to reconstruct the accounts of the participants and organizes their reflections into four categories: (1) the work, (2) conditions, (3) strategies, and (4) outcomes. *The work* attempts to capture the nature of the participants' praxis, what their critical pedagogical approaches entail, how they arrived at their current praxis, and concrete examples of their pedagogy. *Conditions* attempts to summarize the numerous contexts that intersect and shape the participants work. This category addressed numerous ecological dimensions including global, national, regional, local, institutional,

departmental, and personal contexts—and any additional contexts which were salient to the participant. *Strategies* summarizes both the participants' techniques for facilitating critical pedagogies and their leadership approaches for affecting change in their classroom, department, and institution. Lastly, the *outcomes* section summarizes the participants' perceptions of the efficacy and results of their praxis and any relevant reflections on their future goals.

The final section of the case reports, a priori themes, summarizes the results of the coding pass in which I examined the participants' transcripts, field notes, and artifacts for evidence of neoliberal logics, practices, and conditions. I developed the coding scheme (See Appendix S) from the conceptual frameworks outlined in Chapter 2. The incorporation of this section is informed by my application of critical bifocality (Weis & Fine, 2012), and attempts to map the systems which undergird and inhibit the participants' critical pedagogical potential. Where present, I also summarized the participants' antithetical practices that appeared as direct resistance to the machinations of the neoliberal university.

As a whole, the case reports juxtapose different aspects of the participants' experiences and do so with different emphasis and tone. Framed through appreciative inquiry (Cooperrider & Whitney, 2001), the narrative and emergent themes sections prioritize the participants' perspectives, and centers the wisdoms and insights which may be useful to educators with similar goals and aspirations. Distinct from these sections, the summary of a priori themes is more critical and incisive in its examination of the neoliberal structures within which the participants operate. My aim was to map and make explicit neoliberal machinations to raise the consciousness, literacy, and motivations of readers with similar goals and aspirations to those of the participants.

Table 4.1: Summary of study participants

Pseudonym	Inst. Type	Role	Discipline	Teaching Years	Institutional Years	Race	Gender
Claire	4-Year	Full-Time Instructor	Mathematics	18	5	White	Woman
Alicia	2-Year	Full-Time Instructor	Anatomy & Physiology	6	4	White	Woman
Ashley	4-Year	Part-Time Instructor	Geology	5	4	White	Woman
Sela	4-Year	Full-Time Instructor	Biology	8	7	White	Woman

Site of the Study

The socio historical context of the research site is influential to numerous aspects of this research study. In particular, the racial/ethnic history and demographics of the state and its public higher education institutions are germane to both the results of the study sampling, recruitment, and selection as well as the content of the participants’ interviews.

According to the US Census (2017), the state of Oregon’s population totaled 4,142,776. At the time of the census, Oregon residents reported their racial identification as White alone (87.1%), Black or African American alone (2.2%), American Indian and Alaska Native alone (1.8%), Asian alone (4.7%), Native Hawaiian and other Pacific Islander alone (0.4%), two or more races (3.8%) and Hispanic or Latinx (13.1%). Racial and ethnic diversity in the state of Oregon and in the Oregon workforce historically has been limited (State of Oregon Employment Department, 2018). With the exception of Asian workers, people of color in Oregon’s labor force experience higher unemployment rates and lower wages than White workers experience. People of color in Oregon also disproportionately work in lower-paying industries (State of Oregon Employment Department, 2018). However, Oregon’s racial demographics are shifting. While the

percentage of people of color in Oregon grew by 13% since 2006, the state of Oregon remains 15% below the national average for representation of people of color. The largest proportion of people of color in the state, and the fastest growing population among people of color, are those identified by the US census as Hispanic or Latinx (State of Oregon Employment Department, 2018).

Underpinning the low representation of people of color in the state of Oregon are long histories of violence and marginalization against people of color by White settlers (Oregon Historical Society, 2018). Contemporary demographics reflect the forceful removal and relocation of indigenous peoples into confederated reservations (Oregon Historical Society, 2018). Asian-Americans were subjected to Exclusion Laws as well as deportation and internment during World War II (Oregon Historical Society, 2018). Post-slavery, the state of Oregon established Exclusionary laws specifically for African Americans that resulted in forced removal and impeded subsequent migration after the civil war (Oregon Historical Society, 2018). Since the early 1900s, Latinx communities have experienced revolving recruitment and deportation programs due to shifting anti-immigrant attitudes and agricultural labor demands. The mutual demand/disdain for immigrant labor resulted in frequent displacement and disenfranchisement of Latinx people (Oregon Historical Society, 2018).

In the state's public higher education system, student enrollments and faculty appointments reflect Oregon's low representations of people of color. The Oregon Higher Education Coordinating Commission (HECC) compiled a 2017 report detailing racial and ethnic disparities in the state's public higher education system. The report highlights issues of representation, access, and retention (Oregon HECC, 2017). Statewide, representations of part-time faculty (81.8%), and full-time faculty (81.7%) are disproportionately white and do not

reflect the demographics of statewide student enrollments, where university enrollments are 63.1% white and community college enrollments are 53.7% white (Oregon HECC, 2017). For detailed racial/ethnic demographic information disaggregated by institution see Appendix D (part-time faculty), Appendix E (full-time faculty), and Appendix F (students).

Précis: Claire

Claire is a full-time instructor in mathematics at a large 4-year institution. She has been teaching at her institution for five years and teaching for a total of 18 years. Claire received her PhD in Mathematics, and her dissertation focused on issues of abstract algebra. Claire identifies as a white woman and is a fourth-generation college student.

Claire teaches in a mathematics program that predominantly serves historically marginalized student populations, specifically first-generation college students, and students of color. Her conceptualization of social justice education is one that exists in tension between inclusive and critical pedagogical practices. As a facilitator of math learning for students from often low-resource educational systems, she attends to both the potential for her classroom to elevate and support her students in transforming the material conditions of their lives and the pedagogical potential to facilitate critical consciousness and socio-political engagement. The demographics of her classroom are significant to her in these negotiations, as she asserts that a predominately white and high socioeconomic student constituency would lend to focus more on issues of critical literacy. In service to historically marginalized students, her priority is mathematics literacy.

A notable lesson plan of Claire's is one in which she teaches students how to determine the line of best fit with a data set that articulates the gender wage gap. The lesson plan invites reflection on sexist economic disparities as well as facilitates increased understanding of core algebraic concepts. Her capacity to facilitate this lesson plan, and other lesson plans with critical pedagogical potential, is influenced by numerous contextual factors—among the most salient of which is the volume of her base mathematics curriculum and the imperative to prepare her students for more advanced mathematics and science curricula.

Claire intends to continue and expand her critical pedagogical work. Her strategies for doing so include dually attending to both the learning and development needs of her students and dynamics of power and privilege in her classroom. Claire also invests heavily in cultivating honest and meaningful student and collegial connections. She is thoughtful and cautious about mediating risk and is judicious about the potential for conflict and controversy connected to politicized pedagogies. Lastly, she shares responsibility and power in the trajectory and design of her pedagogical practices, and engages the wisdom of graduate and undergraduate students to develop her approaches.

Claire's reflections revealed numerous adverse neoliberal machinations. Most salient were institutional logics of profit and efficiency and instrumentalism. Claire spoke to the implications of her institution's robust assessment culture, that is a form of neoliberal surveillance practices, and which shapes her pedagogical approach. Additionally, she pointed to the influence of the inequalities produced by the K-20 education pipeline as a significant factor in her classroom, and her navigation as a critical pedagogue.

Précis: Alicia

Alicia is a full-time instructor in anatomy and physiology at a large 4-year institution. She has been teaching at her institution for four years and teaching for a total of six years. Alicia received her PhD in Environmental Science and her dissertation focused on issues of amphibian biology. Alicia identifies as a white woman.

Alicia teaches a scaled anatomy and physiology course, which serves between 300 and 600 students. Her conceptualization of social justice education includes three dimensions: (a) supporting the academic success of historically marginalized students, (b) envisioning and enacting an anti-racist curriculum in anatomy and physiology, and (c) facilitating the conscientization of future scientists and citizens. Her students are predominately white. Her main responsibility is a first-year foundations course that serves numerous degree programs, which are predominately pre-health programs.

A notable lesson plan of Alicia's is one in which she administers the Harvard implicit bias test to her students, as an illustration of content in her unit on memory. In addition to facilitating deeper understanding of the plasticity of neural pathways, Alicia intends to normalize dialogue on racialized, gendered, and nationalist biases and prepare health care practitioners to participate in and support a diverse society. Her capacity to facilitate this lesson plan, and other lesson plans with critical pedagogical potential, is influenced by numerous contextual factors. She listed three as the most salient, including: (a) her limited resources, (b) the scale of her classroom and curriculum, and (c) the curricular dependency of numerous degree programs with diverse needs and interests in her prerequisite course.

Alicia intends to continue and expand her critical pedagogical work. Her strategies for doing so include foregrounding community building as her principle pedagogical strategy.

Establishing a secure and trusting community enables her goals of equalizing students' success and creating the conditions in which she is able to engage more politicized pedagogies. Alicia is also intentional about her critical pedagogical ambitions and is focused on consuming scholarship and engaging in professional development that raises her own consciousness, knowledge, and capacity. Because of the scale of her classroom, and numerous other factors, Alicia privileges approaches which are subtle, indirect, and which explicitly align with her anatomy and physiology curriculum.

Alicia's reflections revealed numerous adverse neoliberal machinations. Salient logics in her teaching environment were profit and efficiency as well as instrumentalism. Most substantial was her navigation of massification and the immense scale of her learning environment and her anatomy and physiology curriculum.

Précis: Ashley

Ashley is a part-time instructor in geology and general science at a large 2-year institution. She has been teaching at her institution for four years and teaching for a total of five years. Ashley received her PhD in atmospheric and oceanic science, and her dissertation focused on issues jet stream portrayal in global climate models. Her PhD training also included a graduate certificate in teaching and learning. Ashley identifies as a white woman.

Ashley teaches two to three classes per term and covers a range of topics in general and earth science. She is responsible for diverse teaching modalities as well, including online, hybrid, and community-based learning courses. Her conceptualization of social justice education is framed in what she refers to as praxis, a three-point model for scientific literacy that engages dimensions of scientific knowledge, values, and ethics. It is in the ethical dimension that Ashley feel compelled to engage in issues of social justice in relation to science education. Ashley is reluctant to identify her pedagogy with activism or other politicized dispositions; rather she regards her critical consciousness work as good science. Ashley's students are predominately adult learners, first generation, low resource, and from the surrounding urban community.

A notable lesson plan of Ashley's is one in which she engages her students in the examination of the effects of gentrification on community sustainability and urban planning. In this lesson, she invites students to speak from their own experiences connected to their neighborhoods. Her lesson plan elicits racialized and classed experiences from her students and connects these narratives as legitimate sites of exploration for scientific literacy. Her capacity to facilitate this lesson plan, and other lesson plans with critical pedagogical potential, was influenced by numerous contextual factors, among the most salient of which is the congruence of

her institution's mission, available resources for her and her students, and her limited paid hours as a part-time faculty member.

Ashley intends to continue and expand her critical pedagogical work. Her strategies for doing so include leveraging community-based learning opportunities, leveraging pedagogical advantages of online learning, cultivating and partnering with student leadership, and sustaining a reciprocal community of practice.

Ashley's reflections revealed numerous adverse neoliberal machinations. The most salient logic in her teaching environment was profit and efficiency. Ashley also spoke to the dynamics that indicate the cultivation of flexible labor. Additionally, the influence of the inequalities produced by the K-20 education pipeline is a significant factor in her classroom and her implementation of critical pedagogies.

Précis: Sela

Sela is a full-time instructor in biology at a large 4-year institution. She has been teaching at her institution for seven years and teaching for a total of eight years. Sela received her PhD in forest ecology, and her dissertation focused on issues of plant disturbance management. Sela identifies as a white woman and is a third-generation college student.

Sela manages a massive course with nearly 1000 students, which convene in two sections over the course of three terms. Sela is the steward of the curriculum, the coordinator of 6 additional instructors, and the training and supervision of 26 graduate teaching assistants who facilitate 26 lab sections. Additionally, Sela selects, trains, and supervises 20 undergraduate learning assistants who support active learning exercises during lectures. The majority of Sela's work time is invested in administrative tasks related to her management responsibilities. She also facilitates a two-week section of her course each term. Sela's conceptualization of social justice education is one that privileges inclusive pedagogical practices, and emphasizes cultivating sense of belonging and equalizing academic success for women and students of color. Sela sees connections between scientific and critical literacy and is actively deliberating her opportunities and capacity for engaging with socio-political issues in her curriculum.

A notable lesson plan of Sela's is one in which her graduate assistants facilitate a socio-scientific issue lab in which students explore race and genetics. In the lab, students are invited to analyze DNA sequences of people from different sub regions of Africa, Europe, and Asia as a part of a drug trial proposal to determine if genetic makeup is a relevant factor in developing treatment plans for patients living with HIV/AIDS. When facilitated correctly, the lab should reveal that genetic diversity within the continent of Africa is actually greater than the genetic diversity beyond the continent of Africa. This exploration into human evolution and the

complexity of human genomes has the potential to dispel myths that support and reproduce scientific racism, a set of ideologies, which underpin eugenics. However, at the time of our interviews, Sela had decided to pull the lab in response to critical racial issues exacerbating her campus climate. A compounding factor was the teaching capacity of her graduate teaching assistants. While Sela was confident she could facilitate a contentious topic in adverse campus climate conditions, she could not trust the capacity of her student educators. The limited training and experience of her student staff was one of the many factors that influenced her engagement with critical pedagogical practices.

Sela intends to continue and expand her critical pedagogical work. Her strategies for doing so including furthering her exploration of community building and active learning techniques, and furthering her inquiry into the biology education scholarship related to equity minded pedagogical practices. Sela is also interested in further exploring the integration of socio-scientific issues, with attention to their critical pedagogical potential.

Sela's reflections revealed numerous adverse neoliberal machinations. Salient logics in her teaching environment were profit and efficiency alongside instrumentalism. Most substantial was her navigation of massification and the immense scale of her learning environment and the scope of her biology curriculum. Also influential was her reliance on de-professionalized labor to administer her curriculum, including content focused on issues of critical literacy and sociopolitical engagement.

Case Report: Claire

I walked into Claire's classroom ten minutes before the start of the period. Claire was at the podium in the front of the room, booting up her computer and talking to a student seated in the front row. She smiled at me and nodded toward a chair in the back right-hand corner of the classroom. I walked past the pair, as they strategized and discussed options related to the student's late submission of an assignment. The classroom was set in three long rows of conjoining tables and chairs. I recognized my chair from our interviews. Claire's innovations with mathematics education and corresponding success with under-resourced learners led to an influx of observation requests, and the necessity to add and designate a special chair.

The classroom was bright, lit by tall windows from the rear wall. From the second floor, I could see through tree tops to the green quad of the student union. Six dry erase boards wrapped across two walls. As students shuffled in, they splayed their supplies across clean white laminate tables and settled into wheeled chairs. The students' feet scuffed across seemingly new carpet.

I joined this class more than halfway through its term. As students arrived, they greeted each other and sat in pairs or small groups. One student after entering immediately opened two windows at the rear of the room before setting down their bag. As students murmured, Claire's gaze hung on her computer screen, her glasses reflecting the movement of various applications. At 11:59 am, 14 students had arrived. Claire stepped back from her computer, took off her jacket, and greeted the class. She directed the class into small groups to review their homework assignments. As students opened their laptops, Claire began walking between the table rows. Claire greeted students by name as she walked. The students' conversations grew lively. Working in pairs and groups of three, students leaned in toward one another, pointing at one another's screens, and scribbling notes. Like the light from the windows, laughter filled the room.

Claire returned to the front of the class. “Are we ready to try a couple?” she asked. The class nodded. The course, an introductory algebra curriculum, covered content indicative of pre-calculus. The review focused on logarithms and the power and quotient rules. The small groups set to work. Claire continued to circle the room. Students began to look up from their laptops. “Just keep going” she said. “Do number two; we’re going to do three together.”

Claire walked over to me. “Can I show you something?” I followed her to the podium. The screen of her computer was a dizzy display of windows, texts, and colors, a learning analytics system that networked and tracked the students’ activity in class. She tapped the screen, “see, we won’t need to talk about this one, because they all seem to be getting it.” I returned to my seat as Claire opened up her digital projector. “Should we do a few together?” Claire began to work out problems longhand, students followed along, calling out suggestions.

Students appeared at ease. Several students had put their feet on their tables and were resting their computers in their laps. One student had nestled in the sill of one of the large windows at the rear of the room, looking sideways to follow along with the projector screen. After a period of board work, the students returned to individual and group work. The time was 12:22 pm. The class would repeat this 20-minute cycle of individual, active, and guided learning.

Claire continued to walk the room. “How are you doing, Derrick?” She leaned over the table, touching her finger to the paper where they had been working longhand. “There you go, you got it!” Derrick smiled, Claire continued down the row. At 12:40 pm, Claire called the class’ attention, and worked through five more problems on the board. The class remained full of laughter, students continued to smile, amidst the confusion and frustration of the problems at hand.

Claire looked to the clock on her computer, and called the class's attention the last time. She reminded the class of the agenda for their next meeting. Class ended abruptly at 12:49 pm. A small line of students formed in front of Claire. I gathered my notes, smiled while making brief eye contact with Claire, and quietly left the room.

Emergent Themes

Claire and I met for our interviews in an academic building in the center of campus. Built in the early 1900s, the vaulted ceilings and elaborate moldings reflected a turn of the 20th century academe aesthetic—which was in direct contrast with the newly refurbished and technologically sophisticated classroom building where I observed her teaching. Her office, a spacious room on the top floor, was warm with eclectic furniture. When we talked, I sat in an old industrial office chair in front of her window, next to a side table stacked with papers and her single serve coffee machine.

It was in these positions that we talked for more than three hours, over the course of four interviews. Our dialogue revealed Claire's depth, insight, and intention as a college educator pursuing social justice. Claire's reflections weaved and accumulated across our meetings, revealing the nature of her work, the conditions in which she practices, her curricular and pedagogical strategies, and the risks, consequences, and rewards of her praxis.

The work. Claire reflected deeply on the work of social justice education. Our conversations surfaced Claire's beliefs about the nature of the work, all the work entails, how she arrived at the work, and several rich examples of her social justice praxis.

Claire continuously asserted that social justice in education is a comprehensive practice that requires congruence. Meaningful practice includes numerous dimensions, in and out of the

classroom. Illustrating this point, Claire criticized a peer she had recently observed present at a conference on critical mathematics pedagogy. She shared:

Well this guy at the conference, to be culturally relevant, does a one project on black lives, black killings by police. My problem with that — so I've been thinking about this a lot this week — my problem with that is that, that is such an important big topic and I know that he's not, you know all he's doing is throwing data at the students and saying go. And if you have a handful of black students in a class, the kind of questions that the white students, their white peers are asking them, because you haven't done the work you know to put this in the context, it's putting all of that on those students, all of that cultural teaching, all that cultural educating on that small group of students. You know and it's putting them in a place where they're having to answer questions that they should never have to answer.

For Claire, engaging critical socio political issues in the classroom is as much about the preparation of the content as it is the facilitation of the interpersonal dynamics of her learners. A recurring theme in our conversations was that critical mathematics pedagogy required an all or nothing approach. There is too much at risk to not thoroughly vet the content, and consider the impact and outcomes of course content on diverse learners. Claire cautioned about pedagogical choices that put undue stress on historically marginalized students, specifically students of color, when broaching issues of race in the mathematics classroom. She shared:

I don't want to minimize the importance of black people being killed by police but I don't think, I think that if we're going to talk about those kinds of issues in our classes we have to spend the time to put that into context so that our students aren't the ones, so we're not positioning our students to be the ones who have to educate and solve the problem and

some of those kind of things. So that's something that I, you know if I bring something up that is culturally relevant, I need to either you know spend the time or make sure that it's the kind of question where you know if somebody is like oh hey you know, you're black, what do you know about this? Then it's not putting that student in an uncomfortable situation because that just isolates them more.

Claire also cautioned about engaging critical social justice issues with too narrow a focus, and the potential to reproduce problematic narratives through pedagogy intended to cultivate critical consciousness. She shared:

If we're going to do a project about mass incarceration I think half the students would get the idea that blacks are criminals because we're not spending the time to talk about why, so, so that's really, really, hard to, to, do that correctly and that was one of the things that I felt like the guy at the conference didn't have or hadn't even thought about, that how are we positioning our students, how are we, you know what are we doing.

Deliberating culturally relevant pedagogy and mathematics education that elicits critical consciousness, Claire elaborated on her aforementioned critique of her colleague whom she admonished for engaging his classroom with an unduly narrow activity on anti-black police violence. Claire shared her own revision to her colleagues' approach; one she felt achieved the intended outcomes, and which addressed the needs of a diverse community of learners:

I could have two projects about, I could have one about black killings by police and I can have one about black owned businesses, the growth in black owned businesses and what they do for the economy. And think about the kinds of questions those small group of black students are going to end up answering based on those two projects. You know, I would much rather have them answering questions like 'do your parents own a Black-

owned business?’ Than, ‘Oh, do you know anyone in jail or who has been killed by police?’

Claire asserted that thorough preparation for social justice mathematics education necessitates congruent engagement in and out of the classroom. Claire shared wisdom she internalized from the testimonies of students interacting with the incongruent practices of other teaching faculty. She shared:

I think it's just seeing how other people interact with students versus how students have, you know have, things that students say to me about how their professors interact with them and then watching their professors interact with them it's like yeah you know that's, that's, not cool.

The work was difficult to compartmentalize, and Claire was ambivalent about pulling out any one piece and talking about it by itself. Equalizing student success, raising consciousness to political issues, creating learning environments where people feel comfortable and willing to engage - all of these functions depend on each other in complex and abstract ways. Claire returned to her critique of her colleague to illustrate this point:

[There's] a disconnect between you know social justice being something that you do sometimes and this idea that we've been talking about [that] it's all connected. You know that everything, that it's a bigger deal than that. If that makes sense? So yeah that's something that I have been thinking hard about is how can we move educators from that to, and you know this guy had the best intentions, but I don't know, just didn't quite close that loop or something.

Claire expressed the importance of her preparation to engage these issues in and out of the classroom, and in different ways. Claire reflected continually on how her engagement with

social justice work manifests in the classroom, among her colleagues, and during office hours. Being prepared to engage the work in numerous settings, and doing so congruently, she underscored as essential. Claire's pedagogy emerged through the course of our interviews as conscientious and adaptive:

Actually, some of that comes up in my, you know in office hours and stuff. So that's where a lot of these conversations take place. I thought we were having a study session for a test, but no, we're talking about blackness on campus today. And I was like okay, that's what we'll do. You guys are here, that's what you want to do, fine.

While illustrating the complex and comprehensive nature of the work, Claire continually returned to the imperative to engage social justice education work. While the work is scary, and issues of race are difficult to broach, you have to do something. Claire found motivation and fortitude in the struggles and resilience of her students, and reiterated her trust in their leadership. She shared:

It's a -- I don't know. I know that I tend to be scared to do to do harm, but that doesn't mean that I need, that I can do nothing. And that's one that I've been struggling with for a long, long, time and I think my answer, my only answer to that is listen to what the students are saying because, you know, that student comes to you with something, a cultural idea, and they know what they're talking about. They're living it, so, so yeah, listening to what the students are saying is my only solution to that. And then, go read up on it.

Claire holds keen insight into the formative personal and professional experiences that have shaped her orientation to the work. Claire identified numerous individuals who have helped shape her orientation to the work. Among her earliest influences were her parents, specifically

watching her parents navigate and engage her community as a political minority. Claire's motivations, empathy, and capacity for advocacy work in education has lineage to the social and political contexts of her childhood. Claire affirmed that her parents, specifically her mother, were activists. She watched her mother march for the Equal Rights Amendment, and both her parents coordinate several unsuccessful campaigns for local offices. What formed for Claire was the confidence that no matter how powerful a force, the voice of the social norm is not always right. When making this connection, Claire made explicit the distinctions between her family's political marginalization and the racial bias and violence affecting the lives of her students. She shared:

I grew up in [an area], which was 98% Mormon. You know my parents were one of like, there were maybe eight Democrats in the county, and my parents were two of them. So we had to march in every parade. We had signs on our yard that got stolen or defaced. We had, you know my mother tells stories about, I actually remember this, she came home really angry one day 'cause she was passing out flyers and somebody was like, 'Wait. Hold on.' And went and got his wife and was like, 'There's a real live Democrat on our porch. No, she's not pretending she's a real live Democrat. Come and look, you'll never see this again.' So you know so some of that I think that feeling, not feeling like an outsider but understanding that the assumptions that people make about what's -- what you should believe didn't always match. I think that influences me more than just, and I'm feeling really self-conscious right now because I feel like I'm comparing a choice that we had with something that is not a choice. So I'm not, I understand that there are very different levels. But, but just not fitting the mold and how that can, the fact that not fitting the mold can make you feel like you don't belong.

Claire also connected several of her dispositions to her gendered experiences in academe. While exploring her motivations and the various dimensions of the classroom, she attends to with respect to race and her race privilege, Claire connected through the marginalization and condescension she experiences as a woman in mathematics. She detailed her cautiousness to not *Whitesplain* in her classroom, which is a slang term for the often-offensive practice of a white person explaining to audiences of color the true nature of racism (Anders, 2018). Claire elaborated on the term *whitesplaining* by saying:

So I feel like, okay, so I'm a woman in mathematics so I get an awful lot of men feeling like they can explain my Ph.D. to me even if they only got an undergraduate degree in engineering because you know they know math. I feel like there's kind of this history of white people telling people of color what to do and then telling them how to feel about it. And so for that's, the telling-them-how-to-feel-about-it part that feels like Whitesplaining to me.

In addition to her formative experiences through dimensions of race, gender, and political ideology, Claire has had substantive professional maturation serving differently abled learners. In two roles serving the blind, Claire was pushed to reconsider the limits of her approach and pedagogy and wrestle with the principles of universal design. It was also through her experiences serving differently sighted learners, that she solidified her commitment to community in the classroom as a critical factor for student success. She shared:

I worked on math with blind students and I got to go and test stuff with [a Southern high school] for the blind. And that experience was actually really important to what I do because I — I had to start thinking more about how to make things visual to people without vision. And how to make things applicable in ways that — I'm going to say this

— but to people who have a very different way of seeing the world -- without the pun intended 'cause I don't know how else to say it. And so that was actually pretty important to do that, is that part.

For Claire, the aforementioned experiences were critical in transforming her understanding of how colleges work. Acknowledging her privilege as a 4th generation college student, Claire asserted that her different socio-economic experience clouded her understanding of the experience of others and over-simplified the nature, conditions, and processes of higher learning. She now feels more conscious and astute to the power structures which shape and imbalance the education system. Her collective experiences have enabled a bigger picture view of diversity in higher education and with this added context, Claire feels more conscious of the power that undergirds her experience and the experiences of her students. As Claire further makes meaning and refines her social justice pedagogy, she is confident that her added structural perspective helps shape her work:

Understanding those larger structural things, I think, really made a difference too. You know kind of made the whole thing feel. I don't know how it made a difference but, well it made it so I could talk to the students in a, well I think it made it so, I could talk to the students in a little bit different way. So, and I'm not sure how that way is.

Claire's current pedagogical orientation is one that prioritizes equalizing student success. Her classrooms are designed generally for active learning in an attempt to facilitate community and cultivate self-advocacy. While her training and some of her contemporary practices emulated traditional lecture formats, increasingly, Claire implements learning environments with an emphasis on communication, participation, and team problem solving:

We do, do a lot of -- you know -- how do you figure this out, if you don't know how.

Why are you doing what you're doing? Why are you, where can you go for help? Who can you ask? And how do you ask these kind of questions?

Claire makes pedagogical choices with a focus on addressing high failure rates in mathematics education. Claire is engaged institutionally and nationally in the curricular redesign of introductory mathematics courses. The efficacy of her work is demonstrable, receiving the attention of her administrators and peers. Her innate curiosity related to the puzzle of student learning and her commitment to redressing educational inequity has manifested in noticeable increases in student performance. The insights Claire garnered in her underrepresented minority (URM) classroom is currently being adopted for broader application within her institution. She shared:

What I finally came up with was that when we teach math, we break everything down for students. But [in] these tests we're asking them to put ideas together and build it up. And so the tests were testing the big picture. We were teaching the little pieces, and I ended up rearranging the entire college course just, just to focus on, you know. I sat down and said 'what are the big ideas in this class that we want students to know?' OK. You know, I'm going to teach around this big idea. We're going to teach on this big idea. So I completely rearranged it. And now in the math department, they've done that same rearrangement and they're D, F, W [drop, fail, and withdrawal] rate dropped last term. You know, after they've done it. Just based on some of that making sure that we're, that we're teaching to what we want them to know.

Amidst these successes, Claire is more humble about the efficacy of her broader social justice praxis. Claire's formal journey into critical mathematics education began with a

traditional PhD education that she asserts had nothing to do with social justice. Her early training in abstract algebra included the development of quantitative literacy curriculum. Through a series of temporary, grant funded, and adjunct roles, Claire cultivated knowledge related to the needs and experiences of historically marginalized groups. Claire's early career included work with sizable Latinx and Pacific Islander populations at large public universities in the West and Midwest. In these roles, Claire deliberated the distinctions about helping marginalized and under resourced students succeed, relative to the success of all students.

Claire's current role was her first explicitly social justice-oriented teaching role. It was not until she entered her current role that she explicitly used the term, *social justice*, to describe her work. Claire asserted that she did not initially feel qualified for her current position, and it was not until she was recruited directly that she submitted an application. While she has always felt qualified to teach math concepts, the explicit and ambitious social justice goals of her position called her to question her capacity.

It was through her current position that she has learned the most about social justice in education. In her role, she principally serves students of color and students from low socioeconomic backgrounds. A team of colleagues with deep knowledge and specialization in social justice education are available and happy to engage Claire in ideation, inquiry, and feedback. Additionally, she has utilized several immersive professional development opportunities within her institution to explore core social justice concepts and the design of curriculum with engages issues of power, privilege, and inequality. She shared:

You know, but, I also have a group of colleagues here who are very knowledgeable about these issues. Because I'm in this department, and so, I am able to bounce ideas off of people. And they're really, I mean, I feel really lucky to have people who were willing to

let me be. Let me learn to not, to let me say dumb things early, and then figure it out. If that makes sense.

While Claire's disposition for social justice education is focused on community building and equalizing students' success, she has several lesson plans that explicitly cultivate critical literacy. Claire elaborated on three lesson plans. Her most recent lesson plan is a linear algebra exercise in which she distributes a data set in an excel file related to the gender pay gap from which students fit different types of equations and make meaning of the results as a group. Also, in her lesson plan rotation is a project that explores rising sea levels, and while not explicitly stated, engages shifting environmental conditions brought about by climate change. Lastly, in our conversations Claire referred to a lesson plan she used in the 1990s which drew upon HIV AIDS transmission data. A meaningful distinction of this lesson plan was both the time and institutional context in which she utilized it. At the time of its facilitation, the national discourse and the political and religious disposition of her institution accentuated the politicized nature of her curricular and pedagogical choices.

The conditions. We discussed the various contexts that shaped Claire's engagement with social justice education, and how the conditions of her educational environment shaped her curriculum and pedagogy. Speaking on national and global contexts and their relationship to her classroom, Claire asserted that typically those dimensions rarely influence her classroom. She conceded however that the recent presidential election was difficult for her and her students. Claire shared her concerns for current U.S. President Trump's explicit racism and misogyny, and shared that Trump's anti-immigrant rhetoric and policy has become a present issue in her classroom. She shared:

I think a lot of my students especially a lot of the Latinx students saw him as being anti Latinx, anti-Mexican, anti them. And fair enough. So you know and I do have students who have thought twice about going home to Mexico, going to see family in Mexico, since that happened. And we do have a few DACA students in our program.

Claire shared her dismay and disbelief about the results of the election, and how she experienced the election as a cultural backslide. While crestfallen about the results, and bewildered about the logic and values that led to Trump's election, the results have galvanized Claire's commitment to her praxis. She shared:

I think that it is, I feel like it's more important now. I mean not that it wasn't important before but I feel like some of this is taking on a critical mass you know that is so important that we get people into positions and into positions of power who are who have not had power in the past.

Claire spoke little of her regional context, except to acknowledge that the state of Oregon's dichotomous racial history, the juxtaposition of Oregon's liberal progressive political disposition with the state's violent racist legacy of colonial genocide and anti-blackness, creates an ambivalent regional identity. Claire asserted that her local context had the greatest influence on her classroom and her social justice praxis. Claire shared that the cultural capital of her town establishes a higher baseline for social justice conversations than she had experienced in the past. Further, she shared that local political issues are more likely to manifest with her students than regional or national issues. Critical incidents around town or on campus have more frequently motivated dialogue in her classroom. Referring to the local, Claire asserted, "it's the things that are affecting the students' lives right now" that arise in her classroom. Most recently, conversations on free speech have been present. Local socio-political conflicts that have

motivated Claire to pursue further professional development related to social justice education. Discussing a recent critical racial incident on campus, Claire shared about how her experience motivated her to engage in an immersive professional development experience for teaching faculty to learn how to integrate issues of power, privilege, and inequality into their curriculum and pedagogy:

When we had the, the [critical incident], I went to that, and you know then I just thought you know how do we help these students, what do we do? And so I talked to [a trusted colleague] and said you know, I mean, they had so many stories of professors saying things, maybe with good intentions, and just not, not getting there. And you know I said to [my colleague], you know, what can we do and she said you can do this. It's like okay, guess I'll do this. So that's, that's what drew me into that space was just that you know how can I be a little more aware of what's going on and how can I help?

It is in the local context that Claire feels the tension of traversing opposing political worlds. Claire elaborated on the rapid transitions between her classroom and her personal communities. It is in this context that Claire's social justice praxis transcends the classroom:

You know, it's so, so, hard for me because I know, and I spend, I, okay, I live, I'm going to say this how I think about it, I can pass as a Republican. And yet you know I spend my days with students of color and students who are going through things that I have had no, have no experience with except for through them. And so you know it's weird because I spend my days with them and there are certain assumptions that they make about what I think and you know how I feel about things. And I try to really listen but then I go like to my daughter's volleyball tournaments. And I spend my days with those parents and they make kind of the opposite assumptions about how I feel and what I think. And they'll say

things to me that are, you know, just as far out of my, my knowledge and my zone of understanding as the students — who are my students. Who are living through things that I can't ever imagine. And so it's weird kind of ping-ponging back-and-forth between those. You know. How do I listen to this group of people and this group of people over here? How do I, who I often don't agree with, how do I bring some of the experiences that I know that these people are having in to help these people see that there are other views?

Claire identified both her institution and her department as influential and enabling of her social justice praxis. The institution's messaging at all levels, including the university president's office, affirm her pedagogy. Similarly, Claire's department is not only affirming - but a developmental site through which Claire can take risks, make mistakes, and receive valuable feedback. Unlike previous departments where Claire has worked, "in this department, [social justice is] something that we talk about every day, it's something that we think about every day."

Claire's discussion of her national, regional, local, and institutional contexts was largely a reflection on conditions enabling her social justice praxis. Claire reflected on the influential institutional structures and policies somewhat inhibiting of her from full expression of social justice praxis. As to the required curriculum, Claire identified limitations in curricular space and the interdependence of her mathematics curriculum with several baccalaureate pathways. Claire underscored that the demands of her classroom limit the depth of engagement with cultural contexts. Claire affirmed that she would love to address more issues, but she feels pressure to cover the established curriculum thoroughly. In addition to the ambitious levels of content in her course, her mathematics curriculum is entwined as a prerequisite with many other courses. She shared:

I would love to make a class where I could just talk about these (political) issues and how they address STEM issues. But I have a content to teach [...] in my classes, you know. We have so much mathematics to get through that it is hard to add in other things [...] [my class] leads to so many different classes. There's so many different paths that students can take. So for some it's a terminal class, some go on to trigonometry, and that then leads to physics. Some go onto trigonometry, and that leads to calculus. You know, some go right to the business calculus class. So there are certain things that students have to understand to be successful in their next class.

In the most recent term, Claire forwent her lesson plan about engaging students in the exploration of the gender wage gap. Claire shared her intent to implement the lesson in future courses, but affirmed her omission, asserting the urgency to prepare students for future coursework. She shared:

And you know you can get a C-minus in a class and still miss that one thing that you need for the next for the next class. But if I have a group of students who seems to be struggling with a concept that will be needed, and everything's needed. So if they seem to be, I will spend the time making sure that they're ready for that next class rather than doing [the gender wage gap project].

Claire's classrooms more often than not, are specialized for underrepresented minorities, and enrolled largely with first generation college students and students of color. Her classrooms are unique to several other mathematics courses on campus, as they benefit from smaller class sizes and move at a different pace. The intention of her class size and extended meeting times are to allow for flexibility and to afford more time on problems and topics where the class finds themselves stuck. Claire finds that the extra time and space is consumed fully by the established

mathematics curriculum, leaving limited space for substantial dialogue on sociopolitical issues.

Comparing her course to other mathematics courses on campus, Claire shared:

You know so we spend a lot longer. We kind of talk about strategies. wWe talk about how do you figure stuff out? How do you check things? How do you? Because you know some of them are very good at it, and some of them have never been taught it. So just that little bit of extra time makes a big difference for the students, too. And being able to do one more, try another one, try another one, so.

The URM focus of the majority of Claire's classrooms has a demonstrable influence on her praxis, and shapes the nature and priorities of her pedagogy. Claire discussed the inequitable structures in the K-12 pathway that have shaped the mathematics education experiences of her students. Several of her courses are identified as high failure rate, a phenomena which she associates with the inequalities in the public education pipeline. Claire named practices like rote memorization, tracking, and more broadly the violence of low expectations. For Claire, the raced and classed educational experiences of her students shape the social justice focus of her classes. Where she may engage a predominately White, more affluent mathematics class in critical consciousness curriculum, for her URM classroom, a robust mathematics education is the premier social justice work. She shared:

If I have a group of students who seems to be struggling with a concept that will be needed -- and everything's needed. So if they seem to be [struggling], I will spend the time making sure that they're ready for that next class rather than doing, doing a project like (the gender pay gap lesson plan). Which is a great project. But you know, I just feel like it's more important that we position them to be successful in college at this point.

Especially because I am teaching a class that's already very diverse. And so understanding social issues is not as big a problem for my students.

A resounding theme in our conversations was that student success must precede social justice learning. Claire frequently asserted that the various aspects of her social justice work were difficult to disentangle and isolate, however, she was confident that her investment in community building to realize student success. Claire made clear distinctions between dialogue on critical issues and community building as social justice work, and acknowledged the tensions she experiences between the two pedagogies. She shared:

Even though we're not having some of those conversations about police shootings and some of the stuff that's happening now, until they feel like they're in a safe space, that kind of a message that they've been given about their abilities or lack thereof, usually lack, cannot be, we can't get through that.

The institution's priorities for access and retention affirm Claire's disposition toward community building. Claire shared a story about a social justice curriculum she was developing for her Teaching Assistants' training, which was paused when she was tapped for an inter-institutional grant funded collaboration to transform student success outcomes through curriculum redesign. Claire is confident in her decision to prioritize the justice work of student success, as she has experienced the measurable shifts community building work and curriculum redesign has made in her courses' drop, fail, withdraw (D, F, W) rates. She shared:

We basically took [the introductory math course], threw it away, and started over. And said 'OK, what do we teach now? What do we need to teach? What do we -- and you know, how do we want to teach it?' And we cut our D, F, W rate in half, across campus. So you know and there were other things that we added. And that wasn't the only thing.

But you know we added the adaptive learning piece. We rearranged it to focus on the big content. We added active learning, so students are talking to each other in class. I have students who come in now and just rearrange the desks so they're not facing me. So they're facing each other. So they can talk to each other. You know we have a response system. So that students -- it's not a clicker because there are lots of different question types. There's one where they can draw a graph. You know, but where they can put their answers in so I can see in real time which problems we need to go back over. Or which problems we need more help on. You know, so I can adapt in the classroom as well as, you know, having the little homework procedural part adapt for them. So there have been a lot of things that have added to it, but you know we've cut the D, F, W rate in half [...] and now I'm just tooting my, or our own horns, but I think that that was really worth doing because the other thing that has happened is that every demographic has gone up.

During our conversations, when referencing critical consciousness work. Claire used terms such as *the political* or *political work*. Claire explained simultaneous presumptions that mathematics should take priority over *the political* in her classroom and that mathematics education is itself *political work*. Speaking to the experiences of her students, Claire asserted that for students of color, math is tied up in *the political* and that her students' histories with math education are politicized. She shared:

You know and it is tricky, I mean I feel like we're talking about two different spaces here because, of course, in my classroom, we talk about the math, although that's all tied up in it. Just, just give me a minute to work through this. So in my classroom we're not talking about those bigger issues we're mostly talking about the math. But one thing that I have

found with especially my students of color is that it's [math and *the political* are] all tied up. You know, it's all tied up together.

Claire's focus on community building and cultivating math efficacy is in response to the systemic racism of underfunded schools and low expectations. Further, her focus on math achievement connects with her urgency to prepare a new generation of people to take power. In these ways, transforming students' relationship to math is political, and a concrete social justice project. She shared:

I have students of color who have been told since they were kindergartners that they wouldn't be any good at math and they have believed that. You know, and somehow I need to change that thinking for them. And unless there's that safe space there's no way to undermine 12 years of being told you can't do something.

