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Critical Convergence: Mapping the Boundaries of How Faculty Interrogate whiteness in the Geoscience Educational Landscape

James E. Hobbs
University of Texas at Arlington

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by

James E. Hobbs

A DISSERTATION

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Supervising Committee:

Ericka Roland, Ph. D. Supervising Professor

Sahar Sattarzadeh, Ph. D.

Kelly Bergstrand, Ph.D.

ABSTRACT

Critical Convergence: Mapping the Boundaries of How Faculty Interrogate whiteness in the Geoscience Educational Landscape

James E. Hobbs
The University of Texas at Arlington, 2024

Supervising Professor: Ericka Roland

This study examined the role of faculty members in interrogating whiteness within geoscience education. The dominant reliance on whiteness as the primary way of knowing in geoscience education has long perpetuated a singular perspective that serves as a mechanism for reinforcing existing power structures rooted in white supremacy. Drawing on tenets from Critical whiteness Studies, Curriculum Theory, and Transformative Learning Theory, this research investigated U.S. higher education faculty members' strategies and challenges in disrupting whiteness within the geoscience curriculum.

Through critical qualitative narrative inquiry, data were collected through semi-structured interviews with geoscience faculty members across multiple institutions across the United States. The analysis revealed themes related to faculty perceptions of whiteness in geoscience education, strategies to challenge dominant narratives, and barriers to promoting inclusivity. Findings suggest that while faculty members recognize the importance of interrogating whiteness, they may face institutional constraints and personal biases that might further impede the necessary change for transformative change.

The implications of this study extend to curriculum development, pedagogical methods, and faculty development programs in higher education. By uncovering the complexities of whiteness within geoscience education, this research contributes to ongoing efforts to challenge systemic racism and promote social justice within academia. Recommendations are provided to faculty interested in and those actively engaged with this critical work.

Keywords: geoscience education, faculty perspectives, curriculum development, institutional change, social justice, critical whiteness studies, equity

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DEDICATION

This dissertation is dedicated to all those who have had their voices silenced, their stories left untold, and their perspectives marginalized. May this work serve as a humble contribution toward the path of progress in geoscience education, academia, and beyond.

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CHAPTER 1

INTRODUCTION

During my institution's Spring 2023 convocation, I overheard a troubling conversation. The words would leave a bad taste and a lasting impression of how geoscience educators spoke when *outsiders* were not listening to us, *insiders*. Things began as usual in these situations–my fellow geoscience colleagues from across the college and I were all seated around the same large round table at the convention center amidst a landscape of other faculty and disciplines. The silence was interrupted by forced awkward conversations between sips of coffee that, while not exceptional, I managed to avoid the urge to spit out after every sip. While lacking the flavors of a gourmet blend, the coffee offered a comforting familiarity with its mild, inoffensive taste.

However, it was not until the speaker's keynote address that I heard it. Dr. Tia Brown McNair, lead author of 'From Equity Talk to Equity Walk' and 'Becoming a Student-Ready College,' delivered a powerful message about designing equitable pathways for student success and the significance of building relationships with students, especially those who have been historically marginalized. Her words resonated deeply with me. However, as she spoke about these crucial issues, my colleague's troubling conversation pierced the air, "I don't know why we have to sit here and listen to this shit. This (the experience of Black and Brown students) has absolutely nothing to do with geology." The shock of the statement was only surpassed by my realization that all the geoscience faculty at our table were white and nodding in fervent agreement. Much to their chagrin, I felt compelled to challenge their collective belief, explaining that this conversation has everything to do with geology.

I offer this vignette as a starting point that shapes the remainder of the work. Rather than this experience being an exception, I believe the words spoken by my colleagues reflect a

broader and more troubling trend in the discipline across most U.S. Higher Education Institutions (HEIs). Despite the growing calls by geoscience scholars for inclusivity and the work of social justice, an approach that calls to broaden our visionary and imaginative capacities and develop practices to do so effectively (Bush & Mattox, 2020; Hall et al., 2022; Mattheis et al., 2019; Núñez et al., 2020) remain, unfortunately, at the margins.

To begin, I offer some possible interrogations of my colleague's words, rooted deeply in the ideology of whiteness that maintains white supremacy through not such individual identities rather through the pervasive social processes, systems, organizational cultures, and discourses. As Hitchcock (2002) describes, "We learn our culture in situ, as part of our living experience . . . and we develop an understanding, generally an unconscious one, of things like norms, social roles, characteristics of different groups, social status, and power" (p. 41). From this understanding, then, the resistance to Dr. McNair's message on racial inclusivity–the sentiment expressed as "I don't know why we have to sit here and listen to this shit"–is not merely about personal discomfort or disagreement but echoes more dangerously a broader societal context where whiteness operates as a dominant ideology (Kambon, 2004). Said another way, as Gusa (2010) argues, in the U.S., the concept of whiteness transcends embodied skin color, rather it embodies a societal and philosophical stance that influences one's (inter)actions within society (Leonardo, 2002; Owen & Jones, 2000). This white, dominant ideology marginalizes Black, Brown, and Other racialized bodies at the expense of experiences and perspectives of white individuals through the dismissal of their struggles and contributions.

The convictions shared by my colleague is in part a sense of white entitlement—a perception among white individuals of inherent ownership over spaces, which they believe should echo white ideologies—upholding white dominance. The entitlement is perpetuated by an

adherence to belief in meritocracy (Solórzano & Yosso, 2002), which attributes academic disparities to personal efforts or worthiness having very real consequeince, as it serves to "legitimize the hierarchical and disproportionate concentration of [w]hite wealth and power in American society" (Gusa, 2010, p. 469). Meritocracy and individualism are seen to be mechanisms through which white people are unable to perceive the privileges associated with their whiteness. It is also a byproduct of white privilege, and often overlooked as a form of racism inside Higher Education Institution (HEI) classrooms (Neville et al., 2001). As a consequence, white students, harboring a sense of exaggerated self-importance, may perceive their achievements as granting them rights to academic access and success. Gusa (2010) points out that entitlement is maintained and propagated through adherence to meritocratic belief system that rationalizes academic disparities as the result of individual variations in effort, skill, and worthiness. This entitlement also extends to expectations of dominance with respect to classroom dynamics, participation time, grading standards, and faculty support. Subsequently, Black, Brown and Other historically and systematically marginalized students face diminished classroom engagement, exclusion from study groups, and develop a sense that they are not appreciated as full members in their institution (Moreton-Robinson, 2015).

Contextualizing the sentiments further within the ideological locations of whiteness and its privileges, where systemic processes and organizational cultures, the geosciences have historically prioritized white comfort and perspectives. The assertion that discussions centered around race have "nothing to do with geology" demonstrates an entrenched view within white academic and professional settings that a default, neutral standpoints where inclusion efforts are extraneous rather than central to advancing the discipline. My colleague's words manifest whiteness as an ideology that invisibly shapes what is considered relevant knowledge and who is

deemed a legitimate knower within the field (Swartz, 2009). Neville et al. (2001) describe this white privilege as a "complex system of relationships among individual, groups, and systems" that confer advantages to white people (p.269). These relationships reinforce systemic barriers against racialized non-white Others, perpetuating a monocultral academic environment that privileges whiteness (Bonilla-Silva, 2006; Brayboy, 2003).

Moreover, the reluctance to engage with race, especially within geology, can be seen as a product of ideological underpinnings of whiteness such as promoting a monocultural value system, one that dismisses the importance of Other perspectives and experiences; racial identities are thus dimishished or rendered trivial by the outright omission of academic content that reflects the diversity of racial groups (Sue et al., 2007). The discomfort and defensiveness encountered when traversing racial discourse is indicative of a broader resistance (i.e., refusal, denial, blindness, ignorance, etc.) to confronting the ways in which whiteness as an ideology shapes our perceptions and interactions. This white resistance (Gonsalves, 2008) is further fortified by an apparent lack of exposure to the complexities of racism and privilege, further perpetuating cycles of exclusion and marginalization within white academic spaces. Furthermore, the generalizing comment "this has nothing to do with geology" can be viewed as whiteness obfuscating race and resisting being named in attempts to remain invisible. Other statements akin to this might include "I'm not racist because…" statements such as "my best friend is Black" or "I voted for Obama" or "I've never owned slaves!" Bonilla-Silva (2006), Thompson (2003), and Gonsalves (2008) would view these expressions as assumed liberal agendas that mask the racial implications or a mechanism to distance oneself from race and racism. I argue that this is a way in which power of whiteness is maintained through the silencing, or what Matias et al. (2016) refer to as the "Voldemort" effect, whereby whiteness "gains more power by not being spoken" (p. 6).

Maintaining silence is an emotional strategy used to deflect from confronting the realities of racism, demonstrating how whiteness influences responses to discussions on race, even in benevolent spaces committed to equity and justice.

Essential to this recognition is the engagement of white faculty in white spaces that contribute to the continuation of whiteness as the dominant ideology. As Winans (2012) argues to move past emotional resistance, it "requires some willingness to coexist with uncomfortable emotions" (p.166). My own journey through the Ph.D. program and through the process of writing this dissertation have highlighted the current problems the field of geosciences with the deeply entrenched and unexamined dimensions of whiteness its embodies. This is a call, therefore, for a shift in how the geoscience discipline approaches education and knowledge production. The field can no longer afford to ignore the pervasive influence of whiteness in shaping what we teach, how we teach it, and whom we consider to be the rightful participants in our academic and professional communities. Our decisions regarding curriculum design and pedagogical practices hold the potential to either perpetuate the status quo of white supremacy or actively challenge it (Apple, 2004/2016). Given the pivotal role faculty play in shaping our discipline's future, a pressing need emerges to recognize how they are leveraging their consequential power, be it to challenge or maintain it.

Background

Curriculum

Geosciences, a fundamental discipline in the United States studying Earth's systems, is pivotal in advancing our understanding of our planet. Sub-disciplines such as geology, atmospheric sciences, oceanography, and planetary sciences significantly contribute to our knowledge of climate change (Dzambo et al., 2020; Hensel et al., 2022; Webb & Hayhoe, 2017),

natural resource management (Arthurs, 2018; Lally & Forbes, 2020), disaster prediction (Gromek, 2021), and environmental conservation. The work directly influences policy, societal health, and the sustainable future of our planet.

Geoscience education shapes students' comprehension of the Earth, its processes, and its history. The curriculum is a cornerstone for students to acquire essential knowledge and skills in the field. While curriculum definitions vary (see Bobbitt, 1918; Dewey, 1902; Gagne, 1985), here, it refers to the specific content, approaches, and materials used in educational settings, encompassing topic selection, integration of diverse perspectives and experiences, and methods to engage students effectively.

One critical aspect of the curriculum is how faculty selects and presents content. Within the geoscience curriculum, there is often a tendency to prioritize whiteness and perspectives from those racialized as white, thus marginalizing alternative viewpoints. This tendency reinforces dominant narratives and perpetuates inequities by disregarding, or illegitimatizing other ways of knowing (Carey et al., 2016; Yusoff, 2018). It mirrors the prevalent belief in contemporary science that objectivity can be achieved through rational observation and quantification, divorced from historical context (Aikenhead & Ogawa, 2007).

Moreover, curriculum content significantly influences students' comprehension of Earth's history, geological processes, and the contributions of diverse cultures and communities to geoscience (Cartier, 2021). However, when the curriculum predominantly influenced by white-dominat perspectives, from examples used, case studies covered, highligts a critical oversight in the academic representation of valid knowledge (Rogers et al., 2022). Such biases undermine the geological significance and contributions of other ways of knowing. Hence, it is

imperative to name how whiteness embedded in undergraduate geosciences curriculum manifests and identify how unseen privilege shapes knowledge.

The curriculum is not a neutral or objective entity (Kennedy & Robinson, 2023; Wahlstrom et al., 2023) but a product of the values, beliefs, and biases of those involved in its development and implementation. A study by Rigell et al. (2022) on whiteness within the curriculum revealed that whiteness is prominently centered at every curriculum level, influencing various aspects such as text selection and the organization of thematic grouping. Additionally, the authors identified discursive moves within teacher-facing materials, such as formulating essential questions for learning modules, that further perpetuate the centrality of whiteness. Such pervasive influence of whiteness throughout the curriculum emphasizes the need for critical examination and the challenge of its dominance. Therefore, faculty members are responsible for engaging in critical self-reflection and considering the potential limitations or biases in the curriculum they contribute to shaping.

Faculty

Higher education faculty are crucial in geoscience education as instructors, mentors, and knowledge producers (Dunlop et al., 2021; Gates, 2019). As such, their expertise and guidance shape students' learning experiences, influence the content and structure of the curriculum, and contribute to the advancement of the field. Understanding the roles of faculty members is essential for comprehending the dynamics of power and influence within geoscience education. First, geoscience faculty members are responsible for designing and delivering courses, conducting research, and advising students. Given the faculty's choices in how to teach and what to teach, they and their courses are sites that can serve as either "early roadblocks or entry ramps" to geoscience careers (Beane et al., 2019, p. 443). In other words, as gatekeepers of

knowledge, faculty significantly impact future geoscientists' intellectual and professional development.

In addition to their instructional responsibilities, faculty members play a significant role in shaping the geoscience curriculum (Ryker & McConnel, 2017; Todd & O'Brien, 2016). Their decisions regarding content selection, teaching methods, assessment strategies, and learning outcomes impact what knowledge is prioritized and how it is presented to students (Birney et al., 2019; Sommers et al., 2019). Thus, it is crucial to critically examine the extent to which whiteness is embedded into the curriculum.

By acknowledging and critically challenging the existing power structures, dominant narratives, and concealed biases rooted in whiteness and white supremacy within the geoscience curriculum, faculty members can actively and purposefully strive to create a more inclusive and equitable learning environment (McDaris et al., 2017; Rogers et al., 2022). This process necessitates a willingness to thoroughly examine their positions of privilege and an intentional commitment to ongoing professional development to enhance their understanding.

Faculty members possess the agency to deliberately disrupt and interrogate the prevailing paradigms within the geoscience curriculum (Mol & Atchison, 2019; Sherman-Morris & McNeal, 2016) by explicitly interrogating whiteness. Such an intentional approach can facilitate the development of a more comprehensive and nuanced understanding of the field. Furthermore, it equips students with the essential skills to navigate the intricacies of the geoscience discipline within an increasingly diverse and interconnected global context (Hensel et al., 2022; Posselt & Núñez, 2022).

Faculty engagement and critical examination of the geoscience curriculum together, then, hold the potential to transform the discipline into a more inclusive, culturally responsive, and

socially just educational experience (Metzger & Curren, 2017; Teasdale et al., 2020). Faculty members can advocate for change by challenging and disrupting these power dynamics (Burton et al., 2023; McGee, 2020; Monarrez et al., 2022; Nussbaum et al., 2017). Embracing critical pedagogies, incorporating diverse perspectives, and engaging in ongoing self-reflection and professional development, faculty members wield the power to create a more inclusive and anti-racist geoscience education. Through transformative approaches, faculty members can contribute to breaking down existing structural barriers and dismantle structures that produce inequity within the geosciences (Ricci & Riggs, 2019).

Problem Statement

Existing literature on geoscience education inadequately addresses the role of faculty members as gatekeepers within the discipline. While some studies touch upon racial biases and disparities in science, technology, engineering, and math (STEM) education, a critical gap exists in rigorously scrutinizing how faculty members consciously or unconsciously perpetuate whiteness in geoscience education. This gap hinders our comprehension of how faculty members, entrenched within broader power structures, construct and perpetuate white-dominant narratives, norms, and hierarchies within the geosciences. As such, faculty risk further perpetuating systemic inequalities in the field.

Already considered the least diverse field of science (Bernard & Cooperdock, 2018), geoscience grapples with challenges concerning racial inclusivity within its ranks. A glaring issue within the current curriculum lies in the disproportionate emphasis on whiteness, which further constrains students' grasp of the depth and breadth of the geosciences.

Consequently, the central issue is a lack of comprehensive examination and critical analysis of faculty members' roles as gatekeepers in geoscience education. Failure to address the

harms caused by whiteness, I argue will maintain whiteness as the norm and status quo. The untapped potential of faculty members as agents of change to challenge prevailing power dynamics and interrogate whiteness in the curriculum represents an opportunity for fruitful exploration.

Purpose Statement/ Research Questions

The purpose of the existing study was to examine how geoscience faculty actively interrogate whiteness in the undergraduate curriculum. By critically investigating how faculty members assess their curriculum, the study aimed to provide actionable insight and recommendations to promote equitable and anti-racist practices. Throughout the study, I actively avoided the pitfall of an "us vs. them" narrative, focusing on broader systems and structures. It is essential to recognize that the interrogation of whiteness is not about singling out individuals, as this issue can be upheld by faculty from various racial and ethnic backgrounds.

The following research questions guided the study:

RQ1. How are faculty members interrogating whiteness in designing and delivering geoscience curricula?

RQ2. What are faculty members' strategies, challenges, and successes in interrogating whiteness in designing and delivering geoscience curricula?

Rationale and Significance of Study

Answering the research question requires more than acknowledging geoscience's past wrongs. This work must be accompanied by a critical consideration of how it has been taught and embodied in the practice itself and how it has contributed to the problem. The research sheds light on educational environments' complicity in perpetuating whiteness by uncovering faculty members' strategies and challenges in disrupting whiteness in the curriculum.

Through this work, faculty can begin taking responsibility and be held more accountable for their positions of power and privilege. Furthermore, this study contributes to the emerging literature on faculty development around teaching and curriculum designing approaches that interrogate whiteness in geoscience education. By exploring how faculty members actively resist the normativity of whiteness in the curriculum, the research contributes to ongoing efforts to challenge systemic racism and promote social justice within academia.

Researcher Positionality

Social or educational research can never be value-free (Carr, 2000). As Holmes (2020) noted, "positionality requires that both acknowledgment and allowance are made by the researcher to locate their views, values, and beliefs about the research design, conduct, and output(s)" (p. 2). My positionality is unique and never fixed but situational and context-dependent. I recognize that this can impact all aspects of the research process (i.e., research encounters, choices of processes, and interpretations of outcomes).

My interest in conducting this study on whiteness in geoscience education stems from a commitment to addressing social inequalities. While it is essential to acknowledge that my position grants me certain privileges and may limit my personal experiences with racism, this very recognition motivates me to contribute to the dialogue and work toward positive change. Positioning myself as a white, cis-gendered, heterosexual man within the academic landscape of geoscience education, faculty, higher education, and society necessitates a critical interrogation of the privileges inherent to my identity.

As I navigate these spaces, I reflect on how my race, gender, and sexual orientation intersect to afford me unearned advantages within the discipline. I remain conscious of the role

that whiteness plays in shaping my experiences and interactions within academia and actively work towards dismantling the systems of power and privilege that perpetuate inequality.

Within the context of higher education, my whiteness operates as a normalized standard against which all other identities are measured. As a white male faculty member, I am positioned at the apex of this hierarchy, benefiting from institutionalized systems of privilege that have afforded me access to opportunities and resources unavailable to my colleagues from historically marginalized backgrounds. I recognize the privilege inherent in my position within the discipline is not solely a result of my merit but rather a reflection of the structural advantages afforded to individuals who resemble the dominant racial and gender narratives.

In interrogating my positionality within the discourse, I am confronted with how my identity intersects with systems of power and privilege. As a white, cis-gendered, heterosexual male, I am complicit in upholding systems of oppression that marginalize and exclude individuals from underrepresented groups. I must continuously and critically check my biases and complicity in perpetuating such systems and actively work toward dismantling them within my teaching, research, and service.

Assumptions

As I engaged with this study and shared my beliefs, I made explicit the assumptions that underlie my work. These assumptions shaped how I approached the subject matter and guided my research objectives. By clarifying these assumptions, I provide transparency and enhance the understanding of my perspectives.

Firstly, I have operated under the assumption that systemic racism exists within geoscience education and has significant consequences for racial groups from marginalized communities. Drawing from historical and contemporary evidence, I realize the presence of

discrimination and bias within the field. This assumption drove my investigation into the manifestations and impacts of whiteness in geoscience education.

I recognize that whiteness has historically been positioned as the norm or the default, leading to a lack of awareness about its pervasiveness and impact. As such, I approached the study assuming that whiteness influences educational structures, curriculum design, and pedagogical practices. I strive to critically examine its effects and explore how transformative actions can question and dismantle the normativity of whiteness within the discipline. This assumption emphasizes addressing systemic racial biases and promoting anti-racist practices in pursuit of a more inclusive geoscience educational environment.

I firmly believe in racial diversity and inclusion. I recognize the value that diverse perspectives, experiences, and knowledge systems bring to the field. This assumption fuels my commitment to promoting equitable opportunities and outcomes for all students, regardless of their racial backgrounds. In line with this, I assume that addressing racism in geoscience education requires more than individual-level interventions. I advocate for structural changes in curriculum, pedagogy, hiring practices, and institutional policies. Faculty can only create an equitable educational environment through comprehensive and transformative action.

I recognize and address the power dynamics and hierarchies within geoscience education and the broader academic context. Certain knowledge frameworks and dominant narratives privilege specific perspectives while marginalizing alternative ways of knowing, particularly those diverting from whiteness. With this awareness, my analysis of language, representation, and the construction of power relations in geoscience education aimed to directly interrogate and confront these systemic imbalances.

Finally, I believe change is possible. Through research, critical analysis, and collaborative efforts, we can disrupt existing power asymmetries in the field. I believe in the potential for transformative action and am dedicated to contributing to the ongoing discussion on racism in STEM education. I also operate under the assumption that the work challenging systems of power is a dynamic endeavor, one that is never fixed. As such, change is inevitable and necessary, and there will always remain work to be done.

In laying out these assumptions, I intended to provide transparency and enable a deeper understanding of the principles and perspectives that informed my study and beliefs. I welcomed dialogue, critique, and collaboration throughout this dissertation to help improve my understanding.

Definition of Terms

Curriculum

In education, the curriculum is the scope of courses and other learning opportunities available to a student. Curriculum is the plan for a certain amount of instruction within a certain period to enhance individuals' or groups' knowledge and/or skills. A plan that dictates what teachers teach in what order. Therefore, a curriculum is a coordinated set of courses to educate students. However, curricula are developed as an ongoing process to guide educators in delivering effective instruction and shaping students' knowledge, skills, and understanding in a coherent and meaningful manner (Marsh, 2004).

Faculty

Faculty refers to the academic staff or educators working in universities, colleges, or any other higher educational institutions. They are crucial in delivering instructional content, conducting research, mentoring students, and contributing to the academic community. Faculty

members can hold various ranks, such as professors, associate professors, assistant professors, lecturers, or instructors, based on their qualifications, experience, and academic achievements (Bess & Dee, 2012).

Gatekeeper

In the context of geoscience faculty in higher education, gatekeeper refers to the dominant group that holds power to control access to opportunities and resources within the academic environment, which are often based on established norms and values that predominantly reflect white perspectives. Faculty as gatekeepers influence the curriculum and perpetuate racial and ethnic homogeneity in maintaining the status quo of whiteness as the central framework in geoscience education.

Geoscience Education

According to the National Research Council (1996), geoscience education refers to the teaching and learning of earth sciences, encompassing various disciplines such as geology, meteorology, oceanography, and environmental science. It involves studying the Earth's processes, materials, and history to understand natural phenomena and dynamic systems. Geoscience education aims to create scientific literacy, critical thinking, and problem-solving skills related to geological and environmental issues.

Interrogating

Interrogating whiteness is a process of critically examining the social construct of whiteness (Dyer, 2017; Nancy, 2016). This process requires breaking down the historical, cultural, and systemic dimensions of whiteness, and analyzing how it shapes power dynamics, perpetuates privilege, and intersects with other social identities (Giroux, 1997). The academic

pursuit of interrogating whiteness aims to dismantle racial hierarchies and promote anti-racist scholarship and activism, and ultimately address systemic racism and social inequities.

Racism

As it relates to the geoscience curriculum, *racism* is defined as a system of beliefs, practices, and power dynamics that result in the marginalization, exclusion, or devaluation of individuals or communities based on their racial or ethnic background within the context of geoscience education (Picower, 2021). It involves perpetuating biases, stereotypes, and unequal treatment based on race, which can manifest in the geoscience curriculum's content, structure, and delivery (Solórzano & Yosso, 2002).

Syllabus

A syllabus (Latin, "course") is a list of courses and the corresponding descriptions, a detailed plan to be followed by students in a course. More specifically, a syllabus is a document that provides detailed information about a specific course within a curriculum. It outlines the course's objectives, content, schedule, assignments, grading criteria, and student performance expectations (Diamond, 2008). The syllabus acts as a roadmap for students and instructors, setting clear guidelines and promoting transparency regarding the course's structure and requirements.

whiteness

whiteness can be summarized as a socio-cultural and political construct that positions white people as the default standard of humanity, often perpetuating global white supremacy. This concept argues that whites, consciously or unconsciously, maintain a system where 'white,' 'normal,' and 'human' are synonymously intertwined, effectively dehumanizing others and reinforcing their privileged status (Freire, 1970). Often portrayed as the epitome of kindness and

benevolence, whiteness is a myth vigorously defended despite contrary perceptions by many people of color (McIntosh, 2012). Defense of these myths involves normalizing social spaces in ways that perpetuate white power and privilege, often under the guise of neutrality (Harris, 1993). According to Freire (1970), the oppressor's mindset, which in this context is attributed to whites, involves a mental dysfunction that views others as inanimate, thus stripping them of their human subjectivity and ability to produce emancipatory knowledge.