Strategies. In addition to articulating the shape of her work, and the conditions informing it, Claire spoke to particular strategies she employs in pursuit of her educational goals. Claire's approach is comprehensive and complex and includes attending to dimensions of learning and development as well as power and privilege. Claire also invests heavily in cultivating connection, engaging and managing conflict, and controversy, co-creating and sharing power, and continually improving her praxis and the praxis of others.

Claire's praxis is conscientious and attends to multiple dimensions. Apparent in our conversations was Claire's consideration of students' lifespan, including the nature of their holistic development before entering college, and their needs relative to their future careers and whole life wellness. It is in this frame that Claire conceptualizes her students' readiness to receive her political ideations and how her power and privilege in the classroom informs her cautiousness to make her personal politics explicit. However, Claire is not apolitical in the

classroom. Claire illustrated her decision making, referring to a dialogue she engaged in one of her mathematics courses following a critical racial incident on campus. She shared:

I'm very aware that I hold all the power in the room and because of that I try not to push my ideas onto somebody. [Following the critical racial incident] you know, I did a little bit. You know, I said I found what people were saying very awful to have to deal with and very disturbing that people are having to live through these. So, so, I did do that a little bit.

Claire is selective about sharing her opinion, aware of her influence as a perceived authority paired with her institutional, cultural, and social power. With particular consciousness to her White privilege, Claire actively attempts to decenter her voice. She shared:

I'm very aware that just because I think that I've made something clear doesn't mean that I've made something clear you know. So even if I give my opinion, even if I think that I've made it clear that it's just my opinion, there's still that, I don't know, that that space for it to be misinterpreted or as not just my opinion or you know as this is what's normal or this is what's so, especially by 18 year olds, so. If I was talking to a group of adults I might do differently but I'm talking to 18 year olds mostly. [...] I'm not the voice that they need to listen to. And that's, that's why that particular conversation was hard for me, was because they, they were interested in what I had to say. But I felt like I wasn't, mine wasn't the important voice in the room.

The core of Claire's social justice praxis is cultivating connection and solidarity with the intention of building affirming and inclusive learning communities. Claire invests considerable thought and energy into producing a trusting and mutually affirming relationship with her students. Claire wants students to know that she is on their side, and Claire is attentive to

overcoming the historical and institutional conditions to achieve such a relationship. This means developing a meaningful relationship with her students unlike previous math educators, and perhaps the majority of their other subject matter educators.

Claire is also concerned with representation in her classroom. A practice which she closely connects to her community building goals, Claire is attentive to the frequency and nature with which people of color and other historically marginalized groups are represented in her curriculum. She shared:

You know [I make] sure that if, we don't use just use John, Dave, and Kelly names not just very white washed names when we're writing story problems in which they have to decide which student is correct. Making sure, I mean there was a problem recently where the only obvious wrong answer was also the only obviously Muslim name and you know that got changed right away.

This attention is similar to her efforts to maintain cultural relevance in her curriculum. For instance, Claire considers how narratives in her curriculum may compromise her students' sense of belonging. She discussed a word problem that she believed reproduced class boundaries:

There's one about speed that you're driving versus fuel efficiency. But that one also, the data that I could find was from a BMW 5 series so you then were already out of the realm of what most of our students will ever be able to afford.

While committed to practices of representation, Claire underscored that equity work is about more than representation. Much of Claire's community building efforts include the disruption of Whiteness. Disrupting Whiteness includes challenging predominately White representation. She shared:

There was a problem that somebody pulled from the Internet, where it was how long it takes the average person to sunburn? And of course, the average person is very white in that case in that particular problem. So just kind of being, we're aware that we're not making assumptions about who the students are or how they see the world.

Claire is also attentive about decentering herself as a White person and White narratives as the norm or as an epistemological authority. Claire spends time considering what it means to either resist, sustain, or reproduce White spaces through her communication and decision making. She shared:

If [this class] is defined as a white space, then who belongs is also defined. And yeah, and then that makes it hard for somebody who doesn't fit that definition of who belongs to come in and feel like they belong, so [...] I think the message that I'm trying to send is that I'm not judging you right off the bat or you know I'm not, this isn't a white space, I don't know. Yeah. I feel weird putting it that way but that's kind of what it is.

Claire's strategies for social justice education also include engaging and managing conflict and controversy. Claire is careful about and committed to broaching difficult topics. She also reflects on the effective utilization of pedagogies of discomfort, and perspective taking pedagogies.

Claire is aware that her students are interested in engaging conversations about race, and other contentious socio political issues on her campus. She is thoughtful about how to broach the conversation and does little things to open up space for dialogue. Claire discussed her strategy when opening dialogue in her mathematics classroom after a critical racial incident on campus. She shared:

We spent some time talking about that in class and you know the students were interested in you know they wanted to talk about it but they were uncomfortable talking about it because in some ways it's so personal to them. And so I did a little bit of talking about it. I just, I was very careful not to Whitesplain. And you know what it was it was an interesting conversation and it was it was interesting to me that they were they wanted to know what I had to say and some of them were willing to share their thoughts too. They were really interested in what I had to say. But you know but they weren't quite feeling like they wanted to put themselves out there on a topic like that because it did feel very personal to them.

Finding her pathway into the conversation can be unclear. Claire likes to prepare herself to talk about social issues before opening the topic, and may engage her own networks or in professional development before she is comfortable facilitating the conversation in her classes. This assertion underscored a recurring theme in our conversations, Claire only opens up conversations she can manage, she doesn't start social justice work she cannot finish with care and integrity.

In addition to her comfort, Claire is conscious of her students' comfort. She considers the boundaries of social justice education and dialogue for critical consciousness, and where the challenging nature of exploring socio political issues begins to undermine her core goals of community and students' success:

One of the things that I've noticed with my students is that you know, it's they've had so much to deal with that sometimes they go from comfort to passed that place of discomfort to learning, right to I'm shutting down [...] sometimes you have to manage that discomfort and not get people to that point because as soon as they start to feel a little

bit of discomfort, they're done. And it's you know it's because of stuff that's been, because of stuff that's happened to them especially in a context like that [...] You know the students are 18 years old and they're, some of them are just starting to understand some of this even if they've lived it. So, but that's, that's something also that I'm really careful about.

Central to Claire's managing and facilitating pedagogies of discomfort are practices of perspective taking. Opening space for dialogue includes welcoming divergent perspectives as well as modeling and encouraging humility when encountering unique or challenging perspectives. Claire developed a social justice training about practicing empathy for graduate teaching assistants. Claire shared about her expectations of graduate students working with historically marginalized students, and her guidance to graduate students in training:

So you know it's a lot of, it is just asking questions about you know well why might a student be uncomfortable asking a question in class. Why might a student, you know, what are some of the reasons that you can think of that are pretty valid. So kind of getting them to think about their own learning and how that affects their teaching [...] how would you want to be approached. OK. How might that be different for somebody who's had this kind of an experience in their math class, how might that be different for someone whose had that kind of an experience.

When encouraging dialogue in her class, Claire is attentive to power dynamics relative to the risk of sharing one's perspective - and having one's perspective heard and received with care:

Well you know we've all sat in a room where we had a slightly different opinion or a different experience and didn't want to say 'that's not how I experience the world.' And you know it's one thing for me with all the power in the room to get up and make a

comment. It's another thing for a student to be able to get up and say that's not how I experience the world.

Claire's reflections on broaching difficult topics, and engaging perspective taking and discomforting pedagogy were discussed in the context of negotiating politicized pedagogies in the mathematics classroom. A considerable proportion of our time together was spent exploring what socio political engagement in the mathematics classroom could and does look like. Engaging the political presents a number of challenges for Claire. She connects her trepidation about engaging sociopolitical issues to the inherent non-cultured nature of mathematics. She shared:

It's a little harder in the kind of classes that we're doing because you know because so much of it is non-cultured. Meaning you know the quadratic formula wasn't really a cultural thing but we do have story problems

In our conversations about the non-cultured quality of mathematics, Claire expressed her ambivalence about whether Mathematics was non-cultured or a politically neutral endeavor. Over the course of our interviews, we continued to wrestle with the difficulty of distinguishing science, knowledge, and politics. These conversations revealed a core concern for Claire, that engagement with *the political* might threaten or undermine her critical belief about maintaining a sense of community and belonging for realizing student success. It was in the exploration of these concerns that a core belief emerged for Claire: To engage the political means to impose your opinion on others. Claire engages the political with caution and humility. She shared:

What I think a lot about is the difference between between being correct and the difference between being right and you know just because I can come up with an argument that I believe doesn't make me right. Because you know it's a logical argument

based on probably you know good facts but I may not be taking into account that I'm dealing with real people with real feelings or I may not be taking into account that I'm dealing with people who have strong feelings for reasons that I don't understand.

With additional exploration, Claire confirmed that it was the proscriptive domain where she experienced the greatest ambivalence in dialogue about sociopolitical issues. This insight was revealed in a reflection about how to engage a topic like gun control:

Jeff: Would it move into the territory of political if you started asserting what we should do about it.

Claire: Yes yes

Jeff: Like the proscriptive.

Claire: Yeah or what you need to do, especially if it's what you need, here's what you need to do to fix yourself. That would move into that category. And it's not helpful either, so.

Jeff: You're comfortable saying this is what we know. This is how we know it, but the what we're going to do about it.

Claire: Yes. And what you *should* [emphasis added]do about it.

Claire feels most secure in socio political dialogue when she can turn to science and facts to guide the conversation. She prefers to begin with “what we know” from the research in an effort to avoid, what she fears might become an epistemological free-for-all. Grounding in established knowledges not only helps her manage the conversation; it allows her to engage without taking sides.

Amidst her ambivalence, Claire affirmed the legitimacy of engaging sociopolitical issues in her classroom. Claire asserted that such engagement, when facilitated thoughtfully, could help

establish a safe space for learning. Claire acknowledged that her students are aware of her as a political person, and are curious about her dispositions. Letting students know where she stands can be an important investment in rapport and establishing necessary connection to realize the full potential of the learning partnership.

Claire also asserted that sometimes, engaging the political is more important than the math. When critical campus incidents occur, her students want and need to legitimize socio-political dialogue in class. Claire shared these reflections in the context of the recent presidential election:

See that was so important though. I mean that one was something that I felt like was important enough to spend class time on partly because you know it's an important political thing, but partly because it affirmed that you know we were in a safe space, and in a diverse space, you know the things that I have a hard time with is when they talk about what happened over the weekend or when they want to, but you know, yeah, so so those kind of things, I mean we spent time in one of my classes talking about the election when Trump got elected. Actually it wasn't, it wasn't, it was the day of the election so nobody knew who got elected yet. But we spent time talking about that because the students wanted to know when we would know and how this all worked. And some of those things you know when they're really asking a question that matters to them, we can we can figure out the math, we can figure that out, so.

Congruent with Claire's pedagogical disposition toward attentiveness and responsiveness, she feels responsible for engaging the political when it arises in her classroom. Claire actively cultivates the pedagogical conditions for political engagement outside critical incidents by signaling to her students her openness and readiness through what she calls "small

moments”. Slipped into her regular instruction, Claire makes comments or offers personal insights to acknowledge her power and privilege and indicate to her students that she is comfortable with critical discourses of race, class, and gender. She shared:

Occasionally I'll make a little comment you know. So I'll tell you about the comment that I'm thinking that I made Monday. It was a trig class. We were doing linear and angular speed. And I was trying to kind of show the students how angular speed and when we talk about radian we leave a pi in there and I was like but you know there is the ridiculousness test you know for a regular speed. You probably aren't going to leave the PI in there and then you know I said ‘Ma'am do you know how fast you were going. Yes 37 seven pi over three miles per hour’. And you know the students laughed because we had just gotten that for an answer and then somebody said ‘have you ever done that?’ And my comment was ‘I'd be afraid to, and *I'm white*’. So, ‘even though *I'm white*’ or something like that, you know, every now and then I'll say something like [that].

Claire attributes much of her caution and contemplative disposition toward political engagement to her mathematics training. Asserting that her PhD training afforded her virtually no formal competencies for such engagement, Claire has slowly cultivated her confidence and skill through her professional experiences. Making clear that she has much more learning to do, Claire recognizes that she is increasingly comfortable opening socio political dialogue in her mathematics classrooms. She attributes her growing capacity and comfort to her increasing understanding of the structural contexts of various systems of inequality.

Students themselves are also essential in the realization of Claire’s social justice praxis. Most tangibly, a graduate student authored Claire’s gender pay equity project. The student, who has a background in critical studies and mathematics designed and piloted the project, and

subsequently, Claire eagerly and enthusiastically adopted it. In this way, students were a site of creativity and motivation, from which Claire furthered her critical pedagogy.

Claire frequently acknowledged her appreciation and admiration for students' leadership and risk taking regarding the exploration of socio political issues. Students' willingness to broach difficult topics, their agency and self-advocacy asking for dialogue to be opened in class, and their own astute critical consciousness empower and enable Claire as a facilitator of social justice education.

Outcomes. Claire reflected on the potential outcomes and consequences of her social justice practice. Generally ambivalent about her impact, Claire discussed the relative risks of engaging social justice pedagogy, speculated on the efficacy of her interventions, and wholly asserted that her efforts are insufficient given the severity and urgency of the work. Our reflections however, were sprinkled with affirmative anecdotes, substantiating Claire's capacity to foster connection and cultivate engaging and challenging social justice learning environments.

While Claire was most confident in assessing her ability to create learning communities for realizing student success, she was cautious about her capacity as a social justice educator. Over the course of our conversations, Claire offered numerous anecdotes, in her personal and professional life, in which I recognized a praxis of conscientization. Making this observation to Claire following a story about her daughter's critical engagement with her school-community, she was reluctant to affirm my observation:

Jeff: Listening to you telling stories about your daughter, basically, like pointing out power, like pointing out inequity, sounds like what you both have in common is that you both do consciousness raising work. You help people point out where there's inequity. You point out where there's power.

Claire: Okay, you say that, but I feel like what I do is so-little-so-late that it, that it's not enough. And I don't know, I do, that's something that I struggle with, it's like you know, how do I say something. It feels like I'm not doing enough. You know it feels like I'm not, or like I'm preaching to the choir. Yeah it feels like I'm not doing enough in the places where it would really matter. You know, I don't think I changed anybody's mind [at my daughter's club sports event] where they were making White Lives Matter jokes. Yeah, so, so yeah I mean you put it like that and I feel like no, it's tiny-tiny, how I feel sometimes.

Jeff: Okay. The word that's coming up for me right now is humility.

Claire: That's not a word I want to use on myself. You can decide that, I don't get to.

Jeff: Okay. But, it sounds like, do you feel like I am seeing more in you, than you see in yourself?

Claire: Maybe. I don't know. It's hard to know. I'm not in your head, you're not in my head. Also, it's easy for me to focus on the things that didn't go right.

Jeff: Yeah.

Claire: So that's I think, the reason it feels small sometimes, like well I didn't make a difference there, oh well, you know.

Claire's development as a critical pedagogue is active and ongoing. Our conversations were an illustration of her ever-shifting paradigm and practices in response to the unique needs of her students. Claire described the processes of her development as both exhausting and productive. Engaging in her own processes of transformation has motivated her to facilitate the transformations of others - throughout her personal and professional life. Whether in her classroom, among her peers, or speaking with fellow parents and club sports events, Claire feels

a responsibility to help others move along in their journeys toward critical consciousness, critical literacy, and socio political engagement. Claire intends to add more projects like her gender equity assignment, and re-engage her previously drafted social justice training for her graduate teaching assistants.

Claire operates in a constant state of learning. Our conversations were robust and informative, enriched by the depth and focus of Claire's reflection. It seemed as though our conversations were an extension of Claire's praxis, a moment of dialogue in another cycle of reflection and action.

Jeff: That was really insightful. In addition to the research, I feel like I learn a lot when I'm with you.

Claire: Actually, I feel like I put stuff together too in a way I hadn't before, doing this, so it's been good all around.

A Priori Themes

Our conversations also produced insights relative to Claire's navigation of the neoliberal university. Evident from the results of our dialogue are the influences of neoliberal logics, practices, and conditions in/within/against Claire's praxis. In addition, present in our dialogue are elements of Claire's praxis antithetical to the neoliberal university.

Neoliberal logics. Claire's experiences revealed neoliberal machinations of competition, instrumentalism, and preoccupation with profit and efficiency. In the neoliberal paradigm, competition is the belief that society thrives through unbridled economic competition. Claire's responsiveness to the institutional urgency surrounding the reception of a nationally competitive grant to overhaul their introductory mathematics curriculum is resonant with this logic. Across US higher education, resources are being diverted from the pedagogical and toward the research

enterprise in the interest of securing grant dollars. Claire's pull from her social justice training for graduate teaching assistants in response to such dollars is representative of this drift.

In the neoliberal paradigm, instrumentalism is the belief that something has value to the extent that it serves other neoliberal logics. In Claire's reflections, instrumentalism - for the purposes of profit and efficiency - manifested most prominently as the value placed on time, and the negotiation of how time may be utilized. In the neoliberal paradigm, profit and efficiency are beliefs that individuals, organizations, and societies should ever pursue increased profit and efficiency. The institutional conditions in which Claire operates are conservative and reluctant about investing time and resources in endeavors not immediately and obviously connected with focused goals of mathematics literacy and equalizing student success. A notable demonstration was the impressive learning analytics software Claire wielded during her classroom observation. In her fast paced 50-minute course, starting and ending at the precisely scheduled time, the software allowed for a real-time tracking of progress to confirm where the instructor's time and attention was necessary.

Because time is such a valuable resource in her classroom, with few justifiable claims for its expense, Claire wrestles with whether she can engage social justice issues fully, congruently, and ethically with the time available. As she reiterated many times through our conversations, with respect to social justice education - it's an all-or-nothing endeavor, and to engage in critical dialogue around contentious socio political issues with too little time and attention poses too great a risk to the well-being of Claire's students - and her penultimate goal of student success. Only in the most extreme cases can Claire justify time away from the institution's narrowly defined notions of student success. While neoliberal logic suggests that students' suffering daily microaggressions and indignities in a predominately white institution is not an urgent priority,

Claire cannot tolerate such dismissal at the apex of a critical racial incident on campus. It is in these moments, and many others, that Claire's behavior is antithetical to neoliberal logics.

In expressing her desires for more time and attention on socio political issues, Claire named the distinction between her mathematics courses and other course offerings in liberal arts or specific course designations in the university which sanction engagement with issues of power and inequality across the curriculum. The compartmentalization and hyper-specialization of the institution inhibits her ability to transgress the narrow scope of her curriculum. Claire names the pressure of her meta-curriculum, the prerequisite nature of her course, and the urgency to prepare students for subsequent STEM courses. The little room Claire has to adjust and flex her class time is sanctioned through her URM focused department. Claire's flexibility and autonomy are justified exclusively as a function of equalizing student success.

Such instrumental distinctions are not resonant with Claire's students. Claire asserted in her reflections that the institutional bifurcation of mathematical literacy and critical literacy are unintelligible to her students. In these instances, the students at the center regard neoliberal logics as illogical.

Neoliberal practices. Claire's accounts also detailed her navigation of common neoliberal practices, including commodification, quantification, and the cultivation of flexible labor. The neoliberal practice of commodification is the establishment of tradable value in goods and services. The focus on the curricular overhaul of the math curriculum for which Claire was involved has substantial implications for the economic sustainability of her institution. Where the student as consumer has certain revenue potential over the course of their 4-6 undergraduate years, student attrition undermines this earning potential. Emphasis on retention and attention to high D, F, W courses from a neoliberal perspective is attending to the economic potential of

commodified education. As such, Claire's skills and resources are diverted from social justice education projects, toward an endeavor motivated by the commodification of higher education. The institutional attention to the math curriculum overhaul can also be understood through the neoliberal practice of quantification. Quantification is the translation of value and performance into numerical indicators. The high D,F,W rates of the first-year mathematics curriculum is more legible, assessable, and manipulated by institutional actors than outcomes associated with social justice education, which tend to be more abstract and cultural in its outcomes.

Also present in Claire's experiences is the neoliberal practice of cultivating flexible labor, which is the elimination of labor protections in an effort to secure and manipulate dynamic and temporary labor sources. Claire's career is a thread of temporary or tenuous teaching roles, which necessitated geographic shifts and the reconciling of personal and professional needs and goals. Also of note is that the production of Claire's most robust critical consciousness lesson plan was through the scholarly activity of a graduate student. Innovation and motivation for social justice education, in Claire's accounts, are realized through more vulnerable labor classes - than from the efforts and energies of fixed and stable labor classes.

Neoliberal conditions. Claire's practice is complicated and challenged by the conditions of the neoliberal university. Present in her accounts are environments shaped by homogenization, hyper-individualism, inequality, massification, and surveillance. The neoliberal condition of homogenization is the result of competition leading to benchmarking, patterning, and ultimately homogenization. Claire's challenges with homogenization stem from the neoliberal conditions of her students' K-12 educational experiences. Claire reflected on the challenges of engaging mathematics literacy with students who were subjected to rote pedagogies and common exams.

Also present in Claire's experiences are her navigations of the neoliberal condition of hyper-individualism, which is the dismantling of collectivist systems, norms, and values toward an emphasis on individual survival. Claire's reflections included her increasing consciousness to the structural inequities that underpin and inhibit the access, persistence, and success of her students. Claire now recognizes her naive views about the college experience – previously sustained by her privileges as a fourth-generation college student. Through her current role, she has accumulated a number of narratives troubling and replacing her earlier notions, as she met and formed relationships with people navigating obstacles that Claire would have previously thought unimaginable. These stories are those of families and individuals who have made incredible sacrifices so they or their children could enter higher education. These stories reaffirm that, in this system, these students are alone with very little community or public infrastructure to count on. With respect to mathematics literacy, Claire reiterated the curricular emphasis on self-advocacy and cultivating in students the skills to solve problems as individuals and facilitate their own success - amidst inequitable conditions and resources.

The conditions of hyper-individualism also manifested themselves in Claire's reflection on navigating the implementation of social justice education. Claire's strategies require that students incur the risk of broaching challenging socio political topics. Further, the explicit connections of inequality imbedded in her lesson plans require students to facilitate their own meaning making - a practice which affords comfort to each students' unique opinion, including those opinions which deny epidemics of racialized violence, gender pay inequity, and climate change.

The neoliberal condition of inequality is the creation or exacerbation of inequality through neoliberal logics and practices. Claire is responsible for a mathematics curriculum in an

undergraduate program which directly attends to these conditions, specializing in the needs of URM students. Claire recognizes and strategizes the compounding inequity of her students' K-12 experience with the demonstrably challenging nature of the post-secondary institution's introductory mathematics curriculum posing rigor and struggles for nearly all students. Claire recognizes that the educational conditions which underserved her students result in fewer resources to navigate her mathematics courses, which have potential consequences for their access to and performance in future STEM coursework. As a result of these inequities, there is a non-negotiable urgency to redress the structural inequalities of the K-12 education system which requires cultivating math efficacy, preparing students for future coursework, and ultimately job placement – which re-inscribes social justice curriculum as an elective or secondary endeavor.

The neoliberal condition of massification upscales or downscales goods and services to maximize profit and navigate volatile economic conditions. Claire's experience with higher education massification is unique, as her URM classroom is specially designed with smaller class sizes, serving as few as 20 — Where in other courses, Claire may be responsible for teaching anywhere from 60 to 200 students. Claire predominately interacts with massification through shared exams between math sections, and the standardization of math assessment. However, much of Claire's pedagogy is in direct resistance to the demands of massification as she strives for individual attention and high context pedagogical problem solving. Again, Claire also encounters the conditions of massification through her students' previous experience with the K-12 system, and their experiences with standardized testing and rote pedagogy.

The neoliberal condition of surveillance is the implementation of direct and indirect assessment metrics to confirm productivity. Claire's students have also been adversely affected by surveillance, as their K-12 experiences are underpinned by assessment systems in which they

were tracked down, and from which they internalized unproductive narratives about their math comprehension and as a result experience adverse math efficacy. Claire also encounters surveillance through the demands of the grant-funded curricular rewrite. In line with the aforementioned neoliberal logics and practices of instrumentalism and quantification, the DFW rates for the introductory math curriculum are an institutional priority because these metrics are intelligible for and assessable by neoliberal administratia.

Antithetical practices. Claire's navigation of her institution is marked by a number of antithetical dispositions, which are directly antagonistic with neoliberal logics, practices, and conditions. Much of Claire's resistance is detailed in the previous analysis. To reiterate, Claire's pedagogy centers community, collaboration, and heavy engagement in her classroom. Despite her resource constraints, she insists on high context and dynamic pedagogical interventions. Lastly, Claire remains committed to social justice education and is actively reconciling her dual commitments to mathematics literacy and critical literacy - creating community to equalize student success and opening space for dialogue on socio political issues.

Case Report: Alicia

I arrived at the classroom building at 9:50 am. I joined a line of students waiting to enter and filed with them through the corner door. The atrium was a four-story breezeway with a South facing facade stacked entirely with plate glass windows. It was the passing-period, students zigzagged in all directions. Through the major intersection, was I saw a large bottleneck at a set of double doors, Alicia's classroom.

I followed the students into a dark vestibule and through another set of double doors. Students brushed past me as I stopped and took in the scope of the room. My eyes were immediately drawn up to the concave screen wrapping the entirety of the circular arena. The white screen radiated like a halo over more than 600, tiered seats. Eight digital projectors hung at the center of the exposed ceiling with a visibly complicated network of cables, pipes, and ventilation ducts — all painted black.

The brightly upholstered seats were mostly empty, dotted with fewer than 30 students. I stepped up into the last of seven rows of seats. I sat in the first available chair, near a student who'd created an impasse by drawing the retractable desks on each side of their seat. Ensnared in the soft glow of their laptop, iPad, and mobile, the student looked up and smiled briefly before returning to a fluttered binder of notes in their lap. The auditorium pulsed with music playing in surround sound. As I pulled out my notes, Deniece Williams's 'Let's Hear It for the Boy' was reaching the chorus, "*Whoa, maybe he's no Romeo, but he's my lovin' one-man show, whoa, whoa, whoa, whoa, whoa*".

Alicia stood at a table atop a raised platform at the center of the auditorium. She was turned in toward a circular waist-high table, stacked with technical equipment. At three minutes to the hour, students were flooding in from multiple entrances. The seats were divided into six

sections, forming a rounded hexagon. As students crisscrossed the center of the auditorium toward various sections, they stepped over the two catwalks running the length of the room from the central platform. Several students approached the stage to greet Alicia before heading to their seats. One student stepped up onto the platform to give Alicia a hug. After chatting briefly, the student turned smiling and hurried to their seat in the front row.

At 9:59 am, Alicia looked up from her computer screen and considered the crowd before mounting a mic pack to her waist and placing a headset around her ears. The music faded and the peripheral lights dimmed creating a spotlight on Alicia's stage. The wrap-around screen illuminated with PowerPoint slides, repeated eight times around the room. Alicia picked up an iPad, and slid her hand into a mount on the back of the tablet and laced her wrist in place. In her other hand, she held a white stylus. Both items became an extension of her hands as she gestured.

“Good morning [...] today we are going to transition from cardiovascular to respiratory, and we're going to be talking a little bit about Physics, but we're going to keep it somewhat basic [...] we're going to talk about how changes in volume and pressure affect air flow.” Alicia walked in a circle around the center stage, making eye contact with students in each section. Students continued to file in the doors and find their seats. “So, here's how I want to start today. Talk to your neighbor for 30 seconds: Why do we breathe?”

The students looked back and forth, and turned into one another as they confirmed their neighbors. The students' murmurs grew, and the auditorium began to bustle with conversation. Alicia walked up and down the catwalks observing students' deliberations. She returned to the center. “Okay, shout out your responses, from each section” she sidestepped around the center stage, inviting contributions from each of the six sections.

After addressing each section, she asked students to pull out their clickers. Alicia projected the first question. As she talked, students' submissions began tallying on the screen. She closed the first poll with 295 responses. After considering their responses, Alicia brought her stylus to her tablet. Yellow lines began to run across the projected slides. She circled and underlined words for emphasis. She handwrote, breaking down complex terms into their root words. "Let's do another one." Alicia continued polling the class. As students submitted their responses, she left the platform to attend to individual student questions.

Alicia's lecturing was animated and enthusiastic. Her facial expressions were bright, and the intonation of her voice rose and fell as she emphasized terms and concepts. She punctuated her comments by gesturing with her whole arms, her iPad slicing through the air. She placed her hands against her chest, and emulating lung fluctuation as she circled the stage "This is how we breathe."

At 10:30 am, from the wings of the auditorium, half-a-dozen students entered the walkways between the six sections. These individuals were Alicia's learning assistants, who began handing out worksheets. "Okay, y'all want music?" Alicia asked. "It's going to be Paul Simon." Alicia switched on the audio: "*If you'll be my bodyguard, I can be your long lost pal, I can call you Betty, and Betty when you call me, you can call me Al*".

One of the learning assistants stepped up into my section and handed me a worksheet. The sheet of paper included a series of charts, diagrams, and questions. Across the top of the sheet in bold letters was printed 'Mechanisms of Pulmonary Ventilation'. The room began to bustle as students organized into pairs and small groups to deliberate the worksheet. The student sitting next to me, cloistered by their devices and stacks of papers, chose to work alone.

Alicia and the learning assistants began combing the auditorium walking between the sections, and down the rows, checking in on students. “How we doing?” Alicia asked to students in the third row. Alicia pulled her head set around her neck and squatted on her haunches to talk with a student at eye level. As she looked over a student’s worksheet, the learning assistants hurried to reach the raised hands popping up around the room.

At 10:47 am, with three minutes left, students began closing laptops and packing their bags. As students started stepping into the aisles and exiting the auditorium, Alicia returned to the stage. She smiled and said, “I am going to talk again, in case you were curious.” The students eased back into their chairs. Alicia shared closing announcements and gave updates on the next week's lessons. At 10:50 am, class concluded. Students rushed from their seats. A line of students formed at the podium where Alicia was unlacing her tablet from her hand. The next period’s instructor walked onto the platform and began setting the materials for the next course. At 10:53 am, I was one of the last to leave. I walked out of the auditorium against the flow of the hundreds of students pressing in for their 11:00 am course.

Emergent Themes

Alicia and I met for our interviews in an academic building on the edge of campus. The complex hosted a number of labs and lecture halls, and carried the faint smell of formaldehyde. We sat in mismatched chairs at a Formica table in a room adjoining her office. Above Alicia’s head rose a tall dry erase board filled with calculations. A white lab coat hung on her office door. I recognized diagrams of the stomach and intestinal system in my peripheral vision.

Despite the laboratory aesthetic of Alicia’s office, our conversation forced that feel out of focus. Alicia’s ease, warmth, and humor left me feeling as if we were seated at her kitchen table. We met in this space for more than four hours, over four interviews. Together, we explored, with

depth, the nature of Alicia's work, the conditions in which she practices, her ever evolving strategies, and speculated on the outcomes of her curriculum and pedagogy.

The Work. Alicia's reflections on social justice education were deep and nuanced. Our conversations revealed how Alicia philosophically and practically conceptualizes the work of social justice education, what the work entails in and out of the classroom, how she arrived at the work, and several robust examples of her social justice praxis.

Alicia's take on whether to engage in the work of social justice education was her matter-of-fact revelation: it's the right thing to do. Her philosophical dispositions for social justice work were most apparent when discussing diversity, equity, and inclusion initiatives within her department. Alicia considers social justice work, and the learning involved, to be on a spectrum. From baseline to advanced conversations, Alicia expects the latter of herself and her colleagues. Conversations pertaining to the value of diversity, the nature of diversity, and the urgency for justice are prerequisite. Alicia is drawn instead to learning and engagement which pushes her introspection and cultivates intrinsic motivation. She is attracted to imaginative and creative spaces focused on the identification and implementation of solutions. Alicia's expectations for herself and others include close examination of critical issues, including meaningful engagement through dialogue and thorough research and continued learning outside of dialogue. A key distinction between Alicia's notion of baseline and advanced social justice work was revealed through her aversion to discourses of interest convergence, or approaches which emphasize diversity, equity, and inclusion as a return on investment. We discussed:

Alicia: It's an approach that's not personal and it also it's not, it doesn't share my ethic, I guess, about it because it sort of puts it as like 'what do we get out of diversity?' Instead of being that all people should be able to have equal access and opportunities for these

kinds of jobs. And, and that that matters, right? Regardless of what we get out of having a black member of our faculty or a Latino member of our faculty or what our students get out of that. I mean that all matters too, but --

Jeff: You're coming from like an ethical disposition. It's the right thing to do.

Alicia : Yeah and I, I don't love the conversation of like 'How do we gain from having a diverse faculty?'

Alicia's view of social justice education is one that does not bifurcate the responsibilities of STEM and the Liberal Arts. Alicia believes that equity work and STEM learning are connected, particularly in the university context. Alicia shared her urgency to engage STEM students in learning that is more comprehensive than the interpretation of charts and graphs, she expects critical literacy in STEM learners. Alicia believes her social justice goals align with the larger goals of her institution, and that her efforts to equalize access and success, and cultivate critical consciousness are sanctioned by her institution. She shared:

In addition to teaching my students human anatomy and physiology content I think that there are some broader learning outcomes for the university that include being socially responsible citizens and being members of a community and that there are ways that we can value that in our curricula that isn't simply do you know which direction sodium flows into or out of a cell through a protein channel. And and you know I want my students to have critical thinking skills but I also want them to have skills that will serve them as citizens and as productive members of society in the workforce and so you know I force them to do math and graphing because they have to be able to do that and they have to be able to read graphs if they're going to interpret data or just read the news you know. And I think that this goes hand in hand with that. Right? They have to be able to

reflect on their own bias if they want to, if they're going to make decisions that are appropriately reflective of society's impact on their brain.

Alicia's ideals manifest as pragmatism. Her ambitions are tempered by the resources at her disposal and the remarkable scale in which she is responsible for facilitating learning. In addition to her own goals for social justice education in her classroom, Alicia is tasked with leading learning for diversity, equity, and inclusion for her academic department. Alicia's work in her classroom and department are limited by available resources. Discussing her leadership as a chair for diversity, equity, and inclusion in her department, Alicia shared about the opacity of available resources and the process for securing them in her department. She shared:

When I was made chair of this [Diversity, Equity, and Inclusion] committee I had a conversation with our department head about what we should be working on. I was never given a budget. Not meaning that I have an unlimited budget -- meaning I have no money. Right? Like there's -- and I think if I wanted money for something I could put a proposal together and ask for it. But nobody said, you know, we want you guys to put on various events and figure out some new recruiting techniques and we've got, we've got some money, so let us know what you want to do. Like that never came up. Right. So the way that we've been approaching it is, how can we make efforts that will take advantage of of low hanging fruit that can still actually have significant impact and not just be talk and be relatively cheap.

In the classroom, Alicia's pragmatism emerges in response to her notable scale. Her enrollments vary, but range between 300 and 600 students. As a result, Alicia considers her principal responsibility to be people management. Her appointment is 90% teaching, and during

much of that time she coordinates graduate students across numerous lab sections, and the administration of learning assistants who help with the facilitation of her lectures.

Alicia's limited time and resources is one of the reasons she is drawn to evidence-based practices. She relies predominantly on organizational strategies, curriculum, and pedagogical interventions which are substantiated through robust and replicable empirical research. Evidence based practice mediates the risk of trying new strategies with her department and classroom and leverages the little resources she has for the best possible outcomes. Alicia elaborated on her considerations when incorporating new approaches into her leadership and teaching. She shared:

But you can have a practice and say, I've used this practice in my classroom and I saw that these students closed their gap right. This was the gap here, they closed it, and they, but if that practice worked for me I don't know that it will work for somebody else. Right. And so is it because of me and how I deliver and because I know my particular student populations or is it because this is really a best practice that will somewhat universally help. Right. And so some of the best data I've seen comes from institutions where they have multiple sections of the same course and they, and taught by multiple different faculty members, who are very different in their backgrounds and their gender and they, in their years of experience, and they get the different faculty to all institute a given change then they continually observe and assess to see if the change is really implemented correctly and then assess how the students change their attitudes or their understanding of content based on that. And those have been the most, what's the word, robust.

Alicia's pragmatism also manifests in her desire for pedagogical interventions with explicit connection to her course's core curriculum. In her current context, Alicia cannot justify

content that is not connected explicitly to anatomy and physiology, so she invests her energy looking for novel curricular pathways for social justice connections. Alicia asserted that social justice connections are ever present, but the distance to travel for those connections may be too great for her curriculum. She shared:

It's like when we study, I don't know, bones. I talk about how age affects bones. Right?

It's not really a social justice issue. We can talk about how medication affects bones.

Right. But like I don't have a social justice angle to go with on bones. You know I just got to teach bone, calcium [...] I mean I'm sure with anything and a big enough reach I can get into a big nutrition conversation, you know. But it's not a unit on nutrition. It's a unit on bone.

Where explicit connections are clear, Alicia is eager to incorporate. Alicia is excited about curricular approaches which mutually attend to anatomy and physiology (A&P) content and critical consciousness, which she believes enhances the outcomes of both goals. Alicia elaborated on this mutual potential in one of her most substantial integrations of social justice education. Alicia recounted her implementation of the Harvard Implicit Bias test (Project Implicit, 2018) into a course module on the brain and memory. This example showed how she negotiates her curriculum to prioritize critical consciousness work. She shared:

So this is where I really saw explicit connections, so when we do bias we're learning about learning we're learning about memory and how memory functions. And it's an example, and I use examples for everything that I do because one of the ways that memory functions is by like pigeonholing, you can put information in a little hole where it fits among all the other information you already know that's related to it. And so using examples is actually really helpful for our brains. And so that's an example right. The bias

is an example of memory type and how memory functions and so I like that explicit connection and I think to me that's really important, right. There are bits of breadth that I give up in order to do that. I don't talk a lot about muscle memory because I spend a lot of time talking about bias and they're very similar except for that one is cognitive and I mean they're both cognitive right, but one is physical and one is mental and but they're both about the ways in which repeated stimulation of a certain pathway of neurons makes that pathway of neurons easier to excite. So if you repeatedly repeatedly excite the pathway of neurons that tells you to swing your golf club a certain way that pathways easier to say than a different one. And so if you repeatedly say a pathway that says like black people are dangerous [...] then that's going to be an easier pathway to excite when you see a black person on the street at night. Then another pathway about what that black person represents. And so it's the same exact concept right. But but I choose to use it as an opportunity to address issues and that I think are important for students to think about and don't have the time on muscle instead. They're two different examples of the same basic physiological concept, yeah.

Alicia will however, engage new approaches which she identifies as low hanging fruit - meaning that they are easy to implement, not cumbersome to the curriculum, and require low or virtually no resources. In these instances, she is more comfortable openly experimenting. Alicia discussed her implementation of inclusive classroom practices, which encourage active learning and attempt to bring forth the voices of women and people of color. In particular, Alicia uses a pedagogical strategy she described as a 'values affirmation' in which students articulate what is most important to them, related or not to the curriculum and course experience. A values affirmation encourages learners to reflect on what matters to them, ie family, friends, hobbies,

pets, etc. before engaging in learning or assessments of learning. Alicia elaborated on her willingness to engage the practice, despite lack of empirical evidence of its impact. She shared:

But anyway it was low hanging fruit and whether I know the data or not, if it potentially could help some students to do this values affirmation, it can help them, right. So there are things that I'm willing to do just to try and see or not see what happens because they're easy and then things that take a lot I really want a lot of good evidence I really want to be able to see like multiple people have tried this and this is what happens.

Alicia's instructor appointment is designated 90% teaching, 5% research, and 5% service. As such, she spends the majority of her time deliberating her curriculum and pedagogy, including the integration of social justice education. Alicia's approach to social justice education in the classroom attends to multiple dimensions. Her praxis includes community building, pursuing equity in outcomes, representation in the curriculum, anti-racist curriculum, and facilitating dialogue across difference.

Alicia is committed to creating a classroom where all students feel like they belong. Her commitment is unwavering, regardless of her classroom's scale. Alicia is optimistic and focused on the opportunities of her particular class design. Alicia is responsible for a course sequence spanning three terms. While her classroom size ranges from 300-600 students, she has the opportunity to get to know her students over the course of the year. In addition to giving students time to familiarize themselves with Alicia, her style, and expectations -- this added time motivates Alicia to learn as many names of her students as she can. She loves connecting with students, and she takes advantage of every opportunity to connect and establish rapport.

Alicia's investment in classroom community is tied closely to her equity focus. Alicia utilizes equity-minded practices every day, and it is clear that she foregrounds equity practices amongst all of her social justice commitments. She shared:

[I use] equity minded practices and evidence based best practices in teaching and that aren't necessarily explicit conversations about race or sexual identity or whatever it is gender identity but more practices that promote all students to be comfortable and engaged in the classroom. And so that's like every single day of my job, practices that I include in my classroom teaching. And there are many.

An extension of Alicia's commitment to community and equity is her examination of and leadership for representation in the curriculum. Alicia attends to multiple domains within her sphere of influence to decenter white male archetypes in science. She attends to this through the demographics of her learning assistants who help facilitate her courses. She shared:

I want my students in the classroom to see people who are experts or maybe mini experts who aren't just me a white female with a Ph.D. right. I want them to be able to look at these other students many of them who look more like my students. And so I have LAs [learning assistants] who are students of color and LAs who are international students and LAs who are male and female and it gives them more opportunity it gives my students more opportunities to find people that they feel comfortable with.