This perspective is further complicated as many whites perceive themselves as oppressed, especially in post-Civil Rights contexts where racial dialogues often focus on colorblindness or reverse discrimination against whites, influenced by white identity politics (Bonilla-Silva, 2006; Lipsitz, 1998). This framework of racial whiteness highlights a complex web of social, psychological, and political factors that uphold white dominance while marginalizing others. Moreover, while it may seem redundant for a white person to engage in the study of whiteness, it is essential to recognize that understanding and dismantling systems of privilege and oppression requires active participation from those who benefit from them. Whiteness operates as a normalized standard within society, often rendering its mechanisms invisible to those who embody it.

I feel it necessary to note the decision to employ lowercase 'white' over the conventionally capitalized 'white,' which prompts a critical examination of its potential implications regarding the visibility or invisibility of whiteness. At first glance, this linguistic choice might be viewed as inadvertently perpetuating the erasure or invisibilization of whiteness, thereby reinforcing the very power dynamics it seeks to challenge. The utilization of the lowercase representation brings with it a concern that it could obscure the recognition of white

privilege and the systemic advantages conferred upon individuals who identify as white within society.

In this view, the capitalization of ‘White’ might serve as a visual cue, drawing attention to the racial category and prompting critical engagement with its implications. Furthermore, I recognize that lowercase usage can be viewed as maintaining colorblind ideologies, which advocate for ignoring racial differences altogether. As a consequence, the decision to use lowercase’ white’ might inadvertently contribute to a narrative of racial neutrality, obscuring the historical and contemporary realities of racial inequality.

However, I commit to using lowercase as a deliberate strategy to challenge the normative privileging of whiteness within language and discourse. By disrupting the automatic capitalization of ‘white,’ I seek to subvert the assumption of white superiority and prompt critical reflection on racial hierarchies. This deliberate choice aims to foreground the pervasive influence of whiteness within societal structures and prompt a reevaluation of its implications.

Dissertation Outline

While the existing scholarship has made a significant contribution to the study of racism in geoscience education and its manifestation within the STEM field, there remains a dearth of research explicitly dedicated to examining the role of faculty members as gatekeepers in perpetuating racial biases and disparities. The following chapters of this dissertation aim to address this gap by providing a comprehensive literature review in Chapter Two. The literature review explored the historical context of racism in geoscience education, tracing its development and exploring key factors contributing to marginalized groups’ underrepresentation. Chapter Two also details how racism manifests and is perpetuated within the STEM field and critically analyzes the power dynamics, discourses, and hidden mechanisms that uphold racial biases and

exclusionary practices. In Chapters Three and Four, I described the methodological approach employed in this study and presented the results and data analysis, respectively. Finally, Chapter Five concluded the dissertation by synthesizing the findings, drawing conclusions, and offering recommendations for future research in the field of geoscience education.

CHAPTER TWO

LITERATURE REVIEW

"When you have only ever experienced privilege, equality feels like oppression."

— Adam Rutherford

The following literature review critically interrogates the manifestations of whiteness in geoscience education to illuminate the barriers and biases that impede equal and quitable opportunities in the field. Uncovering and dissecting these systemic inequalities helps develop a more nuanced understanding of the challenges of fostering an inclusive learning environment within geoscience education.

The interrogation of whiteness is not merely an academic exercise. Instead, it is a crucial aspect of dismantling discriminatory practices. This review sheds light on the mechanisms perpetuating exclusionary dynamics and hindering full participation by analyzing how whiteness operates within educational spaces. Only by confronting these entrenched power structures can pathways toward a geoscience community that embraces diversity and actively works to dismantle systemic inequalities be imagined.

Methods

I used Web of Science, Scopus, Google Scholar, and the Education Resources Information Center (ERIC) academic databases to search for literature. These databases offer wide-ranging collections of scholarly articles across multiple disciplines. To complement this, GeoRef, a geoscience database, was used to ensure coverage of field-specific journals and publications. Furthermore, the Science Education Resource Center (SERC) at Carleton College was utilized to capture a broader range of literature that might fall outside the confines of traditional databases. As for the search terms, my initial strategy was to pair geoscience

keywords like ‘geoscience,’ ‘geology,’ and ‘earth science’ with racism-related keywords such as ‘racism,’ ‘racial bias,’ ‘racial disparities,’ ‘diversity,’ ‘underrepresentation,’ ‘equity,’ and ‘inclusion.’ This ensured that I captured the broad range of literature that intersects these two areas. While broadening my search was necessary, being strategic in my exclusions was equally critical. For example, terms like ‘industry’ were excluded to ensure the focus remained on geoscience education. Similarly, I filtered out articles not explicitly aimed at addressing racial tensions, diversity, equity, or inclusion as a focus on scholars’ research.

The search was also time-bound to maintain relevancy. While the exact range was decided based on the project’s needs, most articles included were articles written in the last five years. However, given the limited scholarship, some articles did fall outside the time bounds. Lastly, I intentionally selected literature from scholars representing diverse racial, gender, and other backgrounds, which is crucial to conducting a comprehensive and inclusive literature review. This deliberate decision acknowledges the significance of diverse perspectives in enriching scholarly discourse and ensuring a balanced representation of knowledge. By incorporating works from scholars with varied backgrounds, the literature reviewed is intended to establish a holistic understanding of the broader scope, as it considers a more comprehensive range of experiences, ideologies, and cultural contexts. Additionally, incorporating varied voices allowed for exploring alternative viewpoints, ultimately enhancing the depth and quality of the literature review, and contributing to a more equitable and inclusive body of knowledge.

This literature review focused on exploring the manifestation of whiteness within the context of geoscience education. The initial search yielded a substantial number of articles, and through a systematic selection process, 110 relevant articles were chosen to organize the review. The literature review is organized into four sections: (a) historical context, which provides an

overview of the development of racism in geoscience education; (b) how racism manifests and is perpetuated within the STEM field; and (c) geoscience curriculum; which examines relevant models and approaches in teaching and learning. The review aimed to comprehensively understand the historical, curricular, student, and faculty dimensions of whiteness in geoscience education through these sections.

First, the historical context section will provide an overview of the topic's development over time, considering the contributions of diverse scholars. By highlighting these contributions, the review underscores the importance of incorporating diverse perspectives to explore the complex dynamics of racism within the field comprehensively. Second, I explore the geoscience curriculum. This section will delve into relevant models and approaches in geoscience education. Third, the student impacts section will explore the effects of the topic on students, including the experiences of diverse student populations. Fourth, the faculty dimension section will examine the role of faculty in the topic, focusing on the experiences and perspectives of diverse faculty members. Lastly, I conclude the literature review by summarizing gaps in the literature.

Historical Context of Racism in (Geo)science Education

This section provides an overview of racism in geoscience education, examining its historical context and current research. Like many other fields, geoscience education reflects societal norms and prejudices with a historical legacy of systemic racism (Yusoff, 2018). I explore how early geoscience knowledge was constructed by and for white males, leading to current racial biases. Whiteness-centered perspectives and biases have marginalized non-white contributions, which, in turn, reinforces racial hierarchies. Despite recent progress in the field, challenges remain, including stereotypes, biases, and the need for more diverse role models. Efforts to address these issues encompass diversity initiatives, curriculum reforms, mentoring

programs, and advocacy for equitable access to geoscience education. By examining such topics, we gain insights into the complexities of racism in geoscience education and the ongoing pursuit of racial equity and inclusion.

Science and white supremacy

The idea of the colonial responsibility for the world is expressed as the burden of the white man. In other words, a white, paternalistic belief is connected to a redemptive story of rescuing the world from harm caused by others while preserving an innocent and protective facade. Due to the close association between scientific research and colonial endeavors, what Sammel (2009, p. 653) calls the "western science ontology" has a troubling past of utilizing Bodies of Color for the purposes of knowledge and wealth accumulation (Deb Roy, 2018; Wynn-Grant, 2019). To begin the discussion of addressing the legacy of colonial and exclusionary foundations, I turn to what Marín-Spiotta et al. (2020) argues that the "foundations of our scientific and educational institutions in today's academic culture, structures, and practices need to be acknowledged for effective interventions" (p. 123). In otherwords, for meainingful and impactful change in academia, it is crucial to recognize and understand the underlying principles and norms that have shaped the foundations of our scientific and educational institutions. Given today's academic culture and its stuructures and practices have been built on these foundations, acknowledging the elements is essential for implementing effective interventions to address and break free from systemic biases and disparities within such institutions. As such, a brief historical context of western science follows in an attempt to begin mapping the contours of the past's hidden whiteness.

Scholars such as Yusoff (2018), Wynter (2015), Hartman (1997), and Sturgeon (2009) have recognized for a long time that in the western world, ideology presents itself as a standard

and unquestioned understanding of reality. It portrays the existing state of affairs as natural, as if it were somehow meant to signify a way that has always been. It is essential to the particular structure of western post-Enlightenment ideologies, or what Foucault (1980) refers to as the rise of "biopower." Arguments from the natural perspective often disregard the historical context and fail to acknowledge the changing nature of social relationships. As Sturgeon (2009) astutely notes, "western ideology always presents those who are seen as more natural (including natural resources themselves) as ultimately destined to "develop" to become part of a commercial, commodified system" (p. 13). This line of reasoning has also proved consequential for scientific rhetoric. For a significant period, arguments grounded in the concept of nature have been employed to rationalize various social phenomena, including disparities in educational achievements based on race and culture, athletic, academic, or work capabilities among genders, and the moral evaluation of same-sex relationships.

Despite inconclusive evidence, attempts to discover biological justifications for such social differences continue. This is not to deny the existence of biological distinctions among different groups of individuals but rather to highlight the historically questionable nature of endeavors aimed at uncovering such differences.

Racism in geoscience education

Racism in geoscience education, as in many other fields, reflects broader societal norms and prejudices. Science cannot exist in isolation from society; instead, it relies on society's influence to exert its impact (Kelly et al., 1993). As Kelly and colleagues (1993) argue, the social determination of "scientific status" underscores such an interdependence (p. 211). This implies that society actively shapes scientific endeavors, as Longino (1990) emphasized. Consequently, science can be viewed as a direct outcome of the societal context in which it originates (Kelly et

al., 1993). Much in the same way that science emerges within a framework rooted in white supremacy, it unavoidably becomes subject to the influence of white supremacy.

This case in point is exemplified by geology. In the U.S. and many other countries, geosciences (i.e., geology, oceanography, stratigraphy, paleontology) were developed coterminously with other fields of science during the Enlightenment era. This period was marked by systemic racism (Rogers et al., 2022), where racial and ethnic individuals and communities were denied equal access to educational and professional opportunities (Bernard & Cooperdock, 2018). As McCausland (2022) considered the moment race was politically constructed, science "was used" to justify claims of the white race as "superior" (p.119). As a result, early geoscience knowledge and education were constructed mainly by and catered to white men, embedding a white ideology racial bias that can still be seen today (Stokes et al., 2015/2019).

Previous ideological standpoints in geoscience, rooted in the colonial mindset, have also primarily upheld whiteness. This has led to the overlooking or marginalizing of contributions from non-white communities. As Rogers et al. (2022) stated, the scholarly study of Earth's transformations across time is a comparatively recent discipline, originating around the latter part of the 18th century. They suggest this emergence is driven by multiple factors, including enhanced mobility enabling individuals to traverse and scrutinize vast terrains, exploit resources, and an increasing interest in comprehending Earth and its composite systems.

This bias manifests in multiple ways. First, it is evidenced in the underrepresentation of knowledge from non-western geoscience (Carey et al., 2016) and the insufficient recognition accorded to Geoscientists of Color (Trisos et al., 2021), and in the emphasis on the prevalent of whiteness in numerous geoscience curricula and textbooks (Bush & Mattox, 2020; Stokes et al., 2015). For instance, Peake and Kobayashi (2002) elucidated that this work's epistemological

foundations are permeated with various, often concealed, racist practices and discourses. Secondly, bias manifests in institutional structures. Dzombak (2020) warns that such deeply entrenched institutional structures are reflected in the hiring practices that uphold whiteness and warrant redress to prevent institutions from becoming hostile environments. As such, whiteness, as the standard of knowledge and being, not only narrows the scope of geoscience education but also reinforces racial hierarchies and stereotypes.

Thirdly, to examine biases further, we can look further into the historical lack of diversity in geosciences. O'Connell & Holmes (2011) point to contributing factors such as the inaccessibility of education and resources Students of Color receive due to socioeconomic disparities and systemic biases, as well as the geographic locations of geoscience departments and field studies, which are often situated in areas inaccessible to or traditionally not inhabited by diverse populations. McGee (2020) builds on previous scholarship by looking at the lack of diversity through a cultural framework to examine the perception of geosciences as a "white" field and the lack of diverse role models. "Much of the mentoring literature is flawed, as it misidentifies, minimizes, or downplays underrepresented minority (URM) students' plight in STEM participation" (McGee, 2020, p. 5). Their findings suggest mentoring programs help develop a sense of belonging, improving self-efficacy.

Thus, it can be argued that the lack of representation or diversity, which is the externality of whiteness in the form of institutional racism, discourages historically marginalized groups from actively participating in the geosciences (Huntoon & Lane, 2007).

Legacy of Historical Events and Implications in Present-Day Geosciences

Holmes et al. (2016) argue that the legacy of historical biases can be seen in the persistent racial disparities in geoscience education today. For instance, segregation and racial exclusion

from the early 20th century still influence the underrepresentation of certain racial and ethnic groups in the geosciences. Additionally, Kastens and Ishikawa (2006) maintain that historical prejudices and stereotypes continue to contribute to the lack of recognition for non-white contributions to the field, creating an environment that can discourage the participation of diverse students (Steele, 1997).

Despite progress, many challenges remain in achieving racial equity in geoscience education. Huntoon et al. (2016), for instance, found barriers to include persistent stereotypes, unconscious biases, microaggressions, lack of diverse role models, financial barriers, and the isolating experience of being a racial minority in geosciences. Similarly, Marín-Spiotta et al. (2020) noted that "harassment, bullying, microaggressions, sexism, racism, homophobia, transphobia, etc., are prevalent" not just in the geosciences but "in academia" in general (p. 119). St. John et al. (2020) maintain that harassment in all forms creates a toxic work and learning environment that is stressful, unethical, and counterproductive. However, little research has focused specifically on sexism encountered in geosciences education or related disciplines that share teaching and learning environments, such as fieldwork (Clancy et al., 2015; Dutt et al., 2016). Ongoing efforts to address these challenges range from diversity and inclusion initiatives in universities and professional organizations, curriculum reforms, and mentoring programs to policy advocacy for more equitable access to geoscience education (Diniega et al., 2016; Hernandez et al., 2018; Ryan-Davis & Scalice, 2022).

Overall, examining racism in geoscience education reveals a historical legacy of systemic biases and a current landscape that struggles with racial equity and inclusion. The previous description suggests that white supremacists distorted the course of scientific inquiry. However, it is essential to acknowledge science's contextual nature, as Kelly et al. (1993) and Longino

(1990) emphasized. White supremacy's influence on science arises from the interaction between the scientific community and society (Kelly et al., 1993; Kuhn, 2012). Consequently, in a society marked by racial divisions, it is unsurprising that scientific investigations would explore race-related questions and potentially produce theories that align with the prevailing value system. It is essential to clarify that this does not imply that science is inherently racist but that it can be co-opted by white supremacy. Such framing suggests that "science provided the legitimization for whiteness to take root" (Sammel, 2009, p. 652), recognizing the mutual constitution of science and white supremacy.

Furthermore, geology and similar studies, developed during periods marked by systemic racism, primarily catered to and reflected the perspectives of white men, resulting in persistent racial biases and racism. Curricula rooted in whiteness, the underrepresentation of other geoscience knowledge, and the lack of recognition for non-white geoscientists exemplify the ongoing biases within the field. Despite progress driven by policies like the Civil Rights Act of 1964, geoscience education has not achieved proportional racial diversity. The persistence of stereotypes, unconscious biases, microaggressions, and the scarcity of diverse role models further hinder the participation of racially diverse students.

Racial manifestations

This section explores the manifestation of racism within STEM fields and the urgent need for interventions to address racial biases and promote inclusivity. As a researcher in this field, I aim to contribute to the broader discourse by shedding light on the specific manifestations of racism within geoscience education and exploring the strategies to dismantle oppressive structures and foster a more inclusive STEM learning environment. I first examine shared patterns of racism in STEM, including underrepresentation and racial biases in grading, hiring,

mentoring, and collegial interactions. Taking a closer look at language and representation of how language used in geoscience education constructs power relations and perpetuates dominant narratives. Finally, I examine the intersection of subjectivity and identity construction with geoscience education, recognizing the socially constructed nature of subjectivities and the influence of broader cultural and institutional contexts. Navigating these key areas makes it possible to uncover the need for transformative practices that can dismantle oppressive structures and foster inclusive and equitable STEM education.

Manifestation of Racism within STEM Fields

Numerous studies have highlighted racial biases and inequities within STEM fields (Bernard & Cooperdock, 2018; Bush & Mattox, 2020; Cooper et al., 2019; Dolphin et al., 2018; Fairfax & Brown, 2019; Hall et al., 2022; Ong et al., 2018). For instance, research by Moss-Racusin et al. (2012) revealed that science faculty from research-intensive universities exhibited significant bias favoring men over equally qualified women and were more likely to mentor or hire white students than Students of Color. Another study by Ong et al. (2011) found that students from historically underrepresented communities in physics and astronomy often faced racial stereotypes and microaggressions, negatively affecting their educational experiences and career trajectories. Such studies expose systemic racism and bias within STEM education and highlight the need for targeted interventions.

The findings reveal systemic issues (Bernard & Cooperdock, 2018; Monarrez et al., 2022; Sherman-Morris & McNeal, 2016), including racial biases in mentoring and hiring (Bililign, 2019; Karsten, 2019; McGee, 2020), underrepresentation of students of Color (Bush & Mattox, 2020), and the prevalence of racial stereotypes and microaggressions (Nuñez et al., 2020; Weissmann et al., 2019). The implications of these findings are significant, indicating that

systemic changes are needed to achieve equity in STEM education, such as unconscious bias training, mentorship programs for underrepresented students, and inclusive curriculum and pedagogy.

Science does not exist in a vacuum. Like other STEM fields, geoscience education suffers from racial biases and the underrepresentation of historically marginalized groups. However, the issue might be more pronounced in geoscience due to several unique factors. First, geoscience has historically been even less diverse than other STEM fields (Gaynor et al., 2022; O'Connell & Holmes, 2011; Ricci & Riggs, 2019; Scarlett, 2022). Second, geoscience often involves fieldwork, which presents additional barriers for students of color, such as financial cost, physical accessibility, and issues related to safety and inclusion (McDaris et al., 2019; Posselt et al., 2019; Sexton et al., 2020; St. John et al., 2016; Stokes et al., 2015). Lastly, geoscience also tends to be less integrated into the K-12 curriculum compared to other sciences, which can limit early exposure and interest among underrepresented students (Lewis & Baker, 2010).

Shared Patterns of Racism

A pattern commonly observed across STEM disciplines is the underrepresentation of students from historically marginalized communities. Enrollment, graduation rates, and faculty and professional representation are evidence of this. For example, the National Science Foundation's (NSF) (2019) report on Women, Minorities, and Persons with Disabilities in Science and Engineering indicated that in 2018, Blacks, Hispanics, and Native Americans, who constitute over 30% of the U.S. population, accounted for only 21% of bachelor's degrees in science and engineering. Racial discrimination is another shared pattern, often manifesting as bias in grading, hiring, mentoring, and collegial interactions. STEM curricula often reflect a

white perspective, marginalizing other scientific contributions and worldviews. Recognizing the underrepresentation of faculty and students in STEM disciplines is essential as it highlights the need to address racial discrimination, broaden perspectives, and ensure equal access to educational opportunities.

As Cohen and Steel (2002) noted in their study stereotypes, academic performance can be negatively affected due to stereotype threat, a psychological phenomenon where awareness of negative stereotypes about one's racial or ethnic group leads to anxiety and reduced performance. Career choices can also be influenced, as students who experience discrimination or lack of support may be discouraged from pursuing careers in STEM.

In a similar study regarding stereotypes, Steele and Aronson (1995) contend that the cumulative effects of bias, discrimination, and exclusion can lead to mental health challenges for students, manifesting as increased stress, anxiety, and feelings of isolation. However, these claims often overlook the profound impact of oppressive institutional systems and neglect to recognize the humanity inherent in Students of Color (Le & Matias, 2019). Research by Cohen and Steel (2002) and Steele and Aronson (1995) has predominantly focused on explaining the underperformance of Students of Color compared to their white peers. Contrasting this view, Noguera (2003) argues that such a stance unfairly places the onus on Students of Color while neglecting the broader, inequitable dynamics within schools and the harmful consequences of racially biased educational practices.

While recognizing the damaging impact of stereotype threat, discrimination, and exclusion, this discourse falls short in examining the ingrained oppressive institutional systems that maintain these disparities. The focus tends to be overly concentrated on the individual experiences and characteristics of Students of Color, thus underemphasizing the systemic racism

prevalent in educational institutions and the broader societal factors contributing to inequities in academic performance. The underlying implication in this narrative is the misplaced responsibility of the individual students to overcome these challenges without a critical examination and dismantling of the structures of white supremacy that contribute to these inequities.

Interventions or Strategies

Various individual, institutional, and policy interventions have been proposed to tackle racism in STEM education. Individual-level interventions often focus on increasing awareness of implicit bias among faculty and students, as shown by Devine et al.'s (2012) study on reducing implicit racial bias. Institutional interventions might include efforts to improve recruitment and retention of underrepresented faculty and students, such as the NSF's ADVANCE program (National Science Foundation, 2021), to increase the representation of women in academic science and engineering careers. Policy interventions often promote systemic change, like altering admission policies to improve diversity and equality or legislating for funding initiatives to support underrepresented students.

The efficacy of these strategies varied. While implicit bias training can increase awareness, its effect on changing behavior remains unclear (Devine et al., 2012). Institutional changes like NSF's ADVANCE program have seen some success in improving faculty diversity, although progress is slow. Policy interventions can also be impactful, but they often require robust implementation and ongoing commitment from the institutions involved. A comprehensive study by the American Institutes for Research (2012) noted improved recruitment, retention, and institutional commitment when such policies were implemented effectively.

Conversely, Le and Matias (2019) argue that educators who attend workshops to learn about best practices to teach diverse students often center diversity on dominant ideologies. This is in alignment with what Yancy (2008) refers to in his book, Black Bodies, White Gazes, as liberal, white educators, feeling of "exotica without having their perspectives critically challenged" (p. 43). While attempts to celebrate diverse or "[O]ther" students (Le and Matias, 2019, p. 43) is neccessary, whiteness is still positioned in such a way that keeps Students of Color marginalized and silenced (Arminio et al., 2000). Therefore, to move past the exotica, we must find ways to encourage discussions of racism, whiteness, and systems of oppression and power that promote or lead to critical self-reflection that examines internalized whiteness and white ideologies. As Applebaum (2017) reminds us, anti-racist pedagogy is not a state but a continued practice.

In summary, it becomes evident that the proposed interventions to address racism in STEM education encompass various levels of engagement, from individual to institutional and policy-based approaches. However, it is crucial to recognize these strategies' limitations and potential pitfalls. This section underscores the need for deeper engagement with discussions of racism, whiteness, and systems of oppression and power. It calls for critical self-reflection to examine internalized whiteness and challenge prevailing ideologies. Moving beyond the tokenization of diversity requires a shift towards transformative approaches that dismantle oppressive structures and foster inclusive STEM education.

The individual-level interventions aimed at raising awareness of implicit bias have shown some promise in increasing consciousness but may need to improve in effecting behavioral changes. This raises questions about the underlying power dynamics and structural influences perpetuating discriminatory practices within educational settings (Devine et al., 2012).

Institutional interventions, such as programs like NSF's ADVANCE, contribute to improving faculty diversity, yet progress still needs to be improved.

These initiatives often operated within existing power structures, potentially reinforcing dominant ideologies while marginalizing alternative perspectives. This can limit the transformative potential of diversity efforts by (re)centering whiteness (McIntyre, 2002; Picower, 2009; Yancy, 2012) and failing to critically challenge the prevailing systems of oppression by maintaining what Le and Matias (2019) refer to as "safe multiculturalism" (p. 23). Policy interventions can potentially drive systemic change, but their effectiveness relies on robust implementation and ongoing institutional commitment. The successful implementation of policies can lead to improved recruitment, retention, and institutional dedication to combating racism (American Institutes for Research, 2012). However, it is essential to recognize that systemic change cannot occur without engaging in critical self-reflection that challenges internalized whiteness and dismantles oppressive power structures (Arminio et al., 2000).

A comprehensive and integrated approach is necessary to combat racism in STEM education. This approach should encompass sustained commitment beyond initial changes, addressing systemic barriers faced by underrepresented students, promoting diversity among faculty and mentors, and ensuring the curriculum acknowledges the contributions of scientists from diverse backgrounds. By actively engaging in discussions of racism, whiteness, and systems of power, it becomes possible to foster critical self-reflection and challenge the perpetuation of oppressive ideologies in education (Arminio et al., 2000).

Biases and Stereotypes

In this section, I examined biases and stereotypes in geoscience curricula and instructional practices, focusing on their impact on the learning experience of racially diverse

students. I begin by discussing the biases embedded within the geoscience curricula, such as its white focus and the underrepresentation of diverse cultures and contributions. These biases can perpetuate stereotypes about who belongs in the field and create a sense of alienation among students. Additionally, I explore how biases can manifest in various aspects of the curriculum, from study materials to language and examples used. The section also addresses how biases can permeate the broader learning environment, influencing teacher behavior and peer dynamics. Finally, I highlight promising modifications in curriculum and teaching practices that address biases and promote inclusivity, such as incorporating diverse cultural perspectives, contextualizing geoscience within relevant social issues, and providing anti-bias training for educators.

Stereotypes Embedded within the Geoscience Curricula

The geoscience curricula has been critiqued for its focus on white ways of knowing, often overshadowing other cultures' scientific contributions (Alexiades et al., 2021; Hall et al., 2022; Masta, 2018; Riggs, 2005/2012). For example, Riggs (2012) highlights the overwhelming prevalence of Western theories and discoveries in the geoscience curriculum, whereas the contributions of non-Western cultures are often overlooked. As Le and Matias (2019) emphasized,

> Science has a very strong Western (otherwise, White) origin. While there have been efforts by philosophers, feminist scholars, critical race scholars, and multiculturalists to point out the importance and history of non-Western science, it still does not change the fact that science runs on the institutions and practices that are influenced by western European civilizations (p. 22).

Complementary to this, Bala and Gheverghese Joseph (2007) recognized that some scientists hold the (mis)conception that incorporating indigenous knowledge into the field of science may lead to the introduction of pseudoscience or anti-science perspectives. As a construct, whiteness can marginalize and exclude non-western knowledge by asserting authority over what qualifies as legitimate knowledge (Bonilla-Silva, 2003).

According to Ryan (2008), western science gained prominence and was perceived as universally correct, leading to its imposition on other countries and cultures during European exploration and colonization. This historical context influenced current attitudes towards valid knowledge and how western nations teach science, which often disregards indigenous communities' values and culture. Ryan (2008) argues that this disconnect between science education and the experiences of Students of Color reflects post-colonial discourses of white power and control, as western science knowledge is imposed and internalized.

Several studies suggest that biases in the geoscience curriculum can also perpetuate stereotypes about who belongs in the field. Tanner (2013) underscored that the predominance of scientists in textbooks and course materials is portrayed as white men. This framing reinforces the stereotype that geoscience is a field for white males. In a study examining gender and racial bias in physical geology textbooks, Bush and Mattox (2020) found that rather than representing the 49% of women who make up early career geologists, the books' ratios were 2:1, favoring men.

> The disproportions become even more exaggerated as we combine race and gender. Reynolds and colleagues (2019) and Marshak (2019) both included photos of nine minority geoscientists (18 of 264 photos). Only two texts in our limited survey have at least one photo of each minority male. No text showed

> women of all three races we identified. Overall, female African-American and Asian scientists are rarely portrayed (10 of 153 female scientists). Of the 567 depictions of scientists, not a single one showed an identifiable Latina. Our study demonstrates continued gender and racial bias (Bush & Mattox, 2020, p. 5)

Implicit biases can be conveyed through various aspects of the curriculum, from the choice of study materials to the examples used. For instance, using case studies that predominantly feature settings or contexts with predominantly white people may inadvertently marginalize students from other backgrounds. The language used in course materials, such as gendered language or jargon, can also perpetuate biases and create barriers to inclusion (Schuster et al., 2015). Additionally, the geoscience field tends to prioritize certain types of work, such as fieldwork conducted in outdoor settings, while undervaluing or marginalizing lab-based or theoretical work. This emphasis on traditional geoscientist roles and practices can create barriers and exclusionary dynamics for individuals who do not conform to the conventional expectations or stereotypes associated with the field (Atchison & Libarkin, 2016; Carabajal et al., 2017; Crenshaw et al., 2013).

Here, we have a strong reinforcement of what Esson (2018) calls the "remarkably persistent 'whiteness' in geo-education" (p. 709). The absence of attention to race allows racial injustice, structural and institutionalized racism, white supremacy, and white fragility to continue. Of relevance here is the research of Faria and Mollett (2013) that points out that the absence of race is part of the perseverance of racial oppression, in which whiteness remains the unspoken norm. These biases not only shape the content of the curriculum but also manifest in the broader learning environment, influencing teacher behavior and peer interactions. The presence of racial and gender biases within geoscience textbooks and instructional materials

perpetuates stereotypes and exclusionary practices, reinforcing the notion of geoscience as a field primarily for white men. The language used, and the types of work valued within the discipline further contribute to barriers underrepresented students face.

Modifications in Curriculum and Teaching Practices

It is only recenntly that researchers in the geoscience have begun to examine systematic biases and its effects. There were many case studies where modifications have been made to address biases and promote inclusivity. For example, the NSF-funded “InTeGrate” project has developed curriculum modules that emphasize the contributions of diverse cultures in geosciences and tie geoscience learning to societally relevant issues (Fortner et al., 2020; Gilbert et al., 2019; Manduca et al., 2018; Teasdale et al., 2018). According to Gilbert et al. (2019) and van der Hoeven Kraft et al. (2011) research into InTeGrate as a valid model has demonstrated the appeal of course-related topics of underrepresented populations within the geoscience and has also shown to increase self-motivation, self-efficacy, and learning.

Despite engaging curricula, there is still a gap in their application to larger classrooms and standard introductory courses, as Teasdale et al. (2018) pointed out. This gap highlights the need for faculty at educational institutions to adapt their pedagogical approaches to foster cultural humility and anti-racist ideologies. Nonetheless, Haynes and Patton (2019) point out that many faculty members, particularly those in the STEM fields, believe that discussions about race, racism, power, and privilege are discipline-specific, excluding these vital issues from their courses.

Unfortunately, this perspective provides an escape for faculty members from addressing equity issues within their neutral subjects. This issue is compounded when white faculty members, often oblivious to their racial privilege, consciously or unconsciously disregard its

influence on their behavior, course design, and instruction (Charbeneau, 2015; Haynes & Patton, 2019; Sue et al., 2009). This situation demonstrates the need for a comprehensive transformation in academia, encompassing a broader understanding of discipline applicability, faculty awareness, and inclusive teaching practices. Such a transformation aims to counter what Sullivan and Tuana (2007) described as "white ignorance," a mindset that supports a delusion of white racial superiority and contributes to the perpetuation of inequities within the educational system (p. 3). Charbeneau (2015) addressed the hegemony of whiteness in university classrooms and challenged it through pedagogical practices. The study explored the implicit roles of white faculty in maintaining or upholding white supremacy, including expressing racial awareness by disclosing personal whiteness, acknowledging and attending to plurality and revealing patterns of white hegemony, and challenging white supremacy by creating alliances and acting to alter structures and cultures.

Similarly, Gordon (2007) identified that white faculty members are often unsure of their role in making their campuses more welcoming for historically marginalized students. They often do not see the connections between inclusivity (e.g., issues of race and socioeconomic status) and their disciplines; they may be uncomfortable discussing social justice issues such as race and privilege (Gordon, 2007; Haynes, 2017). However, simply positioning white faculty as passive or unwitting agents within a system of white supremacy fails to account for the active role they might play in sustaining or challenging the racialized status quo.

While efforts to modify the curriculum and teaching practices have shown promise, the remaining gap highlights the need to go beyond surface-level changes. More recently, Matias and Boucher (2023) have argued that simply incorporating diverse perspectives or contextualizing geoscience within societally relevant issues inadvertently reinforces the existing

power structures without critical self-reflection and reexamining the underlying oppressive systems. It is essential to acknowledge that the absence of race in the curriculum is a product of racial oppression, allowing whiteness to remain the unspoken norm.

Within the context of geoscience education, Matias (2016) advances the notion of examining biases and stereotypes within geoscience curriculum and pedagogy reveals the entrenchment of power dynamics and oppressive structures that perpetuate inequities. The whiteness of the geoscience curricula and the underrepresentation of diverse cultures reflect white dominance knowledge systems and reinforce white hegemony within the discipline. The curriculum maintains a status quo that upholds white supremacy by marginalizing other perspectives and contributions that challenge whiteness as normalcy. Still, the need remains to emphasize the importance of challenging the existing power dynamics, engaging in critical self-reflection, and dismantling the structures perpetuating oppression. Faculty must adopt pedagogical approaches that incorporate diverse perspectives and actively challenge and disrupt the dominant ideologies that uphold white supremacy.

Gaps in the Current Knowledge

The growing body of literature on racism in geoscience education encompasses various topics, from analyzing racial disparities in participation and achievement to examining biases in curriculum and teaching practices. The findings generally point to substantial racial disparities and biases in geoscience education, but the conclusions vary depending on the specific focus and context of each study (Bernard & Cooperdock, 2018; Bush & Mattox, 2020; Holmes et al., 2015; McGee, 2020 Núñez et al., 2020; O'Connell & Holmes, 2011; Ryan-Davis & Scalice, 2022). The predominance of research focusing on racial disparities and biases, while crucial, leaves unexplored the foundational systemic and institutional mechanisms that sustain such inequalities.

Such oversight signals a crucial investigation area, particularly examining how curricula and pedagogical practices embed and perpetuate whiteness, thereby excluding diverse epistemologies and perspectives.

One strength of the existing research is its increasing attention to the *systemic* nature of racism in geoscience education, highlighting the need for structural changes rather than just individual-level interventions (Burton et al., 2023; McGee, 2020; Monarrez et al., 2022). However, despite the increasing volume of research on racism in geoscience education, there remain gaps in representation. Studies often focus on the experiences of specific racial or ethnic groups, such as Black or Brown students. While these studies reveal what is already known about geoscience's lack of diversity, missing from the literature is the system structures in place that allow the continuation of white supremacy.

Current literature on racism in geoscience education reflects biases in research focus. There is a heavy concentration on exploring the racial disparities in participation and achievement. At the same time, relatively less attention is paid to investigating the systemic structures and institutional practices contributing to these disparities. For example, Hall et al. (2022) provided a call to action for promoting diversity, equity, inclusion, and justice in geoscience education by recognizing the historical context of geoscience knowledge and promoting inclusive teaching practices (i.e., diversifying sources, integrating historical context, connecting across geographies, champion material transformation). The authors argue that promoting diversity in geoscience education can help address systemic inequalities and biases that have historically excluded marginalized groups from accessing geoscience knowledge and resources.

Begum and Saini (2019) propose a call to "decolonize the curriculum" because it "specifically acknowledges the inherent power relations in the production and dissemination of knowledge, and seeks to destabilize these, allowing new forms of knowledge which represent marginalized groups - women, working classes, ethnic minorities, lesbian, gay, bisexual, and transgender to propagate" (p. 198). As such, the field of geoscience education is shaped by discourses and power structures that influence the knowledge frameworks and narratives privileged within the discipline. Yusoff (2018) more notably indicates that traditional knowledge frameworks, often rooted in whiteness, have historically privileged white people and white epistemologies while illegitimate other ways of knowing. This privileging of specific knowledge systems perpetuates power dynamics that reinforce existing hierarchies (Foucault, 1980) and contribute to the underrepresentation of diverse voices within geoscience education. These discourses are not neutral; they are infused with power dynamics that shape what is considered valid and authoritative, perpetuating a dominant narrative that can reinforce existing inequities. The dominance of these discourses perpetuates whiteness as the norm, marginalizing and silencing diverse voices and knowledge systems, thereby reinforcing the existing racial and epistemological inequities within geoscience education and broader academic contexts.

Furthermore, the limited scrutiny of faculty roles as gatekeepers in the geosciences represents a significant gap that this study addresses. Faculty members are not mere conveyors of knowledge but are actively involved in shaping the curriculum, setting the norms for acceptable knowledge, and influencing their departments' academic and social climate. Their actions and decisions can either perpetuate the status quo or become a catalyst for change. By critically examining how faculty members embed and sustain whiteness in their curricular and pedagogical choices, this study aims to illuminate the hidden mechanisms through which racial and

epistemological inequities are maintained. This inquiry is crucial for developing strategies that challenge these entrenched dynamics. As such, examining the role of faculty members as gatekeepers in the geosciences can shed light on the hidden power dynamics at play and provide insights into strategies for disrupting and challenging these dynamics.

This research is warranted by the need to move beyond identifying disparities to understanding the underpinnings of these inequalities. The aim is to contribute to the broader efforts of promoting diversity, equity, inclusion, and justice in geoscience education by providing necessary insights into the systemic changes necessary to dismantle the perpetuation of whiteness.

Chapter 3

"White privilege is an absence of the consequences of racism. An absence of structural discrimination, an absence of your race being viewed as a problem first and foremost."

— Reni Eddo-Lodge

METHODOLOGY

I employed a methodological framework of critical qualitative inquiry and narrative to explore how geoscience faculty members interrogate whiteness in undergraduate curricula. More specifically, I investigate the intentional efforts made by faculty to challenge the normativity of whiteness in designing and delivering curricula in the classroom. In this chapter, presented are: (a) the study's conceptual framework; (b) the research traditions underpinning this project (critical qualitative and narrative inquiry); (c) the settings, participants, and data collection methods; (d) the rationale behind choosing these methods; and (e) the detailed settings and participants of this study.

Conceptual framework

I used Critical Whiteness Studies, Curriculum Theory, and Transformative Learning Theory as a conceptual framework to guide this study. Each aspect of this framework provided a unique lens through which I analyzed faculty members' experiences as they navigated the complexities of interrogating whiteness. The first aspect, rooted in Critical whiteness Studies, explored how faculty members actively resist the normativity of whiteness in the geoscience curriculum. The second aspect, grounded in Curriculum Theory, explored how faculty members' intentional redesign of the geoscience curriculum. I examined how faculty members critically examine the hidden curriculum, which sought to make explicit the implicit messages perpetuating whiteness. Finally, I employed Transformative Learning Theory as the third aspect

of the framework. This allowed for exploration into how faculty members engage with disorienting dilemmas, embrace moments of racial discomfort, and undergo perspective transformations.

Critical whiteness Studies

Critical whiteness Studies (CwS) emerged as a response to recognizing the historical position of whiteness as the normative standard in various aspects of society, including education (Bonilla-Silva, 2003; Harris, 1993; Leonardo, 2009). DiAngelo (2011) asserts that American society insulates white Americans from having to think meaningfully about race and racism. In the geoscience curriculum, the dominance of whiteness has perpetuated the marginalization of other cultural and epistemological perspectives (Rogers et al., 2022). CwS seeks to identify and critique the power and privileges associated with white hegemony and white normativity in institutions of higher learning (Applebaum, 2017). Scholars using CwS aim to expose invisible structures and systems that perpetuate and even strengthen white hegemony and privilege (Pugh et al., 2019).

CwS challenges the white hegemonic views seeking to dismantle the dominance of whiteness (Connors et al., 2019; Dyer, 2017; Kendi, 2019; Najdowski et al., 2021). Faculty members who adopt this critical approach can be viewed as intentionally resisting the white normativity of whiteness. While CwS has been valuable in challenging white supremacy, it must not become complacent in its pursuit of critical inquiry (Dyer, 2006). Much like Dyer's belief, "the point of looking at whiteness is" not to center whiteness, but rather to "dislodge whiteness from its centrality and authority" as to "not reinstate it" (2006, p. 10). CwS research prioritizes studying whiteness not for its own sake but for the liberation and humanization of individuals and groups oppressed by whiteness. Therefore, to uncover whiteness, representations of

whiteness must be traced along the contours of the racialized regime of representation (Frankenberg, 2001; hooks, 1992).

Resistance to whiteness Normativity

Resistance to whiteness normativity refers to the deliberate efforts made by individuals or communities to challenge and disrupt the pervasive dominance of whiteness as the norm or default in society (Leonardo, 2013; Matias & Boucher, 2023). White normativity encompasses the idea that white culture, perspectives, and experiences are seen as the standard or ideal. At the same time, other racial and ethnic identities are marginalized or considered deviations from this norm (Morris, 2016). As Gusa (2010) notably argues, resistance to whiteness normativity involves questioning and dismantling the entrenched assumptions and practices perpetuating this unequal power dynamic.

In geoscience education, faculty members may interrogate whiteness by intentionally challenging unmarked normativity in their knowledge of geoscience and teaching methods (Rogers et al., 2020). By resisting white normativity, faculty members challenge the broader systems of power and privilege that reinforce racial hierarchies within academia and society.

Conscious Efforts to Acknowledge Privilege

From a CwS theoretical perspective, conscious efforts to acknowledge privilege involve individuals recognizing and reflecting on the advantages and benefits they receive based on their social identities, particularly in relation to race, gender, class, or other dimensions of privilege (Dyer, 2006). This concept sheds light on how social hierarchies and power dynamics shape individuals' experiences and opportunities. Conscious efforts to acknowledge privilege require individuals, especially those who identify as white, to actively confront and understand how their racial identity affords them certain societal advantages (Boutte & Jackson, 2014; Dyer, 2006).

This self-awareness entails acknowledging the historical and contemporary systems that have granted privileges to white individuals while disadvantaging others (Applebaum, 2017). By becoming conscious of these structural inequalities, individuals can engage in anti-racist practices and work towards dismantling systems of oppression (Smith et al., 2017). Conscious Efforts to Acknowledge Privilege contribute to a broader understanding of social inequalities and provide a foundation for transformative action and social change.

CwS also draws attention to the invisibility of privilege associated with whiteness. Faculty members who disrupt whiteness in their curriculum must consciously recognize their privileges and work toward addressing them. This recognition actively pushes back against whiteness, which DiAngelo (2018) recognizes as the feeling of entitlement to racial comfort.

Likewise, Glazer and Liebow (2021) view entitlement as "problematic" as it places all the burdens of emotional labor on people of Color, thereby "circumscribing the range of educational experiences that a white person will expose" themselves to (p. 53-54). Faculty must recognize and acknowledge privileges to understand how they impact the learning environment and what harm might be inflicted on their students (McIntosh, 2012). By actively acknowledging their privilege, faculty members can better understand the impact of their actions and decisions, leading to more intentional efforts to challenge whiteness.

Embracing Racial Discomfort as Catalyst for Change

The study of Critical whiteness Studies encourages faculty members to embrace racial discomfort as a necessary step toward challenging and disrupting whiteness in the geoscience curriculum (Sue et al., 2009). To create a more inclusive and anti-racist educational environment, confronting racial discomfort becomes essential for transformative learning and curriculum reform (DiAngelo, 2018). Faculty members adopting anti-racist approaches understand that

discomfort signals opportunities for growth and change, recognizing that the discomfort arising from confronting the normativity of whiteness can be a disorienting yet transformative experience (Dei, 1996).

Embracing racial discomfort involves engaging in critical reflection and open dialogue (Weber, 2004). Faculty members should be active in the interrogation of their assumptions, biases, and teaching practices. This approach can begin to highlight where the geoscience curriculum's systemic imbalances are perpetuated by whiteness. Through introspection, faculty challenges the existing norms and practices, seeking ways to unveil paradigms that have traditionally dominated the field. Rodriguez (2010) recognizes that mere recognition of whiteness is not enough. He argues that discomfort can be harnessed as a driving force to dismantle and reshape the curriculum in ways that center diverse voices, experiences, and knowledge systems (Rodriguez, 2010).

Confronting racial discomfort also involves creating a supportive and safe space for open conversations about race, privilege, and power dynamics within the geoscience discipline (Bonilla-Silva, 2006; Charles, 2018). Faculty members engaged in courageous discussions with their colleagues and students, recognizing the importance of acknowledging and addressing systemic racial biases and injustices (Smith et al., 2017). By fostering an environment of open dialogue, faculty members encourage others to confront their racial discomfort, enabling transformative learning experiences (Johnson & Longerbeam, 2007; Young, 2004).

Curriculum Theory

As explored by Schiro (2020), curriculum theory encompasses the concept of curriculum ideology, which can be understood as a comprehensive view or worldview held by individuals or groups regarding how the world should be organized and function in terms of education. It

represents a community of ideas and perspectives that guide people's beliefs about curriculum design and implementation. However, the term "curriculum theory" has a chaotic structure, with multiple interpretations in the literature. It has been expressed using concepts such as curriculum beliefs, educational value orientations, curriculum ideologies, and curriculum orientations, yet the literature lacks clear distinctions among these expressions.

Schiro (2020) suggests that curriculum ideology is connected to the efforts made by individuals when dealing with the curriculum and questioning its challenges. On the other hand, Cheung & Wong (2002), who used the term "curriculum orientations" to refer to curriculum theory, defined it as a collective set of beliefs concerning curriculum elements, including objectives, content, instructional strategies, and evaluation. Thus, curriculum theory informs how faculty members deliberately redesign the curriculum to incorporate diverse perspectives, challenge whiteness, and promote inclusivity. Critically examining the curriculum can create a learning environment that challenges dominant norms and fosters critical thinking. This approach highlights the role of the curriculum as a powerful instrument for promoting anti-racist practices and driving social change, making education a transformative force.

Intentional Redesign of Curriculum

Curriculum theory emphasizes that curricula are not neutral entities but are shaped by society and institutions' values, priorities, and perspectives (Posner, 2004). The key to this is recognizing the current limitations of whiteness knowledge paradigms and seeking diverse perspectives, voices, and experiences to be represented in the curriculum (Rogers et al., 2022). This intentional redesign goes beyond tokenism and aims to create a curriculum that authentically incorporates a variety of knowledge systems, cultural contexts, and historical perspectives (Nussbaum et al., 2017; Ricci & Riggs, 2019).

Curriculum as a Vehicle for Social Change

Curriculum can be a powerful vehicle for social change, as it plays a fundamental role in shaping individuals' and communities' knowledge, values, and attitudes (Giroux, 2011). One significant way to harness curriculum for social change is by intentionally incorporating diverse perspectives, experiences, and voices into educational materials. By challenging dominant narratives and promoting inclusivity, students are better equipped to develop a more comprehensive understanding of the various cultures, histories, and social issues (Banks, 2015). Moreover, the curriculum can address pressing social issues such as racism, inequality, climate change, and human rights. Integrating topics into educational materials and classroom discussions encourages students to critically analyze and reflect on these issues, leading to greater awareness and a sense of responsibility to contribute positively to society (Parker, 2018).

Furthermore, a well-designed curriculum encourages critical thinking and analysis of societal norms and structures. Within such a curriculum, students question the status quo, challenge biases, and examine power dynamics, fostering a more engaged and socially conscious citizenry (Freire, 1970). Additionally, the curriculum can cultivate civic engagement by empowering students to participate actively in their communities and society. Including civic education and opportunities for community involvement inspires students to take action on social issues and advocate for positive change (Torres, 2009). By incorporating stories of historical and contemporary activists and change-makers, the curriculum can inspire students to believe in their ability to effect change, promoting empowerment and agency (Noddings, 2006).

Through a curriculum that addresses systemic inequalities and promotes social justice and inclusivity, students gain a greater understanding of social responsibility. They are equipped to make ethical decisions that positively impact their communities (Apple, 2004). As such, the

curriculum is a vital platform for transmitting knowledge, values, and beliefs, making it an essential tool for shaping future generations' collective understanding and action (Johnson, 2003). When thoughtfully designed to promote social change, the curriculum can be a potent force in building a more just, inclusive, and sustainable world.

Critical Transformative Learning Theory

Critical Transformative Learning Theory, developed by Jack Mezirow, provides insights into how individuals undergo deep and meaningful learning experiences that lead to transformative change in their beliefs, attitudes, and behaviors (Mezirow, 1991). At the core of this theory is a disorienting dilemma, which refers to a challenging experience or encounter that disrupts an individual's worldview and prompts them to question their assumptions and beliefs (Mezirow, 2000). Therefore, faculty members who disrupt whiteness in the geoscience curriculum can create disorienting dilemmas for themselves and their students by confronting the normativity of whiteness and acknowledging the impact of white-centered knowledge paradigms on excluding diverse perspectives.

Embracing Disorienting Dilemmas

Critical Transformative Learning Theory emphasizes the importance of disorienting dilemmas as powerful catalysts for transformative change (Mezirow, 1991/2000). Faculty members who disrupt whiteness in the curriculum embrace moments of discomfort and dissonance as opportunities for growth and learning. These disorienting dilemmas challenge their existing worldview and prompt them to critically question the centrality of whiteness in the geoscience curriculum. Faculty members view these moments of discomfort not as obstacles to avoid but as essential stepping stones toward transformative change. By embracing disorienting dilemmas, faculty members can cultivate a reflective and self-critical approach to their teaching

practices, acknowledging that challenging the normativity of whiteness requires constant self-examination and openness to new perspectives.

Engaging in Ongoing Critical Reflection

Another step to effectively disrupt whiteness in the curriculum is for faculty members to engage in continuous critical reflection (Cranton, 2002). Critical reflection involves examining one's biases, assumptions, and teaching practices in light of the disorienting dilemma. By critically reflecting on their positionality and power dynamics in the classroom, faculty members can better understand how their actions and choices may perpetuate or challenge whiteness in the curriculum (Baxter Magolda, 2001).

Faculty members should critically examine their assumptions, biases, and teaching practices, actively seeking opportunities for improvement. Through ongoing critical reflection, they will gain insights into how whiteness may be inadvertently perpetuated in the curriculum and identify ways to address these issues proactively. This continuous self-examination and critical inquiry enables faculty members to challenge the status quo, question existing power structures, and create space for diverse perspectives in the geoscience curriculum.

Perspective Transformation Towards Inclusive Teaching

Another key element of transformative learning is perspective transformation, which occurs when an individual's worldview undergoes a fundamental shift (Mezirow, 1991). Faculty members who embrace perspective transformation through disrupting whiteness in the geoscience curriculum might adopt inclusive teaching practices. Such practices might center on diverse voices and experiences in the curriculum on top of current lesson plans to challenge hidden messages of whiteness (Giroux, 2011). By undergoing perspective transformation, faculty members can create a transformative learning environment that empowers students to think

critically, challenge the status quo, and become agents of positive change in their communities and society (Freire, 1970). This perspective transformation can lead to pedagogical shifts, catalyzing the dismantling of whiteness as the normative lens through which the geoscience curriculum has traditionally been viewed.