Alicia also attends to issues of representation through close readings of her textbooks and the language and symbols in her lectures. Alicia shared the outcomes of comprehensive textbook review she undertook in the past year. She said:

Every single human drawing in the text I was working on was a white person, every single one. And so I talked about wanting to make changes there and making it more inclusive and wanting to start building anti-racist curricula.

Alicia's representation work is one aspect of her commitment to realizing anti-racist curriculum. Alicia's commitment to anti-racist curriculum includes examination of explicit and implicit manifestations of racism and white supremacy in all aspect of her course content. She is motivated to disrupt and decenter whiteness and looks to develop curriculum which engages anti-racism. Alicia shared about the emergence of her anti-racist curricular practices. She said:

Somebody was telling me about the concept of great books and this idea that colleges will have a course called Great Books and they're all books written by old white men and I can't remember if it was a talk that they had heard or a paper that they had read the person who was telling me this but they were saying that there're basically great books all over the curriculum. This idea that our curriculum is established by white men in history and that as educators it's our job to seek out where we are promoting the great books and not promoting equity and inclusion. And so we had this idea of thinking about developing anti-racist curricula for AP like where are the places that this falls into our curriculum and makes an impact.

Realizing anti-racist curriculum pairs with a commitment to facilitating dialogue across difference. While Alicia's course structure does not lend to deep and sustained dialogue on socio-political issues, her engagement with critical conversations germane to power, privilege, and oppression attends to the dynamics which make space for difference in dialogue. Alicia spends time considering the various paradigms her students bring into her classroom, and she makes pedagogical choices which support diverse pathways into the conversations she initiates.

In addition to her classroom practices, Alicia undertakes social justice work in her department. Our conversations underscored the overlapping and intersecting nature of these two contexts for Alicia's social justice work. Alicia's five percent FTE attributed to service is devoted to chairing a diversity, equity, and inclusion committee for her department. Alicia's leadership within her department manifested as a result of her previous equity work in her college. Her department chair noticed her previous work and tapped her to lead the translation of a broader institutional diversity, equity, and inclusion initiative within her unit. In addition to her experience, the decision for her selection was informed by her department's history of tokenized selection of people of color to lead diversity work. She shared:

But I think there are a few other members of the department who over the past decade have been like the only ones talking about issues of diversity. And there had also been a recent conversation where one of those people was like stop putting all of this on the same people. It is not right to just have one person or two people in the department do all of the work related to diversity especially if it falls on minority individuals.

Alicia's responsibilities as a facilitator of change in her department include leading and translating strategic initiatives, assessing departmental progress, and coordinating professional development. Alicia shared that her responsibility does not come with direct structural power. As such, her leadership relies on soft power and offering opportunities for power holders to engage and more meaningfully connect to diversity, equity, and inclusion work. Alicia highlighted this challenge leading initiatives related to the access and retention of historically underrepresented minority (HURM) graduate students. She shared:

That one's been the hardest for me because I don't recruit grad students since they don't have a lab and so I'm trying to more be the trying to be the individual who helps facilitate

the conversation and collect information of what's needed from our faculty who do recruit grad students. But again it's not it's not something that I have a practical application for individually so it's not the kind of work I do.

Access and academic success for HURM graduate and undergraduate students is a growing point of consensus for her department. Alicia shared that her committee early on deliberated projects like establishing shared language or aligning their efforts through the development of shared mission, vision, and values. The committee's conclusion was that while language work has value, to them it was not clear and tangible action. They have chosen instead to invest their energies into improving the graduate student experience. Her department's immediate goals concern recruitment pathways for graduate students into their lab and teaching assistantships. There is also growing interest in finding concrete tools for HURM academic success, connecting students with support services, and cultivating sense of belonging. She shared:

So we just hired a lot of new faculty and we're not anticipating any new faculty hires. So our initial effort is focusing on our graduate student recruitment and how we can reach out to a more diverse pool of applicants how we can kind of overcome some of the hidden curriculum aspects like the fact that maybe some students don't realize that they wouldn't be paying for their Ph.D. here and that there's support for that you know creating some language and information particularly on our website to make that more obvious and to encourage students to apply. And that's ongoing work that we're still figuring out [...] one thing we want to do is figure out how to better serve the grad students we have. And we've been talking about this as really like on the inclusion side of the committee's work, of it's not just about having a department that is diverse it's about making sure that

people in our department have a voice and are welcome and know how to get the support they need so that they're not leaking out of the pipeline so to speak.

Alicia named a number of hopes and aspirations for the progress of her department. In her reflections, she shared urgency to engage dimensions of gender related to power and access inequality in her department. Alicia asserted that broaching conversations of gender equity and engaging in critical consciousness work about gendered power and privilege are tenuous. She shared:

There are some really hard conversations that we need to have as a unit to recognize the problems we have specifically. I think it's really easy to say like yeah of course there's bias and of course, but like we have a real gender problem in our unit but it's, if you walked into our faculty meeting you wouldn't see it because we have about the same number of men and women on our faculty but women by far make up more of the instructors and not the tenure track lines. And within the tenure track lines I think although I might be wrong I think all but one is a spousal hire of the females. And so the women in our department do not have the same power as men in our department. And once these people are hired as spousal hires, they're a full member of the department and they have all the rights and responsibilities that their partner did who was also hired at same time. But I think it does something to that individual's perceived ability, their own perceived ability of their self to take on a powerful role in the department or to have a voice in the department. And I know that there are conversations that happen where people say like Oh you're lucky that people liked your husband or you know these women do not feel as valued. And I think it's a major problem.

Alicia has interpreted her charge to lead diversity, equity, and inclusion work in her department as a multi-pronged project which requires consciousness raising, opening dialogic space, and engaging tangible projects. Alicia's work begins with consciousness raising and assisting her colleagues in seeing themselves as complicit in and responsible for diversity, equity, and inclusion issues within the department. She shared:

There are definitely members of our department who don't, it's not that they don't think things should be equal and just, I don't I don't think that's the issue. I think that they don't necessarily see a problem in our unit and don't see what they're supposed to be doing to fix the problem. And like this just doesn't really matter to them like they don't see themselves as being inequitable in any way.

In addition to opening conversations on gender, Alicia is eager to open diversity, equity, and inclusion conversations more broadly. Alicia asserted that diversity, equity, and inclusion conversations are not centered in her departments' discourse, and she feels the imperative to normalize dialogue on socio political issues so her team can prepare for difficult conversations under more urgent circumstances. Alicia is attempting to normalize dialogue by inviting guest speakers, organizing workshops, and orchestrating guided readings. She shared:

We want to continue to have these seminars and conversations regularly, so that when we're suddenly making a decision about hiring it's not you know somebody from the [our] committee out of the blue saying we really need to think about how this is going to affect diversity in our department. But instead it's already a departmental wide thought and conversation we're used to having so I see a part of our work is just like this maybe slow cultural shift in our unit that just changes what kinds of conversations we have and what's taboo or not around here. And the more we say things out loud the more we get

comfortable with it and it doesn't seem to come out of the blue in the middle of a decision you know or come as an afterthought. So that's, that's, one of my major goals there.

Alicia's engagement with social justice education, in and out of the classroom, presents numerous challenges. When I asked Alicia about what keeps her motivated in the work, alongside the demands of a 600-student classroom, she simply asserted that it's the right thing to do. Alicia has disembarked from discourses of why, and is actively charting the how. She shared:

You know we have these conversations about like why does diversity matter like these things come up at the University. And one of our colleagues always says like stop it already. It does. Now let's move on how we're going to deal with it. And I think I'm kind of in that camp like this matters. So let's just do it, right.

Alicia's passion for both science and teaching emerged early in life. She has enjoyed science and learning at every level of education, starting from grade school. At each educational phase, she imagined she would be an elementary teach, and then a middle school teacher, and then a high school teacher, and so forth. It was in graduate school that she affirmed her ideal teaching context was undergraduate education and she wanted a life in the university focused on instruction. Alicia's interest in teaching is considerably longer than her formal training. Alicia's early pedagogical development was tangential, through her exposure to peers' teaching in their graduate assistantships and by observing other faculty in her earliest teaching roles. Alicia's most substantial feedback and development as an educator has occurred in her current role which she attributes to the presence of a strong community of practice among her colleagues.

It is also in her current role that she has grown the most as a critical pedagogue. In her time at her current institution, she has acquired tools, insights, and opportunities for practice and reflection and solidified her commitment to developing anti-racist curriculum for anatomy and

physiology and has implemented lesson plans which include cultivating critical consciousness. While sharing her successes with the implementation of social justice education into her praxis, Alicia underscored that she has much more to learn and do regarding anti-racist curriculum. She is aware of her limitations as a result of her positionality, and she looks to collaborate with others to advance her praxis. She shared:

And so I think that it, I think that there's probably a lot to be discovered about ways we can do this well and I think it will come from a lot of different people who view the content differently. And so as a white person I think I have a very limited view of the content and the more that I can interact with other people trying to teach it in new and different ways, the more I can reflect on oh yeah you're totally right that fits in here and that's a great point. I never thought about how this affects people from different backgrounds and how that would be a reasonable thing to cover in my A&P course within my allotted time and curricula. So I think you know I've done a few very small steps and I have to continue talking to people about what other people do to learn more about how to change.

Alicia's social justice practices can be understood in two domains, inclusive pedagogy and critical pedagogy. Her inclusive pedagogical practices are those which facilitate active learning, encourage full and meaningful participation from all her students, and which cultivate sense of belonging. Alicia's inclusive practices are numerous, so numerous, she asserted that they were hard to remember in the immediacy of our interviews. Many of her inclusive practices are automated or soft-wired into her intuition. Alicia highlighted one practice, termed "many hands, many voices" which invites multiple hands to answer a question and which gathers students' contributions in reverse order from which hands were raised.

While Alicia's disposition toward social justice education is toward community building and equalizing student success, she utilizes lesson plans which explicitly aim to cultivate critical consciousness. One example of her critical pedagogical practice is her troubling the gender/sex binary in her lecture on reproduction. She explains the sociocultural/political attachments made to physical traits like chromosomal and genital variations. In her assertion that chromosomes and other physical sex characteristics are not distinguished easily in a binary, she disrupts the sociocultural/political binaries of sex and gender.

Alicia also engages clinically relevant ideas, as many of her students are in pathways to become physicians and other health care providers. In particular, Alicia explores issues of race, and how established knowledge and practitioner bias can affect diagnoses and the quality of care across different racial and ethnic groups. Her example during our interviews was the common practice of visual diagnosis for afflictions like cyanosis or jaundice by assessing skin color. Alicia's most robust critical pedagogical practice is her aforementioned administration of the Harvard Implicit Bias Test (Project Implicit, 2018) in her lesson about the brain and memory. Each of her critical pedagogical practices were developed in her current teaching role, and their explicit connections to her A&P curriculum and the design of their facilitation are the result of Alicia's own inquiry and design.

The conditions. We discussed the various contexts that shaped Alicia's approach to social justice education, and how a range of conditions — from the broadest to the most immediate - shape her curriculum and pedagogy.

Alicia spoke to national and global contexts and their growing influence in her classroom. Alicia contemplated whether her sense of change in her classroom was the result of changing national conditions - or the result of her own maturation and resulting paradigm shift - but felt

strongly that evidence of inequity in the past decade has created urgency to engage critical issues in her curricula. Among a number of various percolating sociopolitical issues, Alicia identified current U.S. President Trump's 2016 selection as a flux which brought the national climate to a boil and which her commitment to engage critical issues in her classroom. She shared:

Well I'm not sure that I would have thought about teaching things in the same way 10 or 15 years ago. I think I don't know. Maybe I wasn't old enough 10 or 15 years ago to even think about it because it wasn't, I don't think I had a broad worldview. So and I don't know if it's just because I was like a college student, and now I'm older and maybe wiser. But I think the way in which nationally people have been treated and mistreated over the past decade has really made me see the importance and the value and made me recognize why it's important in all of our curricula to be talking about things and I'm thinking about things like you know the bathroom laws in North Carolina or the many many many people who have been killed by police officers because of their skin color or the ways in which we see individuals portrayed in the media who committed crimes of different races right, like like mugshots we see basically of black men versus senior photos and suits that we see young white men who committed often worse crimes [...] I think Trump being elected also makes me feel like there's something to fight every day in my own personal way, because it's like an abomination of our government to have such a, in my opinion, heinous leader. To me, I think that gave me more energy to make sure I do my part. When things are going well, it's easier to sit back and be like oh yes someone's taking care of that you know. Well when things are going well for your own point of view. Oh yeah they've got this right. Things are heading on the right track. Like now we have

legalized gay marriage and making strides and then it's like wait what we elected that guy? You feel like all right maybe there's still a fight here, it has to fall to us.

Alicia identified the dichotomy of political ideologies in her classroom as the most salient influence of her regional and state context. Alicia discussed her department's recruitment of faculty from out-of-state, and how the majority of her teaching team are transplants from outside the Pacific northwest. Conversely, her students come largely from the state of Oregon, and many from rural counties not reflecting the political dispositions of her institution or its residential locale. She shared:

Oregon's funny. I'm not an Oregonian. I've lived here now for over a decade but I'm not from here and most of the people I work with are not from here. I don't think there's any member of the faculty in my department who was born and raised in Oregon. We almost all are transplants and we are a very liberal group [...] So so I feel like the Pacific Northwest is this kind of an interesting dichotomy of plenty of support from my colleagues in my department for doing some social justice initiatives in our work but then also this really broad student population that's maybe not all as liberal as the faculty, and comes from, it's not to say nobody from Oregon is liberal right, but there's just a big diversity.

Alicia did not speak to the influence of the local context on her praxis, but her institution affirms her social justice endeavors in multiple ways. Alicia identified the formal messaging, informal messaging, and mandates of her institution encourage her exploration of anti-racist curriculum and the implementation of critical pedagogies. Specifically, she cited her institutions promotion of intensive professional development opportunities which attend to diversity, equity, and inclusion for organizational, curricular, and pedagogical change. She also named the

promotions for students to engage in social justice learning, which she is encourage to forward to her students. These communications underscore that social justice learning is important to her colleagues, her leadership, and the institution as a whole. Alicia also named structural changes in her institution meant to encourage faculty and staff engagement with equity work. She shared:

In the past year [at my institution, we have] begun a process of including equity justice and inclusion specifically into our position descriptions so that there's this basic understanding that all faculty will work to promote issues of equity justice and inclusion within their work. It's still pretty vague and it has yet to be determined on the college level how that's going to be assessed for the purposes of things like promotion and tenure. Even though I'm not in a tenure line, I still can get promoted. And so that [equity work] is important for that.

While appreciative of her institutions' support, Alicia is ambivalent about how her institution's communications reflect the majority engagement of the entire faculty and staff: "I feel like the individuals I work with within [my institution] are very social justice minded. I'm not sure that that's true of the university in whole." She shared similar sentiments about the baseline knowledge and engagement of her department with diversity, equity, and inclusion issues. To Alicia, her colleagues fall on a spectrum, some of whom she regards as overestimating their disposition and contributions to the work. She shared:

I think they are people who don't necessarily, like they don't see themselves as racist. They don't see themselves as sexist, they've had female grad students you know, like I don't want to go to meetings and talk about this. So we have that end. And then we've got people who I think are a lot like me who think they're fairly liberal and progressive but

probably if we met with people from the Ethnic Studies Department or the women's studies department, we would feel like we're in the Dark Ages.

Alicia regards her department largely as enabling of her social justice work. While some of her leadership may be sluggish toward the work, she did not identify any administrator as openly antagonistic. Similarly, Alicia's department as an entire community ranges from directly supportive to seemingly disengaged, but they are not openly obstructing progress. Alicia's greatest challenge working with the larger department seems to be the availability of time and sustaining momentum. It can be challenging for her to organize time and space for professional development so her colleagues can learn, develop, and more meaningfully participate in the work. Pressures of time are increasingly difficult as the academic year progresses, and the demands of teaching and research eclipse the diversity, equity, and inclusion goals the department established during the summer planning months. Within her department, Alicia has cultivated a community of practice with colleagues who share similar motivations and who help facilitate imaginative spaces for diversity, equity, and inclusion work.

Regarding her teaching environment, the design of Alicia's classroom has substantial influence on her approach to social justice education. Alicia's scale, which can range between 300 and 600 students, poses challenges to engaging social justice issues. The size of her classroom inhibits her ability to build necessary trust to openly engage with contentious socio-political issues and impedes activities that help to establish group norms and build shared commitments. Similarly, the size of her classroom precludes Alicia from accurately assessing students' risk readiness, how they are experiencing contentious topics, or any adverse impacts as a result of engagement with such issues. Because her class size limits her ability to manage

conflict and produces so many unknowns related to individual and interpersonal dynamics, Alicia is selective about what topics she engages and in what format. We discussed:

Jeff: How does the scale of 600 people factor into some of the stuff we're talking right now.

Alicia: I think it's just the unknown. Right. Like I don't know what their opinions are. I assume a variety of backgrounds like I assume there's Republicans and they're just like I assume there's people who are struggling with their gender identity in there and I don't know because I don't ask them those questions. And you can't see it. Right. And so yeah I just don't know their stories. What will and will not relate for them.

Jeff: What do you think some of your choices would be if you were working with the class of 15, 20, 30 people. How would that change the conversation around bias, the [gender] binary or things like that?

Alicia: I think in a smaller class. It might depend on the individual group of students but you have the opportunity to form a community that has principles that they agree on at the beginning of class at the beginning of the term and create a safe space. And you know you can get every student in that room to know the other students names and be familiar with them in a way that might feel more comfortable in some ways when you're in a really small group it's more personal. Everyone does know you, you're not anonymous if you share out. But at the same time you if it's a good group right, and it's set up correctly you can feel like you can trust those individuals.

Alicia works hard throughout the year to form meaningful connections with her students, but the size of her enrollment limits her opportunities to engage with students one-on-one. Her ability to receive feedback from her students is limited and infrequent and often relegated to end

of term standardized evaluations of teaching. The design of Alicia's classroom also has impact. She loves teaching in the round, but she acknowledges that the format has advantages and disadvantages. She shared:

I love it. I really love teaching there. And I think it feels smaller and feels more, you feel more connected than you do in a place like [a general] auditorium where it's [...] easier to be anonymous. My students are closer to me and I like it, but if you're a student and you're talking, every other student in the room pretty much can see you which is super intimidating to a lot of students.

Reflecting on the curriculum, Alicia identified the influence of limited curricular space and the interdependence of her anatomy and physiology curriculum with multiple baccalaureate pathways. Alicia underscored that the demands of her classroom limit the time and depth with which she can engage with critical socio political issues. Alicia shared that she would love to address more issues with more depth, but she has already made difficult concessions about content directly related to anatomy and physiology. She shared:

I have to try to cover the whole human body and do it justice. And there are already things that I really don't do, I do not do a good job covering. The immune system, that gets, it gets kind of spliced in among other content, that I no longer have a unit on it, I had to scratch that, you know like I ran out of time on sexual systems and so I didn't do the mammaries they got the boot - just pretend they don't exist. And you just have to make choices about what can fit and what can't and so, so I'm always trying to work on those decisions.

Alicia's often has to make difficult choices with the curriculum. She is conscious of the numerous stakeholders who rely on her course to prepare students for diverse scholarly and

professional pathways. Because so many different programs rely on her to prepare students for different training, she is unable to provide a curriculum that comprehensively addresses all of their unique needs. She shared:

Almost no [students from my college] will ever take my course, my course is almost exclusively students from [public health and engineering] because I get the bioengineers and then I get that pre-nutrition dietetics, pre-kinesiology, public health, and so there's no vertical alignment for me to, to the curriculum of the biology. If I were in the biology, core biology major people who come before me would really want to make sure they're covering what I need. And people who come after me want to make sure I'm covering what they need. But that doesn't exist for me since the people I would vertically align with are scattered around campus and I don't interact with them. And we've had occasional meetings but they're not going to tell me what to do because they're not involved with what I do if you will and I'm not going to tell them what to do for the same reason. And I have to serve a lot of masters, I can't just do what kinesiology wants me to do and sacrifice what bioengineering wants [...] so I make these decisions on my own which is a little bit freeing but I always have to be really reflective like, is this something critical to what my students need as they move forward and am I going to shortchange them if I don't cover this in order to cover something else. So I'm trying to make those decisions.

The challenges of the many demands on her curriculum and her limited time are compounded by the linear design of her course. Alicia laments that she always falls behind, but she is hesitant to move past core concepts. Alicia utilizes audience response technology in her classroom to assess students' comprehension of core concepts. If she ascertains that her students

are struggling, she takes the extra time to ensure comprehension. These decisions of time and pace make it difficult to fit exploration of social justice issues in her course. She shared:

What I told you before is that I ran behind this term. And the truth is every time I run behind. You know I set myself up and I have grand ideas for how far I'll get and how much time I'll have to spend on everything. And I think it's important to make a best effort to adhere to the schedule because the students have a basic expectation of what's coming in and it's good to be able to follow that. But I think more important than that is ensuring understanding of the content that we're covering. And so I'm very hesitant to rush through material that my students don't understand just to stay on time.

Alicia shared several ideas for infusion of social justice concepts in her course, and she reiterated that time constraints were a constant imposition. One such ideation was related to racial disparities in heart disease. We discussed:

Alicia: Yeah, so I [had this] idea and then as I went through the curriculum I was trying to find places where it [fit], and there are really minor things that came up like we'll talk about heart disease and we'll talk about how it [affects] more black people than white people. But it's so. It's like a quick tidbit. I don't get into the discussion of the differences and what our hearts look like or why that's caused.

Jeff: So in that conversation about like heart disease, it's not necessarily connected to like the structural inequalities that exacerbate the disease

Alicia: Right, and like the availability of good food and medical care and yeah, no. No. That's why I would need a two-year long course so that I could get to everything.

Strategies. In addition to articulating the shape of her work and the conditions which inform it, we discussed Alicia's particular strategies for realizing social justice education in her

teaching and departmental leadership. Alicia's approach is contemplative and in constant evolution. Her general teaching strategies include active learning and co-learning which she works to establish in a high trust environment.

Alicia infuses active learning strategies into virtually every aspect of the classroom experience. Alicia is an enthusiastic proponent of active learning and attests to their innumerable benefits including increased comprehension and development of metacognition. Active learning strategies also help Alicia manage the scale of her classroom. Her techniques help foster engagement despite her large enrollment and increase the number of active voices during class time. She shared:

So active learning I think comes in a lot of different forms and I include it every day because I, a traditional classroom to me, it's sort of the sage on the stage where you have one person talking and everybody else listening and an active classroom can be you know the person never really on the stage and the students always kind of interacting with each other with just occasional feedback from their instructor or like a flipped classroom style. But I think it can also be instead of one large session where the students are spending the whole time really interacting with each other, lots of small opportunities to interact in many different ways. And so that, I I try to do a combination of that and I try to do that every day in class. I don't try, I do that every day in class.

Alicia is also a proponent of co-learning strategies, in which she shares power and responsibility for constructing knowledge with her students. Alicia acknowledges the rich experiences and perspectives her students bring with them into her class, and she works to create an environment where students' contributions are encouraged and valued. She shared:

We know that you learn by teaching and they know a lot, right, they're not going to learn if I just stand there talk to them for 50 minutes every day. They learn a lot more when they can talk about it, they can explain to each other, and they can remind themselves [...]

I have students in my class who have their CNA, their certified nursing assistant license. I know I have students who are EMTs or who have volunteered with the fire department. I know I have students who have had family members or who they themselves have had major medical problems that I've never dealt with personally and so they know a lot about what we're dealing with and so when we talk about the impact of a stroke there are students in that classroom with very real firsthand experience from their family members, or a second hand experience, with what that looks like and what those effects are or when we talk about the ways you treat a patient who is severely dehydrated, there are students who have helped treat those patients and they know what that looks like. And so students will ask a question and it's taken me a while to get here and be comfortable with this but I'll say I don't really know but I know some of you work with this kind of thing. Like what have you experienced. And students will raise their hand and say, oh yeah well when I'm out in the ambulance this is what we do when we see that case and it looks like this and I try to put it as like I'm not the only expert. There are lots of people in this room with lots of information. We have a lot to learn from each other.

Alicia's inclusive pedagogical practices include prioritizing community, balancing perspectives, and centering compassion. Prioritizing community looks like privileging a supportive learning environment for all her students before all other endeavors. When Alicia engages challenging conversations, she does so with warmth and in the spirit of inclusion. She shared:

[I am] just trying to create a classroom environment where we are all choosing to be there together and choosing to study together and trying to support each other's learning [...]

When we have hard conversations it's a group of students that I frankly don't know that well that I'm trying to engage in some challenging conversations or at least get to be thoughtful about some challenging conversations and doing so you know [I try to do that] from from a place of warmth and welcoming and inclusion.

When engaging challenging conversations, Alicia values political pluralism and aims to achieve balance as a function of strategy. Alicia attempts to include all voices. She acknowledges dynamics of power and representation, and she asserts that dominant narratives will always be represented in her classroom. She invests her energy to represent more marginalized perspectives. She shared:

[I try] to figure out the right balance there, right. Like in in order to build community there's got to be effort to include everyone and I think in general it's very easy for the dominant culture to be included there. They're not being left behind [...] I think it's hard to help people see another side of the story. I don't know if you go too hard and too fast especially where it's ill fit. You know I'm not. They're not enrolled in a social justice class. So, like I try to balance it. I don't know. I feel like there's more there but I'm not sure what it is.

While Alicia is committed to balancing perspectives, her inclusion of perspectives is not *laissez faire*. In her words, she does not equivocate on established truths. There are just some things we know to be true, and she represents those truths in her classroom. She shared:

It's like I try to balance it but I don't equivocate I don't pretend it doesn't, you know you hear people talk about like the climate change debate it's like no there's climate change,

right. And I feel like I treat it the same way. I may not focus on it I may not try and like shove it down their throats but I mention it and I treat it as real and valid. It's not like well this is one option and this is one theory it's like no this is how it is. You need to know about it.

In response to the demands of her curriculum and the various unknowns introduced through the size of her course, Alicia's default disposition to her students is one of kindness, patience, and compassion. She shared:

I mean it doesn't have to be a big class for this but when you think about things like all the school shootings that have happened like what's going to really trigger a student, and trigger's not the right word really but you know what's going to set a student off in some way or make them feel like really unwelcome or really put upon. I don't know. I try to try to put kindness first. You know I try to respect my students and act with compassion towards them.

Alicia's critical pedagogical practices are heavily negotiated to compromise with the conditions of her classroom and curriculum. Alicia acknowledges that consciousness-raising work is difficult, and it is further complicated by her commitment to establishing and sustaining an affirming and engaging learning environment for as many as 600 students. She is thoughtful about her choices, as she does not want her students to feel excluded or forced to participate in topics for which they lack readiness. Alicia illustrated these tensions when elaborating on her implicit bias lesson plan. In past iterations of the activity, students have felt impacted or targeted by the examples used to illustrate the concept. She shared:

It's a tricky thing right. We all have implicit biases and they do affect the way we interact in the world and we need to be cognizant of them. If we want to change them. And that's

why I want to teach about them. But the caution there is in sharing that bias with somebody else, your bias, you might make them feel like like they are less in your eyes in some way and that's not the goal of the example. Right it's not to make them feel as though you don't honor or respect them or think they have a place here. And so it's trying to figure out how do I do this consciousness raising without being offensive or marginalizing at the same time.

Alicia's critical pedagogical practices include intentional and ongoing cultivation of anti-racist curriculum, subtle attending and signaling practices, modeling, indirect references, and personal vulnerability. As previously mentioned, Alicia's approach to navigating various factors to realize an anti-racist A&P curriculum begins with intentionality. Alicia closely examines her curriculum for the reproduction of White supremacy and actively seeks opportunities to engage in consciousness raising activities through her lesson plans. She shared:

So I don't really know what it looks like to develop an anti-racist curricula in A&P because I haven't done that much of it yet in my opinion and so just really briefly I think having the idea in your mind that you want to talk about these issues and seeking out the places where you can and then I think being honest with the people who you collaborate with about like that being an intentional goal of yours and seeking their feedback is really helpful because because we all we all, me and my colleagues, learned by traditional teaching of human anatomy and physiology which wasn't anti-racist curriculum and so we're trying to discover new ways to teach this and we can't fall back on well this is how my professor explained it to me to do that.

Alicia's critical pedagogical practices are often subtle and indirect. To engage critical sociopolitical issues, she relies on practices like signaling and modeling. Alicia attends to the

vast and diverse perspectives of her students, and while she wants all students to feel included and engaged, she is particularly concerned about how historically marginalized students experience her lesson and are represented in the curriculum. One such example is Alicia's engagement with the sexuality and gender spectrums and her attending to the needs of lesbian, gay, bisexual, transgender, intersex, and queer students who may be in her classroom. She shared:

While I'm pushing to make sure that I'm giving at least a little space in the classroom to say like it's not just male female, [that it's] not a true binary, [I also] make sure that [the] students who maybe haven't considered that before, right, begin to consider that. I also want the students who are like 'obviously' and like 'thanks for finally bringing us up' to feel like they're not being left out of the conversation. Right. You know my students who maybe are transgender or gay or lesbian or and perhaps they've got an anatomical difference or know someone in their family who does that, or a genetic difference that isn't very public. But they are very aware of this and probably wish more people understood it. You know I don't want them to, you know, I want them to feel included and I want their perspective there to be heard in the conversation. But part of it's you know bringing those other students into the conversation without steamrolling them especially because it's not the focus [of the course].

Because of her class size, and the necessity to manage the scale of her classroom and the diverse needs of her students, Alicia's opportunities to dialogue are few. Instead, she often relies on modeling behavior. She hopes her disposition and engagement with the class topics models curiosity and humility. She shared:

I don't think we have a lot of hard or deep conversations in my class about these issues. We have occasional conversations that we've talked about before. I think that one of the things that I'm able to do is model behavior that is inclusive and model behavior that promotes equity and so and promotes the idea that we have things to learn from each other.

Alicia's modeling behavior requires vulnerability. For instance, in her implicit bias lesson plan, she shares her own stories of bias and shares with the class the outcomes of her assessment. She attempts to normalize the phenomena of implicit bias as well as the urgency to recognize and attend to it. As a frequent lecturer to an auditorium of as many as 600 students, such sharing comes easily to Alicia. She suggests that scale makes such vulnerability easier, as she can wield the power and confidence that comes with being "on stage". Alicia offers her stories, perspectives, and experiences in part because she is unwilling to impose similar risk on her students — again, because of the size of her classroom.

A significant aspect of Alicia's praxis is her continued learning and development. Alicia's credits much of her growth and pedagogical innovation to the support and consultation she received through her community of practice at her current and neighboring institutions. She has established a network of social justice minded STEM educators, with whom she can imagine, share ideas, and deliberate curriculum and pedagogy. She has many supportive colleagues. One colleague in particular, Diane, is a valuable thought partner. She shared:

And so [Diane] wants me to try out my new ideas and pass them on to her and vice versa. And so as new ideas come up she will invariably question them. OK so you're going to have all of your students all like 500 of your students take implicit bias tests. How are you going to do this. How are you going to make this work, and how is this going to be

valuable. And you know she'll question it. And it's not that she's saying like this is a bad idea I don't think this belongs in an anatomy class. But like okay how do you do this well, how do you make it fit.

Alicia remains in a constant state of learning. Her approach is resonant with design-based research in that her praxis includes a repeating inquiry, experimentation, and assessment cycle. She is careful about what and how she approaches social justice education, and adjusts her strategy with each implementation. Her self-directed learning cycles are supported by ongoing professional development which she receives through her department, her institution, and through regional and national conferences focused on STEM education - in all of which she actively seeks new ideas and innovative practices. Alicia makes clear that her inspiration, motivation, and fortitude are grounded in her community of practice—specifically her immediate colleagues in her department and the intellectual and critical engagement she receives from her partner and sister.

Outcomes. Alicia reflected on the implications of her social justice practice. While uncertain about the qualities of her impact, Alicia discussed moments of learning and perceived successes as a consciousness raiser and community builder. Because of the size of her class, Alicia is often left speculating on the impact of both her inclusive and critical pedagogical practices. She shared:

So, well, when I did repro it was the last day of class when I was talking about issues of gender and of being nonbinary and really that we we're talking about is sex and not gender. And at the end of class my students gave me a round of applause and they seemed very pleased with the conversation we're having. But that was at the beginning of class and the round of applause was at the end. So who knows maybe it was because we

were talking about sex and they think that's fun. But they weren't totally put off by it. Right. They seemed to be nodding along paying attention.

Alicia does have opportunities to receive feedback directly from her students. A formative experience for Alicia occurred in one of her earliest administrations of her memory lesson plan in which she facilitates the Harvard Implicit Bias Test (Project Implicit, 2018). In facilitating the discussion, she modeled her own biases, sharing her results in which the bias test measured a disposition toward regarding Asian Americans as foreign. She shared:

So I didn't hear any initial feedback on that and it was [Gemma] who wrote about it in her eSET, [what we call] her student evaluation of teaching and the reason, well it stood out to me because it was often those things are very general and I get very positive student evaluations of teaching and the negative feedback I get tends to be very consistent and predictable right, like they don't like that I don't give keys to the content, that I expect them to ask for the answers and talk to people they, you know, they think my tests are hard. You know so I'm used to the negative feedback I get but that was very specific negative feedback that was very different from what I normally get. So it really stood out.

Alicia shared on the complications of connecting with her students such as finding the right time and broaching the conversation without further marginalizing her student. The student since became more engaged in Alicia's work and went on to serve as one of her learning assistants, but the experience instilled caution in Alicia about the potential impacts of her teaching decisions. Alicia's direct student feedback, though rare, also includes clear affirmations. Alicia has received appreciation for her implicit bias lesson plan. She shared:

Several students came through my office that week to talk about what their results were and what was interesting to them. So it seems like they get a lot out of it. It's hard in a really large class to always assess what they think.

Conclusion. Alicia is a motivated educator. She is ambitious, creative, and resolved to realize the greatest potential of her students and her colleagues. Our conversations underscored an intrinsic drive to advance equity, raise consciousness, and engage others in positive and sustainable change. Alicia intends to further refine her work underway and is actively pursuing new ideas to realize an anti-racist A&P curriculum. Fortunately, Alicia is not alone. She is a member of a dynamic and creative intellectual community, in which she can imagine for innovative ways to realize social justice education:

Alicia: We're also really lucky just to be physically located close to one another [...] You know a thought pops into my head and I can look at [Diane] and say like hey what do you think about this and it doesn't have to be going out of my way to do it. And so even if it's minor it doesn't just get forgotten you know what I mean.

Jeff: She sounds like a great colleague.

Alicia : She is a great colleague. Yeah.

Jeff: What a lovely note for us to end on.

Alicia : Yeah.

A Priori Themes

Our conversations also produced insights relative to Alicia's navigation of the neoliberal university. Evident from the results of our dialogue are the influences of neoliberal logics, practices, and conditions in/within/against Alicia's praxis. Also present in our dialogue are elements of Alicia's praxis which are antithetical to the neoliberal university.

Neoliberal logics. Alicia's experiences revealed neoliberal machinations of competition, instrumentalism, and preoccupation with profit and efficiency. In the neoliberal paradigm, competition is the belief that society thrives through unbridled economic competition. Competition manifested in our conversations in connection to her diversity, equity, and inclusion leadership within her department. Alicia's disdain for her colleagues' disposition toward interest convergence regarding the hiring of diverse faculty is indicative of competitive logic. In this frame, the value of women and people of color as teaching and research faculty in her department were understood as a competitive edge for branding their program and for cultivating creativity and innovation. This logic was not resonant with Alicia's moral disposition toward redressing structural inequality.

In the neoliberal paradigm, instrumentalism is the belief that something has value to the extent that it serves other neoliberal logics. For instance, the competitive rationality of Alicia's department regarding the hiring of women and people of color is instrumental to the extent that such hiring practices provide a competitive edge in the higher education market.

Similar instrumental tendencies were evident in Alicia's department as she reflected on her leadership for diversity, equity, and inclusion. Alicia shared that her department had recently transitioned its administration. Where her former lead administrator was a stalwart for social justice work, her new interim leadership was installed to refocus her department toward competitive research grants and improved reputation. This context influences the difficulty Alicia experiences organizing learning and professional development spaces for her colleagues. Alicia shared that conversations on equity do not come up in her department, not because of any antagonism to diversity, equity, and inclusion, but because the discourse is focused on research and money. Similarly, she faces challenges organizing faculty time to engage in critical dialogue,

as her colleagues struggle to justify time away from the increasing demands of their teaching, research, and other service responsibilities.

Instrumentalism emerges in her teaching and classroom experience in Alicia's penchant for evidence based practices, her privileging of active and inclusive learning practices, her negotiation of limited curricular space, and her pursuit of explicit connections between critical pedagogical practices and her core curriculum. Alicia's draw to evidence-based practice has multiple motivations. Foremost, Alicia is a scientist, and she values the knowledge and guidance produced through systematic inquiry. Alicia's reflections on her favoring of evidence-based practice also reveal the limits of her time and resources. Alicia asserts that she cannot afford, monetarily or temporally, to experiment with pedagogical interventions that are not demonstrably effective. In this way, instrumentalism seems to temper experimentation, and only permits novel approaches which are perceived as low cost, low time, and low risk, as referenced in Alicia's willingness to engage in her values affirmation activity.

Alicia's privileging of active and inclusive learning practices can also be read through a logic of instrumentalism. Alicia frames her implementation of active learning as an investment in the equalizing of student success. Alicia also appreciates the utility of active learning strategies to help manage and maintain engagement in a class of as many as 600 students, a size which is indicative of neoliberal conditions of massification. The implementation of clickers enables participation of hundreds of students, and break out discussion activities activates voices and invigorates minds that may fall dormant in a large lecture format. Alicia reflected on the added time of implementing any active, inclusive, or critical pedagogical strategy. Alicia is best equipped to argue for and legitimize active and inclusive strategies as a valuable and worthwhile expenditure of time and resources.

Instrumentalism is also apparent in Alicia's negotiation of her limited curricular space. Alicia's content, the entirety of the human body, is a feat in its own right. Conversations above and beyond the body are seemingly out of the question as she already makes difficult concessions when she forgoes critical foci like mammaries or the nuances of the immune system.

The pressure on Alicia's curriculum is compounded by the innumerable stakeholders of her curriculum. Her course is a foundation for many degree programs in diverse fields, each of which rely on Alicia to prepare students with base knowledge to inform various career pathways. While Alicia would love to engage the innumerable second and third degree connections she sees between anatomy and physiology and critical issues of race, class, gender, and ability, she's resigned that such hopes would require a two-year course. Alicia's compromise is to permit only those social justice discourses which have explicit and concrete connection to the core curriculum. Alicia substantiates her incorporations with acknowledgements of social justice educations' vocational value, suggesting that critical consciousness is a necessary endeavor as many of her students persist to roles as health care practitioners.

In the neoliberal paradigm, profit and efficiency are beliefs that individuals, organizations, and societies should ever pursue increased profit and efficiency. Alicia seems to encounter this logic in her leadership through her department and through her classroom teaching. As an advocate for diversity, equity, and inclusion within her department, Alicia encounters challenges organizing time for faculty and maintaining their commitment to social justice work, as her colleagues are struggling to perpetually do more with less. Further, Alicia acknowledges the shifting focus of her departments' leadership from issues of diversity, equity, and inclusion to issues of economic sustainability and market competition. Most notably, in her

classroom, Alicia is responsible for the instruction of between 300-600 students, and the faculty/student ratio is an indicator of organizational focus on profit and efficiency.

Neoliberal practices. Alicia's accounts also detailed her navigation of common neoliberal practices, including austerity, cultivation of flexible labor, and quantification. In the neoliberal paradigm, austerity is the reduction of government spending and elimination of the government subsidized public sphere. Alicia's challenges working with limited resource in and out of her classroom is indicative of austerity practices. Alicia can only afford evidence-based practices - or innovations which are low resource, low time, and low risk. Also, the size of Alicia's classroom and her collapsed curriculum are a recurrent neoliberal theme, as both manifestations are indicative of reduced investments in public education

Also present in Alicia's reflections is the neoliberal practice of cultivating flexible labor, which is the elimination of labor protections in an effort to cultivate dynamic and temporary labor sources. While Alicia's position is not tenure track, her funding is permanent, and she does feel secure in her work. Alicia's role however is in large proportion devoted to people management, in which she coordinates her large-scale classroom through flexible labor sources including graduate teaching lab assistants and undergraduate learning assistants.

In the neoliberal paradigm, quantification is the translation of value and performance into numerical indicators. Alicia's navigation of quantification corresponds to her previously discussed encounters with instrumentalism, profit, and efficiency. Alicia must substantiate her pedagogical choices with evidence, more specifically, quantitative evidence.

Neoliberal conditions. Alicia's practice is complicated and challenged by the conditions of the neoliberal university. Present in her accounts are environments shaped by homogenization, hyper-individualism, inequality, massification, and surveillance. The neoliberal condition of

homogenization is the result of competition leading to benchmarking, patterning, and ultimately homogenization. Reliance on evidence based practices and best (or popular) practices, which is held in place with reduced resources and numerous curricular stakeholders, lend to replication in applied fields. Without space and resources for her own innovation and experimentation, Alicia's pedagogies can drift toward homogenous practice.

The neoliberal condition of surveillance is the implementation of direct and indirect assessment metrics to confirm productivity. Alicia minimally discussed aspects of surveillance in our conversations. One example of surveillance was Alicia's reflection on her own annual review process and her pathways as an instructor for promotion and the process' reliance on her student evaluations of teaching. As previously discussed, eSET scores are one of Alicia's few opportunities to receive robust feedback from her students, and it is in this form that she has received important feedback about the impact of her social justice practices in class.

The neoliberal condition of massification is the scaling of goods and services to maximize profit and navigate volatile economic conditions. Massification is the result of several previously discussed neoliberal logics and values. Alicia's massive classrooms result in a context in which she experiences an enrollment of 325 as small. Classrooms of up to 600 impede access to traditional pedagogical practices which enable critical pedagogical practices. Alicia is limited in her ability to develop community and rapport with and among her students nor is she able to establish shared norms and values, all of which are essential foregrounding practices to engage in robust social justice education practices. The scale of Alicia's classroom also impedes her ability to assess the immediate experiences of her students and receive feedback from her students outside of class in timely and efficient manners. The size of Alicia's class also reduces her risk tolerance. Unable to anticipate or interpret the needs and experiences of her students with her

limited capacity to manage intergroup processes and conflict, she makes more manageable pedagogical decisions, specifically those which lend to harmony.

Antithetical practices. Alicia's navigation of her institution is marked by a number of antithetical dispositions, which are directly antagonistic with neoliberal logics, practices, and conditions. Much of Alicia's resistance is detailed in the previous analysis. To reiterate, despite the massive scale of her classroom and responsibilities Alicia is committed to relationship and rapport building with her students. Further, Alicia resists the hyper-specialization and compartmentalization of fields between and within STEM and the liberal arts and pursues an integration of social contexts and the influences of power, privilege, and oppression in the science classroom. Alicia is committed to preparing all students for engaged and socially responsible citizenship, and she does so through direct and indirect pedagogical practices in her classroom and as a leader in her department.

Case Report: Ashley

The lobby at the union entryway was empty when I arrived. The glass doors opened into a two-story atrium with burnished concrete walls accented with warm wood panels. A welcome desk was nested in the bend of an open staircase. The building was quiet except for the hum of the air conditioner, and the soft flicks of flyers tapping on their posting board as they were stirred by the circulating air. Up the stairs on the second-floor landing was a student lounge, surrounded by programming offices. To my right was a student government suite, the glass walls were filled with posters: “Black Lives Matter”, “Water is Life”, and “Resistance is Happening Now”. Past the suite was a long hallway leading to the student food pantry, the Queer resource center, and an all-gender restroom. A stairway at the end of the hall led to the third floor, where the multicultural center, women’s center, and international resource center were located. To my left was a galley kitchen with a coffee station, through which was the multipurpose room where Ashley’s class was meeting that day.

As our previous conversations had taken place over Skype, this was my first face to face meeting with Ashley. Soon after greeting, students and other guests began to arrive. The gathering was a public presentation coordinated between Ashley, one of her former students, and an organizer for an Indigenous students’ association. The speaker was an Indigenous scholar-activist from a nearby university. She was speaking on the creation of a local Native gathering garden, a public space where community members could pick, gather, and dig the vegetation. The garden was a bio-remediation project, in which an industrial landfill full of construction debris was converted to public green space. The event would detail both the design and implementation of the garden and explore the process of re-indigenization, consider the

interconnections of social and environmental justice, and how projects such as the gathering garden serve to heal both the earth and social relations.

Students and guests began to enter. Ashley welcomed students by name, and introduced herself to those not affiliated with the class. Several students inquired about the assignment due that day. “Electronic is okay, or I’ll take your paper copies” she said. Students began to pull notebooks from their backpacks and tear pages from their spirals. At the hour, 20 students and guests had arrived. The organizer from the Indigenous students’ association called attention and read a land acknowledgement. The statement reminded us that we were active occupiers of Indigenous land and encouraged us to acknowledge “the systemic genocide still affecting Native Americans today”.

We sat in an open U-shape of tables and chairs with the speaker at the front of the room. She greeted the guests, and she projected her first image. The words “What does it mean to be an indigenous place?” were flanked by pictures of wildflowers and a river gorge. She engaged the group in dialogue. She shared her knowledge and invited stories. Questions from the students and guests emerged naturally. She led the group through a long historical arc of Indigenous traumas beginning with the European settlement of North America through present day violences occurring in Syria and Palestine. With this context, she invited us to reflect on the difficult and complex project of reclamation and restoration. The students listened intently. No phones or laptops were visible. The students did not take notes, they only listened. Ashley sat among her students, with her hands folded in her lap; her eyes on the speaker.

The conversation flowed on. “What have we lost when we stopped thinking of the 7th generation?” “How do we heal from the dark period of decolonization, from manifest destiny, relocation, and destruction?” “What is the path to reconciliation?” “What work do you want to be

part of?” “How can White people best approach this work?” The group asked questions and shared stories for more than an hour.

The organizers shared their appreciation for the conversation and transitioned the group. When the talk was over, we toured the future site of an on-campus gathering garden where the speaker introduced us to indigenous flora and continued our dialogue. Before departing, the student leaders addressed the group. In addition to thanking the speaker and the attendees, they implored our engagement with several student initiatives targeting resource disparities and issues of campus climate. “As a student, you can make change through education,” one student assured. The other student affirmed, and shared “It’s important for you to use your voice. Advocate for yourself. Advocate for someone else.”

On our way to the site, we stopped in the foyer to consider architectural drawings of possible designs for the future garden. One of the student leaders shared enthusiastically about the plans, and encouraged each of us to vote for our favorite design or give feedback to the designers on notecards. As we walked down the stairs, the student leader responded to a question about programming and whether the garden would be supported with full time staff. He said, “We hope for a full-time staff member, not just an adjunct — so this person can give it their full time and attention.”

In the courtyard in front of the union, Ashley gathered the students in a circle. She invited students to debrief what they heard. The students, well into their spring term seemed comfortable and familiar with one another, and took to dialogue quickly. The students shared stories and posed questions to one another, deliberating grass roots organizing techniques and strategies for navigating power structures to make changes like those discussed by the guest speaker. Ashley

was an active contributor. As the group delved deeper, she signaled for the group to start moving.

We walked a long grassy corridor between academic buildings. The future garden site was about 500 yards across campus. Students continued to discuss grass roots organizing with Ashley, and the guest speaker as we walked. The conversation emphasized the power and importance of student voice. The day was warm and bright, and the students' discussions were lively. Halfway to our destination, Ashley called the class's attention over to a ditch. She squatted and pointed to the ground where a mass of vegetation had accumulated. "Remember last week when we talked about bio swales?" Ashley pointed to a landscape element designed to concentrate and remove debris and pollution out of surface runoff water. The students nodded.

Now gathered in the future site, the speaker began leading the students through trees and bushes in the nearby landscaping. She pointed out flowers and leaves, discussed their historical applications and their properties. The speaker spotted some rosemary and plucked several stalks. She began detailing the stimulating effects of rosemary and its use in teas and steams. She encouraged us to pluck the leaves and experience the intensity for ourselves. The stalks were passed among the students. They laughed as they smelled their fingers. Ashley took a stalk, tweaked its leaves, and smiled as she rubbed her fingers below her nose.

The speaker excused herself, and Ashley instructed the students to process in small groups. As students clustered, she invited them to consider what they had seen and heard, and encouraged the exploration of thoughts and feelings. The students dispersed and gathered on benches, under trees, and on the sidewalk. The students took to their conversations immediately. Ashley walked among the small groups, stopping in to listen. She would step into groups periodically and offer probing questions, pushing and deepening their dialogue. A group of

students standing near me under the shade of a tree were discussing their experiences with what they called “the White privilege lens of sustainability”. Discussion lasted for 20 minutes, before Ashley invited them back to the large group.

Ashley encouraged students to bring the highlights from their small group discussions to the large group. Beginning with a reflection on earlier readings on indigenous perspectives, the conversation engaged issues of empathy, privilege, capitalism, and consumption. Ashley used elicitation to pull out more reflection “Tell me more about that” and “what does that look like for you?”. Ashley knew students by name and invited individuals into the conversation. Ashley spoke very little. Her students lead the dialogue posing questions to one another and connecting their stories and ideas by “piggybacking” on one another's' contributions. The conversation closed with a final reflection on the colonial history of the institution and the importance of bringing people together in that history. Ashley shared final thoughts about the significance of bringing in outside voices into the learning space: “it breaks us from the colonized nature of our institution”.

I wouldn't see the group again for three weeks. When I returned, I joined them in their regular classroom. The classroom was large, with four long rows of laminate tables with enough seating for 40. I was one of the first to arrive. As students settled in, Ashley stood at the front of the room organizing stacks of paper into neat piles. Ashley addressed students by their name, and made conversation about their summer travel plans. As students shared, she connected the stories between students highlighting what they have in common.

When Ashley began class, nine students had arrived. An additional five would enter over the next hour. She reviewed the content from previous weeks and referred to her spiral approach to teaching - where the class would be revisiting concepts addressed earlier in the term, but now

with more depth, nuance, and insight. During class time, Ashley would implement a variety of techniques, individual written reflections, sharing in pairs, small group discussion and deliberation, large group dialogue, and lecture. The content of the day was broad and centered on sustainability in urban planning. The class time was substantial, the group met from 9:00 am to 1:00 pm. Early in the day, Ashley and her students shared personal experiences with climate change, the psychological and sociological impacts of capitalism on individual, group, and community empathy, and the giving economy's potential to disrupt capitalism. They considered modern notions of time and the contemporary epidemic of stress and its impact on personal choices, and comprehensive sustainability efforts. The class also explored the impacts of hyper-individualism on the environment, in tandem with contemporary epidemics of loneliness and isolation, while considering how indigenous perspectives resist such trends. The group discussed strategies for relationship building and how collectivist practices like sharing, cooperatives, and unions reduce the need for individual wealth.

The students' contributions engaged race and gender dimensions and attached personal stories from their childhoods and the neighborhoods they live in now. The class was lively. Students smiled and leaned in to one another's' sharing. Students at the front of the class spun in their chairs to listen to their peers at the back of the room. When Ashley spoke, she would gesture broadly in the air, and her students would smile knowingly with her stories. Her anecdotes and illustrations evoked student head nods, laughter, and eager requests to attach their own experiences. There were no laptops or smartphones, only notepads.

The last activity of the day was a small group activity, in which Ashley divided the class into four teams each representing a different neighborhood of their city. The teams were to reflect on the 12 features of sustainable community development they had learned in previous

weeks and connect those tenants to their assigned neighborhood. Students were encouraged to discuss, write, and draw maps. The students engaged immediately, some hovering over each other's papers as they wrote and drew. The teams deliberated for 20 minutes, after which Ashley directed the students to translate their discussion onto one of the six dry erase boards hung around the room.

The groups toured each other's boards. They discussed the value of dialogue in building sustainable communities and the urgency for improvements in public transportation. Ashley posed a question to the class: "Why do you live where you live, why did you choose that spot?". The discussion evolved into issues of affordable housing and race and class segregation. The group discussed the "revitalization" efforts of one neighborhood. One student offered that the process was to turn "nothing into something." The student's peers argued that the process was racialized gentrification, and the practice was creating a housing crisis. In the class' disagreement, two students of color told stories about their experiences "being revitalized".

Ashley led the final conversation of the class. She named how equity and social justice training was being implemented in their city to prepare public workers to engage communities in sustainable planning. The discussion underscored the importance of including underrepresented and marginalized community in dialogue on urban planning. Ashley presented charts that illustrated the racial divide in their city and patterns of gentrification. At the class' closing, Ashley encouraged her students to consider her geology course for the next term. She gave her students one last task, a silent written reflection. They quietly wrote in their notebooks, and as they finished, they tore their papers from their spirals, stacked them at the front of the room and left.

Emergent Themes

Ashley and I met for our three interviews over Skype. Sometimes she sat in her shared office space, other times in her apartments' kitchen. The digital divide did not seem to influence the focus and depth of our conversation. In this online format, we met for more than four hours, over four interviews. Together, we explored the nature and nuance of Ashley's work, the conditions in which she practices, her ever-evolving praxis, and the outcomes of her curriculum and pedagogy.

The Work. Ashley approaches the work of social justice education with thoughtfulness and intentionality. Our conversations revealed the nature of her work, what the work entails, how she arrived at the work, and concrete examples of her social justice praxis.

Ashley is responsible for a wide array of content areas. From physics to geology, much of what she teaches falls under the auspice of earth science. In this domain, social justice education is most effectively engaged through connections to sustainability and environmental justice. Ashley attests that almost anything can be connected to sustainability, but conversations like climate change are particularly effective for inviting critical ethical conversations which broach issues of fairness and responsibility. For Ashley, there really is no way to teach earth science without engaging dimensions of social justice, but some courses lend to social justice conversations more than others do. Reflecting on the connections between earth science and social justice, Ashley shared:

Well I mean it's just I mean it depends a little bit on the class too. So you just, you know, some topics are just more, there's more to them than other topics. You know when you're talking about Pleistocene glaciation like there is just not as much social justice to talk about because, well, you know. But I hope [there's justice] for the woolly mammoths.

For Ashley, the connections between social justice and science are clear. Applied in her classroom, social justice education in environmental science means encouraging students to think critically and rigorously for themselves. Ashley makes sense of engaging social justice in earth science through a conceptual framework she describes as praxis, illustrated through a triangle, a conceptual model she adopted from an influential mentor during her graduate training. Each point of the triangle is a unique and interdependent dimension of environmental science reflecting knowledge, values, and choices. One point is science, asking questions about how the world works, what can we know, and how can we know it. The second point of the triangle is ethics, and concerns peoples' unique views of good and bad, right and wrong, and the third point is justice. To her, an environmental scientist should be thinking at all times about their values in relation to others values and ground their exploration in rigorously produced facts. The point of justice regards the choices made with the knowledge produced through science and the values of the people whom will be impacted by science and attends to questions of how we should live. Ashley elaborated on the dimension of justice in her notion of praxis:

And so you know the way I and I so I sort of think of that third [point] as the Justice [point] that they should be thinking at all times of what do they think is right and that you can't just have your values standing on their own. You also have to have some facts and that you can't just do science on its own and you also have to know what your values are to know how to use science.

To realize the potential of her praxis, Ashley is conscientious and disciplined about herself as an instrument of learning. It is important to her that she has a mediated role which limits the degree to which she shares her own opinions. In instances where Ashley does share her

opinion, she does so with transparency and with clear articulation of her context and limitations. Emphasizing the importance of students formulating their own interpretations, Ashley shared:

And when I do share my opinion and sometimes they just ask you know, they'll just ask me what I think about stuff and [I] try to tell them well I think this, but I'm not saying that you have to think that, like there can be like correct and incorrect facts of science and that's what we're trying to learn, but then your interpretation of it is your own interpretation.

Ashley is concerned about the influence of her own biases in the learning and development of her students and as a result, she is careful to compartmentalize her roles as a teacher and fellow human. In these conversations, Ashley reflected on whether she would consider her curriculum and pedagogy to be activism. Ashley invoked her framework of praxis to make distinct her social justice pedagogy from activism or activist education. For Ashley, activism is the imposition of ideas or morality, and she is adverse to wielding her power as an educator in ways that undermine students' development for critical thought. Her responsibility as a social justice educator is to cultivate deep and conscious thinkers and decision makers, who she hopes will produce, apply, and lead with knowledge in ways that advance social and environmental justice.

Ashley's foremost goal for her students is growth in cognitive development. She tries to facilitate students' consciousness of the complexity of environmental science issues and she hopes her students will sit with that complexity and wrestle with the nuances, tradeoffs, and multiple paths of public policy. In these gray cognitive spaces, Ashley hopes she and her students can share the responsibility of knowledge construction. Ashley hopes students will see

their own power and authority in making sense of the world. To do so, Ashley de-centers herself as an expert in the classroom, and invites multiple voices to deliberate complex issues:

I mean it's always fun to have more people in class too I think, it's just like you know like I like when we can have guest speakers or have other people because we're sort of again just like building this knowledge as a group. So it's nice for the students to see that there's other people cause I don't pretend to be an expert on every single topic, because I'm not.

Ashley's commitment to multiple voices is a demonstration of her value of pluralism. She appreciates students' diverse perspectives and ways of knowing, and hopes students draw upon one another's perspectives as they draw conclusions about complex issues. It is in such dialogues that Ashley is cautious about sharing her own opinion. She holds the concern that doing so would take away an opportunity for students to figure out difficult issues for themselves. She shared:

I just I feel that I have my own set of values related to the topics that I teach and I'm biased because I have my own opinions about what should happen but as much as possible I want students to be able to come up with their own ideas about what they need to do based on their values because I know that we are, we have very different life experiences, we have very different priorities sometimes and we might just have a wholly different viewpoint on life.

It is in conversations of pluralism that Ashley's dissociation with activist education is most clear. Ashley reflected on colleagues, collaborators, and co-teachers whom she regarded as activist in their pedagogical style and motivation. She shared concerns that such approaches potentially chill dialogue and alienate students, all of which may undermine opportunities for self-authorship. Ashley offered as a key example an experience co-teaching a service-learning

course with a fellow faculty member at her current institution: “When we taught that class, you know she really like wasn't inclined to say like you can decide what you want. She was like there's only one right answer, like this is the answer.”

While Ashley appreciates critical socio political action, pedagogically she is principally concerned with conscientization. Because she wants her students’ socio political actions to be self-authored, she engages reflective activities through her courses which encourage thoughtfulness about action and inaction. Ashley hopes students recognize and understand why they do and do not act, and they are capable of articulating and justifying their actions as well as their inactions. She shared:

You know I have my own biases, yeah I would like them all to go out and like do action you know but I try to be clear that that's my own bias and they might say "I don't want to" you know and that's, but that's something that I want them to be able to come to intentionally as opposed to just through ignorance or not paying attention sort of [...] I do sometimes feel like even that is a bit of a you know a value judgment that they should want to pursue action. But the way I think about it is I also think about that the the lack of action is also sort of a choice that they would be making. And so trying to illuminate with the students that whether or not they want to do something based on what they're learning whether they do it or whether they don't do anything, that both of those are a choice that they're actively making, you know.

Ashley’s pedagogical approach is one which takes facts and figures and introduces various social and political dimensions to engage students in critical thought and to richen dialogue. Ashley values her students’ critical thought more than she values their politics, she

cares more about how they think, and less about what they think. This commitment is illustrated in how Ashley sets expectations for her students:

I always make a little caveat like your opinion is not graded, just your logical progression of thought you know relating to the question. Something like that so that, I want them, I really want them to reflect about it and think about what they think they should be doing. But I don't want them to think that I have a right answer or a wrong answer even if I agree or disagree with them.

Holding dialogue on complex socio political issues in earth science necessitates that Ashley invite, engage, and help manage students' emotions. More specifically, Ashley's pedagogy often requires that she attends to students' grief. Learning about issues of social and environmental justice is challenging cognitively and affectively. Ashley is interested in a STEM education which attends to emotions, specifically grief, and she has pursued professional development with other STEM educators who are theorizing grief in environmental science learning. Ashley continues figuring out how to engage grief within her classroom, and she is inspired by both affective and nontraditional pedagogical approaches to do so. For Ashley, grief work in social justice education in the context of environmental science is a prerequisite for change in that helping people work through grief is necessary preparation for their engagement in processes of change. She shared:

So trying to incorporate reflection and trying to leave like the space and the time for them to actually think about it is sometimes hard but I think that's a really important part of incorporating justice into the classroom and then also just acknowledging that there're also going to be like feelings to go along with it because that's one thing I noticed like when I first started teaching I just felt like my students would always be like kind of

depressed you know like you would be like teaching about climate change and it's so like overwhelming and horrible, you know, when you start reading about these like island nations disappearing, and oh you know blowing up the mountains to get the coal and so I kind of realize that sometimes I have solutions and sometimes I can present that in class and sometimes it's not in our learning objectives and I just don't have the space to even talk about solutions within the classroom.

To realize critical thought, cognitive development, and emotional engagement, Ashley engages a variety of pedagogical approaches. To bring life to social justice issues in environmental sciences, Ashley is drawn to community-based learning, field trip based learning, and other pedagogies of place. Such approaches facilitate clear connections to social justice issues, invite diverse points of view into her learning space, and lend the time and content necessary for rich and challenging dialogue. Ashley collaborates enthusiastically with local scholars, community organizers, and student leaders to construct unique explorations for her students. When not immersed in the local community, Ashley infuses storytelling and other reflective activities to include students' experiential knowledge into the learning process.

Ashley arrived at these approaches through formal training, ongoing professional development, and practice. Ashley is in a constant state of reflection regarding her teaching. To her, teaching is a form of action research. Ashley's graduate training included a minor in teaching and learning. In this program that she instilled the notion of teaching as constant inquiry, but she laments not having more time to further explore her pedagogical potential. She shared:

When I was learning [in my program] they said teaching was research, like that was a really big thing that you're, like, while you're teaching whether or not you're formally

doing research on your process, like, you need to be critically evaluating yourself in the same way you would your research because you know you that's how you improve, so, so, it's something that I try to do. I don't always have time. That's the problem is the time you know. So I would love to have more time to really like do more. But you do, I do what I can.

Ashley's arrival to social justice education in environmental science was through a more classic science training. Her undergraduate and masters training were in traditional lecture or "sage on a stage" formats. The way she teaches now is very different from the teaching approaches experienced in her own higher education. Her immersive, dialogic, and affective approaches have emerged since her formal training through her engagement in community organizing and through ideation and support from her community of practice.

Mentors have played an important role in the shaping of Ashley's teaching. Among her most formative role models was an instructor of an undergraduate elective course she took at the end of her doctoral program. It was viewing his narrative, active, and dialogic style in the context of environmental science that inspired her current practices. This instructor was also the mentor who shaped her notion of praxis and the intrinsic connections of social justice in STEM education. A more recent mentor of Ashley's is a specialist in science communication, whom Ashley admires for her inclusive and pluralistic pedagogical approach. Ashley is interested in an affirming and accessible STEM education, and her connection with this STEM leader and scholar is a source of inspiration and guidance. She shared:

So she's just a really interesting person too that she kinda thinks about things differently than the status quo I guess. And so I find it really interesting to read what she's putting forth and kind of like I get inspired by her and just how she's able to talk to people, like

any, I feel like she could talk to any person and find a way to talk to them about climate change that's not intimidating or you know threatening or without being like pretentious or you know just being able to like talk to someone and find out what's important, so, what's important to them. And that's also kind of her thing is like you have to find out what's important to someone before you bring up this topic that's so big and controversial. Ashley's social justice practice was formed through a career path comprised of numerous adjunct roles, paid and unpaid internships, and community engagement experiences. Her training has prepared her to teach earth science including geology, chemistry, and general science. She currently works as an adjunct at an urban community college.

The conditions. We discussed the various contexts that influence Ashley's approach to social justice education, and how a range of conditions, from the broadest to the most immediate, shape her curriculum and pedagogy. Ashley spoke to the global and national context as particularly salient for her students. She asserted that the past few years, since the election of Donald Trump, have been difficult for her students. Because Ashley's students are drawn from low-income urban communities, she sees the impacts of hunger and homelessness as students navigate food insecurity and soaring housing prices. Ashley emphasized that we are living in a particularly hostile time for low income and less financially secure people. Ashley has also noticed a shift in her class' dialogue connected to the national context. The political challenges of the executive and legislative branches of the federal government have made salient for her students some of the social and environmental issues raised in her class. She shared:

You know there's different questions I ask them. And it was really interesting because as time goes on I've been doing this for maybe like two or three years now maybe four years now this same thing. And I feel like just in this past year everyone's like so they're like

wow there really is a lot of stuff we can do but too bad the US is horrible and is like pulling out of this Paris climate talk and it's just like really unsettling for them to see that and they really understand it at a new level. But then it's like they're depressed at a whole new level about it because they actually understand.

Ashley shares in some of her students' hopelessness, but she is inspired and motivated by her students' resilience. She also believes her access to information, her information literacy, and her role as a teacher helps curb some of her hopelessness. In addition to filtering content in ways that help her manage her morale, she has access to quality information as a result of her scholarship in earth science. She shared:

I get to like have all the information. Maybe not every piece of information but I get to see it from a really full perspective from many different angles. And so you know, like I got to meet someone who works in renewable energy and they told me all about how fast the prices are coming down those without any long term investments from the public sector and how like to them they felt really hopeful because they said wow the government is subsidizing fossil fuels so much more and yet solar is getting so much cheaper. So we don't need them. It is going to happen either way. And like to hear them say that not everyone gets an experience like that, to be like really like talking to people all the time and learning about it. And I think that when you really do learn about these issues there is a lot of really hopeful stuff happening.

Speaking to her regional context, Ashley shared that the Pacific Northwest's' disposition toward issues of social and environmental justice enable critical socio political dialogue in her classroom. Public and private community organizing efforts have cultivated rich and freely

available resources focused on her region which include data driven explorations of issues like climate change in a manner which helps Ashley realize a pedagogy of place:

There's a really great regional climate office for the Pacific Northwest where they've actually taken climate impacts reports and they've scaled it down for our region. So you can actually look at exactly what the impacts are for the Pacific Northwest. And it's a really really excellent resource and it's really like holistically created. So they really tried to consider. I mean it's all just like the physical science aspect of it. But they have like you know the temperature and precipitation data but then they use it to apply it to agriculture and forestry, to water, you know to our coastlines and different you know different sectors and talk about what the impacts are going to be and so that like I use that in many different classes because it's just a really helpful, it's a really helpful and you know it's not as useful to look at the impacts of climate change on just [our city], I feel like it's a little more useful to extend into our region because you know our food supply is not coming from [our city, nor is] our water.

Most apparent in Ashley's classroom is the influence of her local context. The city plays a big role in the shape and content of her courses. Ashley's city's population is booming, and with it comes a variety of transplants with diverse perspectives and interests in the local context. Her students also have intrinsic motivations to engage social justice issues in her classroom. Ashley asserts that if she were to not broach and facilitate social justice issues, her students would bring them up and push for their deliberation. As a result, their explorations focus on socio political issues which are germane to the surrounding urban environment. She shared:

Like I just feel like you know it is part of learning about these topics like if we're going to learn about agriculture and food like we have to talk about you know food equity. Like

it's just part of talking about it and especially with my students many of whom are food insecure and like have issues around food like you know you can't just talk about the difference between organic and traditionally grown food without talking about like well should, like what do you think, like, should we be doing organic food should we be doing traditional should we all be shopping at farmers markets? Can you afford to shop at a farmers market? You know how you get to a farmer's market, what time's the farmer's market open like it just you know and even if I don't bring it up I feel that they will bring it up. And part of that could be like being in [our city]. My students they they bring it up, like they bring it up as much as I do, or more.

Ashley and I discussed her institutional context in detail. Her institution has numerous enabling factors and conditions which inhibit her social justice pedagogy. Our conversations explored the influence of her institutions' mission, the impact of policy and administration, available resources, campus climate, and the distinction of the 2-year college experience.

Ashley appreciates her current institution for its explicit social justice mission. In addition to courses and faculty projects which directly attend to social justice issues, Ashley feels the whole campus and community is committed to issues of diversity, equity, inclusion, and justice. There is a strong sense of solidarity in the work and open support from her colleagues and students. At a minimum, no one is openly antagonistic to her efforts. Her sense of congruence is reflected in the institution's messaging as well as the attitudes and behaviors of her administration and peers. She shared:

The whole campus community is really committed to the idea of social justice, diversity, and equity because it is a very diverse campus [...] and it's something that the campus is saying is a priority. So like going along with their mission which is one reason I like

working where I work too, you know. It's like a good place to work for that reason because its, you know it is sort of aligns well with what I think is important.

We discussed the administrative influence of her institution through translation and implementation of state level assessments. Her institution's emphasis on assessment influences and narrows the parameters of her course design and her pedagogical choices. Ashley asserted that she could influence the implementation of assessment at the department level, but as an adjunct faculty member, doing so, would be unpaid labor.

Ashley's assessment efforts have been devoted to securing additional resources for her courses and her experiential learning projects. While her institution and department are supportive of her innovations ideologically, she feels under resourced in her design and implementation. The resources of her students also influence her pedagogical choices. For instance, at previous institutions, she could design hybrid or online learning experiences with her students expecting that they have access to a computer and internet. At her current institution, many of her students do not have reliable access to technology and often submit work in pen and paper. While resources may be waning for her curriculum and pedagogy, Ashley is affirmed by her institution's response to the resource needs of her students. She shared:

Yeah and that's a big priority for at least for this campus, I think for the whole college, but it's definitely something that's very, like what's the word, out there, like its everyone's, it's on everyone's minds and everyone is constantly working on you know, on those, because like I think just the student population is maybe like struggling a little bit more.

Ashley elaborated on the distinctions of the two-year college experience, and juxtaposed the conditions of her institution to the 4 year experience at large public and small liberal arts

institutions. For Ashley, this context is significant. Again, the influence pertained to resources - particularly students' resources. She shared:

And I don't know, the other, I just also feel like in the two-year college setting the other big challenge I guess I would say related to that is the students having resources. I don't know if this is exactly answering your question but I feel like sometimes the fact that the students don't have the resources to do things also like makes it hard for me to do things.

The support Ashley feels at the institutional level is echoed in her department. Her colleagues are committed to social justice work. She has peers who she holds in high esteem for their creativity and the innovative connections in their social justice pedagogy related to environmental science. One colleague in particular engages in robust explorations of critical race issues in the context of geology. In sharing this example, Ashley lamented that her time with her impressive colleagues is limited. In addition to the demands of their time as contingent faculty, her most admired colleague is a person of color, and Ashley believes their time is disproportionately co-opted by the institution and that they are over extended in their teaching and service.

Another enabling factor for Ashley's social justice pedagogy is the experiential knowledge and developmental levels of her students. As her college serves a large number of adult learners and students who are also working full or part time, Ashley is able to integrate their experiential knowledge into conversations of social and environmental justice with greater ease. Her students are quick to engage in stories and find connections between their personal experiences and the structural and theoretical issues in the curriculum.

Ashley also discussed challenges navigating students' mastery with reading and writing and facilitating appropriate academic standards for her students and navigating issues with

student engagement. Regarding issues of social justice, Ashley identified her greatest challenge with students was not their intellectual or developmental readiness, but their willingness to go deep and share vulnerably in the exploration of social justice in environmental science. She shared:

I mean sometimes [my students] don't want to really get into it. That's actually the hardest thing is more just sometimes [my students] just don't want to delve deeply into it. They just you know but I can't really force them to, you know that's sometimes the hardest when they just keep giving you the same answer or like surface level answers. Not really like trying to connect it beyond just the very basics like the definition of something.

A substantial focus of our conversations on influential factors was Ashley's job type, and her experience as a contingent faculty member, specifically an adjunct at a 2-year institution. Ashley has held a variety of roles and job types. Reflecting on her experiences as a limited-term full-time faculty member, Ashley appreciates the time afforded by a full-time appointment to connect with students, flex her schedule, and engage in campus life outside of the classroom. As an adjunct, she is not afforded the time or space to connect as often with students nor does she have transparency or agency over her schedule to do so. When working as an adjunct, Ashley keeps a strict and regimented schedule, as not doing so would result in exploitation and unpaid labor. She is deliberate about the hours she devotes to course prep, instruction, and grading, leaving little additional time for engagement opportunities outside of her direct appointment. She shared:

Like now, I have a very regimented schedule. I have to do certain things on certain days at certain times, and if I don't do them like they won't happen or they have to have like come out of basically my sleep time.

As an adjunct, she teaches the same number of courses, typically two or three per semester. Because of her interdisciplinary training in earth, atmospheric, and ocean sciences, Ashley is capable of teaching a number of topics. As an adjunct, she has limited agency in selecting the topics in her course load, and as a result is responsible for a wider range of content areas and spends more time in course prep than her full-time peers. Her responsibility for a wide range of courses also means that finding explicit social justice connections within her curriculum is not always easy. Because of their design and learning outcomes, Ashley finds elective courses to be more enabling of social justice education compared to general science courses that provide wide introductory surveys of content related to geology, chemistry, or physics. As a result, working as an adjunct requires additional investment in ongoing learning so she can master new content in preparation for instruction. She shared:

It's really fun to teach all this although it can be a lot of work because each class is totally different and some are more closer to my area of specialty and some are farther like geology for example so, I spend, and they're always changing so constantly like updating things all the time and so most of those classes have a lab with them.

Ashley also teaches numerous courses online, and she teaches online courses disproportionately to her full-time peers. She shared keen insights about the distinctions between online and in vivo classrooms, particularly the opportunities that exist within the online realm related to critical pedagogy. For Ashley, teaching online and in person both come with tradeoffs. Teaching in person, Ashley feels more engaged and believes she learns more personally. She also appreciates the unique opportunities to build rapport and connection with students in face-to-face classes. She also believes teaching in person is easier in the sense that she is able to be

more responsive and adaptive to students' needs as they emerge and as a result she is required to do less prep in advance. She shared:

And sometimes I think I personally learn more from the Face-To-Face class just because I can like really focus on like listening to them whereas online I feel like a lot of times I'm just focused on grading just because there's so much grading so and it's like on a screen and that could just be me that I'm not as good at like reading from the screen.

Generally, Ashley finds online teaching to be less flexible. With exceptions, online learning is not enabling of hands-on and facilitated experiential learning. Conversely, Ashley sees advantages to online learning, related specifically to social justice education. It is Ashley's experience that online formats enable and deepen reflection and dialogue on critical issues. She finds students sharing to be more nuanced, thoughtful, and vulnerable. She also sees an advantage as an observer of dialogue. In her classroom, she feels her listening into students' discussions can at times stifle dialogue but in the online format, she feels a buffering on the impact of her observations. Students' vulnerability in the online format comes with its own challenges, as some of her students share with such vulnerability that she feels responsible for attending to and caring for students who put their whole stories out there — particularly stories of trauma and grief. Ashley has found that students create a supportive community online and also tend to and affirm the contributions of one another in vulnerable moments, but she is careful to review and ensure that no contribution goes un-honored. She shared:

The benefit of the online class is I think it's really easy to have discussions online. I didn't know this going into it but online like the students are so accustomed to doing online discussion forums and they do in my experience they almost all to a really excellent job with those discussions. And so it's really easy for me to give them some articles and have

them write about it and write to each other about it. And they do it, whereas like a face to face class I give them articles to read, they may or may not read them, and then if we do an in person discussion they may or may not like talk about the topic [...] whereas online they have to write their own post first before they can see anybody else. They, you know everything's written, it's right there, like they know I'm going to read it. So I think they generally do a much better job. Not to say that they do a bad job in person but it's definitely more of a mix. It's like easier to kind of slide by. And you know and I have tried like giving them little papers where they have to write like was everyone prepared for the discussion. How did your discussion go. What could make your discussion, like you know stuff like that. And I've had low success with that [...] I find that online people tend to like be a little bit more forthcoming also with stories like that whereas in person I think people don't quite share as much or unless someone asks them or really like pointed question about it.

In addition to the numerous conditions which influenced Ashley's curriculum and pedagogy, she reflected on her own competence and her desire for more training. She named her want for more insight and education on how to support students through affective pedagogy and managing learning spaces in which students connect through sharing stories of pain and trauma. More broadly, Ashley desires formal training in facilitation, or in-group dynamics competencies which she often referred to as "soft skills". Lastly, Ashley is in active pursuit of more critical training and engagement in core issues of power, privilege, and oppression related to issues of race, class and gender. She shared:

I [would like to] provide [my students] with some you know facilitated reflection to help them at least process [their grief] and at least acknowledge that like yeah this is not easy

stuff to learn about not just because it's science and it's hard to learn about from a topical manner but also just from a personal matter like it can be just hard to hear the information and deal with it. I feel like that helps and I mean again like I'm not trained in any of these sort of like more soft skills of how to get students to think about this stuff but over time I think I'm getting better at it [...] and I would love some more training and just like basic like like any basic training of like I forget what they call it, like critical race theory [...] and all these different things which I know there's resources about and I just don't have time to look them all up for myself.

Ashley's reflection on the constraints of time in her pursuit of more pedagogical training was a recurrent theme in our discussions. Among all influential factors, lack of time was the most consistent and formative factor shaping her curriculum and pedagogy. Her availability to her students, her engagement with professional development, being able to connect and brainstorm with colleagues, and time to think, deliberate, and plan her teaching are all influenced, and often inhibited by the availability of fairly compensated time. When asked what one factor would enable her work with social justice education, Ashley affirmed it was additional time. She shared:

So yeah, like just just time like planning time, just time to like sit and think about what I'm going to do instead of like, like I make this syllabus on Monday. Like classes started Monday so I was like OK like throw down the syllabus, like this class I have Friday and I haven't like I mean I have what I did in the fall I taught this class, so I have that but I haven't spent any other time to like to change anything, so I think probably after we're done I have like a few hours I can potentially, if I have time, like look at it a little bit. So I think I think just time would be the big one.

Strategies. In addition to articulating the shape of her work and the conditions which inform it, we discussed Ashley's particular strategies for realizing social justice education through her teaching. "Forever a researcher" as Ashley described herself, her praxis is in a constant state of inquiry and evolution. Her pedagogical strategies include conscientization, cultivating connection, co-creating and sharing power, engaging and managing conflict and controversy, and maintaining ongoing development of her praxis.

Ashley's strategies for conscientization include consciousness-raising techniques and place based and embodied pedagogies. Ashley emphasized making time for reflection, which is a critical investment when engaging justice issues in the classroom. While negotiating and justifying the time can be difficult, she infuses reflection in creative ways and often does so through discussion on critical issues. Ashley has had success engaging critical socio political issues, and she values creating spaces where people with diverse points of view can dialogue and respectfully disagree. We discussed:

Jeff: When we chatted last week you shared a bit about some of the ways that you facilitate conversations that raise consciousness in the classroom around issues of justice or how science interacts with society in ways that relate to issues of difference or power and discrimination. Have you ever experienced any conflict facilitating those conversations in your classroom.

Ashley: Not really. You know honestly I don't know if it's just, well let me think. I actually feel like it normally goes really well and I feel like my students overall just do a really great job of being respectful in those situations. And I haven't I just don't feel like we ever had like a really major conflict.

Ashley finds that courses designed for community based learning provide the time and context for ample reflection and consciousness raising and provide engaging and explicit connections between earth science content and social justice issues. She finds that in addition to providing an effective framework for social justice learning, community-based learning improves learning overall as the modality is engaging and high context. Ashley asserted that “if you plan the right type of community based event then that the students can kind of like connect connect it to the learning outcomes themselves a little more.” Ashley is a frequent implementer of pedagogies of place and connecting students to the concepts of her coursework through the surrounding city, region, and state. Her emphasis on field trips and other hands on learning experiences pair her high context learning with embodied pedagogies which employ all of her students senses in knowledge construction, including sight, taste, touch, smell, and sound.

Ashley’s strategies for social justice education rest on a foundation of connection and facilitating group formation. Ashley believes in and is committed to building learning spaces where students support one another and establishing necessary psychological safety which she finds is critical for socio political dialogue. Ashley is thoughtful about group formation. She shared:

I try to kind of like start them slow put them in groups you know and try to give them a chance to really like get to know each other, so that once we get to talking about some of those harder things they're more comfortable with sharing with the other students because I think that they often can help each other more in terms of those more like soft skills I guess to say that it's a weird way to say it but you know compared to me.

It is through group formation that Ashley is able to create a learning space where she and her students can share the power, roles, and responsibilities of constructing knowledge. Ashley

does not enforce reflection and exploration of social justice issues. She creates the conditions where students can uptake the responsibility and hopes that they do so. Ashley reasserted that in social justice dialogue learners do not respond productively to forcefulness and coercion. She shared:

But I don't know of exactly a better way to do it than that but that's how I felt like you know I I don't really I personally I don't like it when people are like we need to do this and we need to do this and we should be doing this and you know I just feel like first of all no one likes to be told what to do. We're all adults. My students don't want me telling them, I'm not their mother and they don't want me telling them what to do [...] and to some extent like since usually that's not like one of my most important learning objectives it's kind of like I just have to let it be. Well you know this is something I encourage, I think we call it an aspirational goal like I'm encouraging you to do it but I can't really force you to do it.

To encourage productive engagement with socio political issues, Ashley engages in modeling behavior. Ashley makes a point to acknowledge her biases and values as she broaches contentious topics. She does so to invite in multiple points of view and establish the cognitive conditions for critical thought. She shared:

You know I try to point out my own biases of like I can you know especially like in some classes like sustainability you know it just comes up where I end up telling them what I think you know because it just is sort of the class but then I try to be really clear about you know this is me. This is my opinion based on my own values. You might be really different from me and you might take the same information and have a totally different perspective about it.

One aspect of Ashley's co-creation of knowledge and sharing of power in learning is her embrace of student leadership. Ashley is excited by and responsive to students who bring ideas for social justice engagement to her class, and she has developed community-based learning initiatives around them. In addition to her students' leadership being a site of ideation and collaboration, her students' motivations inspire her own professional development. When she recognizes her students' engagement with issues and content outside her training and competency, she is quick to engage in learning to join them in their interests. She shared:

So as I learn that, and again, so it's my students that are kind of like leading me along because when something is really critical they will bring it up a lot of times and then I'll kind of like be forced to look into it like how they always are like we want to use the pronouns like we do our introductions, like they will do it, so I've like adopted it, but it's more like I maybe wouldn't have ever and like just done that on my own because I've never really had time to go to one of those trainings on my own. But I appreciate it and I'm glad that they've brought it into the classroom.