Transformative Learning Theory, therefore, informs faculty members on how to embrace disorienting dilemmas, engage in ongoing critical reflection, and undergo a perspective transformation in their teaching practices. Actively disrupting whiteness in the curriculum and adopting an inclusive approach is a way for faculty members to create the hope of possibility through a transformative learning environment. An environment that challenges dominant norms promotes anti-racist practices and fosters their students' holistic growth and development. Through transformative approaches, the geoscience curriculum becomes a site for critical thinking, embracing diversity, and cultivating social change.

By incorporating these three theoretical perspectives, this conceptual framework will provide a more comprehensive understanding of the strategies, challenges, and successes experienced by geoscience faculty members in their efforts to interrogate whiteness. The insights gained from this research will inform recommendations for advancing anti-racist practices that promote equity within geoscience education. Through this study, I sought to contribute to the broader conversation on how faculty challenge established norms in curriculum development to improve the experience for the students it serves.

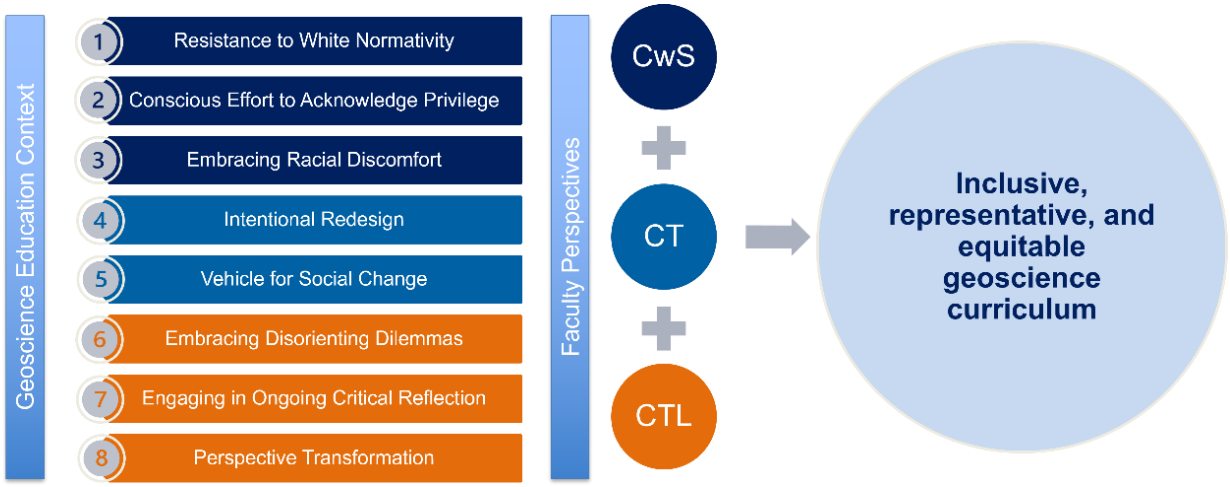
However, while this conceptual framework provides an important starting point, enacting meaningful change in geoscience education requires more than theoretical understanding. It calls for practical action and engagement, which informs the next focus of this study's exploration.

Applying the Framework

Data analysis involved using the conceptual framework in Figure 1 to examine the in-depth interview responses from geoscience faculty participants. Each aspect of the framework informed the coding and thematic analysis process. Critical whiteness Studies guided the exploration of instances where faculty members interrogated whiteness. In the geoscience curriculum, Curriculum Theory was applied to understand further how faculty members intentionally redesigned their curriculum, exploring themes related to incorporating diverse voices, experiences, and perspectives and their critical examination of the hidden curriculum. Transformative Learning Theory helped uncover instances of faculty members embracing disorienting dilemmas, engaging in ongoing critical reflection, and undergoing perspective transformation. The analysis revolved around the participant's experiences confronting discomfort and challenging assumptions.

Figure 1

Conceptual Framework and its application to data analysis



The conceptual framework also shaped the study's overall structure and framing. The research questions aligned with the three aspects of the framework, exploring how faculty members resist whiteness and normativity, intentionally redesign the curriculum, and engage in transformative learning to promote inclusivity. The interview guide was designed to elicit responses that correspond with the themes of the conceptual framework. Faculty members were prompted to reflect on their efforts to disrupt whiteness, experiences of discomfort, and perspectives on inclusive teaching practices. Data interpretation was guided by the conceptual framework, facilitating a way to understand the interconnected themes. The analysis highlighted faculty members' strategies, challenges, and successes in the ways in which they interrogated whiteness in their curriculum.

In the discussion and recommendations section, findings were framed within the context of Critical whiteness Studies, Curriculum Theory, and Transformative Learning Theory. The analysis explored how the themes aligned or did not align with these theoretical perspectives and the literature. By using the conceptual framework to guide data analysis and study framing, the research contributes to a thorough examination of how geoscience faculty members interrogate whiteness and work toward inclusive learning environments.

Research Philosophical Underpinnings

This research, guided by a critical research paradigm, is rooted in a broader philosophical framework that seeks to challenge and transform social, political, and cultural structures perpetuating inequities, marginalization, and oppression (Cannella & Bailey, 1999; Koro et al., 2022). The critical research paradigm operates on the premise that reality is socially constructed and shaped by power dynamics, historical contexts, and cultural values (Haraway, 2016; Ohito & Khoja-Moolji, 2018). Therefore, if people create realities, they have the means to change them.

The research paradigm also adopts a reflexive approach, aiming to understand and actively change the world for the better. However, as Huddleston (2022) discusses, simply "choosing" a paradigmatic frame does not "absolve those choices from having unintended consequences" (emphasis added, p. 651-652). In other words, by simply opting for a particular way to frame this study, I stand the risk of upholding the same hegemonic forces I am actively pushing against. Therefore, I aimed to constantly reflect on how I approached this study concerning uneven power dynamics.

The epistemological stance emphasizes that knowledge is intricately tied to its context (Apple, 2004). It also rejects the notion of a completely neutral and objective researcher; this perspective acknowledges the researcher's subjectivity as an inherent part of the research process (Walsh, 2012). As the researcher, acknowledging personal biases, positionality, and active involvement in co-creating knowledge with participants becomes central. Adherence to rigorous ethical guidelines is a guiding principle, establishing a foundation of trust between the researcher and the participants.

Integral to this research approach was the concept of critical reflexivity, where the researcher must engage in continuous self-reflection, carefully examining their assumptions, biases, and position within the research context. This creates a heightened self-awareness that illuminates potential impacts on data collection, analysis, and interpretation.

By embracing the philosophical tenets of the critical research paradigm, the overarching goal of this study contributes to the ongoing discourse surrounding the interrogation of whiteness to uncover the way faculty members' strategies, hurdles, and accomplishments faculty members' strategies, hurdles, and accomplishments as they navigate the intricate landscape of curriculum reform. Beyond the confines of academia, this research also extends its aspirations toward

personal and social transformation. It recognizes that knowledge can shape attitudes and behaviors, and the study endeavors to influence broader societal perceptions and practices. This research aimed to catalyze positive change in the geoscience educational landscape by addressing the imbalances and inequities embedded within educational systems.

Research Design

I employed a research design using a methodological framework consisting of critical qualitative inquiry and narrative inquiry to explore the experiences and perspectives of the participants. These methodological choices facilitated a thorough exploration of the research questions while enriching the data with personal nuances, emotions, and reflections captured through the spoken word. Further elaboration on these methodological choices, their strengths, potential limitations, and their relevance to the research questions is provided in the subsequent sections.

Critical Qualitative Inquiry

Embracing a critical approach to qualitative inquiry involves challenging assumptions and established truths while meticulously examining the research's interconnectedness with identities, institutions, communities, cultures, and power structures. Denzin (2016) emphasized the urgent need for inquiry that addresses inequities across various domains, including the economy, education, employment, environment, health, housing, food, and water, while heeding the global call for peace and justice. A critical approach becomes essential in engaging with diverse approaches, methodologies, and populations and, more importantly, perceiving research's potential to contribute to a better world. Koro et al. (2022) proposed that this can be accomplished by "challenging boundaries in defining what counts as data, what counts as matter and what matters, what counts as knowledge, whose knowledge matters, and whose voices

deserve scholarly attention" (p. 570). As this project unfolded, the prevailing circumstances demanded that all scholarship surpass simplistic views of research's role, methods, and findings. Instead, it calls for scholarship, particularly this project, to strive for meaningful impact, enhancing the quality of teaching, learning, and organizing in geoscience education and education at large.

Critical qualitative inquiry has faced criticism despite its transformative potential due to its subjective nature. Subjectivity can lead to inherent difficulties in establishing definitive causal relationships. Its emphasis on social critique and change can also lead to potential bias as the researcher may draw on particular narratives or outcomes that align with their ideologies or the research aims (Denzin, 2016). In light of these limitations, critical qualitative inquiry presents a framework for challenging pre-existing assumptions and exposing the socio-political implications of research. Critiquing the status quo can yield new insights that advance knowledge and understanding in various domains. It also fosters an inclusive research process that validates diverse perspectives and experiences, emphasizing voices and stories that may otherwise be overlooked or marginalized (Ro et al., 2021). Therefore, critical qualitative inquiry is a tool that allowed me the framework to explore the depths that underlay assumptions, institutional policies, and cultural practices, allowing the exploration of how whiteness is interrogated to transform geoscience curriculum and pedagogy, as well as the social and institutional factors that impact such efforts (Denzin, 2016).

Narrative Inquiry

This project also employed a narrative inquiry approach and methodology, analyzing the complexities of storytelling outside simplistic definitions (Clandinin & Connelly, 2000). As practiced by various scholars, narrative research encompasses multiple texts and layers of

interaction, including participants' complex stories, interpretations by the investigator, and the narratives constructed by readers after engaging with the research (Riessman, 2008). Narrative inquiry, then, revolves around biographical particulars narrated by those who live them (Chase, 2010).

Drawing from sociocultural theory, this research acknowledges individuals' uniqueness while recognizing their interconnectedness within social contexts (Clandinin & Connelly, 2000). Goldsby and Bateson (2019) note that our species [humans] think in metaphors and when information is present through stories, they become easier concepts to hold on to. Narrative inquiry creates fluid and collaborative constructions of stories that encompass four popular narrative research approaches: biographical studies, autoethnographic studies, life histories, and oral histories (Creswell, 2013). Like a narrator, the researcher engages with participants' narratives, the researcher's experiences, and the historical lineages bridging past, present, and future. Chase (2010) presents analytical lenses for narrative inquiry, viewing narratives as retrospective meaning-making that conveys the narrator's point of view. As such, narratives are verbal actions created and shared within specific social contexts for particular purposes. The researcher, too, becomes a co-creator of situated interpretations, shaping the stories related to the research.

Narrative inquiry also bears connections to critical and transformative research, as it can challenge power dynamics and elevate underrepresented narratives (Luttrell, 2010; Johnson-Bailey, 2003; Solorzano & Yosso, 2002). Embracing the concept of counter-storytelling, this project aimed to interrogate the white normativity and address the static permanence of whiteness. While narrative inquiry can provide profound insights, by its very nature, it is interpretative and may lead to questions about the reliability and generalizability of findings. The

presence of multiple layers of narrative - from participant, researcher, and reader - can also complicate the analysis and interpretation process. Additionally, the complexity of individuals' stories may make it difficult to draw clear conclusions or create universally applicable knowledge (Riessman, 2007). Despite narrative inquiry's limitations, it presents a powerful tool for exploring individual and collective experiences. It allows for understanding how people make sense of their world through storytelling. As such, this methodology can inform complex social, cultural, and personal dynamics and present an understanding of lived experiences (Chase, 2010; Clandinin & Connelly, 2000).

Critical qualitative inquiry and narrative inquiry offer a robust methodological framework to interrogate whiteness in geoscience education. While critical qualitative inquiry facilitates a deep, reflexive examination of the broader contexts and power dynamics, narrative inquiry provides a unique perspective and set of tools, allowing for a comprehensive exploration. Through these combined methodologies, I critically engaged with and provided an understanding of how faculty interrogated whiteness in their geoscience curriculum. Specifically, narrative inquiry allowed me to capture insights into faculty members' experiences, perspectives, and practices (Clandinin & Connelly, 2000).

Methods and Procedures

In this section, I discussed the procedures used to identify, recruit, and select faculty members.

Recruitment and Criteria

I used purposeful sampling as a strategic approach for participant selection. This sampling approach offered me a tailored and focused way to identify individuals or groups with specific knowledge, expertise, or experiences relevant to the phenomenon I sought to investigate

(Cresswell & Plano Clark, 2011). By deliberately selecting participants with relevant insight, I aimed to maximize the depth and quality of the data collected (Billups, 2021). This approach is precious when working with limited resources and time constraints, enabling me to make the most efficient use of available research assets. By carefully choosing participants who could provide in-depth perspectives, the robustness of my findings was enhanced (Campbell et al., 2020; Palinkas et al., 2015).

Selection criteria included:

- Full-time faculty member at a 2- or 4-year U.S. higher education institutions (faculty can be at any rank)
- Teach an undergraduate geoscience course. (i.e., Earth Science, Physical Geology, Historical Geology, Environmental Geoscience)
- Must have taught geoscience education for at least five years.
- Have or are interrogating whiteness within the design and delivery of undergraduate course curriculum.

The criteria for participant selection were deliberate. To ensure an insightful investigation, I first focused on full-time faculty at various ranks within United States HEIs; the research aimed to capture a range of perspectives and experiences. Second, examining geoscience education in the U.S. allowed for a narrow focus on exploring present-day challenges within the field. Third, the participants' criteria for teaching undergraduate geoscience courses were established to give an even more specific context to explore curriculum content and how that content is being approached. Fourth, the condition related to the years of teaching experience added an important dimension, ensuring participants had enough familiarity with the subject matter and its pedagogical aspects.

I initially opted for a select group of 6-8 participants. However, recruitment efforts proved challenging, and I could only recruit 4 participants for this study. Despite this challenge, the stories proved fertile ground for discussion and data collection. As Saunders and Townsend (2016), smaller participant pools can give individualized attention, encouraging more in-depth interactions and responses (Saunders & Townsend, 2016). I reported the process to help provide depth to the present research study, granting readers a clearer view of the methodology to strengthen the authenticity, credibility, and potential transferability of findings to other settings (Lincoln et al., 2011).

An open call for participation was disseminated through professional networks, such as the Science Education Resource Center (SERC) at Carlton College and other relevant academic community listservs (see Appendix A). My choice to leverage SERC was based on their demonstrated expertise in geoscience education, extensive network opportunities, commitment to pedagogical advancement, and the potential for collaborations. SERC has over 1,000 HEIs in its network and has been involved in over 100 award-winning educational projects (Science Education Resource Center, 2022). These factors collectively made this platform the logical and strategic choice for recruiting highly relevant participants to the current research on improving geoscience education.

A detailed flier (see Appendix B) was disseminated to recruit participants for the study, outlining the research objectives and the criteria for participation in the aforementioned networks. After initial responses to the flyer, participants were asked to complete an interest survey (Appendix C). This survey was designed to gather more targeted information regarding the respondents' backgrounds, experiences, and motivations related to the study's focus. Through employing this two-tiered selection process, the aim was to identify individuals who not only

expressed interest but also met specific criteria, helping streamline the selection process. It also established participants aligned closely with the study's objectives, maximizing the potential for significant data generation.

Participants

This section presents the demographic characteristics (see Table 1) of the participants involved in the study, providing the backgrounds and expertise that inform their perspectives. Four participants, (a) Lane, (b) Luto, (c) Nick, and (d) Sofia, were selected to contribute to this study, and each shared their own unique experiences.

Lane

Lane is a white woman who is a tenured Professor of Geology and Oceanography at a two-year community college in the Pacific Northwest with over 20 years of teaching experience. She is the department chair and an Instructional Council Co-Chair to help inform and guide curriculum design. Lane has taught courses in Geology, Earth Science, Environmental Science, and Oceanography.

Lane sees her role as an educator as helping students achieve their goals. She adopts a constructivist approach to education to co-construct knowledge with her students. Her focus is centered on active learning pedagogies in the classroom. She has worked towards decolonizing her curriculum and has experience in face-to-face and online courses.

Luto

Luto is an Asian woman from Sri Lanka who is a Professor of Geology at a two-year college in the South and has over 15 to 20 years of teaching experience. She usually teaches Natural Hazards, Physical Geology, and a research course, which usually runs during the summer semesters. Currently, she is in Sri Lanka as a visiting Fulbright Scholar. She explains

that her usual class capacity consists of 24 to 36 students and that she can personalize the learning experience to her students' needs. She is active in pedagogies that are not passive. She believes in providing experiences for her students, which includes bringing in guest speakers to provide research opportunities through partnerships with local universities.

Nick

Nick is a white man who is a Professor of Geology at a two-year college in the Southeast with 20-plus years of teaching experience in both K-12 and higher education. His previous experience has been an asset for Nick through his working at various outdoor education centers, knowledge gained as an Eagle Scout, and his years serving in the U.S. Peace Corp. Nick is the only geoscience educator at his institution and currently teaches Physical Geology, Historical Geology, Environmental Science, and Field Studies in Geology courses. He is well-versed in field methodologies and has led several summer Field Geology courses.

Nick sees his primary role as a geoscience educator as getting his students jazzed about geology and nurturing the generation of geoscientists. He believes one of his teaching qualities that stands out is his enthusiasm for the subject. He also currently serves as an advisor to the campus Geology Club. He has years of experience creating online learning materials and has worked with publishers to create content inside classrooms across the U.S.

Sofia

Sofia is a LatinX woman from Puerto Rico who is an Associate Professor of Environmental Science at a two-year community college in the Northeast with 10 to 15 years of teaching experience. Sofia began as an adjunct and, through her education, has been promoted. She primarily teaches Environmental Science and Oceanography but has experience teaching Natural Science and Meteorology.

Sofia draws on her own experience as a student to help guide her teaching methodologies. She provides her students with authentic learning experiences by leading place-based education curricula. She is active in her institution's development of curriculum and educational resources and in its DEI initiatives.

Table 1

Participant Demographics

Pseudonym & Gender	Racial Identity	Institutional Role	Institution Type	Teaching Experience (years)	Geographic Location
Lane (Woman)	White	Professor*	2-year college	20+	Pacific NW
Luto (Woman)	Asian	Professor	2-year college	15-20	Southeast
Nick (Man)	White	Professor	2-year college	20+**	South
Sofia (Woman)	LatinX	Associate Professor	2-year college	10-15	Northeast

Note. * Department Chair; ** Higher Education and K-12

Data Generation

This section outlines the participation methods and details data generation techniques. Goldkuhl (2019) noted that labeling activities significantly influence our perceptions and interpretations of them. As such, the term 'data collection' traditionally implies that researchers obtain readily accessible data from empirical sources (Bryman, 2016). However, as Stenbacka (2001) and others have suggested, this stage can also be conceptualized as 'data generation. The use of 'collection' may be problematic, insinuating that researchers merely access "ready-at-hand" data, overlooking the intentional efforts necessary, particularly in contexts like interviewing—a foundational empirical method in qualitative research (Goldkuhl, 2019, p. 577).

In these scenarios, the researcher crafts questions, and the informant offers responses, collaboratively 'generating' the data. Thus, I employed 'data generation' to underscore my proactive and intentional role in creating novel data, setting it apart from the passive connotation

associated with 'data collection.' Foregrounding 'data generation' highlights my direct, participatory involvement in curating a unique dataset in alignment with my chosen methodology.

Interviews

Upon selecting the four candidates, an email was sent detailing the process of setting up their OneDrive folder and reiterated what particpation in the study would entail (see Appendix D). After the participants uploaded a copy of the signed consent form, the study consisted of two 30- to 60-minute semi-structured interviews. Semi-structured interviews are a prominent method in qualitative research, facilitating an in-depth exploration of participants' experiences, perceptions, and beliefs surrounding a specific topic (Sewell, 2005). Distinct from structured interviews, which strictly adhere to a predetermined set of questions, semi-structured interviews involve a flexible approach characterized by open-ended questions and a guiding but adaptable interview schedule (Billups, 2021). The purpose of semi-structured interviews was dual: to extract detailed information and to allow participants to articulate their insights and sentiments in their vernacular and rhythm (Frey & Oishi, 1995).

This methodological flexibility accommodates richer data while fostering a reciprocal dialogue between the interviewer and interviewee, in what Kahn and Cannell (1957) call a "conversation with a purpose" (p. 149). Within the scope of this research, semi-structured interviews were chosen as the optimal tool to embody the participants' complex experiences and viewpoints. As such, the data generated was exhaustive and contextually pertinent (Brinkmann & Kvale, 2014).

Interviews for this study were conducted online using the University of Texas at Arlington's Microsoft Teams platform, chosen for its security features. This approach protected

both participants' identities and the data generated through encryption-protection technology. Microsoft Teams also offers a transcription service, which facilitates the accurate and real-time recording of the interview proceedings. Transcriptions safeguarded the data's fidelity. There were two weeks between Interview 1 and Interview 2, which allowed for ample time for reflection, data analysis, and addressing any themes or insights that were developed.

The first interview centered primarily around the participant's general experiences and perspectives, establishing a foundation for further exploration in subsequent interviews (see Appendix E; Interview Protocol 1). The second interview focused on more specific areas of interest, which was informed by the insights from the first interview and the curricular artifacts provided by the participants (see Appendix F; Interview Protocol 2). The staggered approach assured comprehensive data generation while offering participants an opportunity to reflect upon their initial responses in the following interview and possibly expand upon them. Each interview was recorded using Microsoft Teams through the Record and Transcribe feature. I listened to recordings twice to familiarize myself with the data before proceeding with analyzing the data.

Documents Analysis

Documents are invaluable in qualitative research, offering essential background, context, and supplementary data (Bowen, 2009). *Documents* are data that are readable, tactile, observable, and tangible evidence (Billups, 2021). Significantly, when direct observation of events is infeasible, or informants cannot recall specific details, documents may emerge as the most reliable data source. However, there are inherent challenges, such as "biased selectivity," lack of detailed information, and challenges in retrieval (Yin, 1994, p. 80, as cited in Bowen, 2009). Despite the challenges, artifacts received from the participants served as a conduit for

framing additional questions, tracking changes and developments over time, and deepening findings.

The document analysis encompassed three pivotal stages: skimming (a preliminary review), reading (a comprehensive examination), and interpretation. Integrating elements from both content and thematic analyses, this approach aimed at categorizing information relevant to the research's central research question. While some, like Silverman (2000), argue that content analysis may overshadow the processes of transforming discussions into text, it is crucial to remember that documents extend beyond mere interview transcriptions. The type of content analysis proposed here did not focus on quantifying data in a traditional sense but rather on an initial review where significant textual segments were highlighted. The onus was on me to discern relevant data from the extraneous (Corbin & Strauss, 2008; Strauss & Corbin, 1998).

Documents, while potent sources of data, necessitate a discerning analytical eye. They should not be perceived as infallible records of past events, and I did as much. Using these materials required more than simply extracting passages for inclusion in this research. I adopted an approach to what Bowen (2009) suggested: that researchers grasp the intrinsic meaning of a document and ascertain its relevance to the studied topics. Therefore, for the current study, I used extant documents from faculty in the form of syllabi, course material, and lectures (see Table 2).

Table 2

Primary document types used for analysis

Document Type	Data Analyzed	Analytical Focus in Line with Philosophical Underpinnings
Syllabi	◦ Course objectives and outcomes ◦ Reading lists ◦Assessment methods ◦ Course schedule and topics	◦ Resistance to Whiteness Normativity: The syllabus offers insights into how geoscience courses might be resisting or upholding dominant white norms in their structural content. ◦ Intentional Redesign of Curriculum: It serves as a primary blueprint of the course, revealing any intentional changes or shifts to cater to diverse perspectives or challenge established norms.
Lectures	◦Presentation slides ◦Speaker notes ◦Multimedia materials (videos, images) ◦In-lecture activities	◦ Embracing Racial Discomfort: Analyze whether topics are approached in ways that challenge or embrace racial discomfort, thereby allowing an understanding of faculty efforts in reshaping curriculum. ◦ Curriculum as a Vehicle for Social Change: The lecture content can highlight if the geoscience curriculum is being utilized as an agent for broader social change.
Course Material (e.g., readings, assignments, activities)	◦Reading excerpts and book lists ◦Assignment prompts and guidelines ◦In-class and out-of-class activity descriptions	◦ Embracing Disorienting Dilemmas: The course materials, especially assignments and readings, studied to determine if students are encouraged to face and process disorienting dilemmas, indicative of Critical Transformative Learning Theory. ◦ Engaging Ongoing Critical Reflection: Activities and assignments can reflect whether students are prompted to partake in critical reflection throughout their learning journey. ◦ Inclusive Teaching Practices: The nature and variety of materials offer insights into the inclusivity of the teaching methods, showing efforts to cater to a diverse student body and various learning preferences.

Note. The table illustrates the primary document types utilized in the research, detailing the specific content components analyzed and aligning each with the study's philosophical underpinnings.

In this study, I acknowledged that the existing curriculum materials may predominantly reflect white perspectives on teaching. This recognition is essential as I explore and understand how geoscience faculty use and potentially transform these materials. While I am aware of this bias, my goal was to critically examine and document the current state of the curriculum to identify opportunities for inclusivity within the geoscience discipline.

Syllabi

The syllabus is a cornerstone document in any course, serving as an instructional guide and reflecting pedagogical intent (Baecker, 1998; Parkes & Harris, 2002). Its content and structure provide a unique lens into the philosophical underpinnings of a course, making it a rich source for qualitative analysis in the context of geoscience education.

The course objectives and outcomes are a pivotal area of focus within each syllabus. These signify the envisioned trajectory of student learning and hint at broader pedagogical ambitions (Anderson & Krathwohl, 2001). By critically examining these objectives, I determined whether there was alignment with inclusive pedagogical practices or adherence to traditional whitewashed paradigms. When applicable, the reading lists included in the syllabi were subjected to thorough scrutiny. Historically, reading materials have been critiqued for either amplifying or silencing particular voices, especially in fields traditionally viewed through a narrow lens (Banks, 2015). The diversity and range of these lists in the geoscience syllabi indicate the extent to which 'Other' narratives are incorporated.

Furthermore, the assessment methods employed within the courses offer more than just grading rubrics; they represent the instructor's valued skills, knowledge domains, and, by extension, the institution (Wiggins & McTighe, 2005). Innovative assessment strategies indicate an evolving pedagogical stance that values varied learning modalities and recognizes non-traditional expertise. The course schedule and topics present a sequential roadmap of the course's academic content. An analysis of these topics helped yield insight into the extent to which the curriculum either integrates or resists dominant white norms in the field of geoscience (Ladson-Billings, 1995). Guiding this analytical portion are two core frameworks:

- Resistance to Whiteness Normativity ***(RWN)***: The syllabus, with its structural components and content choices, can reveal the implicit or explicit tendencies of geoscience courses to either sustain or challenge dominant white norms (Delgado & Stefancic, 2017).
- Intentional Redesign of Curriculum ***(IRC)***: Indicators of conscious curricular shifts, whether through topic choices or reading material selections, can signal a deliberate move towards an inclusive and transformative pedagogy (Freire, 1970).

The study sought to identify potential pedagogical shifts, shaping contemporary geoscience education by examining the layered content of geoscience syllabi using these analytical lenses.

Course Materials

Course materials serve as tools and reflections of an educator's intent and the broader curriculum's goals. Their granularity goes beyond lectures; it is a window into students' everyday interactions with the subject. Especially in geoscience, where hands-on, reflective, and inclusive

pedagogies can significantly influence student outcomes, a careful examination of course materials becomes indispensable (Ambrose et al., 2010).

Reading excerpts and book lists represent the foundational knowledge that educators deem essential. The selection of these materials may uphold harmful epistemologies or strive toward challenging entrenched norms. Analyzing such material, one can discern the breadth and depth of perspectives being presented and whether or not they encompass or challenge predominant narratives (Hurtado et al., 2013). Assignment prompts and guidelines can also illuminate the educator's expectations of students' engagement with the content, hinting at the desired cognitive processes, be it rote memorization, critical analysis, or transformative reflections (Parkes & Harris, 2002). The nature of assignments suggests whether students are merely expected to regurgitate information or navigate disorienting dilemmas emblematic of Critical Transformative Learning Theory (Mezirow, 1991).

In-class and out-of-class activity descriptions can offer insights into pedagogical practices, from collaborative tasks to independent reflections. They reveal the balance between passive content consumption and active, critical engagement, thereby indicating the extent of ongoing critical reflection (Brookfield, 1995). Three overarching analytical lenses guide the dissection of these materials:

1. Embracing Disorienting Dilemmas (***EDD***): Central to Critical Transformative Learning Theory, this lens examines if course materials, especially assignments and readings, prompt students to confront and navigate challenging, transformative experiences (Taylor, 2006/2007).
2. Engaging Ongoing Critical Reflection (***EOCR***): Exploration of activities and assignments; this perspective gauges the extent to which students are continually

encouraged to engage critically and reflect upon their learning, a hallmark of deep learning (Moon, 1999).

3. Inclusive Teaching Practices (***ITP***): A diverse student body necessitates diverse teaching methods. Analysis under this lens seeks to identify efforts in course materials that cater to varying learning styles, backgrounds, and preferences, ensuring equitable opportunities for success (Flowerday & Schraw, 2003).

In this study's context, analyzing these course materials provides a lens into the subtle and overt pedagogical shifts within geoscience education aimed at unraveling the nuances of inclusivity, transformative learning, and reflective practice.

Lectures

In many academic settings, lectures remain the primary conduit for knowledge dissemination. Beyond their ostensible role in information delivery, they encapsulate the educator's pedagogical stance, biases, and underlying philosophy (Biggs & Tang, 2007). As such, the content and format of lectures in geoscience education warrant meticulous scrutiny.

The presentation slides, often a lecture's backbone, provide a visual and textual representation of the chosen material and its prioritization (Alley, 2013). Analyzing slide content helped discern thematic priorities and any underlying patterns that suggest an inclination towards or divergence from inclusive practices. Speaker notes, though typically unseen by the audience, unveil the educator's thought processes, potential biases, and additional context that might be subtle in the slides themselves (Duncan & Arthurs, 2012). A deep dive into these notes can shed light on the nuances of content delivery, offering a more complete understanding of the lecturer's approach.

Supplementary multimedia materials, encompassing videos and images, augment the auditory and textual content. Such materials, especially in geoscience disciplines, can broaden horizons by showcasing diverse perspectives or inadvertently perpetuating stereotypes (Nuñez et al., 2022). Their inclusion, exclusion, and use of context can speak volumes about the curriculum's intent. In-lecture activities are interactive elements aimed at actively engaging students. The nature and content of these activities reveal the desired student learning experiences, potentially pointing to traditional or transformative pedagogical underpinnings (Bonwell & Eison, 1991). Guiding this segment of analysis are two pivotal frameworks:

1. Embracing Racial Discomfort (***ERD***): Evaluating lecture content through this lens allows us to discern whether the curriculum pushes boundaries by delving into topics that might challenge or embrace racial discomfort. This perspective offers a clearer understanding of faculty endeavors in curricular reformation (DiAngelo, 2018).
2. Curriculum as a Vehicle for Social Change (***CVSC***): The depth and breadth of lecture content can be instrumental in determining if the geoscience curriculum is being mobilized as an agent for societal transformation, fostering a deeper understanding of global issues and fostering activism within the student body (Giroux, 1985).

Document analysis was pivotal in understanding how educators think about and engage with their curricula. The study contextualized faculty course content and outcomes with broader research objectives by analyzing syllabi, lectures, and course materials. The syllabi stand to reveal structural content, offering insight into potential resistance or alignment with dominant white norms and intentional curriculum redesigns. Lectures, encompassing presentation slides,

speaker notes, and multimedia content, will be analyzed to understand how racial discomfort is approached and if the curriculum serves as an agent for broader social change. Finally, course materials, such as reading excerpts and assignments, were evaluated for their potential to foster transformative learning experiences, promote critical reflection, and adopt inclusive teaching practices.

Data Analysis

Coding and Memoing Process

Saldaña (2021) defines a code in the qualitative analysis as "a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data" (p. 5). This process can occur in two cycles: the first-cycle coding is for analysis, and the second-cycle coding is for synthesizing things into new assemblages and meaning (Saldaña & Omasta, 2018). As Vogt et al. (2014) note, coding is an active process whereby meaning is researcher-generated, and the codes should be a stand-alone representation of the data. Furthermore, while a code may at times distill or condense data (Saldaña, 2021), Madden (2017) emphasizes that such work should not diminish but be a "value add" to the researcher's story (p.103).

Coding is the datum initially coded to discern and label its content and meaning according to the needs of the inquiry (Richards & Morse, 2013). Categories and themes differ. Rossman and Rallis (2003) explain the differences as a category being "a word or phrase describing some segment of your data that is explicit, whereas a theme is a phrase or sentence describing more subtle and implicit processes (p. 282). Each round of coding leads to the transformation of the particular to the general, where the codes are transformed into categories,

which then progress towards major themes (Saldaña, 2021). However, qualitative data generation and analysis are not linear (Vanover et al., 2022).

Therefore, this study employed a multi-round coding process to first analyze the qualitative data generated from semi-structured interviews and document analysis of course materials (syllabi, lectures, and assignments), followed by subsequent rounds to further develop codes into relevant categories and themes.

Memoing

Vanover et al. (2022) point out that the journey of data analysis "begins when researchers initiate data collection" (p. 153). As such, once the transcription is complete, the nascent coding phase will be paired with meticulous note-taking in a dedicated research journal. In this journal, reflective memos will be composed, detailing emerging assumptions and insights. Echoing Mihas (2022), memo writing operates in tandem with coding, which connects discrete codes with the broader data landscape. This memoing process effectively counterbalances the inherent reductive tendency of coding, offering an expansive space for elucidating the role and implications of each code (Goodson, 2013; Maietta et al., 2019).

First-Cycle Coding

During the first-cycle of coding, I employ an *a priori* coding approach. This method was based on a predetermined set of codes derived from the study's conceptual framework and existing literature (see Appendix G). These codes were established before data examination, providing a structured foundation for a comprehensive analysis (Altheide & Schneider, 2013; Schensul et al., 1999).

Interviews

For the interview transcriptions, the initial focus was to identify repeated ideas or themes that aligned with the predetermined codes. Each segment of data (a sentence, paragraph, or specific answer) corresponding to an *a priori* code was tagged accordingly. For instance, when a participant discussed challenges in reshaping geoscience curricula, the corresponding code derived from the framework was coded as "resistance to whiteness normativity."

Document Analysis

Syllabi. Each syllabus was methodically reviewed for course objectives, reading lists, assessment methods, and course schedules. The data extracted were coded using predetermined *a priori* codes. For example, syllabi that emphasized diverse perspectives in their reading lists might be coded under "intentional redesign of curriculum."

Lectures. Presentation slides, speaker notes, multimedia materials, and in-lecture activities were combed for content aligned with the *a priori* codes. For example, lecture slides that highlighted challenges related to racial discomfort were coded accordingly.

Course Material. All reading excerpts, assignment prompts, and activity descriptions were coded based on their alignment with the study's conceptual framework. For instance, assignments that prompted students to reflect on diverse perspectives were coded under "engaging ongoing critical reflection."

Second-Cycle Coding

The second cycle involved a more nuanced exploration of data to discover the patterns, relationships, and irregularities across the data sets (Saldaña, 2021).

Pattern Coding

Following the initial *a priori* coding, I engaged in pattern coding, which involved grouping data segments (from the interviews, syllabi, lectures, and course materials) under the development of major themes or ideas (Saldana, 2021). While the first cycle is about initial categorization, this phase is about understanding the relationship between these categories and identifying overarching patterns.

Focused Coding

After pattern coding, I concentrated on the most significant or frequent codes, seeking connections between them and the broader data (Charmaz, 2014). More specifically, as Charmaz (2014) suggests, I used the most frequent or significant codes to develop the most salient categories in the data, which "require[d] decisions about which initial codes make the most analytic sense" (p. 138). For example, "resistance to whiteness normativity" appeared frequently across interviews and course materials. Therefore, during this phase, I looked deeper into understanding the relationship and implications of this recurrence.

A persistent commitment exists to remain faithful to the data throughout both coding cycles. Saldaña (2021) cautions that coding is an iterative, cyclical process that requires researchers to code multiple times. While the *a priori* codes offered a foundational structure, focused coding ensured the coding process did not force data into predetermined categories and recognized and respected the organic emergence of themes and patterns within the data. This iterative process also ensured the data retained its richness and complexity, and the resultant analysis adhered to the study's objectives and the reality it sought to capture (see Appendix H).

Trustworthiness

Scholars such as Anderson et al. (2007) and Stahl and King (2020) note that the onus of demonstrating how the qualitative study meets standard conventions for trustworthiness is that the work might serve the needs of those using the research. Stahl and King (2020) further elaborate that "credibility is a construction on the part of the reporter(s) and the subsequent reader (s) (p. 26). Given the ontological and epistemological assumptions that reality is socially constructed, I aim to build trust between the research here and the readers. To establish trustworthiness and credibility, I employed three strategies developed by Lincoln and Guba (1985): dependability, triangulation, and transferability, along with critical reflexivity.

Critical Reflexivity

Critical reflexivity was pivotal in this research, as it involved me, the researcher, and my active engagement in self-reflection throughout each stage of the research process (Bolton, 2014). As the researcher, I continuously scrutinized my assumptions, biases, and positionality concerning the research topic and participants. This self-awareness was integral to the research process (Dewey, 1933), as it allowed me to recognize and mitigate any potential influence my perspective may have on data collection, analysis, and interpretation. Throughout the research, I regularly circled back to my positionality statement to reflect on, noting any changes. As I conducted interviews, coded the findings, and analyzed data, I wrote reflexive memos that captured my thoughts and reflections on the data and my interpretations. These memos served as a record of my thought process.

As such, critical reflexivity entailed an ongoing dialogue with myself, acknowledging the complexities of my standpoint and how or why it may intersect or diverge from the experiences and perspectives of the research participants (Humphrey, 2009). By adopting this reflexive

stance, I maintain transparency in acknowledging the subjectivity inherent in qualitative research. I also sought to minimize undue influence on the study's outcomes (Coburn & Gormally, 2017). Additionally, reflexivity safeguards against inadvertently reinforcing existing power dynamics and biases within the research process, which aligns with the overarching goals of this study.

Triangulation

Triangulation in qualitative research signifies the strategic employment of multiplicity to deepen and broaden the understanding of a phenomenon. Central to this approach is the intent to support the credibility of the research as it navigates the subject from varied perspectives, ensuring that the findings are comprehensive and validated (Stahl & King, 2020).

At the methodological level, I utilized a dual approach, incorporating both interviews and content analysis. The interviews with faculty members provided insight into their curriclum, challenges they faced, and their reflective practices. Simultaneously, the content analysis of course materials–including syllabi, lectures, and additional resources–allowed for a thorough examination of the curriuclum’s content and structural organizaiton. Furthermore, the data sources were diversified by collecting insights from direct interviews and analyzing documents. The former lends a voice to the pedagogical intent and experiences of the instructors, while the latter provides tangible evidence of how the curriculum manifests itself in practice.

The environmental triangulation strategy, or using multiple situations or contexts to study (Stahl & King, 2020), embraces diversity in academic settings and pedagogical levels. This approach ensured that the findings were not anchored to a singular institutional narrative but resonated with the broader academic landscape. This triangulated approach, informed by methodological, data, and environmental dimensions, helped validate the research findings.

Dependability

While qualitative research does not seek replicability, it does, however, aim to build trust within the research process to establish consistent results across different contexts and circumstances (Stahl & King, 2020). For this dissertation, I adopted several methods to help strengthen its dependability and trustworthiness within the academic environment.

Firstly, mentorship has been crucial. Regular consultations with my research advisor helped the study maintain academic rigor. These sessions provided me with feedback and guidance that helped further solidify the study's direction. Additionally, the involvement of a committee reinforced the study's dependability. The committee, comprised of experienced researchers, reviewed and provided feedback on the study as it progressed.

Transferability

In qualitative research, transferability speaks to the broader applicability of a study's findings beyond its immediate context (Lincoln & Guba, 1985, as cited in Stahl & King, 2020). It asks the question: How might the insights garnered from this research inform understanding in different settings, groups, or scenarios?

For this study, a careful approach was adopted to establish transferability. Firstly, thick descriptions of the research context were provided. In offering a comprehensive account of the settings, participants, and circumstances, I provide future researchers and readers the tools to understand the depth and breadth of the study's environment. This level of detail is a foundation upon which comparisons can be made with other contexts. The selection of participants, too, was geared towards enhancing transferability. Drawing participants from various colleges teaching at different levels and diverse backgrounds, I wanted to ensure the study's findings were not tethered to one narrow context or demographic.

However, it is essential to note that the goal of this dissertation was not to produce universally applicable conclusions (Lincoln & Guba, 1985, as cited in Coker, 2020). Instead, the aim was to provide a detailed and thorough explanation of the methodology deployed, allowing those in other contexts to discern parallels or divergences relevant to their unique situations. The obligation, then, lies with future readers and subsequent researchers to determine the extent of transferability based on the descriptions provided (Silverman, 2001).

Delimitations

As Coker (2022) and others note, qualitative research is bounded by specific delimitations that define the scope and context of the current research. Delimitations are essential for establishing the parameters within which the study is conducted that provide a frame of reference for understanding the research's applicability and limitations (Coker, 2022; Simon & Goes, 2013). The following delimitations guided the boundaries of this investigation:

- Participant Selection Criteria: Participants were limited to full-time faculty members within the domain of geoscience education at HEIs within a defined geographic region. Participants were selected based on their years of teaching experience in geoscience education, ensuring they were familiar with the subject matter and its pedagogical aspects. This delimitation ensures that the study captured a range of perspectives from individuals with relevant expertise in the field.
- Geographic Scope: The research was delimited to a specific geographic region, namely the United States. This geographic focus provided contextual specificity and acknowledged potential variations in geoscience education practices and challenges within the chosen area.

- Time Frame: The study was delimited to a specific time frame, encompassing the 2023-2024 academic year. This temporal constraint allowed for examining curriculum changes, innovations, or challenges within a defined period, enhancing relevance and contextual understanding.
- Institutional Type: The investigation was delimited to HEIs of 2- and 4-year HEIs. This aligns with the research's objectives and focuses on geoscience education within this institutional context.
- Language: Participants selected for interviews will be predominantly taught in English. This linguistic delimitation is relevant to the curriculum's research focus on communication and language.
- Curriculum Components: This study's document analysis was delimited to specific curriculum components, including course syllabi, lectures, and assignments. Other documents or administrative materials were not included in the analysis, maintaining a focused examination of core curriculum elements.
- Narrative Focus: The study was delimited to narratives related to integrating marginalized epistemologies and challenges faced in the curriculum. Narratives unrelated to these themes will not be the primary focus of analysis.

This study establishes a clear frame of reference for its research design by outlining these delimitations, allowing for a focused exploration of geoscience education within specified boundaries. These delimitations provide transparency regarding the study's scope and contextual constraints while acknowledging potential limitations in the research's applicability to broader contexts.

Methodology Chapter Summary

This methodology chapter has provided an in-depth exploration of the foundational elements guiding my research. The conceptual framework has been instrumental in sculpting the study's direction. Drawing from critical whiteness studies, curriculum theory, and critical transformative learning theory has been the study's compass, helping to align this study with theoretical considerations. The philosophical underpinnings of the study, deeply rooted in a qualitative tradition, recognize the intrinsic value of subjective experiences and the dynamic nature of reality. This perspective has informed the research design, emphasizing its exploratory approach to capture the nuances of faculty members' efforts in interrogating whiteness.

A multi-pronged strategy was employed for data generation. The study triangulated data from interviews, syllabi, lectures, and course materials to understand how faculty interrogate whiteness inside the classroom. The subsequent analysis employed a two-cycle coding process, incorporating *a priori* coding based on the study's theoretical foundations. Trustworthiness was essential to ensure the findings were dependable and transferable.

CHAPTER 4

FINDINGS

"Strivings and failures shape the stories we tell. What we recall has as much to do with the terrible things we hope to avoid as with the good life for which we yearn."

—Saidiya Hartman

In exploring how faculty members interrogate whiteness within the geoscience curriculum, my journey up to this point has been intensely profound and personal. While this inquiry represents my academic pursuit in this research, it also reflects the epistemological and ontological transformation I have undergone through the years of learning, (un)learning, and (re)learning. It has been a story of awakening to my privileges of whiteness and maleness, the biases embedded within the bedrock of geoscience education, and the critical need to dismantle these structures of dominance and exclusion.

As I have come to understand, geosciences is far more than a collection of scientific principles and discoveries. It is a discipline marked by the history of extraction—of both natural resources and human bodies, often exploited in the service of colonial and capitalist ambitions (Yusoff, 2018). This realization spurred a shift in my perspective, compelling me to see my role as an educator through a new lens. It became evident that interrogating whiteness in geoscience was not merely an option but a necessity to confront the injustices perpetuated by and through the discipline.

My journey into this work was born out of a growing self-awareness of the unearned advantages my privileges afforded me as a straight white male professor and a deepening understanding of the systemic inequities that pervade the academic world (Bernard & Cooperdock, 2018). It was through engaging with Critical whiteness Studies that I began to grasp

the full extent of how whiteness operates as a normative force, silently shaping what is considered valid knowledge (Delgado & Stefanic, 2012; Ladson-Billings, 2009; McGee, 2020; Ricci & Riggs, 2019), who is seen as a legitimate knower (MacDonald et al., 2019; McCausland, 2022), and which narratives are amplified or silenced (Leonardo, 2009; Picower, 2009; Rogers et al., 2022; Scarlett, 2022) within our curricula, classrooms, and institutions.

Employing Curriculum Theory and Critical Transformative Learning Theory, I began on a journey toward the end of intentional curriculum redesign and pedagogical innovation to create a learning environment that pushes back against the status quo and encourages critical reflection, dialogue, and transformation. This framework allowed the space necessary to conceptualize curriculum development as an act of social justice and the opportunity to integrate multiple perspectives and histories into the foundations of geoscience education. In doing so, we can begin broadening the scope of what we teach and how we teach.

This chapter, therefore, narrates not only the findings of this research project but also my personal and professional evolution as I navigated the complexities of addressing whiteness within geoscience education. Through narrative inquiry, I engaged in conversation to explore the intricacies of fellow educators' experiences, challenges, and insights, actively engaged in this critical work. Their stories, alongside mine, inform how we, as a community of scholars, are actively working to transform our discipline into one that acknowledges its past, interrogates its present, and reimagines its future.

I first begin by mapping the contours of the findings "Acknowledging and Challenging whiteness," where Luto, Nick, Lane, and Sofia confront the historical and ongoing exclusionary practices in geoscience. Secondly, I reflect on the emotional labor and resilience required to sustain this work through "Navigating Discomfort and Resistance." As to not generalize, these

themes aim to capture the essence of our collective journey at a particular point in time while also highlighting the critical, ongoing dialogue necessary for meaningful change (Willey & Magee, 2016).

In what follows, I hope that this narrative and the stories of my colleagues serve as what Singleton (2015) calls a "compass" for others in the geosciences and beyond (p. 173). This work is a testament to the power of self-reflection, the importance of community, and the transformative potential of education to challenge and dismantle structures of inequity. I invite others to join in this ongoing conversation by sharing our journey, paving the way for a more just and equitable geoscience education.

Finding One: Acknowledging and Challenging Whiteness

Acknowledging and Challenging whiteness (ACw) explored how faculty members in the geosciences acknowledge, confront, and seek to dismantle the deeply ingrained whiteness within their field of geoscience education. The current undertaking necessitates a thorough critical examination of the curriculum—scrutinizing the content it encompasses, the viewpoints it elevates, and the historical and present-day contexts it either accentuates or mutes. Moreover, this section examined the expressed and unexpressed among the participants, situating their discourse within the broader socio-political landscape.

To address the research question and thoroughly explore the embedded whiteness in geoscience education, educators Nick, Sofia, Luto, and Lane provided insights into the transformative process. This process is marked by a threefold approach: Recognition, Representation, and Reconciliation. Recognition acknowledges the omnipresence of whiteness and its implication in shaping the discipline. Representation involves a deliberate effort to include multiple perspectives, thereby challenging the conventional narratives that have long

dominated the field. Reconciliation sought to bridge the gaps identified, aiming to rectify past oversight and injustices by creating a reimagined geoscience. Together, the participants' efforts shed light on a pathway toward crafting an inclusive and equitable curriculum. Such a curriculum does more than simply recognize the intricate relationships between geology, history, and society; it actively engages with them, encouraging a learning environment where diverse voices and experiences are integral to understanding the full complexity of geosciences and their histories.

Recognition

In the recognition process, participants demonstrated an awareness or referred to the colonial foundations of the geosciences, a factor they deemed essential for dissecting the discipline's intertwined legacy of exploitation and marginalization. Individually, they underscored the significance of excavating this past and its repercussions on historically marginalized communities. Notably, two participants shared insights from what they referred to as "aha moments" they encountered during professional development sessions at conferences (i.e., Supporting and Advancing Geoscience Education at Two-Year Colleges [SAGE 2YC], Unlearning Racism in Geoscience [URGE]). For example, Lane when discussing her "aha moment" shared,

> And I had this conversation with a woman who [wa]s helping with some professional development that I was attending on anti-racist pedagogy, really like unpacking what do we mean by anti-racist. Is it really anti-racist? What does it mean to be anti-racist? And so, that was sort of my big *aha moment*, sort of this like 'ohh.' You know, like, "ohh well, but all the geologists are white." So how do

> I add more diverse voices to the perspectives of all the textbooks? [They] are written by white people. How do I address that?
>
> And [the moderator] was like, “don't give me that excuse.” She [was an] amazing influence. We had talked about [Shonda Prescod-Weinstein]’s blog that I'd come across, and she's like, “well, have your students read that blog and then have them figure out what it means for geosciences.” I was like, “oh, good point.”

This was contrasted with two participants who drew upon more personal lived experiences. Something worth mentioning was that those realizations of "aha moments" were experienced by white faculty members, illustrating a mechanism through which whiteness conceals its dominion.

Lane, a tenured professor in the Pacific Northwest, expressed a conscious effort to recognize whiteness within the geoscience curriculum, as is evident by their deliberate decision to incorporate discussions and resources that focused on the contributions and stories of scientists or individuals who have historically not been recognized by science. This awareness was captured by Lane when discussing whiteness:

> For me, the idea of interrogating whiteness is sort of undoing that notion that white is the default and sort of trying to make sure that more voices are represented and that more perspectives are heard beyond just the sort of standard textbook voice and lived experiences as much as possible.

Lane’s effort to “undo” the notion of white as the default and amplify diverse voices is one of many crucial steps toward creating an educational environment that is more inclusive and representative of the multitude of scientific contributions. She continued,

> Basically, [I'm] thinking about how students have assets that are not just academic and how do I help students recognize the strengths that they come into the classroom with that may not necessarily be what have been traditionally been rewarded in academic systems and create opportunities in the classroom for them to demonstrate those strengths, you know?