Ashley tries to show up in a way where she is a facilitator rather than an imparter of knowledge. She is excited about the resources her students bring to enrich dialogue on social justice issues. In this way, she participates as a co-learner in her class. She shared:

They'll go out and find resources that I didn't even know existed and be like well have you read this article about this person's way of breaking down. Like someone just emailed to me the other day, this guy just wrote a book. A new book that just came out all about like how to reduce our emissions. And yeah like I hadn't heard of it. He's really famous and so I was like oh I should really read this book you know and he actually put like, in his top ten like two of them one was educating women and then one was birth

control and I was like wow like I never talk about those like I don't really think about it but that's actually a huge if you can do that in the developing world that can actually reduce carbon emissions substantially. So and I haven't read his book yet but you know, like a student found that kind of like shared it with me so. So it's good for me too.

Ashley's efforts to build secure connection and community in her classroom is a necessary investment to engage in and manage conflict and controversy. The connections between environmental science and social justice issues often elicit personal storytelling and vulnerable perspective taking with her students. Ashley is cautious about student risk-taking, and she offers guidance to her students as they deliberate the personal stories they choose to share, in class and online. Ashley recognizes that personal vulnerability is an important and significant aspect of learning, but she prioritizes analysis over personal and experiential engagement. Doing so reflects her commitment to the established learning outcomes, and the difficulties associated with students engaging in personal storytelling. She shared:

I also like, someone told me this once and I always try to tell it to them, I always say like you don't have to share your personal story, you just share with us your public story. Like I forget where that comes out of like community organizing or something like where they say like it's good to share these stories but it doesn't have to be like the version you would tell to your sister. Like it's like the version you would tell to like an acquaintance or something. And so, but I try to, you know and some of them will still share very personal things but I try to tell them that like I'm not trying to get out like your most personal experiences.

A core aspect of Ashley's strategy for social justice education is ongoing examination and development of her praxis. Ashley keeps a community of practice, a network of academic

colleagues and community partners who support and help her generate ideas for making social justice connections in environmental science. She relies on resources in and out of academia to continue her professional development. Ashley elaborated on organizations she turns to for support in the cultivation of soft skills, or facilitation competencies which help her initiate dialogue and sustain affective pedagogies. Referring to a non-profit organization in her city, she elaborated on the utility of their resources for engaging her students in dialogue on socio political issues. She shared:

So sometimes I use their book formally and sometimes I just use their questions because it'll be some, sometimes their questions are things like in all the readings we did this week, what makes you feel overwhelmed? You know, talk about it. What's something in your life or like how do you deal with feeling overwhelmed in your life normally like could you use any of these tools to deal with this feeling after like learning about this new information. And then like they'll say was there something that gave you hope in what you were reading. Like talk, and so kind of just you know they ask questions like that.

Outcomes. Ashley reflected on the implications of her social justice practice. While uncertain about the qualities of her impact, Ashley discussed the range of outcomes she observes in her students and affirming moments of student leadership and engagement. Generally, Ashley communicates humility and ambivalence about the outcomes of her work. Ashley reflected on the range of student outcomes she experiences assessed through the depth of written reflections and other measures of student learning. Some students leave her courses grasping the concepts in the individual dimension having reflected on individual behaviors related to issues of environmental and social justice, while other emerge having reflected more fully on the structures that sustain inequality and undermine sustainability. Ashley is affirmed by students

who have remained engaged in her courses afterwards and who enthusiastically collaborate in facilitating learning at the intersection of social and environmental justice. Referring to the community-based learning experience illustrated in the introduction of this report, she recounted her experience collaborating with a student leader who was a former student of her course. She shared:

That event [was] actually planned by a student who he was in my class like a year ago and he's done a lot of different things but now he's a student leader and he's, I think he's the leader of [an environmental justice organization] and he's also on [the student government] [...] it's kind of kind of fun because he keeps like inviting me, he creates events that he knows are during our class time because he knows when our class meets and then he'll be like hey if I make this event do you think you guys would come to my event. But it's totally in line with what we're learning about. So it actually works out really well and because he did take the class too so he kind of like knows. So he has a good teaching potential in there for the future. But like this event he's just like I want to have this event and I know your class is like community based learning [...] so it's my students that are kind of like leading me along because when something is really critical they will bring it up a lot of times and then I'll kind of like be forced to look into it [...] like I maybe wouldn't have ever and like just done that on my own because I've never really had time to (research it) on my own. But I appreciate it and I'm glad that they've brought it into the classroom.

A Priori Themes

Our conversations also produced insights relative to Ashley's navigation of the neoliberal university. Evident from the results of our dialogue are the influences of neoliberal logics,

practices, and conditions in/within/against Ashley's praxis. Also present in our dialogue are elements of Ashley's praxis which are antithetical to the neoliberal university.

Neoliberal logics. Ashley's experiences revealed neoliberal machinations of instrumentalism and preoccupation with profit and efficiency. In the neoliberal paradigm, instrumentalism is the belief that something has value to the extent that it serves other neoliberal logics. Instrumentalism was most apparent in the Ashley's reiterated reflection on the necessity for explicit connections between social justice education and the established core curriculum of environmental science. Ashley was unable to justify any time, resources, or decisions in the interest of social justice education that did not privilege the institutionally sanctioned learning outcomes.

In the neoliberal paradigm, profit and efficiency are beliefs that individuals, organizations, and societies should ever pursue increased profit and efficiency. Ashley encounters this logic frequently. Across all of her experiences is an underpinning dearth of time. Ashley reiterated several times that the one factor that could be adjusted to enable her critical pedagogy would be additional compensated time. As an adjunct, she receives fewer paid hours to accomplish the same teaching load as a full-time instructor. As a result, she has a less flexible schedule and less time available for inquiry, ideation, and creative endeavors. Ashley is also responsible for a large swath of course content, and her time is disproportionately consumed in new course preps.

Her course designs also inhibit her critical pedagogical potential. Ashley teaches a volume of classes online, and while she has identified unique opportunities for critical pedagogy in digital spheres, she recognizes that the scale and scope of online environments limit the connection, rapport building, and experiential learning that enables social justice education. She

also navigates challenges of building community in online learning environments. The volume of content in her courses, particularly her general science curricula, leave little space to infuse reflection and other necessary pedagogical tools for critical pedagogy. Ashley asserted that greater flexibility exists in elective, non-required courses.

Ashley's limited compensated time also results in reduced engagement with the broader campus community and colleagues in her department. The narrowed hours and shared workspace amongst her colleagues limits contact. This reduction in time limits collaborations and opportunities for professional development and creates barriers to establishing a community of practice. As a result, Ashley relies on the initiative and innovations of student leadership to engage local socio political issues.

Neoliberal practices. Ashley's accounts also detailed her navigation of common neoliberal practices including austerity and the cultivation of flexible labor. In the neoliberal paradigm, austerity is the reduction of government spending and elimination of the government subsidized public sphere. The phenomena of adjunctification is a confluence of austerity, and the cultivation of flexible labor which is the elimination of labor protections in an effort to cultivate dynamic and temporary labor sources. Ashley's labor class results in a diminished voice in departmental leadership and influence on assessments and policies which govern her curriculum.

While she has access to those spaces and an opportunity to exercise her voice, doing so would be unpaid labor. Similarly, Ashley receives communications from her administration that she is supported in some of her pedagogical innovations, but their realization and implementation would be on her "own time and own dime". Practices such as community-based learning practices, which are effective for both core learning outcomes and social justice education, are inhibited or undermined by limited resources.

Related to aforementioned challenges, adjunctification is also reflected in Ashley's high volume of courses and disproportional responsibility for online and introductory curriculum. This work load consumes creative time with prep time and evaluation activities. As previously mentioned, adjunctification challenges the development of professional communities, limits time to connect with students, and challenges engagement with departmental leadership, the institution, and co-curricular activities.

Neoliberal conditions. Alicia's practice is complicated and challenged by the conditions of the neoliberal university. Present in her accounts are environments shaped by inequality, massification, and surveillance. The neoliberal condition of inequality is the creation or exacerbation of inequality through neoliberal logics and practices. Inequality is most present in the material conditions her students are experiencing. Her students navigate limited resources, poverty, job insecurity and underemployment, as well as food insecurity and housing insecurity. Ashley asserts that this is a particularly hostile time to be low resource in higher education. Immediate manifestations of inequality in her classroom related to pedagogy are her students limited access to technology, unreliable access to internet, and unreliable transportation for community-based learning.

The neoliberal condition of massification is the scaling of goods and services to maximize profit and navigate volatile economic conditions. Massification is the result of several previously discussed neoliberal logics and values. Massification is present mostly in Ashley's responsibilities for online learning. To reiterate, the scale of online learning challenges community connections and sense of security and safety for students. Online learning also impedes the level of attention, flexibility, and responsiveness Ashley is accustomed to in real-time and in-person learning environments. Also, much of her time is consumed in grading and

other assessment practices, rather than facilitating dialogue and providing individualized student attention. Online environments are also challenging spaces to mediate and manage risk taking and emotional engagement, which are foundations of critical pedagogy.

The neoliberal condition of surveillance is the implementation of direct and indirect assessment metrics to confirm productivity. Also addressed in the aforementioned analysis, surveillance manifests as Ashley's awareness of and responsiveness to institutionally sanctioned learning outcomes and the parameters placed on her curricula. Ashley responds to surveillance by asserting that some conversations are relegated to specific courses, often elective or specially designed courses. Ashley is also responsive to state and institutional assessment practices, for which she must prepare students for the administration of standardized tests in her lab sections. While Ashley has an opportunity to influence curriculum and assessment, her input and service would be unpaid.

Antithetical practices. Ashley's navigation of her institution is marked by a number of antithetical dispositions, which are directly antagonistic with neoliberal logics, practices, and conditions. Much of Ashley's resistance is detailed in the previous analysis. To reiterate, Ashley provides unique experiences to her students with a level of individual attention and experiential learning that she describes as special, in comparison to the four-year public and liberal arts college experience. She also conceptualizes her work, which she describes as praxis, in a manner which makes justice and environmental science inseparable. Lastly, her structural conditions are unique in that as an adjunct she is represented by a union and is afforded benefits like paid professional development, unfortunately the time constraints of her appointment deter her participation in these benefits.

Case Report: Sela

I intended to arrive to Sela's classroom ten minutes early to settle in for my observation. I didn't anticipate the limited parking and construction on her campus, and arrived at her classroom as her lecture was starting. I opened the doors to the auditorium and quickly stepped up into the 5th row of the tiered seats. Sela and I had spoken many times about the size of her classroom and the number of students in her purview. In conversation, her descriptions of the scale of her classroom were notable. To experience the scale of her classroom in person was remarkable. I sat down into one of the upholstered theatre chairs at 10:00 am while Sela greeted the class. She stood illuminated on a small stage in the center of the auditorium. She was completing a check-in regarding the exam taken during the previous class session. "How are we feeling?" Sela asked. "Give me a thumbs up, thumbs down." Hundreds of fists raised into the air. Thumbs twisted up or down in accordance with the students' experience. Some students' thumbs wiggled side ways to signal their ambivalence.

Sela circled her small stage as she overviewed the topic for the day. Illuminated on the projector screens across the room was an image of three polar bears snuggling under a banner which read 'introduction to ecology'. Sela reviewed content in preparation for the day's activity on climographs. She walked through ecological levels of organization, making distinctions between the behavioral, population, community, ecosystem, landscape, and global levels. She went on to discuss ecological scales, and the patterns and processes which underpin spatial and temporal dimensions. Sela then reviewed factors which determine regional climate patterns, like seasonality, bodies of water, and mountain ranges.

Despite the dramatic design of the auditorium, the space was relaxed and Sela's lecture style was intimate. Her approach was conversational and peppered with personal stories and

anecdotes. Her intonation was enthusiastic. Sela smiled as she spoke. As she advanced the content, she scanned the audience and made eye contact with students in each corner of the room.

Sela's lecture was punctuated with small group discussions and formative assessments, specifically multiple-choice questions administered through clickers. Sela projected the prompt: "Big snow storm in Wyoming last week" and asked student to discern whether the statement was indicative of (a) weather, (b) global climate, (c) regional climate, or (d) microclimate. Several students' hands raised, and Sela addressed their requests for clarification: "try to figure this one out". She smiled as she encouraged the students to wrestle with the content.

The lecture transitioned to climate regions and global climate patterns. At one point, Sela asked the group "what shape is the earth?" Students chimed in at the same time Sela answered her own rhetorical question. The class murmured with laughter, I inferred because of the obvious and foundational quality of the question. The levity of her question juxtaposed with my previous interviews in which Sela discussed the increasing socio political tensions of the biology classroom and her recognition of waning reception for biological foundations like evolution and the efficacy of the scientific method. In that small moment, I sat with both the humor of the comment and the heaviness of the growing politicization of science education and growing distrust for long established facts — like the roundness of the earth.

Shortly after, Sela projected another question: "I don't believe in climate change because it is extremely cold today', what is wrong with this reasoning?". Students were asked to select between (a) a climate can only be hot, not cold, (b) the person is describing weather, not climate, (c) climates only describe precipitation patterns, or (d) there is nothing wrong with this statement. Students drew their clickers, and their responses began to tally in the lower right-hand

corner of the projection screen. Sela closed the poll with 419 responses, with 100% of the responses correctly reporting “b”.

With twenty minutes of class time left, Sela began to talk through different classifications of biomes, such as the desert, coniferous forest, and tundra. As she spoke, several learning assistants emerged in the auditorium walkways and began distributing worksheets for the final activity. Students were to match different biomes with their appropriate climographs, as well as draw their own climograph for the region surrounding Portland, OR. Once the worksheets were distributed, the auditorium began to bustle with student voices. Sela stepped from her platform and entered the aisles to receive student questions. As students worked, Sela hustled between raised hands. She crouched over students’ worksheets, gesturing with her hands as she illustrated the concepts undergirding the activity.

At 10:47 am, students began packing up their belongings. Several students entered the aisles and began exiting the auditorium. “Stick with me guys” Sela said. “Just a couple more minutes.” Sela hurried to share closing thoughts and final announcements. She shared her appreciation for the students’ time and attention as they began to exit the auditorium en masse.

At 10:52 am, the crowd of students was gone. Eight students remained, and they were lined up at Sela’s podium. As I exited the auditorium, I brushed shoulders in the entryway with the crowd of students waiting to enter for their 11:00 am class.

Emergent Themes

Sela and I met for our interviews in a laboratory building in the center of campus. The hallways were wide, and the floors were pale linoleum. The long stretching cream-colored walls were mostly empty, interrupted occasionally by one of the heavy pale wooden doors leading to various offices and classrooms. The hallways were quiet, and most of the office and lab doors

were shut. Across from Sela's office, a single research poster was pinned to a corkboard, on it was a dense explanation of the processes of subcellular and multicellular signal integration. Next to Sela's office door, 10 inches above the floorboard next to her door stop was a sign taped to the wall. In bold, red, uppercase letters it read: "FOR YOUR SAFETY DO NOT SIT HERE. DOORS OPEN QUICKLY AND FREQUENTLY". At first the sign was puzzling, but the utility of the sign would be made clear to me after our first interview. When I emerged from her office, I found half a dozen students lining the walls, staring at me with their computers and lab notes splayed on across their laps, curious to know if Sela's office hours had begun.

Sela's office was spacious, long, and wide. Her desk and bookshelves were an organized flurry of textbooks, thick spiral bound curriculum guides, reports, and indiscernible papers. Her computer monitors were framed by elaborate spreadsheets and calendars. Her office was bright, and lit by frosted windows at the rear of the room. Green plants draped and vined between bookshelves.

We sat across from one another at a table conjoining with her work desk. We met in this space for more than three hours, over four interviews. The office radiated with the energy of a command center, but our conversations were relaxed, focused, and full of laughter. Being with Sela was comforting, easy, and sincere. Together, we explored with depth the nature of Sela's work, the conditions in which she practices, her ever-evolving strategies, and speculated on the outcomes of her curriculum and pedagogy.

The Work. Sela's reflections on social justice education were thoughtful and emergent. Each interview produced new insights and built upon the previous conversation. Sela's reflections revealed how she philosophically and practically conceptualizes the work of social

justice education, what the work entails in and out of the classroom, how she arrived at the work, and examples of her social justice praxis.

Sela's approach to teaching and learning strives to establish and constantly improve strong learning partnerships. She values constructivist learning environments, collaboration with students, and ongoing evaluation and assessment of her curricular and pedagogical practices. The scale of Sela's classroom is sizeable, but she is undeterred from her commitment to co-constructing knowledge. She also resists modalities which position her as an expert and her students as empty vessels waiting to receive her knowledge. She shared:

I think that you have to be responsive [...] I think that your education is not, it's not like dumping, it's not dumping water in someone's brain, right, you've got to stir it up, I'm just kidding. I mean like maybe if we stir the water in their head. It's the image they always use when they talk about active learning vs lecture, is like the faculty member like pouring their knowledge into the students' brains.

Sela invests in student collaborations to cultivate learning communities where students take responsibility for and engage more fully in their learning. Sela believes that learning partnerships begin with her own intentions and responsiveness to the ideas and needs of her students. Through her connections with graduate teaching assistants, undergraduate learning assistants, and through students she meets during office hours and in class, she creates space for feedback and ideation. Sela asserts that collaborating with students in the formation of her curricular and pedagogical strategies takes time, but the investment is worth it. For her, student collaborations are an invaluable site for creativity and innovation. Sela recounted an instance in which she advocated for undergraduate and graduate student participation in a professional development workshop for her program's faculty:

The workshop that I had with my faculty, I actually invited students, undergraduate and graduate students, to come and participate. And when I told my facilitator that I was going to do that she was like well why would you do that, and I was like well I think it's really important that we consider how the students interface with our with our content. And I also feel like it's a really great experience for them to see curricular planning happen at this level, right, and so it's like this two way street [...] I had a colleague once [...] tell me she was like wait until you put undergrads on your curriculum committee like amazing things will happen. We haven't done that in our department, but soon, and I think that that is like they, like I'm just one, I'm just one person who has some ideas, right, and like I work with a ton of people who have great ideas and different life experiences that can make the whole enterprise better by bringing their experiences into it, right. So that's why I try and do that because it makes it, they're, they're so creative, right, and then when they're there I can steal all of their ideas and make something beautiful.

Sela's drive to engage and partner with students is fueled by her commitment to constant personal and professional development as an educator. Sela implores to her colleagues, graduate students, learning assistants, and other mentees pursuing science education that the art of teaching is about unending responsiveness to time and context. She shared:

You don't just get it, go in and give lectures and be done forever right, like you need to like your job, and [being] an educator is to create the best learning experiences possible for your students and everyone right. And that includes fixing things forever.

Congruent with her passion for responsiveness and constant improvement is a commitment to evaluation and assessment of her curriculum and instruction. Sela values

assessment as an essential component of curriculum. In addition to investing in her own capacity with assessment, she has undertaken leadership in her course sequence and department to raise the assessment capacity of her colleagues. She attends to her colleagues' diverse attitudes toward assessment and attempts to cultivate buy in and skills through mentorship, coordination of professional development, and advocacy in departmental service work. Her commitment to assessment extends to her leadership with statewide biology education curriculum and involvement with regional and national science education organizations. At every level, she advocates for constant inquiry and holistic responsiveness to the dynamic and changing needs of students. Sela emphasized the imperative for a holistic conceptualization of students when reflecting on the stagnation of biology curriculum in higher education:

I think that one of the fundamental problems with higher ed today is that we don't think about our students as a whole. Like those programs were designed a long time ago. Maybe they've been modified maybe they haven't been a lot of times like Oh take this class, right. And I really think that having good assessment can allow you to move your program forward in a way that's good for students and builds the type of students that you actually want to be graduating instead of just doing something that's been done for 30 years. It's what I think about assessment. I just think it's a key part of the process that we've been missing.

Sela's commitments to constructivist and responsive pedagogy exist in a massive learning environment, in which she is responsible for the coordination of dozens of faculty and student educators and more than 1000 students. Sela describes the nature of her work succinctly: "I'm a people manager". Her core responsibility is the oversight and administration of a yearlong biology course sequence, which rotates faculty every two weeks in accordance with their area of

specialization. Sela teaches a two-week section herself. Outside of her own instruction, she orients and coordinates the efforts of 6 instructors, as well as the training and supervision of 26 graduate teaching assistants who facilitate 26 lab sections. Additionally, Sela selects, trains, and supervises 20 undergraduate learning assistants who support active learning exercises during lectures.

The majority of Sela's work time is invested in administrative tasks related to her management responsibilities. She receives high volumes of emails and spends a great deal of time in correspondence. Sela also triages numerous conflicts for and between faculty and students. The demands on Sela's time are substantial, and she negotiates the numerous stakeholders that compete for her attention and expertise:

My job is huge and I mean the things that most compete for my time are my students [...] they need a lot of time answering their emails making sure that their supported dealing with extenuating circumstances over and over again.

Sela's management responsibilities coincide with stewardship of curriculum and course planning and leadership among her faculty colleagues. Sela has high aspirations and a compelling vision for changes to her course curriculum, but the scope of her course precludes her from venturing into those changes alone. She relies on the time, knowledge, and expertise of her colleagues to slowly shape her curriculum. Because of the scope of her role and her rank in the department, she leads these changes with soft power, or relationship capital.

Sela feels obligated to lead change in for her course's curriculum and pedagogy with respect to issues of diversity, equity, and inclusion. Sela is attentive to necessary leadership work at the administrative and ground levels. With her colleagues and administrators, she recognizes that there is a disparity in openness, willingness, and capacity for inclusive and critical

pedagogies in biology education. She is encouraged by colleagues who are responsive to her vision and who carry their own intrinsic motivations to reimagine biology education to advance goals of diversity, equity, and inclusion. She is also encouraged by institutionally led professional development work which has activated the engagement of senior STEM leaders regarding diversity, equity, and inclusion issues.

While work at the administrative and collegial levels is significant, Sela believes change begins from the ground up, and invests in her relationships with students, student educators, and new faculty and finds that it is easier to inspire a shared vision with these constituents. Sela is aware that some of her collaborators are entrenched in their curricular and pedagogical approaches, and she is empathetic for their experience in the process of change and optimistic about the possibility of shifting attitudes and growing capacity. For Sela, leadership is not about force, it's about meeting stakeholders where they're at. She is particularly gentle in the facilitation of change, because her curricular aspirations are substantial. She envisions a major overhaul of the foundations of her course. Her proposed changes attempt to not only improve learning outcomes, but address structural and economic barriers for transfer students and mediate factors which influence the attrition of historically underrepresented minorities (HURMs) in science:

What I really want to do in the redesign is not only, we've done some things that are like biological faux pas, like we've separated the structure from the function of things and so I want to put the structure and function back together. I want to think a lot more about how our course compares across the state for transfer purposes because it actually creates a huge barrier for transfer students in that they sometimes end up taking five introductory biology courses if they haven't finished the full sequence in one place, it's ridiculous, but

then also really thinking about where, how we move from breadth, which is what we're doing right now, we're covering everything, to depth, and thinking about what is really essential content for introductory biology and how can we do that really really well for our students so that rather than sending them running to the hills with trying to teach them everything they ever needed to know in their introductory courses we can instead scaffold their learning more intentionally into their upper division.

Sela is aware that her intended curricular changes will be slow moving. In addition to the constituents within her own program, numerous academic programs outside of her department are linked to her course. Sela's course attempts to prepare students for 57 different academic majors within her institution. In addition to the many curricular dependencies at her university, she is conscious of her course's connection to curricula at institutions around the state and the implications of any changes for transfer students.

A part of Sela's leadership has been securing funds to support her curricular overhaul. She recently secured a grant which will enable her redesign and provide necessary resources to tackle the course's embedded issues. With a few exceptions, Sela asserts that her course, which she inherited when she was appointed, has gone unchanged in its design and facilitation for nearly 35 years. Her priorities include changes in the approach to foundational biological concepts as well as a redesign which supports inclusive and critical pedagogical practices. Her baseline is establishing learning outcomes which will prepare students for more advanced courses:

There are some really key processes that they need to learn in introductory biology to be successful in their upper division classes. So in some ways it's kind of a service course [...] they need to know how science works. They need to start to understand the scientific

process, they need to practice the scientific process and understand where scientific knowledge comes from. In my mind they really need to understand evolution. It's a core tenet of biology. What evolution is and how it happens and that it's not it's not all natural selection which they think evolution is natural selection but a lot of it is random. They need to understand some really key cellular processes. So things like how energy is formed and how we get energy from the sun, what those cycles look like. And then they need to understand some really key physiological and anatomical things both for plants and animals [to] help them understand how organisms work so that when they get to their upper division courses they can really dive more deeply into the details.

Beyond biological foundations, Sela is interested in curricular changes with implications for inclusivity and critical pedagogy. Much of our conversations explored how Sela conceptualizes critical pedagogy and the extent to which she practices in a manner which raises consciousness and facilitates sociopolitical action. Forthcoming discussion explores Sela's deliberations and aspirations related to critical pedagogy. Early in our conversations, Sela was most concrete about her commitment to diverse gender and racial representations in the science curriculum and the connections between scientific literacy and critical literacy. Sela was most confident in her ability to implement changes which would include the contributions of women scientists and scientists of color in the field of biology:

[I've been] thinking about more positive ways I can role model social justice for them or or share diverse examples with them. I think [that] is a better way for that population of students to engage with [social justice]. [...] One of the things I'm really trying to work on at this particular juncture is this idea of like diverse representations of scientists in my classroom. I don't actually represent scientists in my classroom very much at all. So that's

kind of OK. But I would actually like to. And so thinking about like that whole idea of can you see yourself in science and what that feels like for my students. And so that's one of the things I've been thinking about a lot lately.

In addition to examining her curriculum for opportunities to represent the contributions of diverse scientists, Sela reflected on the value of a solid foundation in scientific literacy to prepare citizens who can process and critique information in ways which better inform and enable their participation in social change. Sela is passionate about the value and necessity of rigorous science training as a requisite for cultural and political change. In this way, Sela draws connections between competencies of scientific literacy with the capacities for critique and sociopolitical action inherent in critical literacy. She shared:

I really want my students to have the best most sound scientific evidence that they can have and know how science is completed so that they can use that knowledge to inform their own decisions. And my hope is that by training them rigorously in science is that they can influence the national and global climate as they move forward. That's how, that's how I'm going to phrase all of that.

In tandem with curricular changes, Sela intends to expand her inclusive pedagogical practices and is deliberating possibilities for more explicit critical pedagogical practices. Her inclusive pedagogical practice, or teaching strategies which aim to foster engagement, participation and success for HURMs, include community building, active learning, and addressing issues of economic access.

Of all of Sela's pedagogical priorities, establishing and sustaining an engaging and affirming community is premier. Sela is attracted to critical pedagogical practices which have the

potential to facilitate socio-political consciousness and action, and efforts pertaining to inclusion, representation, and student success take priority. She shared:

I think a lot about in my classroom about this whole idea of again, it's this it's the community and the students being able to see themselves as scientists and in the scientific community. And I think that that's slightly different than [...] social justice education. But in my mind that that's that's where the power would come from the, be that you know if we can start shifting the imaging and the framework about how we see successful people in science I think that that could create space in my classroom for my students to have more opportunity to think about how they get there. And so that's what I think about a lot.

For Sela, there is a tension between the social justice work of creating an inclusive classroom and the social justice work of using the content of the classroom to raise people's consciousness of issues of difference, power, and discrimination. At times, there is a necessary decision to make between the two, and she has concerns that doing consciousness raising work would potentially be at the cost of an environment where people, specifically HURMs, feel safe and secure.

Sela's social justice priorities are connected to the scale of her learning environment. In an auditorium of 600 students, she feels urgency to create a space where people feel like they belong and they have the safety and security to listen, collaborate, and learn. Sela is proud of her work and the work of her colleagues in developing a sense of community in her course, and she believes their efforts are manifesting in measurable outcomes of student success.

A core strategy of Sela's community building efforts is active learning. Sela aims to infuse active engagement in every aspect of the class and increases the opportunities for students to use their voice, connect with one another, and connect with her. She fosters active learning

through paired and small group discussions, through audience response technology such as clickers, and by facilitating guided reflections. It is through active engagement of every member of her class that Sela practices social justice:

We're trying to hear from more voices in the room so that you're getting a more diverse representation of our student body, trying to make sure everybody has the opportunity to talk so we're having these like kind of think pair share activities where they have some time to think and then talk to a neighbor and then maybe share out with the whole class if they want to. And, just really thinking about how we get all of our students feeling like they're a part of our classroom community. So I think of, when I think about social justice I think a lot about community building.

Sela's approach is grounded in what she refers to as equity minded practices, and she draws inspiration from biology education scholarship for pedagogical techniques which aim to improve participation, success, and retention of HURMs. In particular, Sela frames her approach through the work of Kimberly Tanner, and her series of 21 strategies for equity in the classroom. Tanner (2013) organized her equity minded practices thematically into 5 strategic goals: (a) Strategies which include giving students opportunities to think and talk about biology include ensuring students have enough wait time to consider prompts and infuse in-class reflective writing exercises; (b) strategies which encourage, demand and actively manage the participation of all students include monitoring patterns of participation in class and facilitating systematic hand-raising to invite multiple voices; (c) strategies which build an inclusive and fair classroom community for all students include learning and committing student names to memory and being explicit about your intentions and commitments for access and equity; (d) strategies which monitor behavior to cultivate divergent biological thinking include asking open ended questions

and using praise judiciously; and (e) strategies which ensure teaching for all students includes engaging in formative assessment with every student, every class.

Sela's equity mindedness extends beyond in-class pedagogical practices. At the time of our interviews, she was actively investigating and negotiating the creation of open access textbooks for her course. Sela expressed her desires to make her course as accessible as possible, and she was interested in mitigating rising college costs where she could in her spheres of influence. The size of her course, and her coordination with multiple faculty present unique challenges, and Sela was vacillating on the whether it was more strategic to coordinate the creation of a textbook with her faculty or to negotiate down costs with an established publisher. She shared:

Everything in our course, everything I think is like extra challenging because I have so many people and students and faculty that are involved in it, right, and so because of that the context within which I work making a decision about something like an open access textbook is like a group decision [...] so it's, it's harder to make that kind of decision because picking up open access is a lot of work for all of the people involved. It's one time work, maybe, but it's still a lot of work. And so I would love for my students to have free resources and there's lots of resources online and I would love to curate all of that but at some point my faculty also have to want to do that, right. And they have to be willing to put in, it's kind of like that continual time to do that in my mind, its, and I don't think in introductory biology it's a one and done kind of shot, you know I think that you have to be, now you're committing to to curating resources forever, you know, and maybe I'm wrong but that's sort of how I think it has to happen, so, so we'll see.

Sela also discussed her inclusive pedagogical practices which have critical pedagogical potential, specifically the implementation of socio scientific issues (SSIs) and community-based research (CBR). Sela's attraction to SSIs and undergraduate research is centered on their potential to tap into student motivation and increase engagement. Socio scientific issues invite the complexity of sociocultural context in the analysis and deliberation of STEM problems and often broach ethical dimensions at the intersections of science and society. Common examples germane to the biology classroom include issues of climate change and genetically modified organisms.

SSIs are implemented frequently in Sela's labs. Their integration was an effort to inspire more thorough engagement with lab content, as Sela's teaching assistants were reporting that students were passively "checking boxes" in an effort to accomplish tasks quickly. SSIs lend to more active learning, and are the focus of discussion facilitated by teaching assistants for each lab. In addition to cultivating engagement, Sela is attracted to SSIs potential to foster information literacy and systematic thinking. She also believes SSIs bridge connections for students to consider scientific reasoning as a function of informed and active citizenship. Sela elaborated on civic engagement as an addendum to her central goal of scientific literacy:

The other piece of socio scientific issues in my mind that's really interesting is that regardless of where my students end up like they are a voting citizen now and I want them to vote appropriately based on science knowledge. And so I try to tie to social issues where I think it's most important. And so I I definitely think that that's a important part of what we do. And in fact I've actually had my faculty write that into our overall biology program goals. And so thinking about what our biology majors should be able to do is one of them is make informed decisions about social, social needs, socio scientific

issues particularly socio biology issues. Because I do think that like in the end regardless of whether or not my students can pipette or ever want to touch a pipette again or whatever it is that I'm training them to do in the lab I want them to be able to use the way science works to make informed decisions.

Sela acknowledged that SSIs are ripe sites for critical consciousness work and sociopolitical engagement. She named that SSIs lend to perspective taking and invite cognitive dissonance through the exploration of ethical issues. While her SSI curriculum does not explicitly broach social justice dimensions, opportunities to engage issues like poverty in connection with topics like climate change are clear. The scale of Sela's learning environment is an impediment to realizing the critical pedagogical potential of SSIs. Sela is cautious about holding divisive sociocultural dialogues or broaching contentious political topics because the delivery of her content relies on graduate labor, across numerous sections. Sela is trepid about the risks associated with delegating such pedagogical responsibilities to graduate students, particularly the community impacts of marginalizing dialogue. Sela elaborated on one instance that, while not contentious, informs her caution about graduate teaching assistants' capacity to facilitate, meaningfully and productively, the complexities of SSIs:

With the socio scientific issues, we had some (issues) when we started, we started trying to teach them like information literacy by giving them like information from Monsanto for example that sells GMOs versus information from scientists that don't sell GMOs and having them compare, but if my TAs didn't pick up on what was going to happen, the students thought I was giving them information about Monsanto. And so there's always this tricky balance of like making sure that I that I can spread the curriculum in the way that it was designed, rather than, rather than deliver it myself.

Similar to SSIs, Sela engages her students in research activities and prepares students for more robust undergraduate research projects but does not currently engage in inquiry which reflects the tenets of community-based research (CBR). Like SSIs, CBR connects STEM competencies with contemporary socio cultural issues and engages student investigators in real world partnerships with community stakeholders. Sela recognizes and is interested in the transformative potential of CBR and its implications for both scientific and critical literacy, but the scale of her classroom and the goals of her curriculum are prohibitive. Sela is confident in her ability to facilitate meaningful CBR activities, she is unsure of the capacity of her entire staff and her ability to provide the necessary support and oversight. Further, the coordinated efforts to engage more than 1000 students in research beyond her institution is an administrative feat that is well beyond the scope of her role. Lastly, her course is designed as a survey and covers ambitious content in a year-long sequence. Sela is cautious that the incisiveness of CBR is not compatible with the comprehensive nature of her course. She shared:

We do elements of [CBR] that are really more about inquiry and how science works and part of the part of my hold up on that sort of work is well [...] I have 28 TAs. They come from all sorts of backgrounds. And so it's not about whether I could teach my thousand students to do a course based on good research it's about whether or not my teachers can actually support them in that work [...] And so this is one that I think is tricky in my context for the obvious reasons, the thousands of them.

In our conversations about Sela's implementation of inclusive pedagogies and her deliberation about the integration of more critical pedagogies, she reflected on several salient attending factors in her role as the coordinator of her massive course. Reflections on the congruence, utility, and practicality of critical pedagogies were often accompanied by reflections

on the interpersonal and intergroup complexities of her learning environment and her role as a facilitator and mediator for her classroom community. Specifically, Sela elaborated on her role as a mediator of conflict, her negotiations with politicized topics, and her care as a facilitator of grief in the learning process.

Sela's self-described role as a "people manager" is imbued with innumerable interpersonal conflicts, which Sela responds to either as a consultant to her staff or as a direct arbiter of conflict herself. Conflicts arise for various reasons. The focus of our conversation was those conflicts that are grounded in biased or marginalizing behavior, and which stem from racist or other oppressive attitudes. Sela asserted that the number one conflict she mediates in her role is issues of bias. Her approach to conflict resolution is one that centers perspective taking, fairness, and sustaining a healthy learning community where all students can thrive. Sela reflected on the challenges of responding to bias incidents in her classroom, and the challenge of training and coordinating the efforts of her many teaching assistants who are often the first responders and facilitators of bias incidents:

I would say that's the number one conflict that comes up within my students that really ends up being unresolvable has to do with perceived or true you know bias and racism and mistreatment of individuals based on some sort of status or something like that. And my students are not all young but often they're fairly young and so they are fairly inexperienced with dealing with a lot of that stuff.

Mediating bias issues is one of many social and political tensions Sela attends to in her coordinating role. Sela is thoughtful and deliberative about the integration of political dimensions into classroom activities and discussions as she is careful to sustain a learning environment where everyone feels affirmed and that they belong. In her current lab structure,

social and political issues may emerge in dialogue as a function of the discussions and formative assessments facilitated by teaching assistants. Sela's guidance to her teaching assistants is to not explicitly engage moral and ethical dimensions of scientific issues as her TAs do not have the necessary training to engage in critical consciousness pedagogies. Sela is aware of the risk of misinterpretation with social justice learning in her lab environment, and she feels the structure of her course precludes direct engagement with contentious topics.

Sela recognizes the imperative to engage students' moral and ethical dimensions, and is currently attuned to issues related to faith in the context of evolution. Sela believes it's important to understand students' needs, which includes emotional experiences with cognitive dissonance. Where the norm is to bifurcate conversations about faith from biological conversations of evolution, Sela is recognizing that such dissociations are not serving to reach all the students in her class and creating a disconnect between students of faith from more advanced biology conversations. Sela is actively engaged in professional development as to how she may broach issues of faith and religion in her fall course, and hopes to implement discussion or other interventions in her unit on evolution. She shared:

I want religious students to feel comfortable in my classroom as well. And so I think that there's some balance there and I used to think that we shouldn't talk about religion in the by the biology classroom at all and that we should just ignore it and we just teach the science. But I've realized that that is also isolating for those students. And so when I think about how we bring all of our students in I think that we have to recognize we have to acknowledge that it may be uncomfortable and that may be against some of their beliefs but that I'm going to share with them the best science that I know. And I think that's

better. [...] I think about how we just acknowledge that they that they can have religious beliefs and still understand science, right, I think is important.

At the time of our interviews, Sela had recently deliberated classroom climate tensions related to one of her lab activities, and after a process of negotiation, chose to remove the lab in the interest of sustaining a healthy learning community. The lab was designed to engage students in an exploration of race and genetics, and invited students to analyze DNA sequences of people from different sub regions of Africa, Europe, and Asia as a part of a drug trial proposal to determine if genetic makeup is a relevant factor in developing treatment plans for patients living with HIV/AIDS. Sela said that when facilitated correctly, the lab should reveal that genetic diversity within the continent of Africa is actually greater than the genetic diversity beyond the continent of Africa. This exploration into human evolution and the complexity of human genomes has the potential to dispel myths which support and reproduce scientific racism, a set of ideologies which underpin eugenics. Sela intended for her TAs to facilitate a discussion about natural selection and evolution and would prompt students to make a decision about whether it was appropriate to develop the proposed drug trial based on race. When facilitated correctly, and students' comprehension is sufficient, the answer should be no. The remainder of the lab would be devoted to discussion as to how different teams arrived at their answers and to clarify misconceptions and misunderstandings.

Sela had the lab under review when her campus was unsettled by a set of critical racial incidents. In the months preceding our interviews, her campus was embroiled in dialogue and debate about a student actively organizing as a white supremacist in her institution's student government. The white supremacist was promoting rhetoric that affirmed the scientific racism of the thoroughly debunked racial intelligence movement, a discourse commonly associated with

Herrnstein and Murray's (1994) publication *The Bell Curve*. Sela's staff, one of her graduate teaching assistants in particular, had an unsettling interaction with the student activist during one of her course's lab meetings, and the teaching assistant reported their concerns to Sela.

In addition to their white supremacist activism through student government, the student was also a graduate assistant in STEM and responsible for teaching on campus. Amidst these tensions, her campus was again rocked by another critical racial incident - a series of racist and xenophobic tweets which threatened violence against her campus community. Shortly after the tweets were released, local authorities confirmed that they were not a credible threat. The impact of the tweets for the campus, in particular students of color and international students, was terrorizing.

Sela considered the campus climate tensions exacerbated by both the visible student activist and the anonymous threats happening on twitter, and she decided to pull the lab from her curriculum. Sela had not heard concerns directly from her undergraduate students. Sela felt it was important to act with care and caution. She was particularly aware of the capacity of her Teaching Assistants. While she has high esteem for their work as educators, she was not confident in their ability to facilitate tense dialogues about current campus climate which may emerge from the lab activity. Sela's negotiation began with a heavy editing of the lab, but the intensity of the campus' critical racial incidents in combination with her consultations with colleagues and campus leaders led her to conclude that pulling the lab was in the best interest of her learning community and sustaining an inclusive classroom. She shared:

I literally just pulled it out because I feel like our campus is in a climate where I don't think we can teach that right now. So I pulled it out like last week. So I don't have a lab for next term, and that spot in my lab manual I'm going to have to come up with

something else [...] it has to do with the TAs versus myself teaching. You know what I mean like I'd be very comfortable that I could get the outcomes I wanted out of it. But I wanted, I'm not, I wasn't confident, and we've done this for five years and it's never been an issue. But I wasn't confident at that particular moment that our, that we could handle it in the current campus climate [...] my fear was that I'd just be giving fodder to someone to have a different conversation because they wouldn't understand the results appropriately [...] I want [my students] to feel safe and included in my classroom. And so if taking that lab out is how I make that happen I want them to feel safe and included in my classroom and that's what I'm going to do, right.

Sela is thoughtful about students' cognitive and emotional needs in facilitating an inclusive and productive learning environment. In addition to caring for students' psychological well-being connected to issues of race, religion, and other social group membership, Sela attends to students experiences with grief as they encounter the gravity of topics like climate change.