Lane's focus, here, on recognizing and valuing the non-academic assets that students bring into the classroom represents a significant turn from traditional U.S. white educational paradigms. This approach acknowledges students' experiences as valid knowledge, challenging the conventional white academic systems that often privilege certain forms of knowledge and ways of learning over Others. By creating opportunities for students to showcase their strengths, Lane appeared to be working towards dismantling the existing hierarchical structures in education spaces. Lane continued,

> And so, like community, aspects of learning are something that is important to me and something that I try to bring into the classroom because I recognize that there are more communal cultures outside of our sort of white-based culture. So, you know, the sort of things where I try to help create spaces in addition to the words that I use trying to create spaces all around that allow different students to feel different levels of comfort at different times.

Furthermore, Lane's emphasis on fostering community aspects of learning and creating spaces that accommodate different levels of comfort reflects an understanding of cultural inclusivity's importance in education. Recognizing that communal cultures often contrast the individualistic tendencies of white-based, liberal cultures, Lane's strategies aim to bridge those differences and provide a learning environment that respects and celebrates communal values.

When asked about interrogating whiteness within the geoscience curriculum, Nick acknowledged the historical dominance of white males as being “something that’s bugged [him] for a very long time.” He continued, “The discipline has historically [been] very dominated by guys that look like you [James] and me [Nick], you know, with beards and white skin. And that’s a shame because it doesn’t match society.” Nick looked down and paused for reflection,

> And, who knows how many brilliant, you know, minds or paradigm -changing advances we would have if we weren’t so off-putting as a group of practitioners. So, I'm very prepared to interrogate whiteness in my curriculum. And I would say I’m also comfortable with disrupting the level of whiteness in the community of practitioners.

The acknowledgment of Nick’s positionality as a white man in the field and his simultaneous recognition of the importance of his contributions, here, benefits from interpretation within the larger social framework of power dynamics and privilege. His recognition reflects a critical engagement with one’s role and responsibilities in perpetuating or challenging systemic structures, including white supremacy. However, this self-examination is not without tension. Nick continued, “ I myself am white, you know? And so, I also don’t want to throw myself out of the equation because I feel like I’m doing good stuff.”

In this moment of reflection, Nick reveals a complex interplay between recognizing the need for systemic change and maintaining one’s power within that very system. It unmasks the tension between individual contributions to the field and the broader imperative to dismantle structures of power and privilege that limit diversity and equity. It also reflects the broader challenge of how individuals in positions of power, especially those who are “white” and “male” in academia, can work towards inclusivity without reinforcing the very structures of privilege

they aim to challenge. It is an important aspect to consider in the discourse on interrogating whiteness, as it speaks to the ongoing need for greater reflexivity, accountability, and transformative action among those with systemic power.

Sofia is an associate professor from the Northeast who has always known they wanted to be involved with academia. In reflecting on her path into higher education, with a grin on her face, Sofia recalled giving her cousin "math exams for fun." She proudly described herself as "the granddaughter and niece and daughter of many professors." When I asked her about whiteness in the geosciences, she quickly pointed out that there was "definitely a definitive moment." She explained,

> I would say six years ago is when I started to question why the only textbooks that I was given to teach from, because the way it works at [Sofia's institution], is all the faculty that teach a course, a committee decides on what book gets chosen, and everyone who teaches that course has to use the same book. And, what I noticed is that the oceanography book, in particular, only had white males, especially in the exploration chapter, which is the first chapter. You know your usual names like Alfred Wegner and Captain James Cook. All Western European Caucasian males.

Her comments suggest that when "there was no voice given to anyone else," Sofia felt compelled to actively challenge "the eurocentric and white-dominant perspectives" traditionally presented in geoscience textbooks. In her critique of the portrayal of explorers like James Cook and integrating discussions about Indigenous perspectives and representation, Sofia can be viewed as resisting white normativity by not "look[ing] at everything with a white lens" and emphasizing the importance of multiple narratives.

In the broader context of recognition within the geoscience curriculum, Lane, Sofia, and Nick each demonstrate an awareness of the discipline's colonial foundations and actively, to some degree, engage in practices aimed at dismantling the normativity of whiteness. Lane's deliberate efforts to include diverse voices and perspectives, and her emphasis on valuing the non-academic assets students bring represent a proactive stance toward creating a more inclusive educational environment. Similarly, Nick's acknowledgment of the historical dominance of white males in geoscience and his commitment to interrogating whiteness reflects a critical engagement with the discipline's power dynamics.

In contrast, Luto, a professor from the South, took an approach marked by statements such as "I try not to... because we are in [conservative state], right?" and "Usually, those conversations [pushing against whiteness] will begin from the student," underscores a hesitancy to confront uncomfortable truths about the discipline's colonial legacies and the ongoing marginalization of historically excluded groups. This also contrasts sharply with Sofia's active resistance against eurocentric and white-dominant perspectives, highlighting a divergence in the extent to which educators are willing or able to engage in the critical work of interrogating whiteness within their curriculum.

Luto's story reveals a significant difference in the level of recognition and engagement with the systemic underpinnings of whiteness in geoscience. While Lane and Nick actively seek to challenge and expand the narrative boundaries of their curriculum, Luto's approach is characterized by a cautious and reactive stance, which might suggest a gap in the recognition of whiteness as a pervasive force within the discipline. Luto was reluctant to proactively address or challenge dominant narratives, preferring instead to let students lead discussions that indicate a passive engagement with the critical issues of representation and equity in geoscience education.

This lack of proactive recognition can be a way in which white supremacy is maintained as the status quo, where the dominion of whiteness remains largely unchallenged. However, equally as plausible is the strategic approach given the local sociopolitical environment.

In conservatives regions, like the south, direct confrontations about systemic racism may lead to significant backlash, which might potentially harm both educator and student. Her more cautious approach may be a pragmatic choice intended to maintain a safe educational space. Luto, as faculty member of Color might also be a protective measure against potential professional jeopardization or personal safety concerns, which could severely limit their ability to educate effectively if ignored.

The juxtaposition of Sofia, Lane, and Nick's proactive strategies with Luto's more cautious approach illuminates the varied landscape of recognition and engagement with whiteness in geoscience education. While some educators like Lane, who openly admit to actively "trying and push back in those white spaces," are making strides towards challenging the historical and systemic biases embedded in their discipline, others are reluctant to fully embrace this critical work. Luto's narrative, in particular, serves as a reminder of the complexities and challenges inherent in navigating discussions of race and representation in educational settings, especially within conservative contexts. It brings to light the need for continued efforts in creating environments where the interrogation of whiteness and the amplification of diverse voices are not just welcomed but actively pursued as integral components of transformative educational practice.

Representation

Sofia's journey of challenging the "eurocentric and white-dominant" narratives within geoscience textbooks by resisting the normalization of white viewpoints sheds light on a broader

issue within geoscience education. The struggle for inclusivity and representation is highlighted in the following vignette and extends into how environmental crises are portrayed in educational materials (see Bullard's Dumping in Dixie [1994]). When reviewing course materials with Sofia, she brought a lot of her own lived experiences into the discussion,

> I talk about "Cancer Alley," [be]cause I've been there. I ask students why they think that Shell refused to acknowledge that they pollute the air. Are they really like [Shell], 'oh, no, nothing is coming out of our smoke stacks, nothing comes out into the water right next to the communities'

We were looking over Sofia's lecture slide (see Figure 2). She continued,

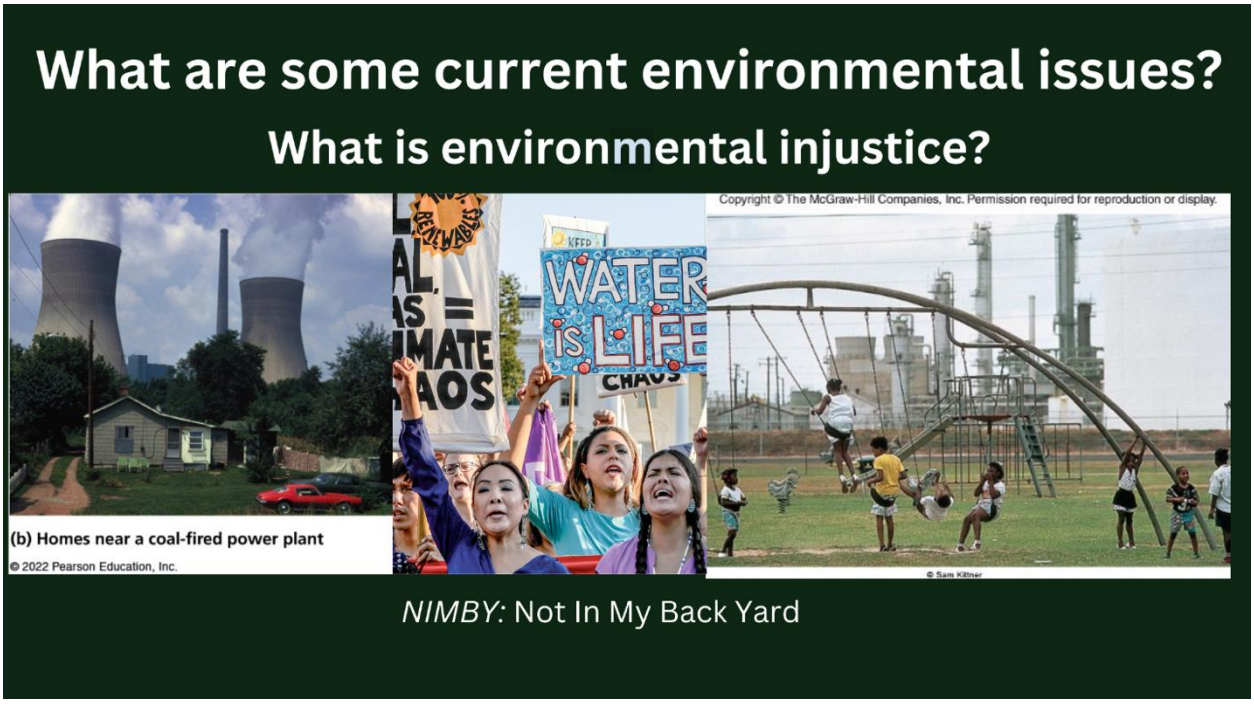
> And the picture on the right is Cancer Alley. That's actually Norco, the "fence line community" in Norco, known as the Diamond Community. They [residents] were living there first. It was one of the first free Black communities post-slavery, and then Shell came in and bought up part of the plantation land and built a petroleum refinery and a chemical company right next to it. And you can see there's a playground with a fence, and that's their [Shell's] refinery right there. And it's the NIMBY mentality, which is why that's on the bottom [of the slide] like that, which only really means rich white people can do as they please because they can pay lawyers and they can pay politicians to not put stuff in their backyard.

Turning a critical eye to the visual representation of environmental-injustice slides provided by Sofia in educational materials plays a critical role in shaping perceptions and understanding these complex problems. While not pictured, images associated with environmental activism like Love Canal often feature activists who are predominantly white, reinforcing a single narrative that positions white communities as proactive and capable of

mobilizing despite environmental injustices. This portrayal highlights their struggles while also implicitly celebrating their agency and resilience in the face of adversity.

Figure 2

Slide from Sofia's lecture



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In contrast, images depicting environmental injustices in communities of color, such as those from Cancer Alley, frequently display Black children playing in polluted playgrounds or families living in close proximity to toxic facilities (see Figure1). While the intent of these

images aim to illustrate the severe impact of environmental degradation on vulnerable communities, they inadvertently convey a problematic message. Such depictions stand to reinforce harmful stereotypes that suggest Black and Brown communities are passively resigned to their circumstances, stripping them of their agency and the vigorous efforts they have undertaken to combat environmental injustices. Alongside the image, missing from the conversation, are stories representing these communities' resilience.

As I reflect on this contrast in visual representation, it is not merely an issue of "aesthetic" choice but reflects deeper societal biases shaped by asymmetrical power dynamics. By consistently portraying white activists in a light of empowerment and resilience while framing communities of Color as victims of their environment, educational materials perpetuate a single narrative that overlooks the activism, leadership, and resistance efforts led by these marginalized groups. This selective portrayal fails to acknowledge the strength and agency of communities of Color in navigating and challenging the systemic forces contributing to environmental racism.

Expanding on this, we can turn toward the mechanisms through which these narratives are perpetuated and the potential pathways for dismantling them. One such mechanism is the curriculum itself, which often prioritizes western methodologies and achievements while marginalizing or altogether omitting non-western contributions and perspectives. Another is the pedagogical approach, which may reinforce hierarchical teacher-student dynamics and discourage critical engagement with the material. Addressing such issues requires a concerted effort to diversify curricula, employ inclusive pedagogical strategies, and the space to encourage questioning and critical analysis.

For example, Nick shared a story of an experience that speaks to a multitude of potential issues. He explained,

> Another thing that occurs to me offhand is there's a certain comfort level that I have with being outside, right? I was a Boy Scout. I feel like I know how to be safe outside and cut away from me when I'm using a pocketknife and how to start a fire, and you know, how to dress in layers? I was a runner, and I feel confident knowing the limits of my body and what I'm physically capable of.
>
> But I find that a lot of my students, particularly students of Color, don't come into class, and specifically into field aspects of the class, with a lot of that same understanding and that can lead to trouble if they if they show up without proper footwear for a hike, then they're going to be miserable. All the blisters they're getting rather than being able to learn about the geology and having their minds blown about how they are simultaneously standing on the ancient sea floor and at the heart of an ancient mountain belt.
>
> And it can also be unsafe. I had a Black Woman student who came out to my [state] field class that I used to lead every summer. And she overheated. You know, we were out mapping, and she just got way too hot and had to go and sit in the shade, which meant she didn't get to see the stuff, didn't get to learn the stuff, but also basically was like the person who couldn't do it. And then that kind of made it worse, right? Like, how am I to know that somebody is particularly prone to overheating? How were they to know if they don't spend time outside in the sun, you know, that's a tough nut to crack.

> But I ended up feeling awful about that. You know, I essentially tried to give her an awesome experience and ended up basically driving her back to, I think she ended up going into ballet. Yeah, so not geology.

Analyzing Nick's response through a critical whiteness lens and considering the aspects of hidden whiteness and privilege in the curriculum, several key points highlight the pervasive, often unnoticed, impacts of racial and socio-economic privilege in educational settings, particularly in disciplines with practical fieldwork components like geology.

Firstly, Nick's comfort and familiarity with outdoor activities–stemming from his experiences as a "Boy Scout" and his personal hobbies–illustrate a form of privilege that is taken for granted within predominantly white spaces. This comfort is not a personal attribute but is indicative of a broader societal structure that affords certain groups more opportunities for engagement with nature and outdoor activities. This is contrasted with the experiences of his students of Color, who, according to Nick, "often do not come to class with the same level of outdoor preparedness or experience." While the evidence provided was purely anecdotal, the discrepancy is not a reflection of individual capabilities or interests as suggested but is rather a systemic barrier that limits access to such experiences.

Further analyzing this exchange, it is possible to tease out the embedded whiteness within the geoscience curriculum, as Nick's reflections, intending to highlight inclusivity issues, inadvertently reveal barriers that Students of Color face in the geosciences. Nick began by contrasting his own personal outdoor experience with the perceived lack of preparation among his students of Color. This comparison itself is problematic, as it assumes a default standard based on the faculty's white, outdoor-experienced background. Such assumptions fail to recognize the systemic reasons–such as economic barriers, lack of access to outdoor spaces,

and/or historical exclusion from certain recreational activities–that may prevent students of Color from acquiring similar experiences.

Furthermore, the example of the student who overheated during the field class underscores the practical consequences of these disparities and unchecked assumptions. While the educator framed the incident as a physical readiness problem, it is an issue of a curriculum that does not account for the varied backgrounds and needs of its students. Nick's rhetorical questions about anticipating students' physical vulnerabilities reveal an oversight of the broader issue of a curriculum that *expects* students to adapt to it rather than the curriculum adapting to the diverse student body it serves.

Moreover, the recounting of the student shifting her focus away from geology post-incident is emblematic of the much larger, systemic problem. Again, the issue here is not one of "personal choice" or "preparedness" but one of how educational environments that are structured around certain normative standards ***can*** and ***do*** alienate and exclude those who do not fit white standards.

Reflecting further on the overheating incident also hints at an undercurrent of white guilt–a recognition of racial privilege and systemic injustices yet marred by inaction. The white guilt, perhaps prompting an initial awareness, was not enough to propel the necessary change within his curriculum. His expression of feeling "awful" and his subsequent reflection are characteristic of the deeper issue of passive acknowledgment of privilege without the critical actionable steps needed to dismantle the entrenched biases and barriers that students of Color face. Actual progress requires moving beyond feeling "awful" by challenging the status quo and implementing concrete measures to ensure geoscience is inclusive, accessible, and equitable. This scenario demands more than introspection of being a "tough nut to crack." It calls for a

rigorous overhaul of educational practices to address and rectify the systemic inequalities perpetuated within academic settings.

Reconciliation

The typical white-centered narratives that have long dominated geoscience education have recently been called into question (Burton et al., 2023; Bush & Mattox, 2020; Hall et al., 2022; Jones, 2021; Monarrez et al., 2022; Núñez et al., 2020). By interrogating the historical whitewashed narratives, educators can expose the biases and assumptions that have historically shaped the field, opening up space for a more inclusive portrayal of the geosciences. For example, Sofia pointed out,

> They [textbooks/publishers] put him [James Cook] on a pedestal as this person who "discovered" Hawaii. He is also credited as the person who discovered Australia and New Zealand. But the problem with that narrative is that there were people there already, right?

While multiple faculty members, myself included, were quick to mention stories like Sofia's or those of Marie Tharp's contributions to plate tectonics, Lane pushed for a deeper and more holistic understanding as she recognized even the problematic nature of a single example, explaining,

When I do my unit on plate tectonics, it is sort of like an overview of here's plate tectonics. Here are some of the general terms. All that fun stuff. And then there's also a video about Marie Tharp and how she was excluded from the process and not necessarily acknowledged and included. And so that's one really nice example, but it's also a white woman.

Lane's introspection on integrating Marie Tharp's narrative into the plate tectonics unit serves as a step toward diversifying geoscience education and critiques the discipline's

entrenched whiteness. Tharp's story, which illuminates the overlooked contributions of women in a male-dominated field, simultaneously sheds light on the broader issue of recognition and reconciliation. However, Lane's reflections reveal a deeper, more critical awareness of the limitations inherent in celebrating such contributions within a predominantly white framework. This acknowledgment is not about adding diversity for diversity's sake but fundamentally questioning and challenging the whiteness that has historically dictated whose contributions are recognized and valued in the geosciences. Lane continued,

> And so again, I sort of like making sure that we're moving past the idea that the people who have made the greatest advances have been white [and in this instance, a woman] and making sure that then there's a story about who is being impacted by the dangers of earthquakes and because of the history.

Lane's comments are significant because they move beyond simply including underrepresented scientific figures to interrogate the structures that have perpetuated a narrow view of who can contribute to the field. This approach calls for a radical reimagining of geoscience education that not only corrects historical oversights but also actively dismantles the systemic barriers that have marginalized contributions based on race, gender, and geography. Lane explained,

> Part of the science that influenced the desire to understand oceanography better was because of the [transatlantic] slave trade. Our history of our science is not pure. I should say the motivations aren't always pure. There is sort of this common theme that humans are part of science that we can't separate out the two. And it doesn't make science less valuable in the sense of like what we learn. It's just important to, you know, acknowledge that history and the legacy that comes

> from some of that history. So, that's the racist legacy of oceanography. But I also want to celebrate the knowledge holders. I share a video of Polynesian navigators that describes the Polynesian navigators and the work that they did. So, within that one week [of lecture] is sort of an example where it's both acknowledging the problematic history from a single, white lens. But then also celebrating a non-white lens of knowledge holders.

The mention and acknowledgment of the transatlantic slave trade as a driving force for a better understanding of oceanography points toward an often-overlooked aspect of scientific history; it illustrates how economic and exploitative endeavors, deeply rooted in racism and colonialism, have contributed to the advancement of scientific knowledge. Such acknowledgment can challenge the often-sanitized narratives of scientific progress by exposing the unethical motivations and actions that have sometimes fueled discovery.

Lane also challenges educators and students to confront and deconstruct the whiteness embedded within scientific narratives and practices by advocating for a more inclusive acknowledgment of diverse contributions and impacts within geosciences.

> Geosciences are so much of a field where it's not just this theoretical construct, but it's actually impacting human lives. And, there is so much interaction between what happens to geology happens to humans and what we have done as geologists has impacted humans and continues to.

Moreover, Lane's mention of the impacts of geological phenomena on diverse communities emphasizes the real-world implications of geoscience knowledge and its application. Nick's comments are in agreement with Lane as he views the geosciences as a field "helping society grapple with resource issues, hazards, and risks." However, where Lane and

Sofia challenge the status quo outwardly, Nick is more easily prone to omission rather than interrogation. For example, when asked about what future changes or developments would he like to see in the geoscience curriculum regarding interrogating whiteness, Nick responded,

> Most of the ideas we talk about, we don't give credit to the people who developed them. The idea that granites are interpreted as being intrusive igneous rocks. You know that they were magma in the past. Like, who came up with that? There's a history there, right? And you could go into that. But oftentimes, we don't, it's not efficient, and we are like, 'Ok, this is pretty well accepted. Let's just move on.' But in terms of ideas and geoscience, like the idea of plate tectonics doesn't actually require any, you know, it doesn't require Alfred Wegner (ODwP) or Harry Hess (ODwP), or even Marie Tharp. *We can explain the physical manifestations independent of the people who produced those ideas* (emphasis added).

To begin, I would like to draw attention to the response from Nick as it reveals a perspective that, while acknowledging the historical underpinnings of geoscientific knowledge, it simultaneously underscores the deeper issue prevalent in the academic and scientific discourse– the omission of contributor acknowledgments, which is particularly prevalent in the geosciences. When examined through the lens of interrogating whiteness, Nick's perspective can begin a critical dialogue about how educational curricula, particularly in the sciences, can inadvertently perpetuate a form of epistemological whiteness. This form of whiteness is characterized by the *universalization* and *depersonalization* of knowledge that, while seemingly *neutral*, can obscure the diverse origins of scientific discoveries and, by extension, reinforce the marginalization of non-white contributors within the scientific community (Christians, 2016; Weber & Schell

Word, 2001). Even the idea that "that granites are interpreted as being intrusive igneous rocks, you know, that they were magma in the past" suggests that the interpretation of granites as intrusive igneous rocks is an objective fact, unaffected by the cultural or historical context of 'its discovery.' While this is a general example, this perspective aligns with a scientific pattern of presenting knowledge as *universal* and *ahistorical*, often obscuring specific cultural and intellectual contexts in which it was developed (Pennycook, 1989; Young & Muller, 2013).

Nick's comments can be viewed as a missed opportunity to critically interrogate how whiteness operates within the academic curriculum and the broader scientific community. By omitting the contribution of scientists, the curriculum inadvertently upholds a narrative that centers on white, predominantly male contributors as the default purveyors of scientific knowledge. In addressing the teaching methodology of geoscience, it is critical to discuss the prevalent "efficiency-driven" approach, which tends to emphasize the most "well-accepted" theories over a more explorative narrative of scientific discovery. This method, while seemingly practical, supports a narrative that is sanitized of diversity, effectively erasing the contributions of Scientists of Color and those from marginalized communities. The exclusion of key figures in significant scientific narratives, such as the development of plate tectonics theory, is a glaring example.

While some, like Nick, argue that the science of plate tectonics can be taught devoid of its historical contributors, such perspectives overlook the essential role of contextualizing scientific advancements within their broader socio-historical frameworks. Nick's omission contrasts sharply with the acknowledgment of oceanography's historical context, which includes exploiting trade routes to optimize 'efficiency' between continents, as highlighted by Lane and Sofia.

These perspectives highlight one of the many cross-sections of the geosciences, where the study of Earth's processes is inextricably linked to social, economic, and historical contexts that disproportionately affect marginalized and vulnerable populations. It points to the responsibility of our discipline to recognize and address the ways in which whiteness intersects with broader societal issues, advocating for a geoscience education that is attuned to the social justice implications of scientific inquiry.

Finding Two: Navigating Discomfort and Resistance

This section, Navigating Discomfort and Resistance, explored the emotional and intellectual challenges educators face as they confront and navigate the discomforts associated with interrogating whiteness and implementing curriculum changes. It provides insight into managing resistance and creating a classroom environment conducive to open dialogue and growth. Navigating racial discomforts and resistance is not about eliminating these feelings but managing them to promote learning, growth, and understanding. By acknowledging and addressing the challenges head-on, educators have the ability to transform their classrooms into spaces where difficult conversations can lead to meaningful change. In what follows is a discussion that explores the nuanced interplay between Luto, Sofia, Lane, and Nick as they navigate pivotal moments in their personal and professional discomfort, resistance, and engagement, shedding light on the powerful transformations that can occur when we dare to confront entrenched norms and biases head-on.

Personal and Professional Discomfort

Each educator spoke to the discomfort inherent in challenging entrenched norms and biases within the curriculum and themselves. Lane candidly shared their journey towards integrating decolonization themes into their courses, acknowledging the discomfort as a catalyst

for their professional development, “It was definitely uncomfortable when I first started...I wasn’t as used to how to frame what I was talking about.” This sentiment is also echoed by Sofia and Luto, who discussed the process of “self-reflection” required to understand their positionality within the framework of whiteness in geoscience education. Openly grappling with these discomforts, these educators model the process of critical self-reflection.

In one of the interviews with Luto, we discussed one of her assignments. I asked Luto, “I wanted to clarify the wording in your journaling assignment. How can we discuss the impact of environmental policies on Black and Brown communities in a way that highlights their resilience and agency, rather than solely focusing on the adversities and systemic challenges they face?” Luto initially seemed taken aback by my question but responded,

> But I mention Ethiopia, a country in Africa, who plant over 1,000,000 trees in a single day. If they can do this, why can’t we [U.S.] right? We’re seeing these are poor nations, right? These poor nations who have poor people, yet they do this and they’re fixing the problem. Why can’t we [U.S.], when we’re the ones putting the pollution out there. So, I try to show examples of success as well, so it’s not always negative.

“Yeah. There’s not an easy answer.” I admitted.

“No, and it’s a valid question and it’s something I’m working on,” Luto responded earnestly. “I try and it doesn't always work, but I try to end every lesson on a positive note. Something that someone did that’s worth noting, and I use those examples from other countries,” Luto continued. “So, it’s not always, ‘Oh, the Americans are the best.’ In fact, I always say we’re the worst, if anything.”

"We kind of are sometimes," I admitted. "But thinking through pushing back against whiteness, if we are always framing it [our conversations or focus of our assignments or our lectures] from the negative, it maintains that vulnerable stereotype. Or, the kind of thing where we tell stories of [white] America comes in and saves the day."

Luto nodded. She thought for a moment before responding,

> Yeah, and I can see where this [assignment] can have its flaws, but what I'm looking at is, like, Americans are to blame for the pollution, we [U.S.] are causing climate change. But other people might not have the means or economic funding to deal with the problem that we are creating, and they have had little to contribute towards it. It [the assignment] is something that you can have good intentions to be anti-racist, but sometimes it doesn't always pan out because you still have that worldview of where you are coming from. Most of us have good intentions and might not execute them as well as we want to.

"I think it is a continuum," I agreed, recognizing the shared complexities of conversation.

This exchange between me and Luto provides a rich ground for critical analysis. The dialogue reveals the complexities of addressing systemic issues within educational settings while attempting to shift the narrative toward resilience, agency, and global responsibility. The initial question I posed aimed to challenge the traditional narrative that often centers on the adversities faced by Black and Brown communities without equally highlighting their agency and resilience. This approach is critical in interrogating whiteness, as it seeks to dismantle the often white-centered perspective that positions these communities primarily as victims of environmental injustices rather than active agents of change. Luto's response, which cites the example of a country in Africa planting over a million trees daily, demonstrates an attempt to shift the focus

towards positive action and empowerment. This shift is an essential step in challenging the *white savior complex* (Jailani, 2016; Wilcox, 2021) that pervades many environmental narratives, where the Global North [white] is often positioned as the "hero" coming to the aid of the "helpless" Global South [Other].

Luto's comments on the efforts of "poor nations" to address environmental issues, juxtaposed with the pollution primarily generated by wealthier countries like the United States, underscore the global imbalance in environmental degradation and response. On the surface, this perspective appears to interrogate the whiteness embedded in environmental discourses by questioning the global North's responsibility and the often-overlooked contributions of the global South to combating climate change (Collyer, 2018; Redclift & Sage, 1998). For example, Luto highlighted examples of success and resilience, which challenges the narrative that associates technological and financial wealth with environmental stewardship, revealing a critical awareness of the systemic inequalities that shape global environmental policies. However, when Sofia describes African countries uniformly as "poor," it reinforces a stereotype that contributes to a paternalistic and pity-oriented view of the continent.

This perspective is problematic and deeply rooted in colonial narratives. This perspective also fails to recognize the complexity and diversity of African societies, economies, and cultures. It also overlooks the richness of African contributions to global knowledge, culture, and the economy, reducing the continent to a singular story of poverty and need. I believe this gets to what Lane described as "words have meaning, and in science, we talk about a whole lot of technical words, but it's important to say how culture is tied to the words that we come up with to speak about topics."

The dialogue between me and Luto reflected the challenges educators face in shifting perspectives and narratives within our/their teaching. Luto's acknowledgment of the assignment's potential flaws and her intention to end lessons on a positive note demonstrates a conscious effort to navigate these complexities. However, the conversation also reveals the inherent difficulties in completely breaking free from entrenched worldviews and biases. As I brought Luto's attention to the potential for her assignment to inadvertently maintain vulnerable stereotypes or perpetuate a narrative of American exceptionalism (Sonya, 2023), I was initially met with resistance, which points to the process of interrogating and pushing back against whiteness in educational content.

However, the world is not always just or equitable. During the interviews with Sofia, she spoke about her systemic challenges, shedding light on the complexities of identity and privilege. She shares,

> I'm LatinX, but I am also aware of my privilege. I blend in. People don't believe me [that i'm LatinX]. So, people think I'm either Italian or Greek at first until I tell them where I'm from [Puerto Rico]. I see a switch go off like 'oh' and [they] treat me differently, and I'm like, that is part of that system we are talking about, right?

Sofia's reflection stresses the pervasive influence of societal perceptions and stereotypes, prompting a closer examination of the inherent biases embedded within such arrangements. This exchange unearths the impact that the identity of faculty members can have, both on their personal experiences and their ability to navigate and challenge systemic inequities in academic and social contexts.

Sofia shared another experience of hers that further exposes racial erasure and systemic biases in predominantly white academic environments. She recalled a colleague recently telling her, “No one can ever remember that you’re not white,” epitomizing the subtle yet pervasive challenges she and other Academics of Color face, including racial gaslighting and internalized racism. Despite such obstacles, Sofia actively engages in DEI initiatives, leading efforts to highlight underrepresented scientists and develop a more inclusive curriculum. She detailed her organization of a seminar series focusing on diversity in STEM fields, showcasing her commitment to fostering change. Sofia also underscored the importance of addressing systemic inequities within her field, noting the overwhelming whiteness of faculty across various scientific disciplines at her institution. Nick described similar efforts through his work on “scientist spotlights,” which aim to make the community “look like the community you want rather than the community you have by intentionally centering People of Color and women and people from non-binary perspectives.”

When asked about looking toward the future and the changes she would like to see, Sofia acknowledged the formidable hurdles ahead. “I think it’s going to be hard looking at my colleagues and their backgrounds. I’m thinking about all the full-time faculty in geology, environmental science, earth science, oceanography, and even physics are all white.” Her assessment exposes the need for greater diversity and inclusion within the geosciences and related disciplines. Her story reflects the struggles and resilience of navigating academia as a Person of Color and the crucial role of allyship and uncomfortable conversations in promoting diversity and inclusion.

Sofia’s narrative offers a glimpse into the lived realities of navigating white-dominated academic spaces, highlighting themes relevant to this study. Firstly, her colleague’s comment

serves as a prime example of racial erasure, where Sofia's identity is invisibilized and assimilated into the normative whiteness of academia. This incident is emblematic of how whiteness operates as the invisible standard, marginalizing and negating non-white identities and experiences. The subtle dismissal of Sofia's racial identity also touches upon the concept of racial gaslighting, where the realities of People of Color are questioned or invalidated, often leading to internalized racism. This reflects the broader systemic issue where individuals are made to doubt their experiences of discrimination, further perpetuating white dominance and the marginalization of minority voices.

However, Sofia's proactive engagement in DEI initiatives and her efforts to bring visibility to underrepresented groups in STEM highlight resistance to these systemic biases. By leading projects that celebrate diversity and challenge the homogeneity of academic spaces, Sofia is able to assert her identity while working towards dismantling entrenched structures that uphold white normativity.

Moreover, while she acknowledges the overwhelming whiteness of faculty in scientific disciplines at her institution, the reality underscores the persistent barriers to inclusivity and equity. It highlights the institutional nature of racism and the need for systemic change that goes beyond individual actions. The critical role of white faculty in engaging with these issues points to the necessity of interrogating whiteness—examining the privileges, biases, and structures that allow whiteness to remain the default and unmarked category. This vignette of Sofia's experience and actions embodies the dual challenges and potentials within the academic sphere to confront and transform the entrenched norms of whiteness. Her story is a call to action, emphasizing the importance of recognizing racial biases, actively working towards inclusivity, and the essential role of individuals and institutions in addressing and dismantling systemic inequities.

Student Resistance and Engagement

In addressing the critical task of interrogating whiteness within their teaching practices, Luto, Nick, Sofia, and Lane spoke to a range of student reactions that varied from resistance and discomfort to eventual engagement. This sub-theme explored how the participants and their students responded to attempts at interrogating whiteness, highlighting the journey from initial skepticism or opposition to a deeper understanding and participation. It also considered the approaches educators took to navigate and facilitate these responses, aiming to transform the educational landscape into a space where challenging conversations about race and privilege can lead to growth and learning for everyone involved. By examining these interactions, we can gain better insight into practical strategies for guiding students through critically examining whiteness and its impact on geoscience education.

When speaking with Nick, I asked, "through any of the work you do or have done, have there been any instances where you've encountered any kind of discomfort or been met with any type of student resistance?"

> "Yeah, I mean, there's always things," Nick shifted from side to side as he responded, I took a group of students out to our local [university town]'s walking mall. And I said 'Look!' as we were all looking at building stones which were these neat diabase monoliths in a fountain. And that fountain had been turned off for the winter, so I happily jumped over the chain and got down there into the fountain and was pointing out stuff. And then it came time for a group photo. I was like, everybody come on down here!' And one of my students was like, 'Man, I don't know, I'm Black. If I go down there, I'm liable to get arrested.' I was like, 'Wow." Even though I was there to vouch for him [the Black student]. But again,

> it's the kind of thing that wouldn't have ever occurred to me. I guess if you trespass on even something like jumping into the fountain, you're more likely to get in trouble if you don't have that get-of-jail-free skin color.

I chose this moment to reflect on the interaction between Nick and his students, as it highlights the unexpected moments of discomfort and resistance that can arise in educational settings. Also, through this dialogue, Nick shared a specific instance reflecting his learning process while pointing out students' differing experiences and concerns based on racial identities.

At the outset, Nick's decision to jump over the chain into the fountain, followed by his invitation to students to join him, seems innocuous and driven by an enthusiasm for teaching. In an early part of the interview, Nick admitted that his role as a geoscience educator was to "get [his] students really jazzed about geology." However, the hesitation expressed by his Black student underscores a significant racialized reality: the differing perceptions and treatments of public behavior based on race. This moment of discomfort for the student brings to the fore the pervasive issue of racial profiling and the fear of police or security intervention that Black individuals often navigate, a reality that Nick, through his white lens, had not anticipated.

Nick's recognition of the student's concern and his decision to change the photo backdrop is a positive step towards adapting to the discomfort expressed by his student. However, this action alone does not fully address the deeper issue at hand—the privilege of unawareness that Nick, as a white educator, benefits from. His surprise at the student's reaction reveals a gap in understanding the lived experiences of Black and Brown people, a gap that is symptomatic of whiteness in educational spaces.

The critical aspect of this exchange lies in the reflection that followed. Nick's realization that his skin color affords him a 'get out of jail free' card—a metaphor for the societal privileges that come with being white—marks an important moment of self-awareness. However, the depth of this reflection is somewhat limited by the language used (i.e., "the kind of thing that wouldn't have never occurred to") and the lack of a deeper exploration into how these dynamics of privilege and race might affect his teaching practices and the inclusivity of the learning environment.

Lane reflected on her own experience of her work interrogating whiteness, borne out of a "frustration about the lack of women and representation" in her geology program. Through her many years of work in interrogating whiteness, she has expanded her approach to "close the equity gaps." She explained, "I want students to understand that I see them, and I see that they have different needs." Lane has an awareness, much like Sofia, that "not everybody is coming into the classroom with the same lived experiences." However, Lane admitted that there is a difficulty when doing the work, "I think it is not as common for students to be coming across people, particularly in a science class, and it still takes students by surprise [to be interrogating whiteness]."

Building Supportive Learning Environments

The subtheme of building supportive learning environments plays a critical role in navigating discomfort and resistance within educational settings. These environments are essential for promoting vulnerability, stimulating dialogue, and enabling shared learning experiences between students and instructors. The insights from educators Luto, Nick, Lane, and Sofia shed light on the effective strategies and notable challenges encountered in this effort. Their experiences provide a clear view of how such environments are constructed and the

hurdles that need to be overcome. This analysis aimed at exploring the actions taken by these educators to create classrooms that are not only receptive to diverse perspectives but also conducive to personal and collective growth.

Lane's approach, as she described, showcases her commitment to transforming traditional classroom dynamics. Through the participatory creation (Cooper et al., 2021) of classroom norms and the integration of course-based undergraduate research experiences (CUREs), Lane actively works to decentralize power in the classroom and challenge the standard hierarchical structures that often underpin educational settings.

Lane emphasized the importance of student involvement in establishing classroom norms, highlighting a shift from instructor-led dictation to a more democratic, student-centered process. By stating, "I don't set what the kind of policies are for the classroom. I let the peers create that for themselves," Lane relinquishes traditional authority, allowing her students to define their own expectations and standards for interaction and engagement. This practice empowers students by promoting a sense of community and mutual respect among peers. When students expressed concerns about peer interaction, Lane's reminder of the collectively established norms demonstrates the shared responsibility for maintaining a conducive learning environment. Such an approach challenges conventional power dynamics in the classroom, positioning the learning experience as a collaborative endeavor rather than a unidirectional transfer of knowledge.

The incorporation of CUREs into Lane's courses further exemplifies a commitment to decentering traditional educational power structures. By stating, "the idea is that students are doing their own research projects embedded into the course," Lane underscores the shift towards a co-constructive model of knowledge generation. This method aims to democratize the learning

process and validate each student's capabilities as a researcher and scholar, irrespective of their level of expertise. Lane's willingness to explore unfamiliar topics, such as fungi, alongside her students, admitting, "I know absolutely nothing about fungi," reinforces a notion that learning is a shared journey of discovery. This approach dismantles the traditional hierarchy between instructor and student, creating an environment where knowledge is collectively constructed rather than imparted by an authoritative figure.

Such pedagogical strategies contribute to interrogating whiteness by challenging the norms and structures that have historically privileged certain voices and perspectives within educational settings. By redistributing power and encouraging diverse methods of inquiry and expression, Lane's classroom becomes a space where multiple identities and experiences can be acknowledged and valued. The emphasis here is on the *co-construction of knowledge,* and the collaborative establishment of norms that disrupt the traditional, often white, eurocentric, educational paradigms, making room for a broader range of perspectives and ways of knowing.

Sofia's approach to teaching reflected a deliberate effort to show multiple standpoints to foster what she calls "cognitive dissonance," which encourages a critical examination of conservation history within her classroom. By introducing conflicting narratives and challenging the glorified images of conservation figures, she aims to "broaden my students' perspectives." Sofia stated, "I sort of break their brains, what do you call it, cognitive dissonance? So, if someone presents to you information that doesn't agree with your faith and your worldview, you might not accept it. I know it might anger some people, but I do bring up these different perspectives to show there are different worldviews." This statement emphasizes her commitment to presenting a comprehensive view of historical figures and events, acknowledging the complexity of societal narratives.

Sofia's pedagogical strategy directly confronts the sanitized narratives often found in textbooks. She elaborates on her method: "For example, I will introduce Sand County Almanac by Aldo Leopold (white). As an assignment, I give these [journal entries] to my students, I tell them 'Leopold is a great conservationist, but he wasn't necessarily a great human being'." Through this approach, she invites her students to critical environmental literature and highlights the moral complexities of its authors. She further explained the importance of recognizing the adverse impacts of conservation efforts on Native Americans and Indigenous peoples, challenging her students to reconsider the conventional wisdom that state and national parks are unequivocally beneficial.

Acknowledging the discomfort such discussions might provoke, Sofia shared, "It's important to mention and to talk about. I know it feels like you're just bringing down the house even more with this Debbie Downer information. Students call me Debbie Downer all of the time." Despite the potential for discomfort, she persists in these conversations, valuing their educational significance over the ease of maintaining unchallenged narratives.

With the use of journal assignments as a tool for reflective engagement, Sofia encourages her students as a method to not just to learn but to think deeply and personally about the material. "Journals that are given to them after the lecture... can serve as a formative assessment that I'm checking to see that they're not just regurgitating information, but really thinking about it and putting their own words into the conversation." This method is used to cultivate a deeper understanding and personal connection to the topics discussed inside her classroom.

However, Sofia's characterizing her students introduces a nuanced challenge to her pedagogical approach. She continued, as she highlighted the importance of incorporating diverse viewpoints,

> And, a lot of my students are minorities, so I think it’s super important, I tell them to pull from actual sources and give me real-life information that is cited, but to really focus on it their perspectives and reflections, and I really do hurt their brains because I try to get them to think outside the box and I make them think and they’re not used to that.

This narrative offers a point of entry for critical analysis contrasting Sofia's pedagogical approach with Lane's inclusive perspective on student contributions. Such analysis is needed to bring to the fore the complexities of incorporating diverse viewpoints into the curriculum and the challenges of doing so in a way that respects and validates all forms of knowledge. Sofia’s exchange raises critical concerns regarding the implications and actions on students, particularly those from minority backgrounds.

Sofia's intent to challenge her students and encourage them to think critically is clear and seemingly aimed at enriching their educational experience. She emphasized the importance of drawing from "actual sources" and engaging deeply with the material through personal reflection. However, the critique here centers on how her approach could inadvertently uphold traditional academic hierarchies that privilege certain types of knowledge over others. By emphasizing the need for information to be "cited" and derived from "real-life sources," Sofia may unintentionally reinforce the barriers she seeks to dismantle, particularly if this emphasis discounts her students' lived experiences and insights as equally valid forms of knowledge.

Moreover, Sofia's characterization of her students as "minorities,” could be easily interpreted as a belief that minority students are unaccustomed to critical thinking. Such an assertion perpetuates stereotypes about the intellectual capabilities of Black and Brown students

and their place in scientific disciplines. Such stereotypes contribute to feelings of alienation and impostor syndrome among students from underrepresented groups.

In contrast, Lane's approach is presented as more thoughtfully inclusive, treating students' insights as valuable contributions to the learning process. This juxtaposition highlights a key tension in educational strategies: balancing challenging students academically and ensuring the classroom remains a space where all voices are heard and respected.

Nick shared a pragmatic and reflective approach to building supportive learning environments within the context of an extracurricular setting, he explained,

> Well, one thing that I think we've been really successful at—and I'm going to use we rather than me or I here, me and the Geology Club leadership—is that we've been really deliberately inclusive of people who might not even take a geology class but just want people to hang out with. So, you've got some folks in the club who are happy to go hiking but, you know, they're not particularly intrigued by rocks. We've been successful at integrating LGBTQ+ folks.
>
> Another thing I got from SAGE is the importance of asking for pronouns. And, early when we started sort of emphasizing pronouns, I was resistant. I was like, isn't it obvious that I'm a dude? Like why? Why do I need to say that I'm a dude. And then I realized that it wasn't about me, and it was about creating a community where everybody else had an opportunity to say what they identify as. I feel like I was really slow to get on this bandwagon, but now that I'm on it, I really see the value.

Nick's emphasis on using "we" instead of "I" underscores a collective effort towards inclusivity, not just limited to academic interests but expanding outward and extending to social

belongingness. This approach is significant in creating spaces where students feel welcomed and valued, regardless of their academic pursuits or personal interests. By acknowledging the club's success in being inclusive of individuals who may not share a direct interest in geology, Nick points to the importance of fostering a sense of community beyond the confines of disciplinary boundaries.

The integration of LGBTQ+ individuals into the club and the adoption of asking for pronouns represents a deeper understanding and commitment to inclusivity. Initially resistant to the idea of pronouns, Nick's personal journey from skepticism to acceptance to advocacy illustrates a transformational shift in such perspectives. This shift is not trivial; it signifies a broader recognition of the need to create environments where all individuals, regardless of race or gender, can feel acknowledged and respected. The act of asking for pronouns, which might seem minor or redundant to some, emerges as a powerful tool in affirming individuals' identities and fostering a culture of respect and understanding.

While not directly related to the geoscience curriculum, this vignette offers a glimpse into the ways educators adopt, implement, and normalize inclusive practices. Nick's reflection on his initial resistance and subsequent realization shows the process of personally navigating discomfort and resistance within the geology club's operations. His admission of being "slow to get on this bandwagon" can be seen as an honest acknowledgment of the challenges inherent in adapting to and embracing practices that may initially seem unnecessary or counterintuitive. However, his eventual recognition of the value of these practices speaks to a broader theme of creating supportive learning environments in the face of discomfort and resistance.

Chapter Summary

The study explores the perspectives of geoscience faculty regarding the ingreation of critical perspectives on whiteness into the curriculum. More specifically, the study examined the approaches and strategies taken by Nick, Luto, Sofia, and Lane, who critically challenge the inherent whiteness in their discipline in an efforts to diversify content, create safe learning environments, and evaluating the underlying structures of the curriculum. Through narrative inquiry, the research examines their experiences as they reflected on the practices, content, and assessment.

The findings demonstrate that addressing whiteness in education, specifically the geosciences, is a complex and demanding undertaking. It requires a deep commitment to self-examination and a willingness to confront uncomfortable truths about oneself and one's field. The study revealed that educators approach this critical work at different stages, indicating a spectrum of engagement among those dedicated to this important work. However, the precise methods to achieve systemic reform remain unclear, and the study acknowledges the need for systemic changes in geoscience education to address racial inequalities that remain. It involves questions and rethinking the structures upon which the curriculum rests.

This research contributes to the broader conversation about how education, particularly geoscience education, recognizes the need to progress beyond mere recognition of privilege and discomfort to dismantle systemic structures that maintain racial disparities, further elaborated in Chapter 5. It calls for continuous learning, reflection, and action to challenge normalized practices that uphold racial hierarchies and exclusion within the discipline. The study highlights the potential for implementing such changes. It emphasizes the importance of a dedicated effort

to self-reflection and a willingness to confront uncomfortable truths about oneself and one's academic discipline.

CHAPTER 5

DISCUSSION

"You have to get over the fear of facing the worst in yourself. You should instead fear unexamined racism. Fear the thought right now, you could be contributing to the oppression of others and you don't know it. But do not fear those who bring that oppression to light. Do not fear the opportunity to do better"

—Ijeoma Oluo

This critical qualitative narrative inquiry examined how geoscience faculty actively interrogated whiteness in their undergraduate curriculum. In this chapter, I discussed the findings related to the current literature in geoscience education. I also discussed connecting the findings to the conceptual framework, specifically Critical whiteness Studies, Curriculum Theory, and Critical Transformative Learning Theory. The chapter concludes with a discussion of the study's limitations, areas for future research, and a summary.

This chapter contains a discussion and future research possibilities to help answer the research questions that guided this study:

RQ1. How are faculty members interrogating whiteness in designing and delivering geoscience curricula?

RQ2. What are faculty members' strategies, challenges, and successes in interrogating whiteness in designing and delivering geoscience curricula?

The findings of this study revealed the efforts made by educators in the geoscience community to interrogate whiteness within their own curriculum and pedagogical practices. Such efforts were characterized by conscious efforts to diversify educational content, create inclusive spaces, and initiate critical dialogues around race, privilege, and systemic inequities. Through

narrative inquiry and the journey faculty participants took toward self-reflection and growth, this work helps further illuminate the challenges inherent in dismantling deeply ingrained structures of whiteness—be it institutional norms, colleague skepticism, or student discomfort.

Educators, active in interrogating whiteness, are not simply adjusting curriculum content; they are challenging the foundations upon which (geoscience) education has been built. As shown through the participants' stories, the work required is a sustained commitment to critical self-reflection coupled with a readiness to confront uncomfortable truths about themselves and the discipline itself. Despite this, the findings reveal that the work is not without tensions; there is no one prescribed way to do the work. What was revealed is that there exists an entire spectrum upon which educators acknowledge, engage with, and are committed to such critical endeavors.

As such, the implications of these findings extend beyond mere individual-level efforts, a point I hope to make more transparent in the subsequent discussion. There remains a need for systemic changes across the geoscience educational landscape to address the glaring absence of racial equities in the discipline (Bernard & Cooperdock, 2018). How this becomes actualized remains yet to be seen. This research does, however, reveal a few ways to such ends.

Furthermore, the findings raise critical questions about the broader impact of these efforts on both the students and the faculty members. To deepen my understanding while attempting to answer the research question, I also consider how pedagogical changes might influence students' sense of belonging and identity within geoscience. To what extent do faculty contribute to dismantling the barriers to full participation and success in the field? And perhaps most importantly, how does the geoscience community build upon seemingly individual efforts to create a sustained movement towards becoming a more just discipline? Through engagement

with these questions, in what follows, I offer a critical insight into a deeper understanding of the work of interrogating whiteness in geoscience education.

Discussion of the Findings

The following discussion centers on geoscience education as a critical examination of the interconnected relationship between whiteness, power, and the institutional structures that govern academic spaces. Examining the narratives of Luto, Nick, Land, and Sofia through critical analysis illuminates the contouring of whiteness within a discipline deeply embedded with its legacy, highlighting how these ingrained systemic interactions sustain the dominance of specific epistemic frameworks and cultural norms. For example, as Kleinhans (2021) noted, recent advancements in the history and philosophy of science have made these fields more relevant and accessible to science students and scientists, notably through the Philosophy of Science in Practice and the concept of scientific understanding. This study is in alignment as it emphasizes the importance of engaging with theories, sensory experiences, and practical interventions for gaining epistemic skills in geoscience curricula and enriching the conceptual history of knowledge by highlighting the interplay between concept representation and understanding. Through such concepts, this discussion might speak across disciplines into other sciences and engage with scholarship to interrogate and dismantle whiteness within the academy.

Central to the exploration is the explicit acknowledgment of the implicit systemic persistence of whiteness—a force that, though often unmarked and unnamed, significantly shapes the educational landscape (Adelman, 2003; Bonilla-Silva, 2001; Leonardo, 2008; Marx, 2006). This persistence is not a mere artifact of historical inequities but a living, breathing presence that continues to influence curricular content (Apple, 2004; Giroux, 1997), pedagogical approaches (Allen, 2004; Matias & Mackey, 2016), and the fabric of institutional life. As the

educators in this study navigated this complexity, their consistencies, and inconsistencies of what the participants said or did not say revealed the various contours of embedded whiteness. Their efforts underscored a crucial realization: addressing whiteness in education cannot be reduced to a series of technical adjustments but requires a deep engagement with the moral and ethical dimensions of teaching and learning.