Sela is committed to teaching students the science of climate change, and she feels it is imperative that students engage with and accept the realities of climate change. She is also thoughtful about how to share such topics in a way that mitigates difficult feelings like hopelessness. Sela reflected on how she brings closure to conversations on climate change, which occur at the end of her course sequence:

I try to spin it in this really positive light. Because I don't want to end my last lecture on like this like gloom and doom of global climate change and so then I had to come up with like some sort of like, a here's how we can mitigate, you know like and come up with all these like sustainability strategies and stuff like that but don't make them feel like they want to go out and and you know, jump off a cliff after they leave my last day of my

lecture because global climate change is really depressing. So, so that's what I try to do. So we talk a little bit about some organisms would be winners and some would be losers. You know what I mean like some organisms will actually be positively benefited by global climate change and some won't, stuff like that.

Sela's reflection on her deliberations with her lab related to percolations of racial tension in her campus climate and her attention to students' experience with grief were closely connected to her reflections on her evolution as a college educator and her development as a practitioner of inclusive and critical pedagogies. Sela arrived to this work through a traditional science training focused on botany and ecology. Her graduate work focused in environmental science. When discussing her training as an educator, Sela asserted she was trained like most faculty, not at all.

Early in her education, she was attracted to psychology and other dimensions of human dynamics and imagined her career to include teaching. While she aspired to have a role in academia that centered teaching, she never imagined she would be teaching at such a scale with so many administrative responsibilities. Her surprise at the circumstances of her career is pleasant: she loves her job, and by all accounts she's good at it.

Since her formal training, Sela has remained active in her ongoing learning and development as an educator and is active in the development of others. In addition to mentoring her graduate students and other college educators in her department, she is an instructor in a college teaching certificate program. She attends and coordinates workshops on curriculum and pedagogy for herself and her department. She is also actively engaged at the state and regional levels in professional associations devoted to biology education.

At the time of our interviews, Sela was actively deliberating the harmonies and incongruences of inclusive and critical pedagogies, and contemplating the feasibility,

practicality, and value of critical consciousness and sociopolitical action work through her curriculum and in her classroom. Sela asserted that social justice work in her classroom manifests as access and equity practices. Her professional development has focused on expanding her knowledge of diversity, equity, and inclusion practices in the classroom, and she is clear that she is further along in her development as a practitioner of inclusive pedagogy than critical pedagogy. Sela has recognized a change in discourse, and that she sees a language pattern shift which increasingly addresses issues of social justice, and social justice education. Reflecting on her incorporation of SSIs in her lab sections, Sela discussed her primary interest in the motivational and culturally relevant potential of socio scientific issues, and further recognized the opportunities for critical consciousness work. She shared:

[I wanted to know what] are topics that students that are going to grab students interest and make them want to learn this biology. And so the whole premise behind it was that by engaging their interest in social scientific issues we can engage them more within the biology and help them understand its relevance to their lives. So that's what it, how the curriculum was designed. But there are pieces of it that could have [broached social justice issues]. Like I was just talking with my TA yesterday about differential impacts of air pollution on different people based on where they live and how it can impact different races differently and all of these things. There's elements of that could certainly be built into that curriculum. And I have not done that yet. Not explicitly any way.

Sela discussed the formative role of graduate students in the shaping of her praxis and how their energy and initiative is shifting her notion of diversity and equity work in the classroom. Sela has responded to these shifts with enthusiasm. Congruent with her passions for assessment, she believes her teaching should be in a constant state of inquiry and development.

Sela commented on her responsiveness to the changing discourse for diversity and social justice education in biology:

It's a moving target because we know more now and it should be a moving target. And I think right, it's just like my biology being a moving target. And so I think [...] the way that my my knowledge and training has come about, right, in that as I, as I know more about social justice and social justice issues and social justice ideas I think more deeply about how to incorporate them into my student, in my student engagement work, right, and so the fact that I first learned about diversity and inclusion is part of the reason why you see that as this really big sphere, because that's something I've been more aware of and cognizant of a lot of longer, right, and I think that, I think that I see the same sort of shifts happening within my graduate student population, which also tends to influence me a great deal because they can be so forward thinking in a really positive way [...] I see them bringing these social justice issues forward themselves you know and like wanting to incorporate them into the lab curriculum and as I see really positive ways that we can do that, it influences my ability to make that happen for all of our students, right.

At the time of our conversations, Sela was thinking through how she could weave social justice concepts into her course. Some of her ideas emerged over the course of our interviews.

She shared:

I hadn't ever really thought about expressly putting those types of issues into the classroom before. And so that's the kind of thing I've been thinking about is is that part of what we want to go into our classroom content. Right. And if it is, how do we weave that in a way that doesn't just become one more thing for students to memorize and regurgitate on a test but becomes a meaningful, you know what I mean, like becomes a

meaningful thing for them and not just like oh here's the impact of air pollution on you know whatever. And I don't know that I have any answers for those questions but those are the kinds of things I've been thinking about [...] but I could see using case studies and some different types of learning activities that will allow students to again if we if we get past that point where we're covering not quite so much breadth and we're choosing some depth we could we could specifically think about choosing things that allow us to explore sort of this impact of science of biological science on sort of social justice type issues in a way that could tie things together in a way that I can I hadn't really haven't really thought about all that much and certainly those the issues that would do that are issues that are going to be selected in our curriculum. And so thinking about that holistically we, I'm redesigning my workshop in my brain as we talk, like literally like redesign this and then like we need to do this.

Throughout our conversations, Sela reiterated her commitment and conviction for diversity and social justice work, and her enthusiasm for tackling difficult issues. She asserted that the more she learns about inequity and her sphere of influence, the more motivated she is to redress it through inclusive and critical pedagogical practices. Sela reflected on the movement and energy of her colleagues and students who were advancing change in biology education:

So it's been really, it pushes me to be, to think more about my biology classroom in a way that I can think about how I can push those issues forward more. And it's it's hard right. That's all. It's it's like work. It's work. It's good work but it's work you know. So that's kind of how I got where I am today. I really felt like I was at a time when I could really start to tackle this stuff and I'm still just just starting.

While Sela is in touch with the ways she can grow, she is proud of her capacity and recognizes that she does good work. She practices ongoing assessment throughout her work, and is attune to both her strengths and opportunities for innovation as a college educator.

The Conditions. We discussed the various contexts that shaped Sela’s approach to social justice education, and how a range of conditions - from the broadest to the most immediate — influence her curriculum and pedagogy. Sela spoke to the growing influence of the national context in her classroom. Sela is concerned about the growing mistrust of science, and how the politicization of issues like evolution and climate change are complicating students’ engagement with the course material. Sela lamented that the national discourse of science, particularly on the federal level, has taken steps backward in recent years. She shared:

Well I think that part of that national global climate right now is I think that there's that element of science getting [dismissed]. [...] I'm not trying to indoctrinate [my students] instead I'm trying to teach them the best knowledge that we have, based on what we know, right, and that that's what science is, right. And that science isn't just like us willy nilly throwing things out there for people to think about. It really is. It's a way of knowing that's built on evidence. And but in order to get them to understand that I need them to be willing to even have a conversation about [things like] evolution.

Sela is struggling with students’ waning open-mindedness. She is concerned about how she can create a learning space where students of all political ideologies feel included while maintaining an environment where all students feel safe. Sela has thought deeply about how to build a community that enables her principle outcomes: engagement with and understanding of foundational biological principles and increased capacity for scientific reasoning. Sela asserted that as a field, biology education has taken for granted that students know how science works. As

a part of her forthcoming curricular overhaul, Sela is considering how she can spend more time with students exploring the history of science and the epistemological foundations of science.

She shared:

I think that science has become more politicized and I think that I think that the need for us to spend more time training students not just in the content but more in the process of what science what science means like what is science, right, has really become more important [...] I mean some of it is even just spending more time less time just telling students facts and more time telling students how we know these things right, spending more time on a little bit of the history of science and sort of like experimental design and just like how science builds upon itself and like builds a body of knowledge and that at some point it becomes almost becomes knowledge because so many things have proven this thing and how it's not just a single point in time [...] and the fact that science is collaborative and that scientists work together and that almost no science is done by a single individual. And that like we're going to have to be collaborative and work in teams and that that helps us build our understanding. And part of that you know this whole idea of diversity becomes so important when you think about collaboration because diversity makes collaboration better and having a diversity of ideas means that you're more likely to have a diversity of thought which means you're more likely to potentially solve big problems you know. And so I think all of those elements of science are things that our students don't come here thinking they're going to learn that. And yet in our current climate it's very important.

At the same time that Sela holds concerns about the adverse conditions for science at the national level, she is hopeful and grateful for the direction of her discipline, biology education.

She sees biology education to be in a moment of change, and she considers herself lucky to be practicing and collaborating at a time where new and innovative diversity, equity, and inclusion approaches are emerging in her field. Through the course of our conversations, Sela shared with me scholarship and visioning documents from her professional associations which clearly and concretely articulated imperatives and strategies for inclusive and critical pedagogies. Sela's sense of gratitude extends to her regional context, and her affiliation with professional associations in Oregon and the Pacific Northwest which focus on and support diversity, equity, and inclusion work in biology education.

I mean I feel like in a lot of ways I've been really lucky in that I came into a moment when things were ready to change in a lot of different ways, right. At least within biology education there is a big movement happening and I just happened to like stick my foot in it, is really how I feel it happened.

Sela is similarly encouraged by initiatives and progress being made at her institution. Institutional messaging, the provision of professional development opportunities, and her growing community of practice in diversity, equity, and inclusion work are affirming of her own efforts. Her appreciation for her institution's espoused commitments to diversity, equity, and inclusion work is tempered however by her skepticism that many institutional efforts may be mere lip service. She shared:

I think that we make strides at [my institution] and I think that [my institution] still struggles with this. Maybe it's its history maybe it's who our population is. Sometimes it's hard for me to tell if we pay lip service to things or if we're really putting our money where our mouth is with these kinds of things [...] So I feel supported in many ways in my efforts to think about diversity inclusion and social justice but then at the same time it

feels like there's I don't know there's a little there's some gaps going on that make it hard to really, there's not a reward system or something I don't really know what it is. There's no incentives, there's no incentives for being successful at it I guess and that's with it being in my position, It's like a stick, not a carrot.

Sela perceives a wide disparity in faculty and staff capacity and motivation for diversity, equity, inclusion, and social justice work. Sela sees students increasingly as the leaders of social justice work at her institution. She regards students as ahead of the administration and faculty in their thinking and motivation. As an instructor in a graduate college teaching certificate program, Sela observes first-hand the engagement and passion of aspiring college educators to integrate issues of social justice in their curriculum and pedagogy. She shared:

My students are just so much further ahead on diversity inclusion issues this year than they've ever been before that like their their knowledge and understanding of these types of issues felt so much further out ahead than most grad students have ever been before. And so I think that the university is getting somewhere but maybe with our younger population, younger portions of our population who are more invested in these ideas than with our upper administration.

Sela asserted that change is needed at her institution. She is personally concerned about how she can affect change, and how she can move her colleagues and administration forward in their motivation and capacity for diversity, equity, inclusion, and social justice work. Sela sees professional development as a necessary investment and a foundation for change. She identifies in herself and her institution the need for new thinking and innovation. She sees productive work happening at her institution, but believes that the various efforts occurring are disparate and lack a centralized and unified vision. Sela believes her institution would benefit from leadership

which helps students, faculty, and staff make sense of and organize their resources for DEI and social justice learning.

Within her department, Sela is encouraged by the growing conversation among her colleagues regarding diversity, equity, inclusion, and social justice issues. She feels lucky to be working among colleagues who are motivated and open to change. Like the institution at large, she regards her colleagues on a spectrum of engagement and capacity. Sela is emerging as a leader in her department and has undertaken formal and informal roles to steward the commitment and development of her peers. She discussed the difficulty of this work citing both the demanding research priorities of her department which direct her colleagues time and attention as well as her rank and the necessity for her to cultivate and wield soft power to lead change. She shared:

I think our department is making strides in a good direction and I generally think that my colleagues are generally on board with that right. At the same time you know two thirds of our department is research faculty who are incentivized to do their research. But even within them we have some really strong proponents of diversity and inclusivity and people who are thinking about those kinds of issues for various reasons [...] [I] work with really phenomenal people who one, trust me, two, are willing to follow the evidence and use evidence to make decisions about their teaching and who aren't so stuck in their ways as that they can't change their teaching.

Present throughout all of our conversations, in every context, was the immense scale of Sela's learning environment. As previously mentioned, Sela is responsible for a course of more than 1000 students which spans three terms, which meets in two sections and breaks into 26 lab groups. Her responsibilities include the coordination of 6 faculty instructors as well as 26

graduate teaching assistants. Scale seems to be among the most salient factors which inform Sela's approach to inclusive and critical pedagogies. She must consider not only the feasibility of whether a strategy will translate to her scale, but also what approaches and techniques are within the capacity of the faculty and graduate students Sela must delegate the curriculum to. Reflecting on the challenges of a massively scaled classroom, Sela discussed the failed implementation of a scientific literacy lesson plan in her lab sections. This experience is one of many formative curricular experiments which inform her caution about broaching critical social and political issues in her curriculum. She shared:

You have to be really careful. Like we used to try to do this thing where we gave [students] some information about how some bad information [like] about information literacy right, we'd give them like bad sources and good sources and try to have them analyze and it turns out about [only] half the TAs [understood] that that's what we were doing. [...] [So] those students just got bad information and didn't really get challenged to think about what was the right information and how you knew that. You know I mean, the whole point of the exercise was to identify positive, you know, what are good sources of scientific information. And instead these students walked away thinking that GMOs were great or whatever or terrible or whatever it was at that moment for that section. So I have to be careful. Scale is hard.

Challenges of scale also appear in the ambitiousness of her course curriculum. Currently, curricular space is a premium and Sela has difficulty imagining and justifying the inclusion of additional content related to social and political issues when she is struggling to cover the core biology content for her survey course. Through our conversations, Sela contemplated the feasibility of integrating social and political issues:

[I'm] thinking more deeply about how you would do that in a STEM classroom without [...] really having a full class focused on social justice, right [...] and where those issues might come up and how you would bring them in in a class that has so much content in it already without it feeling really overwhelming for people.

The challenges of scale also manifest in her ability to receive critical feedback from her students on her curriculum and pedagogy. Sela is cautious about curricular and pedagogical experimentation, and she invests in empirical strategies because of the risks accompanying a class of her size. Sela is not likely to receive immediate or even timely feedback from her students. Where she is likely to receive students' concerns is through their end-of-term evaluations.

Sela thinks there is a place for social justice education in her course, but she's not sure where. In our reflections, she continually affirmed her interest in integrating social justice concepts into the curriculum, but she remains unclear as to how and where those ideas and conversations will be infused. She shared:

What's really challenging in my classroom is that again I'm I'm only in that room for five weeks. And so it's it's hard to think about how you address [critical issues]. But I also think that there's space for thinking about how issues of science differentially impact specific groups of people in a way that that contributes to these power differences. And I'm not sure, again you saw the breadth of what we're going to cover [...] it would be great to build in some of these social justice ideas into that new curriculum. But again I have no idea how that's going to go.

Strategies. In addition to articulating the shape of her work, and the conditions which inform it, Sela spoke to particular strategies which enable her inclusive and critical pedagogical

work. Sela maximizes the energy and creativity of student leadership and engages in her own constant development in a growing community of practice.

To advance her own praxis, Sela has leveraged her students' knowledge and enthusiasm for issues of inclusion and social justice in the biology classroom. Sela has responded affirmatively and collaboratively to students' equity mindedness and their curiosity about how to engage social and political dimensions in the classroom. For instance, Sela's teaching assistants and learning assistants offer feedback on how to be more conscious and inclusive with lesson plans and the facilitation of classroom activities. Sela's students have referred her to professional development opportunities and skill building workshops available on campus, which Sela has subsequently promoted to her colleagues. Also, the socio scientific issues which are now integrated throughout Sela's lab sections were initiated and designed by a high-performing graduate student. Regarding her aspirations for more critical pedagogical interventions, Sela sees student leadership as a possible path forward given the structural constraints of her classroom. Sela reflected on the possibilities within student-run biology organizations to help facilitate community-based research initiatives:

Our [biology clubs] are working on developing ways to tie students to graduate student researchers as as a mechanism for tying them into the department and giving them undergraduate research opportunities. The problem of course with that is that if you don't have the capacity to volunteer and you have to work and like all that stuff there's other problems that are associated with those types of things. But it's a way that we can try to get more students doing undergraduate research earlier that doesn't involve them necessarily doing it in biology class.

Sela's core strategy is remaining in a constant state of development. Throughout our conversations, Sela referenced her hyper-vigilance for personal and professional development and her fear of becoming "recalcitrant" or becoming unresponsive and losing momentum to develop as a college educator. Sela is an avid reader, and increasingly engaged in the scholarship of social justice education. As previously referenced, she is also engaged in the discipline of biology education at local and regional levels, and immerses herself in spaces which wrestle with emergent issues of diversity, equity, and inclusion. Sela underscored the imperative to stay nimble as a college educator, and to constantly pursue growth and her flexibility and responsiveness is reflected in her ongoing changes in her instruction and curriculum. She shared:

I think that we have to move. I think that we should, we should be moving breathing changing institutions. And I think that we have become a bit recalcitrant because as we've gotten larger that makes it harder to change. And I think that our students need us to change with the times, right, like with this the world is a very different place today than it was when I went to school and yet my biology students take largely the same curricula that I took right, that's not appropriate, maybe it's appropriate, they do alright, but it could be better.

Sela's continued growth is made possible by her community of practice. Sela regards her colleagues within her department, her teaching team, her graduate assistants and learning assistants all to be valuable stakeholders in her growth, and the growth of her department. Sela acknowledges the challenge and exhaustion of constant examination and evolution in curriculum and pedagogy, and underscored the value of her learning community in continually inspiring, motivating, and problem solving with her.

A Priori Themes

Our conversations also produced insights relative to Sela's navigation of the neoliberal university. Evident from the results of our dialogue are the influences of neoliberal logics, practices, and conditions in/within/against Sela's praxis.

Neoliberal logics. Sela's experiences revealed neoliberal machinations of instrumentalism and preoccupation with profit and efficiency. In the neoliberal paradigm, instrumentalism is the belief that something has value to the extent that it serves other neoliberal logics. Instrumentalism was most apparent in the tensions Sela experienced between inclusive and critical pedagogical practices. Inclusive pedagogies seemed to be more intelligible to Sela's institutional culture and more justifiable given their emphasis on student success and retention. Further, critical pedagogical practices threaten the already scaled classroom and curriculum and demand training and development which would include time and resources for which Sela is already in deficit.

It seems Sela's curriculum is so ambitious, she struggles to justify engagement with core philosophical foundations of biology and science - concepts which she feels take precedent before engaging students in reflection and examination of issues of power, privilege, and oppression. The institutional priorities toward inclusive pedagogy were also evident in the lack of institutionalized incentives for learning and practice related to critical pedagogy and social justice education. Notably, Sela's experience negotiating her SSI exercise regarding genetics, race, and drug trials for HIV/AIDS patients at a time of tumultuous campus climate underscored the pressure she feels to prioritize community and belonging in the interest of student success before grappling with the complexity and nuances of contemporary social and political issues.

In the neoliberal paradigm, profit and efficiency are beliefs that individuals, organizations, and societies should ever pursue increased profit and efficiency. Sela encounters this logic frequently. Across all of her experiences is an underpinning dearth of time. Sela reiterated several times that the one factor that could be adjusted to enable to critical pedagogy would be additional time. Sela expanded on the lack of time to address and resolve student issues with access to affordable texts. She also acknowledged the lack of time available to engage in professional development to grow her capacity for inclusive and critical pedagogical practices. Obstacles of time are a reflection of the ambitious scope of Sela's position description and the expectation that she provides a meaningful and robust learning experience to over 1000 students from 57 unique majors.

Profit and efficiency is also reflected in the staffing and support Sela received, largely de-professionalized labor in the form of graduate teaching assistants and learning assistants, who are effective in facilitating basic functions of the course but who lack the dynamic training to advance more nuanced and potentially contentious lesson plans and pedagogical practices. The volume of staff that Sela is responsible for has drifted her responsibilities from direct access to teaching and learning to predominantly administration, or as she refers to herself: a people manager. Profit and efficiency also appear in her challenges leading change within her department, and her coaxing tenure track and research faculty to engage in professional development opportunities that are not aligned with the research and development priorities of her department - and to do so without the provision of concrete incentives. Lastly, Sela's ambitions for curricular innovation are impeded by a lack of necessary time and resources. She is subsequently encouraged to compete for external funds to support her innovative endeavors.

Neoliberal practices. Sela's accounts also detailed her navigation of common neoliberal practices including austerity and the cultivation of flexible labor. In the neoliberal paradigm, austerity is the reduction of government spending and elimination of the government subsidized public sphere. For Sela, austerity is similarly reflected in her encouragement to compete for external funds to buy out her own time to develop and improve her curriculum and course design. The systematic de-funding of public higher education is also expressed in her department's preoccupation with research and development, and subsequent lack of resources and incentives for endeavors outside of R&D. This research and development focus isolates her as an advocate for critical diversity, equity, and inclusion work.

The cultivation of flexible labor is the elimination of labor protections in an effort to cultivate dynamic and temporary labor sources. As previously mentioned, the scale of Sela's course is made possible by investing in de-professionalized labor, namely 26 graduate teaching assistants and 20 learning assistants. This reliance on early career educators with high school and bachelors level training limits Sela's curricular and pedagogical possibilities. TAs and LAs instead are focused on classroom management and basic support and conflict resolution.

Additionally, Sela's course design which rotates 6 faculty in 2-week sessions targeted to their expertise creates a compartmentalized learning experience in which faculty can be swapped and interchanged with greater ease. Further, this design creates disjointedness in the tone and priorities of the course and undermines the community development and rapport building which is essential to critical pedagogical practices.

Ironically, the critical pedagogical practices that are infused in the course are as a result of graduate student labor. While grateful for her graduate student's initiative and innovation, Sela comments that there were not pre-existing ambitions to integrate SSI curriculum prior to her

graduate student's initiative. In this instance, advances in critical pedagogical labor have fallen to educators with minimal training and insecure labor contracts - a solution that is precarious for both the graduate level educator and the stakeholders of the learning community.

Neoliberal conditions. Sela's practice is complicated and challenged by the conditions of the neoliberal university. Present in her accounts are environments shaped by inequality and massification.

The neoliberal condition of inequality is the creation or exacerbation of inequality through neoliberal logics and practices. Inequality is most present in the material conditions her students are experiencing. Several of Sela's reflections on her pedagogical priorities connected to resource disparities among her students. At the time of our interviews, Sela was actively negotiating how to implement open access textbooks for her course in recognition of the growing and prohibitive costs of college attendance. More broadly, Sela's emphasis on inclusive pedagogical practices attending to what she referred to as the "achievement gap" has also been described as an opportunity gap (Carter & Wellner, 2013) and academic performance correlated with race and gender is reflected in resource disparities for women and people of color in the K-20 pipeline. In this way, the systemic inequalities exacerbated by neoliberal educational institutions are eclipsing and obstructing the implementation of critical pedagogies.

The neoliberal condition of massification is the scaling of goods and services to maximize profit and navigate volatile economic conditions. Massification is the result of several previously discussed neoliberal logics and values. Massification is evident in Sela's accounts, and linked to the aforementioned neoliberal logics and practices. The environment in which Sela practices is of such scale that any change process is slow, arduous and resource intensive. Sela reiterated that her time is consumed predominately by administratia and her role as a people

manager requires that she attend to triaging problems before investing in her professional development, the development of others, or exploration and experimentation with her curriculum and pedagogy.

The size of her classroom, the depth and breadth of her curriculum, the volume of staff she supervises, and the curricular dependency of her course with more than 57 programs and institutions around the state result in a behemoth educational project which has remained relatively static for more than 35 years. Sela commented specifically on her challenges initiating social justice work relative to access, inclusive pedagogy, and critical pedagogy. Sela identified scale as an inhibiting factor in her exploration of developing open access textbooks. She also named scale as an obstruction to developing sense of community and belonging in pursuit of HURM retention and success. Scale was also a premier concern when contemplating possible critical pedagogical work. Most apparent were Sela's challenges preparing undergraduate and graduate level college educators for the nuance, responsiveness, and contention of social and political issues. Similarly, Sela was concerned about her ability to respond with care in a timely manner to critical pedagogical projects that miss the mark and result in classroom community conflict. As a result of the scale of her classroom, Sela feels compelled to prioritize inclusive pedagogies and invest her limited resources in sustaining community and sense of belonging.

CHAPTER FIVE: DISCUSSION

Chapter Introduction

The purpose of this study was to understand the praxis of critical pedagogues who successfully negotiate and navigate STEM disciplines, amidst neoliberal conditions. To complete this study, I utilized a collective case study design. The data sources were interviews, classroom observations, artifacts, and a questionnaire. The participants were four contingent STEM faculty at public universities in the state of Oregon. The results of the study were analyzed using two coding schemes each informed by a different theoretical framework. The emergent coding scheme utilized appreciative inquiry (Cooperrider & Whitney, 2001) and the a priori scheme utilized critical bifocality (Weiss & Fine, 2012). The results were organized into four case reports and synthesized into recommendations for research and practice. This chapter summarizes and discusses and implications for practice in relation to the extant literature and recommendations for future research.

Summary of the Study & Findings

As the future of higher education likely further entrenches itself in neoliberal rationality (Giroux, 2014a; Lawrence, 2015), understanding the praxis of those critical pedagogues that successfully negotiate and navigate STEM disciplines, amidst conditions of austerity and vulnerability is essential. As such, this study was guided by one primary research question, with two sub-questions:

- Primary Question: How do contingent teaching faculty in STEM who practice critical pedagogies navigate the neoliberal university?
- Secondary Questions:
 - How did their praxis develop?

- What does their praxis look like?

The following outlines the contributions of each case to each of the research questions, and connects to the review of the literature where appropriate.

Primary Question: How do contingent teaching faculty in STEM who practice critical pedagogies navigate the neoliberal university?

Claire. Six navigational strategies emerged in Claire’s case related to the primary research question. Her strategies included: (1) leading with vulnerability, (2) engaging politicization with caution, (3) cultivating connection through politicization, (4) anticipating and managing conflict and controversy, (5) co-creating and sharing power, and (6) continually improving praxis.

Leading with vulnerability. Venturing into new and potentially risky pedagogical domains requires bravery. For Claire, bravery looks like vulnerability. Admitting the limits of her knowledge and skill, remaining open to feedback from her students and peers about her praxis, and extending the empathy and compassion she hopes to receive to her students and colleagues.

Engaging politicization with caution. Claire regards the discipline of mathematics as largely a-cultural. Since her discipline does not normalize politicization, she enters into politicized dialogue in her classroom with caution. She recognizes that political dimensions are important to her students, so she encourages their leadership into political domains. However, she prefers to remain in realms of established knowledge, and is averse to entering in proscriptive dimensions of political issues. When in doubt, she would rather assert “this is what we know” rather than “this is how we should live.” Claire’s strategies reflect Heyman’s (2007) assertion that teaching faculty under-utilize activist spaces in education and further reflects the

neoliberal drift towards “safe” pedagogies (Hill, 2003; Leonardo & Porter, 2010; Aikenhead, 2006). Claire’s strategies fall short of the assertions by radical science education scholars that college educators must go beyond the transmission of content knowledge and reasoning skills, and must further commit to the cultivation of character, civic action (Choi, Lee, Shin, Kim, & Krajcik, 2011; Zeidler & Sadler, 2008; Zeidler et al., 2005) and sociopolitical action (Bencze & Sperling, 2010; Hodson, 1998, 2003; Roth, 2003; Roth & Lee, 2004; Roth, 2009). Claire’s caution toward politicization is indicative of Bryce and MacMillan’s (2009) assertion that social justice education in science learning required a substantial overhaul beyond the capacity of most science educators. It appears that Claire’s caution also affirms science education scholars’ assertion that teachers and students experienced tension with cultural, dialogic, and political dimensions of science learning and are reticent to engage moral, ethical, and social issues (Bryce & Gray, 2004; Levinson et al., 2001; Sadler, Amirshokohi, Kazempour, & Allspaw, 2006; Cotton, 2006; Cross & Price, 1996).

Cultivating connection through politicization. While cautious about politicized topics, Claire sees opportunity to build necessary community and rapport with her students through critical socio political issues. Her current classroom is predominately students of color and first-generation students. She sees politicized topics regarding issues of race, class, and gender as particularly salient to her students and as an opportunity to access the culturally relevant potential of politicized topics. Cultivating such connections looks like acknowledging her own whiteness and the subsequent power and privilege she holds. It also looks like being responsive to the issues that are most important to students and asserting their power by assuring that some critical incidents are worthy of class dialogue, and more important than the mathematics at hand. Claire’s utilization of politicization to build classroom rapport confirms Garibay’s (2015)

assertion that while STEM students tended to enter college level STEM programs with lower multicultural dispositions and engagement with political issues, students of color in STEM were an exception to the trend.

Claire recognizes that her courses, which are predominately students of color and first-generation students, are uniquely drawn to political dimensions of mathematics learning. Claire's responsiveness to students' engagement with social and political dimensions in the mathematics classroom reflects assertions in the SSI literature that socio cultural dimensions invited multiple modes of thinking and meaning making that enhance logical mathematical exploration (Zeidler & Sadler, 2008). Claire's experiences also confirm scholarly assertions that social and political dimensions in STEM learning improved student engagement (Murray & Reiss, 2005; Osborne & Collins, 2000; Zeidler et al., 2002; Aikenhead, 2006; Ratcliffe & Grace, 2003). Claire's recommendations also confirm scholarly assertions that engagement with social and political dimensions in STEM education cultivated group formation and improve collaboration in inquiry (Ekborg, Ottander, Silfver, & Simon, 2013).

Anticipating and managing conflict and controversy. The foundations of critical pedagogy, like perspective taking and personal storytelling, often result in discomfort, conflict, and even controversy. As such, Claire does not broach difficult topics without thorough preparation. She is responsive to her students' needs, and opens dialogic space as they see fit, but she will initiate after thorough preparation on her end. Given the limits of her class time, she does not engage issues she cannot handle with care or bring closure and resolution to the extent that her classroom's sense of community is not undermined. Claire's disposition for thorough preparation affirms Bryce and MacMillan's (2009) assertion that engagement with social and political dimensions required capacity above the typical expectations of STEM educators, and

further reflects scholarship that asserted many teachers have not received adequate training and resources to engage beyond the established course content (Gray & Bryce, 2006; Newton, Driver, & Osborne, 1999).

Co-creating and sharing power. Where Claire may feel personally encumbered by various constraints of her institutional contexts, she is enthusiastic about students' agency and their leadership into critical social issues. Her praxis attempts to limit the pedagogical space she occupies, and attempts to center the knowledge, experience, and direction of her students. Her release of power and sharing in the design of the learning experience looks like letting go of the curriculum and set learning goals for the day to respond to students concerns about contemporary issues or eagerly integrating lesson plans developed by graduate students with the intent to integrate mathematical and critical literacies.

Continually improving praxis. Claire's navigation is grounded in constant learning. She is concerned about her capacity and growth, as well as the capacity and growth of her colleagues, graduate students, and greater community. Claire's recognition and drive for continued training and development confirms Calabrese Barton's (1997) assertion that high context approaches to STEM inquiry, particularly those which engage political and liberatory dimensions, required knowledge and skills not common in the increasingly deprofessionalized field of college teaching.

Alicia. Three navigational strategies emerged in Alicia's case related to the primary research question. Her strategies included: (1) foregrounding inclusive pedagogy, (2) tempering critical pedagogical practices, and (3) establishing a community of practice.

Foregrounding inclusive pedagogy. Alicia integrates a number of inclusive pedagogical strategies which attempt to maximize student engagement, sense of connection, and ultimately

learning outcomes. These strategies include active learning and co-learning. Inclusive pedagogies are foregrounded (1) because they are most resonant with the values of the institution and the academic priorities of her program, but (2) the outcomes of inclusive pedagogical practices are prerequisite for the successful facilitation of critical pedagogical practices. The risk and vulnerability associated with perspective taking and sharing necessitates a learning environment grounded in trust. Given the scale of her classroom, inclusive pedagogical practices build a foundation and a community resilience through which greater pedagogical risks can be taken. Claire's foregrounding of inclusive pedagogy in pursuit of critical pedagogical practices aligns with established approaches to transformative learning (Mezirow, 1991) and affirms Hoggan et al.'s (2016) assertion that adequate rapport, reflection, and dialogic engagement was a means for transcending and transforming epistemic, psychological, and sociolinguistic distortions.

Tempering critical pedagogical practices. Adapting to the size of her classroom, and various other contextual factors, Alicia tempers her critical pedagogical practices. For direct engagement with social justice education in the anatomy and physiology curriculum, Alicia seeks and implements only those strategies which have explicit connection to the core curriculum such as her implicit bias test facilitation during her lesson on memory or prioritizing representations of women and people of color in the curriculum. Alicia also utilizes indirect pedagogical strategies. Her consciousness raising efforts largely rely on her subtly introducing new language, offering progressive frameworks to understand issues of race, sex, and gender, or undertaking the risk of vulnerable and personal storytelling. Alicia's strategies reflect Heyman's (2007) assertion that teaching faculty under-utilize activist spaces in education and further reflected the neoliberal drift towards "safe" pedagogies (Hill, 2003; Leonardo & Porter, 2010;

Aikenhead, 2006). Alicia's strategies fall short of assertions by radical science education scholars that college educators must go beyond the transmission of content knowledge and reasoning skills, and must further commit to the cultivation of character, civic action (Choi, Lee, Shin, Kim, & Krajcik, 2011; Zeidler & Sadler, 2008; Zeidler et al., 2005) and sociopolitical action (Bencze & Sperling, 2010; Hodson, 1998, 2003; Roth, 2003; Roth & Lee, 2004; Roth, 2009). Alicia's tempering of critical pedagogical practices in response to the potential for conflict and discord among her students confirms Garibay's (2015) assertion that STEM students tended to enter college level science with lower multicultural dispositions and engagement with political issues. Alicia's tempered practices also reflect scholarly guidance for the integration of critical pedagogical practices in college teaching. Macedo and Bartolomé (1999) asserted that practitioners of critical pedagogy must reflect the intended outcomes of critical pedagogy, and model conscientization, critical literacy, and socio-political action. Further, scholars like Wilson and Howitt (2016) asserted that while critical theory and the pragmatic and neoliberal outcomes of science education in public higher education are markedly different, they shared similar processes and a compromise between the binary of neoliberal and critical pedagogical practices is possible and reasonable.

Establishing a community of practice. The scale of her classroom, the breadth of her curriculum, and numerous other factors necessitate a community of uniquely skilled and experienced colleagues to ideate and vet critical pedagogical practices with. Also, a community of practice mediates feelings of isolation, confusion, and vulnerability that accompanies the risks of critical pedagogical practices. Alicia's disposition towards a community confirms Kumashiro's (2001) assertion that the translation of anti-oppression education theories into practice was difficult, stifling, and often resulted in practitioners' questioning their own

intentions. Anti-oppression pedagogies required unique teacher efficacy, capacity, additional resources, and time (Kumashiro, 2001). Alicia's desire for a community of practice, and her adamancy of its necessity confirm Calabrese Barton's (1997) assertion that critical and liberatory science education practices required knowledge, skills, and expertise above and beyond the expectations of the increasingly de-professionalized discipline of college teaching.

Ashley. Six navigational strategies emerged in Ashley's case related to the primary research question. Her strategies included: (1) teaching as research, (2) facilitating group formation and rapport, (3) pedagogies of place, (4) participatory pedagogies, (5) modeling behavior, and (6) leveraging partnerships.

Teaching as research. Teaching for social justice is less a performance of knowledge and skill, and more so a constant state of inquiry through which praxis can continue to grow. Ashley's responsiveness and relevance to the needs of her students is connected to her vigilant examination of her praxis, and her eagerness to incorporate feedback and realize improvement through practice and reflection.

Facilitating group formation and rapport. Realizing her critical pedagogical goals begins with heavy investment in her learners' sense of community. In direct and indirect ways, Ashley shapes the learning environment in a way that students can anticipate psychological safety, grow in their familiarity with one another, and establish secure relationships which can withstand conflict and controversy.

Pedagogies of place. Place-based pedagogies have unique potential to maximize student learning at the intersection of social and environmental justice issues. Leveraging the parameters of her institutions course design and leaning into the resources and connections of the surrounding community, Ashley invests heavily in community service, field trips, and other

explorations beyond the institution. While time and resource intensive, pedagogical of place have the potential to realize all of Ashley teaching priorities: cognitive development, engagement with environmental justice, and engagement with social justice.

Participatory pedagogies. Ashley privileges participatory pedagogies, and she resists centering herself as an expert in the content of her course. She infuses her lesson plans with guided reflection and discussion, often connected to critical social and environmental issues. Her dialogic approaches invite story telling and as a consequence the vulnerability, perspective taking, and dissonance which underpins critical pedagogy. Further, her dialogic approach is resonant with her constructivist disposition and her commitment to co-creating knowledge with her students rather providing knowledge to her students. Ashley's penchant for participatory pedagogies reflected Mezirow's (1991) transformative learning which similarly employed dialogue, reflection and other engagement strategies to transcend and transform epistemic, psychological, and sociolinguistic distortions (Hoggan et al., 2016).

Modeling behavior. Where possible, Ashley utilizes herself and her life experiences to illustrate outcomes of social justice education. She freely acknowledges her own biases, she broaches contentious topics and offers wicked problems, and she enthusiastically invites multiple and challenging points of view. While she is reluctant to make such participation an explicit expectation of her students, her modeling serves to normalize and encourage such participation. Ashley's inclination to utilize herself as an instrument of critical pedagogy reflects scholarly guidance for the integration of critical pedagogical practices in college teaching. Macedo and Bartolomé (1999) asserted that practitioners of critical pedagogy must reflect the intended outcomes of critical pedagogy, and model conscientization, critical literacy, and socio-political action.

Leveraging partnerships. Ashley accounts for the parameters on her role and resources by leveraging partnerships with student leaders and activists and community organizers. Her invitation of student, faculty, and community leadership into her classrooms is symbiotic and results in encounters which facilitate her critical pedagogical goals and realize her vision for a learning environment that does not center her agency and knowledge.

Sela. Three navigational strategies emerged in Sela's case related to the primary research question. Her strategies included: (1) leveraging student leadership, (2) constant development, and (3) leading a community of practice.

Leveraging student leadership. Sela regards her students to be ahead of the curve regarding issues of diversity and social justice in the biology classroom. She believes deeply in student learning partnerships and student collaboration, and critical pedagogy is no exception. Sela perceives her students as having unique perspective, knowledge, and capacity to lead diversity and social justice work, and leverages opportunities for her students' passion and motivation to advance her curriculum and pedagogy. Examples include integrating the educational research of her graduate students on socioscientific issues, opening space for dialogue in her lab sections, and exploring opportunities for student clubs and organizations to facilitate community-based research.

Constant development. Sela does not regard herself as an expert in critical pedagogical practices, or as a leader or navigator of institutional culture, but she is passionate and motivated. She is open to learning through self-direction, through the feedback of her peers and students, and by staying abreast of changes and trends in the discourse and practice of college teaching. Sela's drive to continually pursue additional knowledges, skills, and experiences to support her inclusive and critical pedagogical praxis affirms Calabrese Barton's (1997) assertion that critical

and liberatory science education practices required knowledge, skills, and expertise above and beyond the expectations of the increasingly de-professionalized discipline of college teaching.

Leading a community of practice. Where Sela does not regard herself as an expert of critical pedagogy, she has a penchant and proven capacity to facilitate communities of practice. As such, the teaching teams, graduate learning communities, and collegial alliances she cultivates are all spaces in which she can ideate, vet, and cultivate confidence to pursue critical pedagogical practices. Sela's disposition towards building communities of practice affirms Kumashiro's (2001) assertion that the translation of anti-oppression education theories into practice was difficult, stifling, and often results in practitioners' questioning their own intentions. Anti-oppression pedagogies required unique teacher efficacy, capacity, additional resources, and time and opportunities to reflect on and resolve ambivalence (Kumashiro, 2001).

Secondary Question 1: How did their praxis develop?

Claire. Six formative factors emerged in Claire's case related to the development of her praxis. Her formative factors included: (1) politicized childhood, (2) gendered experiences in academe, (3) early experiences with historically under resourced minorities (HURMs), (4) consciousness work, (5) immersive professional development, and (6) finding a community of practice.

Politicized childhood. Claire grew up in a politically engaged household, in a region in which her family was marginalized as a political minority. She witnessed her parents advocate for policy, run for office, and organize in their community. In her earliest moments, political engagement was normalized, and these experiences shape who she is, and consequently how she shows up as an educator.

Gendered experiences in academe. A site of empathy and motivation for Claire is her experience as a woman in the academe, specifically in the discipline of mathematics. Her own experiences with marginalization connect her to the struggles of her students and peers and motivate her to leverage her curriculum and pedagogy to lead change in her institution and the larger culture and society.

Early experiences with historically under resourced minorities (HURMs). Clare's earliest professional roles included postsecondary teaching at institutions with high proportions of first-generation college students and students of color. Her early career also included teaching as a secondary school for the visually impaired. These experiences shape her disposition and motivation for inclusive, culturally responsive, and critical pedagogical practices.

Consciousness work. Claire attributes her motivation and capacity for critical pedagogical work to her own consciousness raising and intrapersonal development. Her examination of her own power and privilege as a white person and 4th generation college student and further exploring how her life experiences are distinct from those of her students empowers her to advance both her personal development of the social justice potential of her work.

Immersive professional development. Claire's current institution affords immersive and high impact faculty development experiences. Her early mathematics training was traditional and virtually devoid of any pedagogical training. In her current role, she has had access to workshops and paid intensive retreats to explore foundational issues of power, privilege, and oppression as well as engage the theory and practice of inclusive and critical pedagogy.

Finding a community of practice. Claire's current role is in an academic program with an explicit social justice mission and with colleagues whose scholarship and practice are centered on issues and skills related to inclusive and critical pedagogy. It is in this space, with these

colleagues, that she has experienced the most growth, found a community that will challenge and support her, and a creative and empowering space where she can ideate, take risks, and refine her praxis.

Alicia. Three formative factors emerged in Alicia's case related to the development of her praxis. Her formative factors included: (1) politicized nuclear family, (2) early passion for teaching, and (3) finding a community of practice.

Politicized nuclear family. Alicia grew up surrounded by politicized discourse. Family conversations about issues of equity, inclusion, and social justice were a common occurrence. And as a cohort, she and her siblings each pursued service and professional work emphasizing issues of social justice. Two of her siblings are alums of the peace corps, her sister is a race scholar in education. Her family was formative in her development as a critical pedagogue, and they remain active contributors in her community of practice.

Early passion for teaching. Alicia's earliest memories of her career aspirations were centered on teaching, and have remained as such. As long as she can remember, she wanted to be a teacher - and an excellent one. Her long running passion and motivation for teaching, paired with her conceptualization of excellence in teaching which centers issues of diversity, equity, inclusion and social justice - all inform her drive and innovations in inclusive and critical pedagogical work.

Finding a community of practice. Alicia feels lucky to have found her role and her department, particularly for the support she feels to explore and lead diversity, equity, inclusion, and social justice work. Though not her first teaching role, she regards her current position as her most formative for the development of her inclusive and critical pedagogical practices. Her

immediate colleagues and collaborators throughout campus help shape a community of practice which facilitates imagination, reflection, feedback, and conviction.

Ashley. Four formative factors emerged in Ashley's case related to the development of her praxis. Her formative factors included: (1) teaching exemplars, (2) mentorship, (3) community organizing, and (4) developing a community of practice.

Teaching exemplars. Ashley recognizes the formative influence of college faculty, and one graduate faculty member in particular, who raised her consciousness and expanded her knowledge to the form and potential of critical pedagogical practices. Though her formal training was devoid of pedagogical training, she supplemented her education with both a graduate certificate in teaching and learning with elective courses from faculty members who were reputable for their teaching practices.

Mentorship. Ashley has benefited from mentorship during graduate school, and since from scholars, educators, and community organizers who exemplify the pedagogical skills she admires. Their facilitation, ability to broach and communicate on difficult topics, and their innovative designs for lesson plans and course activities inspired her, and she benefited from their individual encouragement, feedback, and guidance.

Community organizing. Outside of academia, Ashley has been involved in community based educational initiatives, focused specifically on issues of social and environmental justice. It was in these spaces that she was exposed to and practiced what she refers to as soft skills - or facilitation practices which invite, hold, and manage emotional dimensions of learning and intergroup processes. These experiences have since translated into her academic practices and these organizations remain a site for resources and ongoing mentorship.

Developing a community of practice. Ashley's community of practice is limited do to the parameters of her part-time role. To account for her limited time and availability, Ashley fashions a community of practice largely from community organizers and educators in her surrounding community, and supplements when possible the insights and expertise of her college educator colleagues when they may be available or when their paths cross.

Sela. Three formative factors emerged in Sela's case related to the development of her praxis. Her formative factors include: (1) passion for excellence in teaching, (2) responding to trends, and (3) inviting a community of practice.

Passion for excellence in teaching. Sela has long held a passion for teaching, with an interest in a teaching career early in her college years. She actively pursued a teaching-focused position after finishing her PhD, and she has devoted her scholarship and professional development to the field of biology education. She is passionate about excellence in teaching, and as a result is responsive to the diversity, equity, inclusion, and social justice movements occurring in discipline-based education research. Her passion extends to her leadership and service within her institution and her cultivation of fellow educators. She is an active supervisor and mentor of fellow instructors and tenure track faculty members, and she also teaches in a graduate college teaching certificate program, in which she incorporates curriculum related to inclusive pedagogical practices.

Responding to trends. Sela's formal graduate training was absent of any focus on the theory and practice of teaching and learning. Her scholarship and leadership have developed since graduate school. She does not regard herself as an expert, but she does maintain that she is open, enthusiastic, and committed to constant development. As such, she is responsive to educational movements which implore progress related to diversity, equity, and inclusion. She is

most familiar and practiced in inclusive pedagogical practices, and she is increasing her knowledge about critical pedagogical practices. Sela's responsiveness to trends, in particular the socioscientific issues (SSI) reform movement appears to be connected to measurable outcomes related to increased content learning (Bell & Lederman, 2003; Colucci-Gray, Camino, Barbiero, & Gray, 2006; Kolstø, 2004; Simonneaux, 2001; Zeidler et al., 2005a; Zeidler, Walker, Ackett, & Simmons, 2002), more complex thinking and critical analysis (Dawson & Venville, 2010; Zohar & Nemet, 2002), and collaboration (Bryce, 2010). Sela is also attracted to SSIs for their demonstrated ability to increase student motivation and numerous developmental outcomes including personal, moral (Sadler, 2004b; Zeidler, 2003; Zeidler & Keefer, 2003; Zeidler & Schafer, 1984), and cognitive (Bryce, 2010) development. Sela's enthusiasm for SSIs however does not reflect the empirically validated effects of SSI teaching approaches which cultivate character, instill global perspectives, and foster sociopolitical action (Bencze & Sperling, 2010; Fowler et al., 2009; Lee et al., 2012; Mueller & Zeidler, 2010; Roth, 2009; Roth & Désautels, 2004). Sela's predominant disposition reflects the robust discipline based educational research movement (National Research Council, 2012). As such, her pedagogical choices are largely focused on inclusive pedagogical practices, specifically active learning (Singer & Smith, 2013).

Inviting a community of practice. Sela is open and eager to collaborate with all educators, including graduate and undergraduate level educators. It is in collaboration with her students that Sela has experienced the greatest push to engage critical pedagogical practices. Specifically, her students have led the implementation of socioscientific issues in dialogic formats in her course's lab sections. Her students are also leading conversations to realize the potential for critical consciousness in the SSI lesson plans established in the curriculum.

Secondary Question 2: What does their praxis look like?

Claire. Three qualities emerged in Claire's case related to the description of her praxis. Qualities of her praxis included: (1) constant negotiation, (2) comprehensive, congruent and committed, and (4) responsive.

Constant negotiation. Claire's praxis exists in tension, at the intersection of inclusive and critical pedagogical practices. Her deliberations about what, how, and when to broach critical social and political issues in her classroom are weighed against her need to establish community, trust and rapport with her students. Further, Claire considers multiple social justice goals in her classroom which at times do not seem harmonious. While Claire appreciates and to an extent desires the outcomes of consciousness, critical literacy, and socio political action she often privileges the social justice work of teaching marginalized and under resourced students' mathematics literacy so they may transform the material conditions of their lives and communities.

Claire is also concerned about the risk of critical pedagogical practices which may unduly reproduce painful and oppressive narratives and misinformation which may disconnect her students and undermine the sense of community which is necessary to realize success related to mathematics literacy. As a result, her deference is often to inclusive pedagogical practices which manifest as active learning and community development practices. Claire's negotiations reflect Heyman's (2007) assertion that teaching faculty under-utilize activist spaces in education and further reflected the neoliberal drift towards "safe" pedagogies (Hill, 2003; Leonardo & Porter, 2010; Aikenhead, 2006). Claire's strategies fall short of the assertions by radical science education scholars that college educators must go beyond the transmission of content knowledge and reasoning skills, and must further commit to the cultivation of character, civic action (Choi,

Lee, Shin, Kim, & Krajcik, 2011; Zeidler & Sadler, 2008; Zeidler et al., 2005) and sociopolitical action (Bencze & Sperling, 2010; Hodson, 1998, 2003; Roth, 2003; Roth & Lee, 2004; Roth, 2009). Claire's caution toward politicization is indicative of Bryce and MacMillan's (2009) assertion that social justice education in science learning required a substantial overhaul beyond the capacity of most science educators. It appears that Claire's caution also affirms science education scholars' assertion that teachers and students experience tension with cultural, dialogic, and political dimensions of science learning were reticent to engage moral, ethical, and social issues (Bryce & Gray, 2004; Levinson et al., 2001; Sadler, Amirshokoohi, Kazempour, & Allspaw, 2006; Cotton, 2006; Cross & Price, 1996). Claire's negotiations appear to support the caution of educational scholars who asserted that students may experience tension with the dialogic and cultural challenges latent in narrative approaches to science learning, particularly narratives which reverberate moral, ethical, and social issues (Bryce & Gray, 2004; Levinson et al., 2001; Sadler, Amirshokoohi, Kazempour, & Allspaw, 2006).

Comprehensive, congruent and committed. Claire's regards her approach as all or nothing. Her focus on issues of diversity, equity, inclusion, and social justice in education extend to every student, every class, and her spheres beyond the institution. She does not regard this aspect of her praxis as a side project, an addendum, or interest - it is an integral aspect of how she approaches the work. With that, she recognizes the work is rigorous and risky, she is often reluctant to engage curriculum or pedagogical practices which she has not fully vetted and feels confident in her ability to facilitate effectively and with great care for her students. And while she is cautious, she works hard to mediate ambivalence grounded in fear. She sees capacity as a reason to slow the work, but not fear. Claire's disposition reflects assertions in the scholarship which underscored the imperative for political and ideological clarity in critical pedagogy

(Ayers, 2001; Bartolomé & Trueba, 2004; Freire, 1998; McLaren & Farahmandpur, 2001; Sleeter, 2012)

Responsive. Claire's praxis is attentive and flexible to the needs, motivations, and wisdoms of her students. She attempts to stay attune to the issues which are salient for her students, and educates herself outside of class in preparation for dialogue which is critical and meaningful to her students.

Alicia. Six qualities emerged in Alicia's case related to the description of her praxis. Qualities of her praxis included: (1) conviction, (2) negotiation, (3) holistic student development, (4) leadership for equity, (5) direct and efficient, and (6) intentional.

Conviction. Alicia does not equivocate about the import and urgency to engage issues of diversity, equity, inclusion, and social justice. To her, pursuing this work through her teaching is simply the right thing to do. She detests conceptualizations of the work that seek or underscored interest convergence. To her, the work is an ethical imperative, and that's the extent to which she cares to deliberate whether or not to engage the work. Alicia's disposition reflects assertions in the scholarship which underscore the imperative for political and ideological clarity in critical pedagogy (Ayers, 2001; Bartolomé & Trueba, 2004; Freire, 1998; McLaren & Farahmandpur, 2001; Sleeter, 2012)

Negotiation. The scale of her classroom and the institutional imperatives to realize equitable academic success exacerbate tensions between inclusive and critical pedagogies. Considering her many contexts, Alicia often prioritizes and defers to community and inclusion. Alicia's strategies reflect Heyman's (2007) assertion that teaching faculty under-utilized activist spaces in education and further reflected the neoliberal drift towards "safe" pedagogies (Hill, 2003; Leonardo & Porter, 2010; Aikenhead, 2006). Alicia's strategies fall short of assertions by

radical science education scholars that college educators must go beyond the transmission of content knowledge and reasoning skills, and must further commit to the cultivation of character, civic action (Choi, Lee, Shin, Kim, & Krajcik, 2011; Zeidler & Sadler, 2008; Zeidler et al., 2005) and sociopolitical action (Bencze & Sperling, 2010; Hodson, 1998, 2003; Roth, 2003; Roth & Lee, 2004; Roth, 2009). Alicia's tempering of critical pedagogical practices in response to the potential for conflict and discord among her students confirms Garibay's (2015) assertion that STEM students tended to enter college level science with lower multicultural dispositions and engagement with political issues. Alicia's tempered practices also reflect scholarly guidance for the integration of critical pedagogical practices in college teaching. Macedo and Bartolomé (1999) asserted that practitioners of critical pedagogy must reflect the intended outcomes of critical pedagogy, and model conscientization, critical literacy, and socio-political action. Further, scholars like Wilson and Howitt (2016) stated that while critical theory and the pragmatic and neoliberal outcomes of science education in public higher education are markedly different, they share similar processes and a compromise between the binary of neoliberal and critical pedagogical practices is possible and reasonable.

Holistic student development. Alicia does not bifurcate the goals of STEM and liberal arts education. To her, these pursuits are connected and at times synonymous. She also feels her conceptualization is sanctioned by the established learning outcomes and messaging of her institution. She sees synthesis between scientific and critical literacy. In this way, she sees harmony and mutual potential for integration of both inclusive and critical pedagogical practices. Alicia's inclination toward holistic student development reflects the guidance in the science education scholarship which implored the preparation of STEM learners for post academic science contexts by engaging in more complex and dynamic notions of knowledge, through more

diverse ways of knowing (Tytler, 2007). Alicia similarly challenges scientific dogmatism which historically has asserted hard science to be dispassionate or apolitical (Bryce, 2010). Alicia's disposition affirms Kitcher's (2001) argument for a democratic framework for science, calling for an integration of moral and political values. Alicia affirms Bryce's (2010) assertion that necessary skill development for post academic science included reflexivity, communication, and deliberation. Alicia's holistic approach is resonant with a convergence of scientific and critical literacy, in which science was understood as a social activity, and aptly trained scientists have the ability to contextualize knowledge, and the application of knowledge in social, cultural, and political domains (Dillon, 2016). Alicia's disposition also affirms advocates of humanistic science education reforms who have been active in re-conceptualizing scientific literacy (Vesterinen, Manassero-Mas, & Vázquez-Alonso, 2014), arguing that scientific literacy included socially responsible action (Hodson, 2003).

Leadership. Alicia's vision for her classroom necessitates leadership beyond the classroom. Her praxis includes active engagement in departmental, college, and institutional levels. Her numerous projects include text book reviews to improve representation, infusion of equity minded teaching practices, and shared inquiry into the development of an anti-racist anatomy and physiology curriculum. To advance this work, she coordinates professional development among her colleagues and administrators hoping to build shared language, normalize dialogue on difficult issues and cultivate intrinsic motivation among her peers to advance work themselves.

Direct and efficient. Due to the constraints on Alicia's learning environment, with respect to scale and resources, she must prioritize curricular and pedagogical changes which are evidence based and low risk. As a result, she defers to the discipline based educational research

(National Research Council, 2012) which seeks innovations with explicit connection to the established anatomy and physiology curriculum. As such, her pedagogical choices are largely focused on inclusive pedagogical practices, reflective of active learning as identified by Singer and Smith (2013).

Intentional. Alicia's pedagogical development is intentional and enthusiastic. She has self-authored goals of developing an anti-racist curriculum, and she eagerly engages her community of practice and other colleagues to ideate and explore opportunities to create and advance diversity, equity, inclusion, and social justice work.

Ashley. Seven qualities emerged in Ashley's case related to the description of her praxis. Qualities of her praxis included: (1) action research, (2) multidimensional, (3) co-learning and sharing power, (4) foregrounding cognitive development, (5) multipartiality, (6) attending to emotions, and (7) varying pedagogical strategies.

Action research. Ashley was mentored in a pedagogical frame which regards all teaching as research. As such, she considers every aspect of her praxis through a lens of inquiry and considers her approach through iterative cycles of exploration, experimentation, and augmentation.

Multidimensional. Ashley espouses a pedagogical approach which her graduate mentor referred to as praxis, a tripartite model which engages science learners in dimensions of knowledge, values, and behaviors. As a result, she invites cognitive, affective, spiritual, ethical, and behavioral dimensions into science learning, and she does so at the intersection of social and environmental justice issues. Ashley's inclination towards a multidimensional science education reflects the guidance in the science education scholarship which implores the preparation of STEM learners for post academic science contexts by engaging in more complex and dynamic

notions of knowledge, through more diverse ways of knowing (Tytler, 2007). Ashley similarly challenges scientific dogmatism which historically has asserted hard science to be dispassionate or apolitical (Bryce, 2010). Ashley's disposition affirms Kitcher's (2001) argument for a democratic framework for science, as Kitcher called for an integration of moral and political values. Ashley affirms Bryce's (2010) assertion that necessary skill development for post academic science included reflexivity, communication, and deliberation. Ashley's holistic approach is resonant with a convergence of scientific and critical literacy, in which science is understood as a social activity, and aptly trained scientists will have the ability to contextualize knowledge, and the application of knowledge in social, cultural, and political domains (Dillon, 2016). Ashley's disposition also affirms advocates of humanistic science education reforms who were active in re-conceptualizing scientific literacy (Vesterinen, Manassero-Mas, & Vázquez-Alonso, 2014), arguing that scientific literacy included socially responsible action (Hodson, 2003).

Co-learning and sharing power. Ashley is intentional about mediating her role as a facilitator of learning, and she is judicious about how and when she shares her opinion. She is cautious to not exert her power and privilege, she aspires to create a learning environment where students recognize their own agency and expertise, and as a result, are more motivated and engaged in collective processes of knowledge construction.

Foregrounding cognitive development. Foremost, Ashley regards social justice education as a pursuit of teaching others how to think rigorously and critically for themselves. Ashley regards social and environmental justice as ripe sites for engaging complexity and wrestling with difficult concepts. In these intellectual and often emotional spaces, Ashley pursues opportunities to facilitate consciousness, self-awareness, and the cultivation of intrinsic motivation.

Ashley's foregrounding of cognitive development resonates with humanistic science education reform movements which emphasized measurable outcomes related to increased content learning (Bell & Lederman, 2003; Colucci-Gray, Camino, Barbiero, & Gray, 2006; Kolstø, 2004; Simonneaux, 2001; Zeidler et al., 2005a; Zeidler, Walker, Ackett, & Simmons, 2002) and more complex thinking and critical analysis (Dawson & Venville, 2010; Zohar & Nemet, 2002).

Multipartiality. Ashley is quick to distinguish her pedagogy from activism. She regards activism as the imposition of ideas, a type of pedagogical forcefulness. As such, she associates activism with the stifling of dialogue and the foreclosing of opportunities in which critical and meaningful thought can develop and flourish. As such, she strives to create dialogic spaces where diverse and contentious points of view are included, honored, and held in such a way that they may be taken, released, or transformed. Ashley values critical thought more than she values specific political dispositions. She likens her values to mathematics learning. She doesn't care whether students got a predetermined answer, she wants students to wrestle with the problems and show their work. Ashley disposition toward multipartiality affirms the scholarship of humanistic science education which asserted measurable impacts related to increased content learning (Bell & Lederman, 2003; Colucci-Gray, Camino, Barbiero, & Gray, 2006; Kolstø, 2004; Simonneaux, 2001; Zeidler et al., 2005a; Zeidler, Walker, Ackett, & Simmons, 2002) and more complex thinking and critical analysis (Dawson & Venville, 2010; Zohar & Nemet, 2002) when science learning is expanded through social, cultural, and political contexts.

Attending to emotions. Ashley's critical pedagogical approaches anticipate and invite emotion. As a result, she is concerned with and actively pursuing resources and skills to support students through grief, despair, and other difficult emotions associated with social and

environmental justice learning. Ashley's attending procedures reflect pedagogical challenges observed by Bryce and MacMillan (2009) and other scholars related to the facilitation of social, cultural, and political dimensions in science learning (Bryce & Gray, 2004; Levinson et al., 2001; Sadler, Amirshokoohi, Kazempour, & Allspaw, 2006).

Varying pedagogical strategies. To increase student engagement, improve outcomes, and realize outcomes of consciousness, critical literacy, and socio political engagement, Ashley diversifies her pedagogical strategies. She implements pedagogies of place like community-based learning, field trips, and service learning. She also welcomes the challenge of translating critical pedagogical practices in online and hybridized formats, and she finds unique opportunities in digital spaces as well.

Sela. Five qualities emerged in Sela's case related to the description of her praxis. Qualities of her praxis included: (1) negotiation, (2) scientific literacy as critical literacy, (3) student collaboration, (4) leadership, (5) perpetual motion.

Negotiation. Sela experiences tension between inclusive and critical pedagogical practices. She is clear that the scale of her classroom and her priorities for student success necessitate foregrounding inclusive pedagogical practices, which she is concerned may at times be undermined by critical pedagogical practices. As a result, she privileges approaches like active learning and other movements emerging from discipline based educational research. She is most confident in advocacy work like textbook access and issues of representation in the curriculum. She is more ambivalent about the contentious issues that are imbedded in socio-scientific issues, or engaging in lessons which explicitly broach contentious political issues. She sees the power and opportunity of critical pedagogical practices, but the scale of her classroom and her reliance on de-professionalized labor underpin her ambivalence and negotiation.

Sela's strategies reflect Heyman's (2007) assertion that teaching faculty under-utilized activist spaces in education and further reflects the neoliberal drift towards "safe" pedagogies (Hill, 2003; Leonardo & Porter, 2010; Aikenhead, 2006). Sela's strategies fall short of assertions by radical science education scholars that college educators must go beyond the transmission of content knowledge and reasoning skills, and must further commit to the cultivation of character, civic action (Choi, Lee, Shin, Kim, & Krajcik, 2011; Zeidler & Sadler, 2008; Zeidler et al., 2005) and sociopolitical action (Bencze & Sperling, 2010; Hodson, 1998, 2003; Roth, 2003; Roth & Lee, 2004; Roth, 2009). Sela's negotiations are in response to the potential for conflict and discord among her students. These negotiations confirm Garibay's (2015) assertion that STEM students tended to enter college level science with lower multicultural dispositions and engagement with political issues.

Scientific literacy as critical literacy. Sela regards scientific literacy and critical literacy as connected and overlapping. She sees the products of rigorous science training as producing engaged, informed, and critical community leaders who are active in democracy and pursuing positive sustainable change. Sela's integration of critical and scientific literacy reflects the guidance in the science education scholarship which implored the preparation of STEM learners for post academic science contexts by engaging in more complex and dynamic notions of knowledge, through more diverse ways of knowing (Tytler, 2007). Sela's disposition affirms Kitcher's (2001) argument for a democratic framework for science, calling for an integration of moral and political values. Sela affirms Bryce's (2010) assertion that necessary skill development for post academic science included reflexivity, communication, and deliberation. Sela's holistic approach is resonant with a convergence of scientific and critical literacy, in which science is understood as a social activity, and aptly trained scientists have the ability to

contextualize knowledge, and the application of knowledge in social, cultural, and political domains (Dillon, 2016). Sela's disposition also affirms advocates of humanistic science education reforms who have been active in re-conceptualizing scientific literacy (Vesterinen, Manassero-Mas, & Vázquez-Alonso, 2014), arguing that scientific literacy included socially responsible action (Hodson, 2003).

Student collaboration. Constructivism underpins Sela's approach to college teaching, as she values the formation of strong learning partnerships, elevating student agency and voice, and mediating her role as an expert or imparter of knowledge. As a result, she is eager to form collaborations with students and engage them in every aspect of her teaching and learning including curricular development, lesson planning, and assessment.

Leadership. To realize the full potential of her classroom, Sela engages in leadership at departmental, institutional, and regional levels. At local levels, she works to cultivate openness, willingness, and capacity for change and hopes to connect more faculty to inclusive and critical pedagogical practices. She is also active in securing funds to lead a curricular haul of her massive course. These efforts co-occur with her curricular and assessment leadership in her state and in her region through professional association.

Perpetual motion. To use Sela's language, she hopes to never become 'recalcitrant'. She hopes her praxis will continue to change and grow. Currently, she is exploring the critical pedagogical potential of the socioscientific issues currently embedded in her course design. She is also attracted to the outcomes associated with community-based research, and while her course design precludes meaningful engagement with community research she is hopeful pathways for such experiences exist in partnership with student organizations.

Implications for Practice

This study provided insight into the experiences of four contingent STEM faculty who practice critical pedagogies with/in Oregon public colleges and universities. Throughout the writing process, I memo-ed and noted ways in which this study has implications for practice. The findings have implications for several higher education constituents including aspiring or practicing critical pedagogues, faculty developers, and institutional leaders.

Implications for Aspiring or Practicing Critical Pedagogues

Considering the results of this study in combination with relevant literature, I recommend college educators interested in pursuing or advancing their critical pedagogical work consider four strategies. My recommended strategies include: (a) cultivating a community of practice, (b) initiating professional development, (c) sustaining intrapersonal development, and (d) leveraging student expertise.

Cultivating a community of practice. Growing a community of student and professional practitioners with similar pedagogical goals helps sustain creative, supportive, and deliberative space. Each participant of this study attested to the crucial role of their community of practice in both developing, sustaining, and advancing their praxis. Recommending a community of practice affirms and accounts for scholarly assertions that college educators preferred safe pedagogies (Hill, 2003; Leonardo & Porter, 2010) and experienced ambivalence when broaching highly politicized issues and cultivating socio political action (Kumashiro, 2001; Dos Santos, 2009).

Initiating professional development. While many of the participants benefited from resources at their current institution, each practitioner pursues professional development in their local communities, inside and outside higher education disciplines, and through regional and national organizations. The participants fervor for exploring and negotiating critical pedagogical

practices in their classrooms was matched by their enthusiasm to pursue new literature, expert conversations, and examples of effective practice.

Sustaining Intrapersonal development. Each participant either referred to or made explicit formative moments of self-awareness and critical consciousness that accelerated and fortified their critical pedagogical practices. Intrapersonal development which examines one's sociopolitical location with respect to power and privilege as well as the construction of one's epistemological, ethical, and communicative dispositions are all rich sites for critical pedagogical development. Recommending intrapersonal development attends to and affirms scholarly assertions about the factors which underpinned faculty ambivalence about pursuing critical pedagogical practices teacher thinking and identity (De Vos, Bulte, & Pilot, 2002; Gess-Newsome et al., 2003; Lee & Witz, 2009).

Leveraging student expertise. Underlying each of the participants' most illustrative and rich examples of their critical pedagogy was a lineage to the motivation and activation of an undergraduate or graduate student eager to partner in or advance the participants' curriculum. Each of the participants' attested to the essential resources of their students' perspective and imagination. Student partnerships challenged and advanced the pedagogy of each participant, and each participant has remained committed and enthusiastic about student collaboration.

Implications for Faculty Developers

Considering the results of this study in combination with relevant literature, I recommend faculty developers consider eight domains in which to expand education and services to raise the capacity of teaching faculty to engage critical pedagogies. My recommended domains include: (a) responding to climate, (b) foundations of social justice education, (c) broaching the political,

(d) building learning partnerships, (e) facilitation skills, (f) assessment, (g) pedagogical innovation, and (h) developmental pathways.

Responding to climate. Teaching faculty would benefit from educational spaces which raises their awareness to the significance and impact of campus, local, regional, national, and global critical incidents in the lives of students and the classroom climate. In addition to appreciating the influence of critical incidents in the lives of students, teaching faculty would benefit from technical and practical training on how to broach and facilitate reflection on current issues, connected or not, to their curriculum.

Foundations of social justice education. Ongoing access to social justice education tailored to faculty's needs as adult learners and adapted for their professional context would enable their critical pedagogical pursuits. Teaching faculty need their own developmental spaces to raise their consciousness of the realities of difference, power, and structural discrimination, increase their capacity to read the world for inequality and author strategies to pursue social justice, and build their confidence and motivation to engage in socio political action.

Broaching the political. Teaching faculty need developmental spaces where they can consider the potential and opportunity of broaching and integrating politicized topics in their curriculum and lesson planning. In addition to creating a learning community for ideation and deliberation, teaching faculty would benefit from reflective opportunities to share their concerns and anxieties and receive encouragement and support among peers. Recommending developmental spaces to explore broaching the political attends to and affirms scholarly assertions about resisting de-politicized teaching (Freire, 1998; Giroux & Giroux, 2006; Shor, 2000) and challenging faculty penchant for safe pedagogies (Hill, 2003; Leonardo & Porter, 2010). This recommendation also attends to scholarly concerns about science education reforms

which fell short of cultivating sociopolitical action (Choi, Lee, Shin, Kim, & Krajcik, 2011; Zeidler & Sadler, 2008; Zeidler et al., 2005; Dos Santos, 2009; Hodson, 2003)

Building learning partnerships. Teaching faculty would benefit from dialogue, resources, and strategies related to leveraging student partnerships. Integrating student voice and expertise in curriculum, pedagogical, and assessment practices and responding with enthusiasm and flexibility to undergraduate and graduate activism to advance critical pedagogical innovations. Recommending the development of learning partnerships attends to and affirms scholarly assertions that teaching served as a vehicle for social change (Ayers, Hunt, & Quinn, 1998; Freire, 2000; Greene, 1988; Payne & Strickland, 2008) through the cultivation of learning relationships which balance power (McLaren, 1995) and mutually pursue liberation through critical consciousness, critical literacy, and sociopolitical action (Darder, 1991; Giroux & McLaren, 1986; Macedo & Bartolomé, 1999; Nieto, 1999).

Facilitation skills. Training and practice related to dialogue facilitation skills, specifically facilitation skills which attend to dynamics of power and privilege is essential to successfully cultivate critical consciousness, critical literacy, and sociopolitical action. Facilitation skills include the mechanics of group formation, managing conflict and emotions, and intergroup collaboration. Recommending the development of learning partnerships attends to and affirms scholarly assertions that critical pedagogical practices required teaching and learning approaches which were dialogic and facilitate mutual knowledge construction (Denzin, 2009; Darder, 2002). Further, facilitation includes knowledge and skills which were foundational for successfully engaging and realizing pedagogies of discomfort (Giroux, 1992; Giroux, 2011a; Zembylas & Boler, 2002) and pedagogies of hope (Freire, 2014). Facilitation skills also attend assertions in the literature about challenges faculty faced regarding teaching beyond the established content

(Gray & Bryce, 2006; Newton, Driver, & Osborne, 1999), cultivate argumentation and critical thought (Ekborg et al., 2013), and mediated cultural and political tensions (Bryce & Gray, 2004; Levinson et al., 2001; Sadler, Amirshokoochi, Kazempour, & Allspaw, 2006; Aikenhead, 2006; Cotton, 2006; Cross & Price, 1996).

Assessment. Training and consultation regarding learning outcomes associated with critical pedagogy would enable teaching faculty's praxis. Capacity building should include consciousness of social justice learning outcomes, expectations related to student baselines and growth relative to interventions, and formative and summative assessment strategies for diverse classroom environments.

Pedagogical innovation. Teaching faculty would benefit from developmental and experimental spaces where they can ideate, design, and implement critical pedagogical practices. Whether formal design-based research initiatives or professional practice seminars, spaces where faculty can brainstorm, share their work, and practice on and with one another would be fruitful. Recommending the development of spaces for pedagogical innovation attends to and affirms scholars who asserted that critical pedagogy is messy and risky (hooks, 1994; Gregory Martin, 2015; Martin & Brown, 2013; Sharma, 2010) and teachers tend to be ambivalent about broaching politicized pedagogies (Kumashiro, 2001). Further, faculty need time, space, and support in imagining possibilities for critical pedagogies in scaled learning environments (Martin, 2015; Morris & Hjort, 2012; Stommel, 2014).

Developmental pathways. The most common faculty development pathways do not thoroughly attend to the foundations of critical pedagogy. New and revised professional development pathways for growth in teaching and learning are needed. Formal interventions could look like the establishment of graduate certificate programs focused on the theory and

practice of teaching and learning. Faculty developers could also initiate structured mentorship programs or facilitate the coalescing of communities of practice. Recommending the expansion of developmental pathways for college educators affirms scholarly assertions that the work of critical pedagogy was far outside the typical training of increasing deprofessionalized college teachers (Calabrese Barton, 1997). Further, this recommendation attends to scholarly assertions that reform of faculty approaches to curriculum and pedagogy required focused and intimate engagement with faculty identity, paradigm, and individual teaching philosophy (Southland et al., 2003; Gess-Newsome et al., 2003; De Vos, Bulte, & Pilot, 2002; Eriksen, 2002; Lee & Wiz, 2009; Aikenhead, 2006; Davis, 2002; Jenkins, 1992, 2002; McGinnis & Simmons, 1999)

Implications for Institutional Leaders

Considering the results of this study in combination with relevant literature, I recommend institutional leaders consider twelve domains in which they can effect change to enable critical pedagogical practices: (a) organizational messaging, (b) organizational mission, (c) organizational culture, (d) faculty development pathways, (e) student partnerships, (f) faculty partnerships, (g) labor standards, (h) pedagogical innovation, (i) curriculum, (j) assessment, (k) the “scalability” discourse, and (l) temporal and material resources.

Organizational messaging. Teaching faculty would benefit from formal and informal institutional messages which affirm and sanction participation in critical pedagogical projects. Institutional messages may come in the form of official statements from academic and administrative leaders, promotion of events, programs, or other professional development related to critical pedagogical practices, or the celebration of accomplishments related to social justice education.

Organizational mission. Formal and informal affirmations of an institutional mission which aligns with the goals of critical pedagogy would improve faculty's engagement and sense of security. Organizational mission is reflected in succinct statements, the contents of a strategic plan, budgets and financial guidance documents, institutional and college level learning outcomes, and assessments and incentives related to promotion and tenure.

Organizational culture. An organizational culture in which faculty perceive and experience engagement and solidarity in social justice education from their colleagues and other institutional stakeholders improve faculty's sense of security and pedagogical risk taking. Institutional leaders can influence culture by encouraging engagement from all institutional constituents and by mediating any factors or constituents which are directly antagonistic to teaching faculty's critical pedagogic practices. Institutional leaders can also influence the cultivation of shared language and model their own engagement with social justice education initiatives. Recommending leadership for cultural change affirms scholarly assertions that critical pedagogy was antithetical to neoliberalism (Giroux & Giroux, 2006; Giroux, 2011b; Giroux & King, 2016) and was often derided or marginalized as indoctrination (Horowitz, 2006; Giroux, 2014a). Institutional leadership can serve to affirm that critical pedagogy's distinction was not indoctrination, but its commitment to connecting learning to criticality and democratic action (Gutman, 1999). Recommending leadership for cultural change also addresses scholarly assertions about the cumbersome and often ineffective processes of science education reform, the imperative to engage college teachers through more personal, meaningful, and nuanced reflexive development (Southland et al., 2003; Gess-Newsome et al., 2003; De Vos, Bulte, & Pilot, 2002; Eriksen, 2002; Lee & Wiz, 2009; Aikenhead, 2006; Davis, 2002; Jenkins, 1992, 2002; McGinnis & Simmons, 1999).

Faculty development pathways. Teaching faculty would benefit from more formal developmental pathways related to the scholarship and practice of teaching and learning. Pending their sphere of influence, institutional leaders should advocate to initiate or expand teaching and learning curriculum in graduate preparatory programs and expand certificate programs in college teaching for graduate students. Recommending the expansion of developmental pathways for college educators affirms scholarly assertions that the work of critical pedagogy was far outside the typical training of increasing deprofessionalized college teachers (Calabrese Barton, 1997). Further, this recommendation attends to scholarly assertions that reform of faculty approaches to curriculum and pedagogy required focused and intimate engagement with faculty identity, paradigm, and individual teaching philosophy (Southland et al., 2003; Gess-Newsome et al., 2003; De Vos, Bulte, & Pilot, 2002; Eriksen, 2002; Lee & Wiz, 2009; Aikenhead, 2006; Davis, 2002; Jenkins, 1992, 2002; McGinnis & Simmons, 1999)

Student partnerships. Collaboration with undergraduate and graduate students in curricular and pedagogical design advances critical pedagogical innovation. Pending their sphere of influence, institutional leaders should advocate for the inclusion of students in leadership and decision making, and transform structures where necessary to account for the complexities of undergraduate and graduate student collaboration.

Faculty partnerships. Contingent teaching faculty need compensated access to decision making spaces which shape curriculum and assessment. Institutional leaders should advocate for inclusion, and for paid hours to enable the participation of part-time, adjunct, and low-ranking teaching faculty.

Labor standards. Teaching faculty would benefit from greater investment in professionalized and secure teaching labor. Institutional leaders should resist overreliance on

deprofessionalized educators to provide introductory and first-year coursework, including undergraduate, graduate, and masters level educators. Where there is strength in all partnership with individuals of all levels of pedagogical training, over reliance on educators with minimal pedagogical training inhibits critical pedagogical projects. Recommending the buttressing of labor standards for college educators affirms scholarly assertions that the work of critical pedagogy was far outside the typical training of increasing deprofessionalized college teachers (Calabrese Barton, 1997). Further, this recommendation attends to scholarly forecasts that an even larger contingent workforce will grow in higher education teaching, with limited agency in curriculum and instruction (Cannella & Miller, 2008). Unabated trends will continue to grow a deskilled class of college educators, who are technically focused with limited control pedagogically or administratively (Giroux, 2014b).

Pedagogical innovation. Resources, spaces, and encouragement to engage in potentially risky or experimental pedagogical practices are essential. This may require release time to engage in communities of practice, developmental seminars, or participation in design-based research initiatives. Further institutional leaders should encourage, affirm, and recognize pedagogical risk taking and support the dissemination of faculty success and findings. Recommending the development of spaces for pedagogical innovation attends to and affirms scholarly assertions that critical pedagogy was messy and risky (hooks, 1994; Gregory Martin, 2015; Martin & Brown, 2013; Sharma, 2010) and teachers were ambivalent about broaching politicized pedagogies (Kumashiro, 2001).

Curriculum. Realizing critical pedagogy requires reduced scope in learning outcomes and breadth of curriculum, particularly in first year and introductory coursework. Further, linear course designs, hyper specialization and compartmentalization of curriculum, and curricular

dependency reinforced through the prerequisite system also inhibit flexibility, responsiveness, and innovation. Institutional leaders should consider and reimagine the scope and organization of curriculum which improves faculty agency. Further, institutional leaders should improve contingent faculty access to upper level and elective coursework. Recommending evaluation of curriculum and its structures attends to and affirms scholars who asserted that corporate interests are increasingly integrating with college curricula to parallel demands of labor and production (Slaughter & Leslie, 1997; Slaughter & Rhoades, 2004) and as a result undermining the value of the humanities and liberal arts (Sigelman, 2016). Curricular reform can serve to reveal and maximize the intersections of critical and scientific literacy and advance scientists and science educators who are more socially conscious and willing to transform structural inequity and advance democracy (Garibay, 2015).

Assessment. Teaching faculty would benefit from timelier, more nuanced, lower stakes, and formative opportunities for student feedback. Further, institutional leaders should consider expanding the scope of learning outcomes to allow for range and flexibility to enable student engagement and co-construction of the learning experience. Lastly, assessment and evaluation of teaching for faculty who engage in critical pedagogical practices should account for student responses that reflect outcomes associated with pedagogies of discomfort and the dissonance and conflict associate with social justice education. Recommending evaluation of assessment standards and practices affirms scholars who asserted that the growing student as consumer relationship in higher education results in an undue focus on student happiness and satisfaction (Hill, 2007) resulting in an over reliance on student evaluations which undermine comprehensive measurement of learning.

The “scalability” discourse. A critical examination of scholarly and professional communications which affirm and normalize the scaling of institutional programs, services, and outcomes would reduce administrative policies and practices which inhibit faculty’s critical pedagogical practices. Unexamined purporting that individuals and organizations maximize efficiencies, do more with less, or “scale” practices and services to reach larger audiences to generate greater revenue advance policies and practices which exacerbate inhibitive conditions for critical pedagogy. Pedagogies of scale limit a practitioner’s flexibility, responsiveness and ability to assess and mediate risk. Further, pedagogies of scale are cumbersome and lend to prescription and homogeneity in the curriculum. Recommending examination of scalability discourses attends to and affirms scholars who asserted that demand to produce more with less is incommensurable with the complexities of teaching and learning (Cannella & Miller, 2008). Classroom conditions which center consumer satisfaction and incentivize streamlined and scalable instructional design disincentivizes rigor, complexity (Cannella & Miller, 2008) and other fertile learning conditions for critical pedagogy. Further, the ballooning of faculty responsibilities related to competition for external revenue (Winefield et al., 2003) and increased managerial workloads (Giri, 2000) consume critical time for research, teaching, and other projects related to critical pedagogy (Shore, 2010).

Future Research

The goal of my research as a higher education scholar-practitioner was to reveal the experiences and knowledge of contingent STEM faculty who practice critical pedagogies with/in public colleges and universities. This study was not intended to generalize, but to generate knowledge about practitioners within a specific context. My aim was to take a small step by adding to the sparse literature.

Throughout the facilitation of this study, I maintained memo writing and documented my ruminations and recommendations for further lines of inquiry. The following lists of research questions detail the trajectory of my research agenda and may be useful to scholars hoping to address and advance this dimension of the literature. Qualitative research questions, which may lead to further case study, ethnographic, or phenomenological research include:

- How do teams of STEM faculty, or communities of practice, who practice critical pedagogies navigate the neoliberal university?
- How do tenured or tenure-track STEM faculty who practice critical pedagogies navigate the neoliberal university?
- What are academic administrator's perceptions of critical pedagogical practices in STEM education?
- How do STEM faculty make meaning of and respond to critical racial incidents on campus through their curriculum and pedagogy?
- How have college teachers adapted critical pedagogies for scaled learning environments?

Quantitative research questions, which may lead to survey design, include:

- What factors predict STEM faculty engagement with sociopolitical issues through their curriculum and pedagogy?
- What factors predict STEM faculty self-efficacy with sociopolitical issues through their curriculum and pedagogy?
- How do critical pedagogical practices among STEM faculty compare between institutional types (including research classification, institutional size, public/private affiliation, region, institutional demographics, average class size, faculty course per term ratio, etc.)

Conclusion

The purpose of this study was to generate knowledge in an effort to sustain and advance critical pedagogical practices in college teaching. This study focused principally on the knowledge and insights of contingent STEM faculty who practice critical pedagogies in the neoliberal conditions of public universities in the state of Oregon. Four participants explained how the formation and nature of their praxis, and how they negotiate and navigate the numerous contexts which envelop their curriculum and pedagogy. The findings of this study largely corroborate assertions in the literature which affirm the importance of critical pedagogy, the imperative to advance critical pedagogical work in challenging contexts, and the imperative to resist conditions which undermine educational social justice projects. The experiences of the participants in this study revealed directions and opportunities for institutional leaders, faculty developers, and like-minded educators to advance social justice education. The contributions of this study's participants also mapped next steps for inquiry in pursuit of innovation in critical pedagogical practice and organizational change.

APPENDICES

Appendix A

Clemson University: Institutional Review Board (IRB) Approval

Subject: Exempt Determination for IRB2018-025 | A Case Study...
Date: Thursday, February 15, 2018 at 1:13:19 PM Pacific Standard Time
From: Amy F Smitherman
To: Tony Cawthon
CC: Kenney, Jeff M

Dear Dr. Cawthon,

The Clemson University Institutional Review Board (IRB) reviewed the protocol "A Case Study Investigation of Non-tenure track STEM Faculty Who Practice Social Justice Education within Oregon Public Colleges and Universities" using exempt review procedures and a **determination was made on February 15, 2018** that the proposed activities involving human participants qualify as **Exempt under category B2** in accordance with federal regulations 45 CFR 46.101.

No further action or IRB oversight of the protocol is required except in the following situations:

1. Substantial changes made to the protocol that could potentially change the review level. Researchers who modify the study purpose, study sample, or research methods and instruments in ways not covered by the exempt categories will need to submit an expedited or full board review application.
2. Occurrence of unanticipated problem or adverse event; any unanticipated problems involving risk to subjects, complications, and/or adverse events must be reported to the Office of Research Compliance immediately.
3. Change in Principal Investigator (PI)

All research involving human participants must maintain an ethically appropriate standard, which serves to protect the rights and welfare of the participants. This involves obtaining informed consent and maintaining confidentiality of data. Research related records should be retained for a minimum of three (3) years after completion of the study.

The Clemson University IRB is committed to facilitating ethical research and protecting the rights of human subjects. Please contact us if you have any questions and use the IRB number and title when referencing the study in future correspondence.

Good luck with your study.

Best,

Amy Smitherman

IRB Coordinator

OFFICE OF RESEARCH COMPLIANCE

Clemson University, Division of Research
391 College Avenue, Suite 406K-1., Clemson, SC 29631, USA
P: 864-656-6460

<http://www.clemson.edu/research/compliance/irb/>

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Appendix B

Oregon State University: Institutional Review Board (IRB) Oversight Determination



Oregon State University
Research Office

Human Research Protection Program
& Institutional Review Board
B308 Kerr Administration Bldg, Corvallis OR 97331
(541) 737-8008
IRB@oregonstate.edu
<http://research.oregonstate.edu/irb>

Date of Notification	02/16/2018	Study Number	8456
Notification Type	Oversight Determination		
Principal Investigator	Jeff Kenney		
Study Team Members	None		
Study Title	A case study investigation of non-tenure track STEM faculty who practice social justice education within Oregon public colleges and universities		
Funding Source	None	Cayuse Number	N/A

DETERMINATION: OSU NOT ENGAGED

It has been determined that your project, as submitted, **does not** engage OSU in research involving human subjects per the 2008 Guidance on engagement of institutions.

Additional review is not required for this study. However, this study does meet the definition of research involving human subjects under the regulations set forth by the Department of Health and Human Services 45 CFR 46 and IRB review may be required by another institution or organization.

Note that amendments to this project may impact this determination.

The federal definitions and guidance used to make this determination may be found at the following link:

[Institutional Engagement](#)

Appendix C

Oregon Higher Education Coordinating Commission (HECC) Affiliate Institutions

Oregon Public Universities

- Eastern Oregon University
- Oregon Institute of Technology
- Oregon State University
- Portland State University
- Southern Oregon University
- University of Oregon
- Western Oregon University
- *Oregon Health & Science University

Oregon Community Colleges

- Blue Mountain Community College
- Central Oregon Community College
- Chemeketa Community College
- Clackamas Community College
- Clatsop Community College
- Columbia Gorge Community College
- Klamath Community College
- Lane Community College
- Linn-Benton Community College
- Mt. Hood Community College
- Oregon Coast Community College
- Portland Community College
- Rogue Community College
- Southwestern Oregon Community College
- Tillamook Bay Community College
- Treasure Valley Community College
- Umpqua Community College

Appendix D

HECC Report on Disparities in Higher Education: Part-Time Instructional Staff Race/Ethnicity, Fall 2013

Institution	Part-time Instructional Staff									Total Part-time Instructional Staff
	American Indian/Alaska Native	Asian	Black/African American	Hispanic/Latino	Native Hawaiian/Pacific Islander	White	Two or more races	Unknown	Total	
Eastern Oregon University	0.0%	0.0%	0.0%	5.9%	0.0%	94.1%	0.0%	0.0%	100.0%	17
Oregon Institute of Technology	0.0%	15.0%	0.0%	0.0%	0.0%	80.0%	0.0%	5.0%	100.0%	20
Oregon State University	2.2%	5.7%	1.4%	1.4%	0.0%	83.7%	0.5%	5.1%	100.0%	369
Portland State University	0.4%	2.8%	2.3%	3.8%	0.1%	78.1%	1.4%	11.1%	100.0%	791
Southern Oregon University	1.8%	1.8%	0.9%	0.0%	0.0%	94.7%	0.0%	0.9%	100.0%	114
University of Oregon	1.0%	4.0%	1.0%	2.8%	0.3%	85.9%	0.3%	4.8%	100.0%	398
Western Oregon University	1.1%	2.7%	1.1%	4.4%	0.5%	84.6%	1.1%	4.4%	100.0%	182
Blue Mountain Community College	0.0%	0.0%	0.0%	2.3%	4.6%	40.8%	0.0%	52.3%	100.0%	130
Central Oregon Community College	0.9%	1.4%	0.0%	0.9%	0.0%	87.5%	0.5%	8.8%	100.0%	216
Chemeketa Community College	1.2%	1.8%	1.0%	7.1%	0.0%	82.7%	3.3%	2.9%	100.0%	510
Clackamas Community College	1.0%	1.4%	0.7%	4.1%	0.0%	91.9%	0.0%	1.0%	100.0%	296
Clatsop Community College	0.0%	1.3%	1.3%	0.0%	1.3%	96.1%	0.0%	0.0%	100.0%	77
Columbia Gorge Community College	0.9%	1.9%	0.0%	3.7%	0.0%	93.5%	0.0%	0.0%	100.0%	107
Klamath Community College	1.4%	0.0%	2.7%	2.7%	0.0%	93.2%	0.0%	0.0%	100.0%	74
Lane Community College	1.0%	1.5%	1.2%	2.7%	0.0%	80.1%	2.5%	10.9%	100.0%	403
Linn-Benton Community College	0.6%	3.3%	1.2%	2.7%	0.6%	86.6%	1.2%	3.9%	100.0%	336
Mt Hood Community College	0.3%	2.6%	1.3%	3.9%	0.0%	69.1%	1.3%	21.6%	100.0%	385
Oregon Coast Community College	0.0%	0.0%	2.0%	0.0%	0.0%	98.0%	0.0%	0.0%	100.0%	49
Portland Community College	0.4%	4.5%	1.7%	3.7%	0.1%	80.9%	1.0%	7.8%	100.0%	1452
Rogue Community College	0.3%	1.5%	0.0%	2.0%	0.0%	85.5%	1.0%	9.7%	100.0%	393
Southwestern Oregon Community College	2.0%	0.7%	0.7%	0.0%	0.0%	64.7%	0.7%	31.4%	100.0%	153
Tillamook Bay Community College	2.3%	0.0%	2.3%	0.0%	0.0%	93.0%	0.0%	2.3%	100.0%	43
Treasure Valley Community College	0.7%	1.3%	0.0%	5.4%	0.0%	87.9%	0.0%	4.7%	100.0%	149
Umpqua Community College	0.7%	1.3%	0.7%	0.0%	0.7%	84.3%	7.2%	5.2%	100.0%	153
Statewide	0.8%	2.8%	1.2%	3.2%	0.2%	81.8%	1.2%	8.7%	100.0%	6817

Appendix E

HECC Report on Disparities in Higher Education: Full-Time Instructional Staff Race/Ethnicity, Fall 2013

Institution	Full-time Instructional Staff									Total Full-time Instructional Staff
	American Indian/Alaska Native	Asian	Black/African American	Hispanic/Latino	Native Hawaiian/Pacific Islander	White	Two or more races	Unknown	Total	
Eastern Oregon University	0.0%	1.9%	1.9%	2.8%	0.0%	92.5%	0.0%	0.9%	100.0%	107
Oregon Institute of Technology	0.7%	5.2%	0.0%	2.2%	0.0%	89.6%	0.7%	1.5%	100.0%	134
Oregon State University	0.7%	9.1%	0.7%	4.9%	0.0%	77.2%	0.7%	6.7%	100.0%	856
Portland State University	1.4%	6.2%	2.0%	4.2%	0.0%	74.5%	1.4%	10.3%	100.0%	698
Southern Oregon University	1.4%	4.8%	0.0%	4.3%	0.0%	88.9%	0.5%	0.0%	100.0%	207
University of Oregon	0.9%	7.9%	1.4%	4.9%	0.0%	76.8%	0.3%	7.8%	100.0%	862
Western Oregon University	0.0%	2.8%	2.3%	5.1%	0.0%	87.0%	0.0%	2.8%	100.0%	216
Blue Mountain Community College	0.0%	0.0%	0.0%	0.0%	0.0%	89.3%	0.0%	10.7%	100.0%	56
Central Oregon Community College	0.0%	2.5%	0.0%	2.5%	0.0%	86.7%	0.8%	7.5%	100.0%	120
Chemeketa Community College	1.1%	2.1%	1.1%	5.3%	0.0%	83.7%	3.2%	3.7%	100.0%	190
Clackamas Community College	1.9%	1.9%	0.9%	4.6%	0.0%	90.7%	0.0%	0.0%	100.0%	108
Clatsop Community College	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	27
Columbia Gorge Community College	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	18
Klamath Community College	3.2%	0.0%	0.0%	3.2%	0.0%	93.5%	0.0%	0.0%	100.0%	31
Lane Community College	1.6%	2.4%	0.8%	3.9%	0.4%	86.2%	1.6%	3.1%	100.0%	254
Linn-Benton Community College	0.0%	1.6%	1.6%	1.6%	0.0%	92.8%	0.8%	1.6%	100.0%	125
Mt Hood Community College	0.7%	1.3%	1.3%	6.6%	0.0%	86.1%	2.0%	2.0%	100.0%	151
Oregon Coast Community College	0.0%	0.0%	0.0%	0.0%	10.0%	90.0%	0.0%	0.0%	100.0%	10
Portland Community College	0.5%	4.6%	2.1%	5.1%	0.0%	82.9%	2.1%	2.8%	100.0%	433
Rogue Community College	0.0%	1.3%	0.0%	2.6%	0.0%	90.8%	0.0%	5.3%	100.0%	76
Southwestern Oregon Community College	3.7%	3.7%	1.9%	0.0%	0.0%	83.3%	0.0%	7.4%	100.0%	54
Tillamook Bay Community College	0.0%	0.0%	0.0%	0.0%	0.0%	87.5%	0.0%	12.5%	100.0%	8
Treasure Valley Community College	0.0%	1.7%	0.0%	0.0%	0.0%	94.9%	0.0%	3.4%	100.0%	59
Umpqua Community College	0.0%	0.0%	1.6%	0.0%	0.0%	68.9%	16.4%	13.1%	100.0%	61
Statewide	0.9%	5.3%	1.2%	4.2%	0.0%	81.7%	1.1%	5.6%	100.0%	4861

Appendix F

HECC Report on Disparities in Higher Education: Student Race/Ethnicity, 2014-2015

Institution	Not Reported	Multi-Racial/Ethnic	American Indian Or Alaskan Native	Asian	Black	Hispanic Or Latino	International	Pacific Islander	White
Eastern Oregon University	18.3%	0.9%	2.1%	2.0%	2.1%	6.7%	1.4%	0.8%	65.8%
Oregon Institute of Technology	3.6%	4.8%	1.1%	5.3%	1.7%	8.3%	1.3%	0.6%	73.3%
Oregon State University - Corvallis	3.6%	5.4%	0.6%	6.3%	1.7%	7.1%	11.0%	0.3%	64.0%
Oregon State University - Cascades	8.6%	4.4%	1.2%	1.1%	0.4%	6.7%	0.7%	0.2%	76.8%
Portland State University	6.1%	4.4%	1.4%	6.7%	2.9%	8.7%	7.4%	0.5%	61.9%
Southern Oregon University	30.1%	4.0%	1.2%	1.9%	1.7%	7.0%	2.4%	0.4%	51.4%
University of Oregon	2.3%	5.2%	0.7%	5.2%	2.1%	8.2%	13.9%	0.4%	62.1%
Western Oregon University	4.5%	0.3%	1.8%	3.0%	2.9%	8.9%	6.6%	2.2%	69.8%
Statewide - Universities	6.5%	4.4%	1.0%	5.4%	2.2%	7.9%	8.8%	0.5%	63.1%
Blue Mountain Community College	9.8%	2.2%	2.3%	0.8%	1.4%	23.3%	0.0%	0.5%	59.8%
Central Oregon Community College	28.3%	1.9%	1.7%	1.0%	0.4%	7.4%	0.0%	0.2%	59.1%
Chemeketa Community College	18.6%	2.7%	1.4%	1.7%	1.0%	23.2%	0.5%	0.7%	50.2%
Clackamas Community College	33.9%	2.6%	0.9%	2.5%	1.3%	8.0%	0.3%	0.2%	50.2%
Clatsop Community College	31.3%	2.0%	1.4%	0.9%	0.7%	6.4%	0.0%	0.3%	57.0%
Columbia Gorge Community College	9.6%	1.5%	1.0%	1.5%	0.3%	24.0%	0.0%	0.6%	61.6%
Klamath Community College	17.7%	0.1%	4.6%	1.3%	1.0%	11.7%	1.5%	0.3%	61.8%
Lane Community College	29.0%	3.5%	1.3%	1.8%	1.4%	9.0%	2.3%	0.4%	51.3%
Linn Benton Community College	22.2%	2.2%	1.0%	2.2%	0.7%	7.2%	2.4%	0.3%	61.9%
Mt. Hood Community College	26.7%	2.3%	0.8%	6.0%	3.9%	13.2%	0.1%	0.5%	46.4%
Oregon Coast Community College	5.5%	3.6%	2.8%	1.4%	0.4%	12.1%	0.0%	0.2%	73.9%
Portland Community College	16.5%	4.1%	0.8%	6.9%	4.8%	9.5%	1.5%	0.5%	55.5%
Rogue Community College	20.7%	2.6%	1.3%	1.2%	0.7%	12.5%	0.1%	0.4%	60.6%
Southwestern Community College	35.3%	2.1%	2.2%	1.0%	0.7%	5.4%	0.6%	0.4%	52.2%
Tillamook Bay Community College	7.8%	0.5%	1.1%	0.7%	0.3%	8.3%	0.7%	0.1%	80.5%
Treasure Valley Community College	24.0%	2.1%	0.8%	0.8%	0.6%	17.2%	0.7%	0.1%	53.7%
Umpqua Community College	56.6%	0.1%	1.1%	0.5%	0.4%	3.6%	0.0%	0.2%	37.5%
Statewide - Community Colleges	24.0%	2.8%	1.2%	3.4%	2.2%	11.4%	1.0%	0.4%	53.7%

Appendix G

Participant Recruitment Card

Side A

Jeff M. Kenney, Doctoral Candidate



Hello, my name is Jeff Kenney and I am a doctoral candidate in Education Leadership at Clemson University. I am a higher education practitioner-scholar, dedicated to the transformation of academia through administration, teaching, and scholarship.

My research agenda is currently focused on the creativity, resilience, and persistence of social justice educators in diverse educational contexts.

Email: jkenney@clemson.edu

LinkedIn: www.linkedin.com/in/jeffmkenney

To learn more about my current research, please see the reverse.

Side B

A case study investigation of non-tenure track STEM faculty who practice social justice education within Oregon public colleges and Universities

This study aims to better understand the creativity and wisdom of STEM educators who integrate social justice education in their curriculum and teaching and how they reconcile their practice with the cultures and structures of their institutions.

To learn more about this project, feel free to view a two-minute video presentation:

www.tbd.clemson.edu

If you are interested in participating, please review the information letter and complete the survey found here:

<https://goo.gl/aMBRdT>

If you are interested in collaborating on a current or future project, or have questions about my research, please contact me directly at jkenney@clemson.edu.

Appendix H

Participant Recruitment Flyer



CALL FOR RESEARCH PARTICIPANTS

- Are you non-tenure track faculty at an Oregon public college or university?
- Do you teach classes in science, technology, engineering, or mathematics?
- Do you integrate social justice education in the STEM classroom?

If so, you may be a good fit for our study:

A case study investigation of non-tenure track STEM faculty who practice social justice education within Oregon public colleges and Universities

This study aims to better understand the creativity and wisdom of STEM educators who integrate social justice education in their curriculum and teaching and how they navigate the cultures and structures of their institutions.

To learn more about this project, feel free to view a two-minute video presentation:

www.bit.ly/studyvideo

If you are interested in participating, please review the study information letter and complete a brief survey:

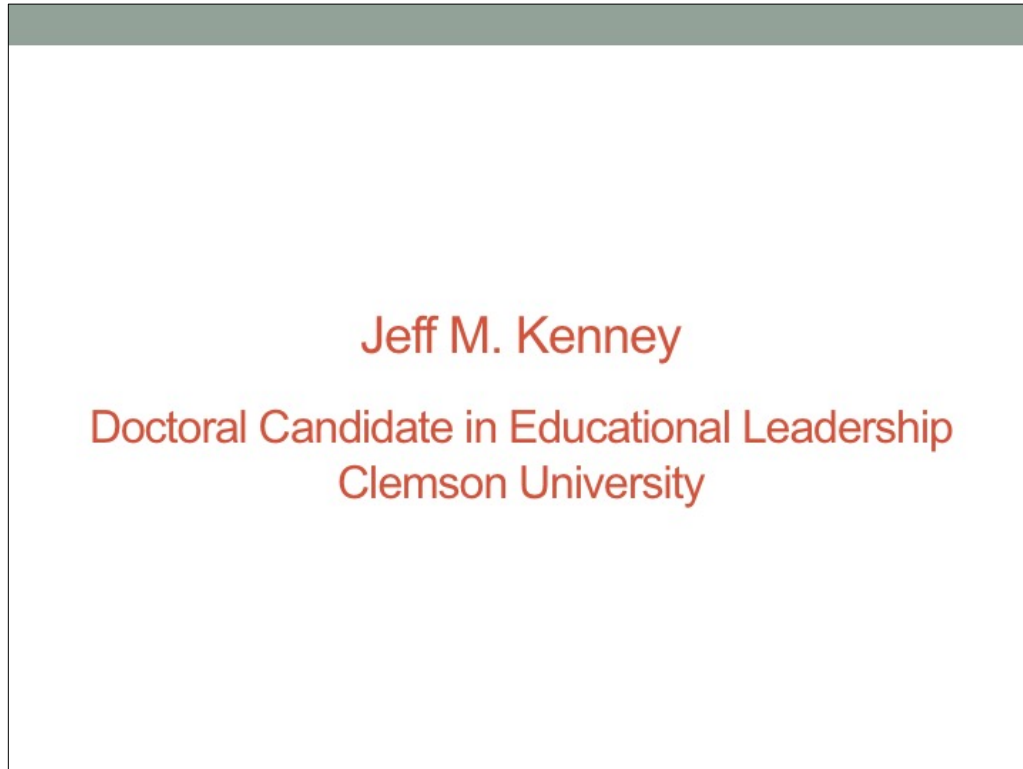
www.bit.ly/studyinformation

If you are interested in collaborating on a current or future project, or have questions about our research, please contact Jeff Kenney directly at jkenney@clermson.edu.

Appendix I

Participant Recruitment Video (PowerPoint and Script)

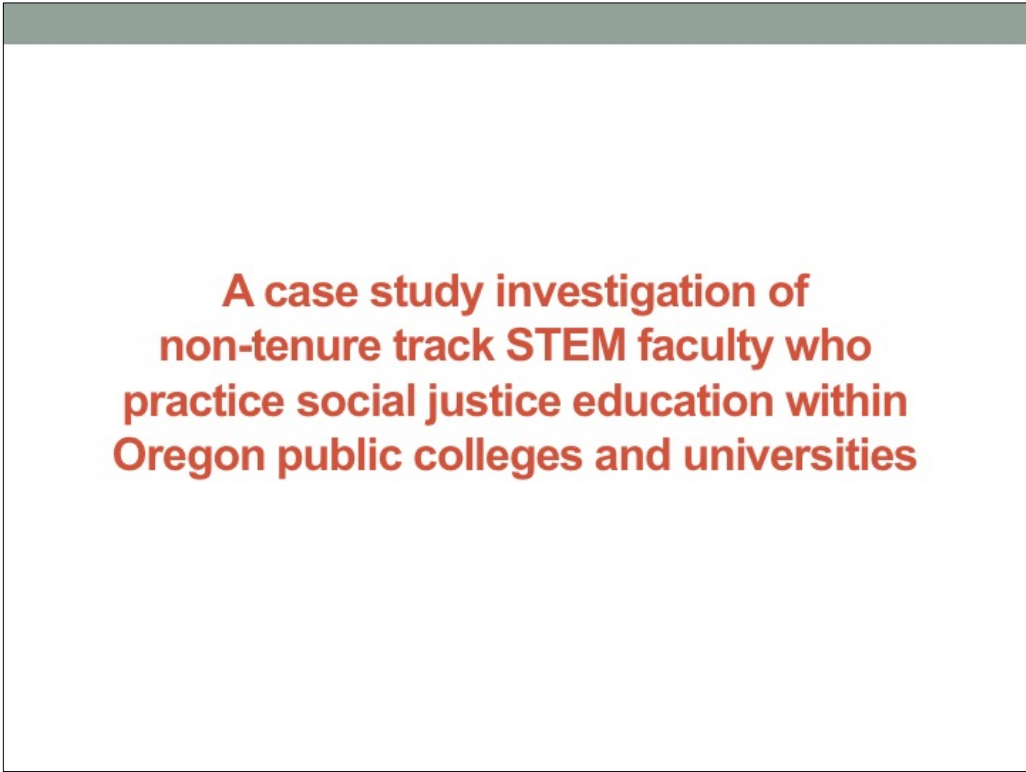
Slide 1



Hello, my name is Jeff Kenney and I am a doctoral candidate in Educational Leadership at Clemson University. I am a higher education practitioner-scholar, dedicated to the transformation of academia through research, teaching, and administration.

My research agenda is currently focused on the creativity, wisdom, and persistence of social justice educators in diverse educational contexts. I am committed to the production of knowledge which informs critical educational practices as well as the amplification and proliferation of these practices in hopes of realizing a more just society.

Slide 2



**A case study investigation of
non-tenure track STEM faculty who
practice social justice education within
Oregon public colleges and universities**

My current dissertation research is focused on contingent faculty in science, technology, engineering, or mathematics at Oregon public colleges and universities who integrate social justice education in their curriculum and teaching. The goal of this study is to better understand the creativity and wisdom of these educators, with particular attention to the institutional structures and cultures through which they navigate.

The purpose of my study is to make visible extraordinary practices in unlikely contexts, and to produce knowledge which realizes the potential for a social justice STEM education and ultimately the preparation of more conscious, critical, and engaged STEM learners and professionals.

Slide 3

To participate or collaborate ...

- Complete the questionnaire:
 - <https://goo.gl/aMBRdT>
- Contact me:
 - jkenney@clemson.edu

If you are interested in participating in this study, please follow the link to a brief questionnaire. If you are interested in collaborating on a current or future project or have questions about my research, please contact me directly via email.

Thank you for your time and consideration, I hope you have a wonderful day.

Appendix J

Participant Informed Consent and Questionnaire

Study Information and Questionnaire

Information about Being in a Research Study

A case study investigation of non-tenure track STEM faculty who practice social justice education within Oregon public colleges and universities

Description of the Study and Your Part in It

Dr. Tony Cawthon, along with Jeff Kenney, are inviting you to take part in a research study. Dr. Cawthon is a Professor of Educational and Organizational Leadership at Clemson University. Jeff Kenney is a student at Clemson University, running this study with the help of Dr. Cawthon. The purpose of this research is to explore the experiences of non-tenure track STEM faculty integrate social justice education in their teaching and curriculum.

Your part in the study will include the completion of a brief survey, participation in 4 semi-structured audio-recorded interviews, and a direct observation of your teaching. Participation in this study will total about 6 hours (10 minutes to complete the survey, 60 minutes for each of the four interviews, and 50-90 minutes for the teaching observation).

Risks and Discomforts

There are minimal risks or discomforts expected if you take part in this research. They include potential for identification based on the intersection of your professional identity including faculty rank and demographic information including but not limited to gender identity and racial/ethnic identity. In order to minimize this risk, collection and documentation of this information will be judicious. Additionally, you will have the opportunity to select a pseudonym prior to participating in the interview.

Possible Benefits

We do not know of any way you would benefit directly from taking part in this study. However, this research may help us to understand how non-tenure track STEM faculty integrate social justice education in their teaching and curriculum and navigate public universities.

Protection of Privacy and Confidentiality

We will do everything we can to protect your privacy and confidentiality. We will not tell anybody outside of the research team that you were in this study or what information we collected about you in particular. Direct quotes will be used in the final reporting, but only attributed to your selected pseudonym. You will be allowed to review the final report, if desired, before the information is published. Interview responses will be audio recorded and may be accessed by persons outside of the research team only for transcription purposes.

We might be required to share the information we collect from you with the Clemson University Office of Research Compliance and the federal Office for Human Research Protections. If this happens, the information would only be used to find out if we ran this study properly and protected your rights in the study.

Participant information and participant interview data (i.e. audio recordings, interview transcripts, field notes) will be stored in separate, password-protected files on the Clemson University cloud storage system and a locked file cabinet possessed by the co-investigator, Jeff Kenney. Data collected will be destroyed five years after completion of this study.

The results of this study may be published in scientific journals, professional publications, or educational presentations; however, no individual participant will be identified.

Choosing to Be in the Study

You do not have to be in this study. You may choose not to take part and you may choose to stop taking part at any time. You will not be punished in any way if you decide not to be in the study or to stop taking part in the study. By completing the survey on the following page and submitting your contact information, you are agreeing to participate in this study and providing consent. If you choose to stop taking part in this study, the information you have already provided will be used in a confidential manner.

There will be approximately 3 participants in this study.

Contact Information

If you have any questions or concerns about your rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-0636 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC's toll-free number, 866-297-3071. The Clemson IRB is a group of people who independently review research. The Clemson IRB will not be able to answer some study-specific questions. However, you may contact the Clemson IRB if the research staff cannot be reached or if you wish to speak with someone other than the research staff.

If you have any study related questions or if any problems arise, please contact Dr. Tony Cawthon at Clemson University at 864.656.5100 or Jeff Kenney at Clemson University at 402.669.1387.

A copy of this form will be given to you.

Do you wish to participate in this study?

- I consent to participating in this study
- I do not consent to participating in this study
-

Demographic Information

What is your current institution?

▼ Blue Mountain Community College (BMCC), Pendleton ... Western Oregon University (WOU), Monmouth

What is your faculty rank?

Please use the language relevant to your current institution, ie.. adjunct, instructor, clinical, visiting, research, teaching, professor of practice, etc.

Please describe the discipline in which you work.

How many years have you been in a college teaching position?

How many years have you been in your current college teaching position?

Please describe your racial/ethnic identity.

Please describe your gender identity.

Contact Information

Please share your first and last names

Please share your email address

Please share your phone number

What is your preferred method of contact?

Email

Phone

Appendix K

Participant Recruitment Follow-Up Email

Hello *_ParticipantName_*,

I've received your questionnaire, and your consent to participate in our study: *A case study investigation of non-tenure track STEM faculty who practice social justice education within Oregon public colleges and universities*

Thank you for your interest, I look forward to meeting you and learning from you.

Our next step is to schedule your first 60-minute interview. Please reply to this email with your availability and format preferences:

1. From the following list, please share two dates and times when you may be available for a 60-minute interview. Please let me know if you would benefit from additional date and time options:
 - *Availability 1: Day, Date, Time*
 - *Availability 2: Day, Date, Time*
 - *Availability 3: Day, Date, Time*
 - *Availability 4: Day, Date, Time*
 - *Availability 5: Day, Date, Time*
2. Please share your preference for interview format. We can meet in-person or arrange for a Skype interview. If your preference is an in-person meeting, I will arrange for a private meeting space on campus.

Please let me know if you have any additional questions, and thank you again for your participation.

Sincerely,

Jeff Kenney
Doctoral Candidate
Educational and Organizational Leadership Development
Clemson University

Appendix L

Participant Recruitment Summary

Pseudonym	Institutional Type	Appointment Type	Teaching Discipline	Informed Consent (Y/N)	Study Selection (Y/N)
Elli	2-Year Public	Part-Time Instructor	Chemistry	Y	N
Linda	2-Year Public	Full Time Instructor	Biology	Y	N
Brenda	2-Year Public	Part-Time Instructor	Architecture	Y	N
Claire	4-Year Public	Full Time Instructor	Mathematics	Y	Y
Alicia	2-Year Public	Full Time Instructor	Anatomy & Physiology	Y	Y
Ashley	4-Year Public	Part-Time Instructor	Geology & General Science	Y	Y
Sela	4-Year Public	Full Time Instructor	Biology	Y	Y

Appendix M

Interview Protocols

- **Interview I** (On-Line or On-Site) “Professional Pathway” [60 Minutes]
 - Semi-structured, addressing the following topics:
 - Tell me about your ...
 - General practice
 - Training
 - Personal and professional experience
 - Role models and mentors
 - Critical Events
 - Purpose and goals
 - Intrinsic & extrinsic motivations
- **Interview II** (On-Line or On-Site) “Influential Contexts” [60 Minutes]
 - Semi-structured, addressing the following topics:
 - Follow ups and emergent questions since last interview
 - Tell me about your ...
 - Personal context
 - Interpersonal context
 - Institutional context
 - Local context
 - Regional context
 - National context
 - Global context
- **Interview III** (On-Line or On-Site) “Curriculum & Instruction” [60 Minutes]
 - Semi-structured, addressing the following topics:
 - Follow ups and emergent questions since last interview
 - Tell me about your ...
 - Experience, skills, and insights regarding:
 - Pedagogy
 - Curriculum
 - Assessment
 - Practice trajectory, including:
 - Mission
 - Vision
 - What are your obstacles
 - What are your assets
- **Interview IV** (On-Line or On-Site) “Member Check” [60 Minutes]
 - Semi-structured, addressing the following topics:
 - Follow ups and emergent questions since last interview
 - Review of previous content
 - Member checking initial themes and interpretations

Appendix N

List of Artifacts

Claire

- Course Manual, Introduction to Quantitative Reasoning, November 2000
- Lesson Plan, Modeling data on HIV/AIDS, Introduction to Quantitative Reasoning, November 2000
- Lesson Plan, Finding the Best Model: Gender Wage Gap, College Algebra, Spring 2018 term
- Lesson Plan, Finding the Best Model: Sea-Level Change, College Algebra, Spring 2018 term

Alicia

- Course Syllabus, Human Anatomy & Physiology, Fall 2017 term
- Course Syllabus, Human Anatomy & Physiology, Winter 2018 term
- Course Syllabus, Human Anatomy & Physiology, Spring 2018 term
- Class Activity, Mechanisms of Pulmonary Ventilation, Human Anatomy & Physiology, Spring 2018 term
- Book, formative text, sister's publication on race conscious pedagogy
- Written classroom address, Reflection on Trump's election

Ashley

- Curriculum Vitae
- Teaching Philosophy
- Course Syllabus, Introduction to Sustainability, Winter 2018 term
- Lesson Plan, Film Reflection I, Introduction to Sustainability, Winter 2018 term
- Lesson Plan, Film Reflection II, Introduction to Sustainability, Winter 2018 term
- Course Syllabus, Introduction to Individual Sustainability, Spring 2018 term
- Lesson Plan, Carbon Footprint, Introduction to Individual Sustainability, Spring 2018 term
- Lesson Plan, Ecological Footprint, Introduction to Individual Sustainability, Spring 2018 term
- Lesson Plan, Walk Score, Introduction to Individual Sustainability, Spring 2018 term
- Lesson Plan, Water Footprint, Introduction to Individual Sustainability, Spring 2018 term
- Lesson Plan, Sustainability Model, Introduction to Individual Sustainability, Spring 2018 term
- Course Syllabus, Global Climate Change, Spring 2018
- Discussion Questions, Weeks 2 – 9, Global Climate Change, Spring 2018
- Final Exam, Global Climate Change, Spring 2018
- Lab Activities, Labs 7 – 10, Global Climate Change, Spring 2018
- The Third Oregon Climate Assessment Report, Oregon Climate Research Institute, January 2017
- Field Trip Announcement, Introduction to Individual Sustainability, Spring 2018 Term
- Course Syllabus, Environmental Grief and Anxiety: Building Hope in the Age of Climate Consequences, University of Washington – Bothwell, Dr. Jennifer Atkinson

Sela

- Curriculum Vitae
- Course Syllabus, Principles of Biology, Spring 2018
- Course Syllabus, Course Design and Methods for College and University Teaching, Draft
- Video Link, HHMI, Obesity and Diabetes in Pima Indians
- AAAS Vision and change in undergraduate biology education: A call to action, 2013
- Lab manual for socio-scientific issues in biology, Principles of Biology, 2017
- Lesson Plan, Are humans evolving by natural selection?, Principles of Biology, Spring 2018 term

Appendix O

Field Observation Protocol

Participant Pseudonym:

Date & Time:

Setting	Participants

1. Describe on the odd lines

2. Reflect on the even lines

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

Description of Artifacts (Handouts, Class Activities, Power Points, Readings, Etc.):

Appendix P

Participant Member Check Emails

Email 1

Hello *_ParticipantName_*,

I hope you're well. I am happy to share that I have completed my analysis of our interviews and classroom observations and have a draft report ready to share.

If you are available in the next few weeks, I would like to arrange a 30-45 minute interview to discuss the report and receive your feedback. Here are a few dates and times where I can be available in the next 3 weeks:

- *Availability 1: Day, Date, Time*
- *Availability 2: Day, Date, Time*
- *Availability 3: Day, Date, Time*
- *Availability 4: Day, Date, Time*
- *Availability 5: Day, Date, Time*

Please let me know if you would benefit from additional availability.

Once we've scheduled our interview, I will send along a copy of the report and additional information to help you prepare for our meeting.

Please let me know if you have any questions.

Sincerely,

Jeff K.

Doctoral Candidate
Educational and Organizational Leadership Development
Clemson University

Email 2

Hello *_ParticipantName_*,

I've marked my calendar. In the meantime, please review my draft report.

The attached report aims to give the reader a sense of who you are pedagogically, and how you navigate various contexts as a social justice educator. As you read, I would appreciate your attention to:

- How you are represented
- Where I may have underemphasized or overemphasized aspects of our conversations
- Whether I was successful in giving the reader an accurate sense of how you navigate as a social justice educator

At the time of our conversation, I will collect your feedback and we can deliberate any necessary edits.

Thanks so much for your time and energy in this process. I look forward to seeing you soon.

All the best,

Jeff K.

Doctoral Candidate
Educational and Organizational Leadership Development
Clemson University

Appendix Q

Data Collection & Analysis Protocol

Research Phase	Sub-Phase
1. Recruitment	1.1. Distribution, networking, and snowballing
	1.2. Informed consent & questionnaire
2. Primary Data Collection	2.1. Interview 1
	2.2. Interview 2
	2.3. Interview 3
3. Secondary Data Collection	3.1. Artifact solicitation
	3.2. Classroom observation
4. Analysis	4.1. Narrative summary
	4.2. Open coding
	4.3. Axial coding
	4.4. A Priori coding
	4.5. Report writing
5. Member Check	5.1. Interview 4
	5.2. Revisions

Appendix R

Data Collection Schedule

Pseudonym	Interview 1 Date, Location, Length	Interview 2 Date, Location, Length	Interview 3 Date, Location, Length	Observation 1 Date, Location, Length	Observation 2 Date, Location, Length	Member Check Date, Location, Length
Elli	03/13/18, Skype 43m	N/A	N/A	N/A	N/A	N/A
Linda	03/21/18, Skype 12m	N/A	N/A	N/A	N/A	N/A
Brenda	03/14/18, Skype 15m	N/A	N/A	N/A	N/A	N/A
Claire	03/16/18, On Campus 37m	04/11/18, On Campus 67m	05/02/18, On Campus 65m	05/16/18, On Campus 60m	N/A	08/24/18, On Campus 17m
Alicia	03/22/18, On Campus 55m	03/29/18, On Campus 60m	04/26/18, On Campus 62m	05/02/18, On Campus 60m	05/04/18, On Campus 60m	09/27/18, On Campus 50m
Ashley	03/07/18, Skype 53m	03/20/18, Skype 72m	04/04/18, Skype 64m	04/20/18, On Campus 240m	05/18/18, On Campus 240m	09/20/18, Skype 47m
Sela	03/09/18, On Campus 60m	04/05/18, On Campus 55m	04/24/18, On Campus 67m	05/16/18, On Campus 60m	N/A	10/25/18, On Campus 15m

Appendix S

A Priori Coding Scheme

Code Theme	Code	Code Description
Neoliberalism: Logics	Market Fundamentalism	Belief that a free market will best lead society
	Profit & Efficiency	Belief that individuals, organizations, and societies should ever pursue increased profit and efficiency
	Competition	Belief that society thrives through unbridled economic competition
	Instrumentalism	Belief that something has value to the extent that it serves other neoliberal logics
Neoliberalism: Practices	Austerity	Reduction in governing spending
	Deregulation	Reduction in governing regulations
	Cultivating Flexible Labor	Elimination of labor protections, cultivation of dynamic and temporary labor sources
	Privatization	Transition of public services to private services
	Quantification	Translation of value and performance into numerical indicators
	Meritocracy	Establishing systems of winners and losers through individual competition
	Commodification	Establishing tradable value in goods and services
Neoliberalism: Conditions	Homogenization	Competition leading to benchmarking, patterning, and ultimately homogenization
	Massification	Scaling goods and services to maximize profit, navigate volatile economic conditions
	Surveillance	Direct and indirect assessment metrics to confirm productivity
	Disposability	Discarding of goods, services, or individuals no longer deemed valuable
	Hyper Individualism	Dismantling of collectivist systems, norms, and values - emphasis on individual survival
	Narrowed Imagination	Declining belief in the value of any economic philosophy or common sense other than neoliberalism
	Inequality	Creation or exacerbation of inequality

Appendix T

Coding Summary

Emergent Codes

Procedure	Claire	Alicia	Ashley	Sela	Code Total
Open Codes	245	217	226	242	930
Axial Codes	65	71	53	44	233
A Priori Codes	81	82	46	71	280
Code Total	391	370	325	357	1,443

A Priori Codes

Theme	Code	Claire	Alicia	Ashley	Sela	Total
Logics	Market Fund.	0	0	0	0	0
	Profit & Efficiency	18	9	13	17	57
	Competition	2	3	0	0	5
	Instrumentalism	20	24	1	6	51
Practices	Austerity	0	4	2	4	10
	Deregulation	0	0	0	0	0
	Flexible Labor	3	3	13	10	29
	Privatization	0	0	0	0	0
	Quantification	2	4	0	0	6
	Meritocracy	0	1	0	0	1
	Commodification	1	0	0	0	1
Conditions	Homogenization	2	6	0	1	9
	Massification	3	22	2	21	48
	Surveillance	9	2	5	4	20
	Disposability	0	0	0	0	0
	Hyper Individualism	9	3	3	5	20
	Narrowed Imagin.	0	0	0	0	0
	Inequality	12	1	7	3	23
Code Total		81	82	46	71	280

Appendix U

Timeline of Major Study Activities

Study Week	Primary Study Activity
1	IRB Approval
2	Recruitment
3	Recruitment
4	Data Collection
5	Data Collection
6	Data Collection
7	Data Collection
8	Data Collection
9	Data Collection
10	Data Collection
11	Data Collection
12	Data Collection
13	Data Collection
14	Transcription
15	Transcription
16	Analysis & Reporting (Claire)
17	Analysis & Reporting (Claire)
18	Analysis & Reporting (Claire)
19	Analysis & Reporting (Claire)
20	Analysis & Reporting (Claire)
21	Analysis & Reporting (Claire)
22	Analysis & Reporting (Alicia)
23	Analysis & Reporting (Alicia)
24	Analysis & Reporting (Alicia)
25	Analysis & Reporting (Ashley)
26	Analysis & Reporting (Ashley)
27	Analysis & Reporting (Ashley)
28	Analysis & Reporting (Sela)
29	Analysis & Reporting (Sela)
30	Analysis & Reporting (Sela)
31	Analysis & Reporting (Sela)
32	Manuscript Writing & Revision
33	Manuscript Writing & Revision
34	Manuscript Writing & Revision
35	Manuscript Writing & Revision

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