The study illuminated the inherent tension between order and consensus, traditionally valued in educational systems and the transformative potential of conflict and disorder. Far from being antithetical to the smooth functioning of the educational systems, these elements were identified as essential for preventing the reification of institutional patterns of interaction that maintain racial hierarchies and exclusion (Apple, 2004). Reflecting on the dominant interests that have historically shaped the field, geoscience educators are called to become more self-aware and committed to transforming their discipline (Monarrez et al., 2022). This implies that educators in the field examine the ideologies and epistemologies underpinning their curriculum and actively engage with the ideological and economic forces shaping educational realities.

These realities make the notion of interrogating the power of whiteness in geoscience education significant. Through this framework, then, this study provides the necessary scaffold for (re)thinking through some of the relationships between education, power, and societal structures. By unraveling the complexities of this relationship, the discussion provides deeper inroads toward acknowledging and addressing the deeper-seated inequities that have long shaped the academic landscape.

Enduring Presence of Whiteness

Situating the study's findings within the scholarly discourse helps shed light on a concerted effort reflecting individual, institutional, and systemic levels. The enduring presence of

whiteness in geoscience education was evidenced in each of the findings, suggesting whiteness manifests itself through various dimensions, the apparent lack of recognition for Geoscientists of Color, and a curriculum steeped in western perspectives. Carey et al. (2016) suggested that the broader issue indicates a systemic bias that narrows the disciplinary scope while reinforcing racial hierarchies. This, in effect, sidelines contributions for People of Color as legitimate knowledge holders. Similarly, Trisos et al. (2021) contribute to this narrative by highlighting the minimal acknowledgment afforded to non-white scientists, further entrenching the discipline within a white, eurocentric framework. However, simply referring to "non-white scientists" without specifying which groups are underrepresented continues to (re)center whiteness by treating whiteness as the default and, in effect, serves as a way to lump all other identities into a vague "other" category. To address underrepresentation and move away from recentering whiteness, it is crucial to explicitly name the groups that are underrepresented in the geosciences, such as Black, Indigenous, Latino/a/x, Asian, and other People of Color, more effectively. Acknowledging the specific identities and contributions of scientists from these groups helps to dismantle the monolithic view of science as a white-dominated field (Cajete, 1994).

Furthering that point, participants were aware of and acknowledged the discipline’s colonial histories, which closely aligns with Marín Spiotta and colleagues' (2020) assertion that effective interventions necessitate acknowledging the foundations of our scientific and educational institutions within today's “academic culture, structures, and practices” (p. 123). The authors illustrate the biases as not merely surface-level discrepancies; instead, the biases are deeply entangled with the historical evolution of geoscience. Such entrenchment in colonial and white supremacist narratives perpetuates an exclusionary environment, as is evident in the work of Bush and Mattox (2020), who explored the emphasis prevalent in many geoscience curricula

and textbooks. Consistent with their findings, participants in the current study felt as if the figures represented in the textbooks were problematic. The narratives of faculty help emphasize the problem of glorifying the achievements of "old dead white men," further contributing to a distorted view of scientific discovery within the field of geoscience education.

However, when the participants would simply highlight instances where the traditional focus on "old white men" or "old dead white people (ODwP)" that were misaligned with current disciplinary values might serve to, in fact, reaffirm their centrality in our academic and cultural conversations. This approach, while seemingly progressive, falls short of meaningfully confronting the entrenched narratives that bolster white dominance. Kahn (2018) articulates this dilemma as engaging in "recreational anti-racism," where actions that ostensibly challenge racism fail to address the underlying narratives that sustain white supremacy, effectively offering a superficial gesture towards correcting historical wrongs. Kahn's insight suggests the importance of a more intentional interrogation of whiteness, moving beyond superficial acknowledgments to critically examining the foundational narratives that shape our understanding of race and history.

Faculty Crossroads

Echoing Michael Apple's critical scholarship (2004), I aim to expound further on the mechanisms of domination and repression subtly embedded within educational institutions. This approach advocates for moving beyond superficial inclusivity to critically examine how whiteness functions within geoscience educational settings, revealing the contradictions in educational practices that unknowingly perpetuate racial hierarchies. At this metaphorical crossroads, faculty must confront the underlying reasons guiding their pedagogical decisions, which often inadvertently uphold whiteness.

This critical juncture, termed as a ‘faculty crossroads,’ mirrors the literature’s challenges, such as the bridge between expert practice and critical engagement in teaching highlighted by Shipley and Tikoff (2017). This study adds complexity by showing how even well-intentioned pedagogical efforts can inadvertently maintain whiteness. The ability for such unintentional acts to be harmful (Evans-Winter & Hines, 2020) underscores the need for a committed, reflective approach to pedagogy that actively confronts and dismantles systemic racism while remaining critical of those decisions.

As custodians of knowledge, instructors are at a critical crossroads within geoscience education. This crossroads presents a dual pathway: perpetuating existing paradigms or confronting racial inequities by critically assessing and deconstructing entrenched architectures of white supremacy. This duality underscores the significant responsibility that educators bear more broadly. It demands a shift towards more inclusive teaching strategies, a deep dive into self-reflexivity, and an acknowledgment of their role in either sustaining or dismantling systemic structures, specifically white supremacy, within the educational sphere.

Much like the current literature, as discussed in Chapter 2, racial discourse in the geosciences falls short in the examination of the ingrained oppressive institutional systems that main disparities (Bernard & Cooperdock, 2018; Fairfax & Brown, 2019; Hall et al., 2022; Karsten, 2019; Moss-Racusin et al., 2012; Ong et al., 2011; Sherman-Morris & McNeal, 2016). Furthering the discussion, to critically analyze how some works, even with claims of advancing such inclusive pedagogies (e.g., culturally responsive pedagogy, active learning, inquiry-based learning) within geoscience discipline, there remains the possibility they may inadvertently maintain the status quo of whiteness. While these studies aim to improve engagement,

understanding, and inclusivity in geoscience education, it is crucial to interrogate how they might also perpetuate existing power dynamics and norms rooted in whiteness.

Implementing active learning and inquiry-based learning strategies in geoscience education, as Kortz & nan Der Hoeven Kraft (2016) and Dzambo (2020) demonstrate an innovative shift toward engaging students in a more interactive and participatory learning process. However, applying a more critical lens reveals that these strategies may inadvertently perpetuate the dominance of whiteness within the discipline if not carefully scrutinized. As such, the content, examples used, and contexts are conscious decisions made by faculty, which often remain unexamined for their embedded cultural assumptions and biases, most notably discussed by Rogers et al. (2022) and Monarrez et al. (2022) and thereby risking the reinforcement of a geoscience narrative that privileges western perspectives and methodologies. Consistent with the findings, such oversight subtly underpins the notion that western science is the definitive framework for interpreting the Earth, sidelining other epistemologies and ways of knowing. Such perspectives narrow the scope of geoscience education and exclude the rich diversity of global scientific traditions, thus maintaining the status quo of whiteness within the discipline.

Faculty and institutions are thus called upon to engage with their practices critically (Shipley & Tikoff, 2019; Rogers et al., 2022), curricula (Metzger & Curren, 2017; Soja, 2018), and policies (Núñez et al., 2020; St. John et al., 2016) to dismantle frameworks upholding whiteness and to create an educational environment that proactively challenges racial inequities. This study advocates radically reevaluating faculty roles—from mere conveyors of knowledge to active agents of change in deconstructing whiteness and systemic domination in geoscience education (McDaris et al., 2019; Semken et al., 2017). Following Webb and Hayhoe's (2017)

lead, this approach entails a comprehensive engagement with the structural underpinnings of racial inequality, pushing for a discipline that reflects and serves its diverse community.

However, as alluded to earlier, this process is not without tension. As seen in the findings, participants navigated a delicate balance between well-intentioned classroom environments and assignments meant to create open dialogue risked the unintentional perpetuation of marginalization of already underrepresented (his)stories. In this context, faculty members operated as both educators and pivotal figures in the reconstitution of geoscience education. Thus, the faculty's role in interrogating whiteness within geoscience education emerges as a complex endeavor.

The duality touches on good intentions versus execution. While acknowledged by some educators in this study who specifically named their work as 'anti-racist,' their outcomes were not necessarily aligned with such intentions. This fact can be related to the broader challenge of interrogating whiteness in the geoscience curriculum as it reinforces the necessity of continuous self-reflection, critique, and adaptation in anti-racist work. As noted in the findings, the intentional efforts existed along a continuum, suggesting the understanding of anti-racist pedagogy as an ongoing process rather than a fixed destination (Hammons, 2023). Thus, the importance of challenging traditional narratives, recognizing global environmental responsibilities, and continually reflecting on and refining pedagogical approaches is a process that takes time and intentional effort.

Furthering this point, some faculty in the study viewed students' insight as valid knowledge, while others remained unconscious of their biases. On the one hand, instructors indicated they were incorporating "diverse" perspectives into their curriculum; on the other, they simultaneously validated whose knowledge was viewed as valid. Valid knowledge was stated as

"actual sources" that reflect "real-life" information that is to be "cited." In the same breath as discussing their students, they would characterize their students as "minorities" and claim they would "make them think, and they are not used to that," which is troubling and problematic. The language used by the participants perpetuates a harmful stereotype that Black and Brown students are not meant for or even belong in the sciences (Beane et al., 2019; Núñez et al., 2020; Ryan-Davis & Scalice, 2022). Rather than deficit-centered approaches to teaching, I agree with Willey and Magee (2016) in their argument:

> With heightened racial consciousness, teachers will be better positioned to recognize and remedy practices that serve to perpetuate inequitable arrangements for Black and Brown learners, especially in seemingly exempt disciplines, such as science and mathematics. Teachers' skill sets will include the conscious belief and subsequent expectation that students of color will excel in science, as well as the ability to support learners to see themselves as a science "doer," thus disrupting the white cultural notion that science is something that another kind person (white) does. (p. 133).

This acknowledgment and reimagining of pedagogical practices, as advocated by Willey and Magee (2016), demonstrate the need for a transformative shift in how educators perceive and interact with students of Color. Not surprisingly, Charles (2016) noted that "traditionally, teachers new to the profession focus on deficit skill sets, and that becomes the intervention" (p. 204). While none of the participants were "new to the profession," their approach would suggest as much as they perpetuate a meritocracy approach to evaluating their students.

Embracing a framework that challenges and dismantles the pervasive stereotypes and biases would require a commitment to developing an inclusive strategy, necessitating a departure

from traditional norms, that I argue begins with racializing whiteness. When one starts the process of learning how to identify and name the ways in which whiteness operates and maintains its power, the possibility emerges as a way forward to begin critically analyzing how our actions either support or disrupt those very systems we seek to address.

Implications & Recommendations for Practice

As revealed by this study and supported by the broader academic discourse, the imperative for structural transformations within geoscience education marks a critical evolution toward addressing the foundational causes of racial disparities in the field. This evolution from superficial adjustments to systemic overhaul suggests a growing recognition within the academic community of the need for profound structural changes rather than isolated reforms (Atchison & Libarkin, 2016; Beane et al., 2019; Bernard & Cooperdock, 2018; Fairfax & Brown, 2019; Gates, 2019; Gaynor et al., 2022). Such changes acknowledge that the challenges within geoscience education reflect larger institutional and societal frameworks that perpetuate racial inequities rather than merely result from individual biases.

This study's findings align with Rogers et al. (2022), who emphasize the harmful impact of colonial and white supremacist narratives within geoscience education. These narratives not only perpetuate exploitation and disenfranchisement of marginalized communities but also limit oppressors' understanding—herein, the educators and individuals who benefit from white supremacy—by adhering to a monolithic colonial perspective. This adherence restricts the ability to cultivate a more holistic and integrative approach to geoscience education.

The focus on a singular narrative, as critiqued by Rogers et al. (2022), underpins a systemic issue where inequitable power dynamics are embedded within educational structures. Such an approach not only narrows the oppressors' understanding of the natural world but also

creates an academic environment where critical thinking and diverse perspectives are suppressed rather than celebrated. This suppression can extend beyond the purview of academia, thus influencing how future scientists might address such crucial issues as environmental challenges, engage with various cultures, and consider the socio-political implications of their work. However, because whiteness is a concept that has been constructed socially (Leonardo, 2002; Marx, 2006), we can disrupt the normalizing gaze it has long cast over the geosciences.

Moreover, this study's findings urge dismantling the whitewashed versions of scientific history to offer a more accurate portrayal of science's development. This approach aligns with the need to humanize science. Acknowledging the diverse contributions that have shaped its progress, confronts rather than omits past injustices, challenges the cycle of invisibility for marginalized groups, and promotes a more inclusive narrative within geoscience education. As Willey and Magee (2016) pointed out, the readings and presentations in the sciences have created racialized experiences for our students. As such, an actionable step towards such ends would be including readings and resources that offer varied perspectives to recognize the rich contributions to sciences outside western thought. As one participant demonstrated, this act can be as simple as adding a word of the day in their daily announcements of different knowledge holders.

As proposed by this study, interrogating whiteness in the geoscience curriculum necessitates a deliberate integration of diverse scientists' histories and contributions, moving beyond adding a multicultural aspect to the curriculum. It should challenge students and educators alike to critically engage with how race, power, and privilege have influenced scientific discovery and dissemination. Critical engagement calls for reevaluating what is considered "canonical" knowledge in relation to its historical context. This engagement better

serves to illuminate whose perspectives are valued, echoing the broader academic discourse that advocates for systemic reforms to address racial inequities in geoscience education.

Based on the findings of this study and their significance for the geoscience community, it becomes evident that the path to interrogating whiteness within the discipline demands more than superficial acknowledgments or minor, incremental adjustments (Bratman & DeLince, 2022). It calls for a deeper, introspective examination of the foundations on which geoscience education has been built and sustained. While this may seem overwhelming, it is essential for crafting a discipline that advances scientific understanding with principles of equity, diversity, and inclusivity in mind (Mattheis et al., 2019). Central to this idea lies a questioning of norms that have long been accepted as given within geoscience (Rogers et al., 2022). The findings reveal the presence of whiteness and how deeply they are entrenched in the curriculum, pedagogy, and institutional culture. This insight serves as a mirror for the geoscience community, reflecting back the systemic biases that shape our discipline (see Yusoff, 2018). The reflection can be uncomfortable and unsettling, but it is in this discomfort that the potential for genuine transformation resides.

As I reflected on the broader impact, it became even more evident that change requires more than external adjustments (i.e., modifying lectures, updating assignments, or attending conferences); it necessitates an internal reevaluation of values and beliefs. Educators and researchers are invited to look inward, question the assumptions underpinning their teaching and research, and consider how these assumptions perpetuate exclusion and inequality. As shown, the introspective process is not easy, especially for white educators, as this act challenges us to confront our complicity in sustaining structures of power and privilege that have marginalized others (Cobb & Haynes, 2016). Yet, it is precisely this kind of self-examination that can lead to

meaningful change. Additionally, faculty engagement in self-reflection and learning about the pervasive nature of whiteness and its detrimental impacts is imperative (Sue, 2009). Much like my own journey, such self-awareness facilitates the further development of a racial consciousness, which enables educators to critically assess what stories are told and how these narratives reflect upon the individuals and communities they depict (Tatum, 1997). As Ahmed (2012) noted, integrating this reflective practice is essential in fostering an educational environment that challenges and dismantles the hegemony of whiteness in the sciences.

What might this look like in action? By examining the stories told and the voices amplified in textbooks, through the frameworks in this study, we can see the weight of legitimacy that continues to uphold whiteness and white supremacy. By selectively highlighting specific (his)stories over others, textbooks inadvertently reinforce the notion that some struggles—and, by extension, some communities—are more worthy of attention and action than others.

A lecture from the study serves as a prime example of this point. As environmental education does, the discipline often uses case studies of environmental disasters to go hand-in-hand with the concepts being covered. However, the portrayals usually highlight the mobilization of a predominantly white, middle-class community against environmental injustices, such as Love Canal. A critical reflection reveals that while these stories are undeniably important, their prominence in educational narratives often overshadows equally crucial but less represented events, such as the protests in Warren County, North Carolina, or the ongoing environmental crisis in Cancer Alley, Louisiana. Disparities in representation are not an oversight, as they may reflect underlying power structures within the geoscience educational landscapes. The implication here is that given that geoscience education is a field that is composed of

predominantly white educators teaching to mostly white students in predominantly white spaces, why would the longstanding practices ever be questioned? Apple (2013), in his book Can Education Change Society, reminds us about the relationship between society and education and that educators will make decisions informed by their (white) perspectives.

The range of interpretations of interrogating whiteness highlights the need for ongoing dialogue and professional development within the geoscience community. It is crucial to provide opportunities for educators to explore and discuss the concept of whiteness, its implications for teaching and learning, and strategies for addressing it in educational settings. Such initiatives can help build a shared understanding and commitment to interrogating whiteness, fostering a more cohesive approach to tackling racial inequities in geoscience education.

The recommendations for practice, therefore, extend beyond adopting new teaching strategies or policies. It calls for fundamental shifts in how we conceive of and engage with curricular content. Critical involvement by faculty members has shown the ability to create spaces for dialogue and reflection where challenging conversations about race, power, and privilege occur. However, as discussed previously, without critical reflexivity risks the maintenance of existing power structures, such as whiteness. I encourage educators at the crossroads to embrace vulnerability, acknowledge past failures, and commit to ongoing learning and growth to cultivate an environment where all members of the geoscience community—regardless of their background or identity—feel valued, respected, and empowered to contribute to the discipline.

Recommendation for Future Research

Faculty Participation

By engaging with a more diverse array of educators in discussions about interrogating whiteness in geoscience education, future studies can work towards developing a more comprehensive understanding of the challenges and opportunities associated with this critical work. The geoscience community is diverse, encompassing educators from various geographic locations, types of institutions (ranging from community colleges to research-intensive universities), and sub-disciplines within geosciences, each of which could offer unique insights into the process of interrogating whiteness. Expanding the participant pool could allow for the inclusion of voices from historically underrepresented groups in geoscience, whose experiences and perspectives are crucial for understanding the complex nature of whiteness and racial inequities in the field. Such strategies might consider broader outreach efforts, collaborations with professional organizations and academic networks within geosciences, and the utilization of social media and other digital platforms to connect with potential participants.

Spectrum of Engagement and Interrogation

The different interpretations of interrogating whiteness challenged the research process, particularly in data analysis and synthesis. Drawing conclusions or recommendations from the findings becomes more complex when participants operate with different conceptual frameworks for what it means to “interrogate whiteness.” This difference necessitates a careful approach to data interpretation that acknowledges and respects the variability in perspectives but also seeks to find underlying themes or consensus where possible. To help mitigate such variability, future research might consider further how geoscience educators conceptualize and operationalize the interrogation of whiteness. Interpretations of pedagogical and philosophical underpinnings can

offer valuable insights into the challenges and opportunities educators who are engaged in critical work face. Additionally, research that examines the impact of different approaches to interrogating whiteness on student outcomes and educational equity could provide further guidance for educators seeking to navigate this complex terrain.

Methodological Considerations

This methodological limitation of this study points to the potential for future research to employ immersive methodologies to explore the interrogation of whiteness in geoscience education. Such research could offer a more granular view of educators' challenges and successes in real-time, providing a grounded basis for developing strategies and interventions to enhance equity and inclusion within the discipline.

Future research may consider engaging in comparative studies across different disciplines within STEM and beyond, which might elucidate the unique and shared challenges of addressing whiteness across academic fields. This research could explore how disciplinary norms and epistemologies influence the interrogation of whiteness and the implementation of inclusive practices. Furthermore, integrating insights from critical race theory, sociology, and cultural studies can enrich the analysis of whiteness in geoscience, offering interdisciplinary frameworks that capture the complexity of racial inequities in education.

Additional studies could benefit from more longitudinal research designs that provide insights into the evolution of practices and policies for addressing whiteness over time, capturing shifts in pedagogical approaches, institutional cultures, and student outcomes. Together, these methodological approaches could help uncover the transformative processes and challenges involved in dismantling systemic whiteness in geoscience education.

Researcher Reflections on the Research Study

Up to this point, I have had several bouts of confusion, moments of clarity, spurts of joy, and feelings of despair. There were times when there was nothing more I wanted to do than find a nice rock to crawl up underneath and dissappear. These moments I noted in my research journal reflected the times I had no idea what I was doing or how I would even begin tackling such a big and intricate topic. Words would fill the pages in an attempt to find something to hold on to. Even now, I struggle with finding the right words to say. My apprehension very much so stems from being white and the ever present feeling of who am I to speak on such things. Why do we need another study on whiteness from another white man? However, if I have learned one thing about whiteness, it is that it does not like being named (Dyer, 2017; Nancy, 2012). Perhaps, then, this moment marks an opportunity to open the critical discussion at hand.

In situating myself within this research, I must address the reality that my positionality inherently shapes the construction and presentation of the narrative in this research. Critical scholars argue that whiteness' ability to slide from awareness (Jensen, 2005; Rasmussen et al., 2001) makes the task of identifying how whiteness manifests difficult. Moreover, this task becomes more complicated when considering everything that has happened in my life "occurs in the context of the supremacy of whiteness" (Frideres, 2015, p. 46). Despite efforts to remain faithful to the perspectives and insights shared by participants, interpreting and narrating these experiences through my own (white) lens is fraught with the potential for distortion. I risk in my attempt to articulate how educators navigate and challenge whiteness by inadvertently centering my own understanding and interpretations, thereby reinforcing the epistemic dominance that whiteness commands in academic discourse and inquiry (Mills, 1997).

Furthermore, this study's narration and representation process grapples with the ethical and methodological challenges of translating lived experiences and pedagogical practices into a single coherent narrative. The intentions of the current work as a white researcher interrogating whiteness raise critical questions about authenticity, fidelity, and the ethical responsibility to represent participants' realities respectfully and accurately. I struggled with the potential of mischaracterization—whether through the omission of a particular context, the flattening of complexities, or the imposition of my interpretive frameworks—highlights the precariousness of constructing and reconstructing a narrative that purports to explore the contours of racial inequities in education.

I hope to align my approaches with the broader calls within academic research for reflexivity, inclusivity, and the democratization of knowledge production (Foucault, 1980; Freire, 1970). Throughout the research, I have engaged in an ongoing, reflexive engagement with my positionality and the power dynamics it implicates (Aveling, 2004).

Another point of contention I struggled with was the limited number of faculty members participating in the study. When designing this study, coupled with my desire to contribute to this field of scholarship, I naively assumed more faculty would be interested in participating, too. Thinking back, I would have spent more time appropriately identifying possible avenues for recruiting participants. While professional networks, geoscience listservs, and monthly newsletters seemed initially to be a fruitful approach, I successfully recruited participants through meeting and getting to know the people.

Knowing the participants, during the construction of the research narrative, I spent considerable time in my reflections and writing of Chapter 4. I wanted to ensure my relationships with the participants did not unintentionally guide my data analysis. I wrestled with the

mischaracterization and intent of the stories the participants told. Being a novice qualitative researcher with limited experience as an interviewer, I often wondered throughout the interviews about the validity of the questions I was asking and not knowing when to dig deeper or let things be. Inherent in this, there are obvious areas that could have been further elaborated upon. However, I tried to strike a delicate balance between their narratives with my interpretation.

Despite my best efforts, the diverse interpretations of what constituted "interrogating whiteness" among the study's participants presented a limitation, in my opinion, affecting the coherence of the research findings and the derivation of actionable insights. The variance in understanding and approach accentuated the complexity of addressing whiteness within geoscience education. They reflected the broader challenges of operationalizing such critical examinations across different educational contexts and individual perspectives.

In recognizing such varied interpretations of interrogating whiteness among participants, there was the contemplation of whether or not the participants were actually speaking to interrogating whiteness or whether it was simply performative. I only mention this as a potential for future study and analysis. But to speak to this point in more detail, Khan (2018) details the corporatized work of DEI as an institution and the co-opting of language to seem more “woke.” However, as others have noted with this DEI work, companies and institutions engage in such efforts without fundamentally challenging or changing the underlying “neoliberal narrative that maintains white supremacy” that further supplants the narrative of using vocabulary as “an active effort to avoid disrupting the structure of whiteness” (Prescod-Weinstein, 2018). This type of modification was easily ‘felt’ during the interviews. Participants felt comfort when speaking about the work they were doing when framed through a DEI lens. However, when race was

mentioned, specifically whiteness, participants were a great deal more hesitant and uncomfortable in their commentary.

Another aspect of the study I wondered about was whether or not the methodology I chose was the most appropriate. Given the limitations, as mentioned earlier, of my own experience within qualitative methodologies, would an ethnographic study capture a fuller depth and range into how whiteness was or was not interrogated within geoscience classrooms? With its emphasis on immersive observation and participation, ethnography might have offered a unique lens through which the dynamics of classroom interactions, the subtleties of pedagogical practices, and the nuances of educator and student experiences with race and whiteness can be more deeply understood.

As I close out this section, I am still left wondering if I said the right words. Was it enough words? What do my words mean? Is this just a performative act? I would like to think not. Despite these tensions, I remain conscious of how my whiteness operates. I must never become complacent or comfortable.

Conclusion

Interrogating whiteness in the context of geoscience education, as repeated throughout this discussion, requires moving beyond recognizing individual moments of privilege or discomfort to examining the systemic structures that enable such disparities in experience and perception to persist. It involves fundamentally questioning how educational activities are planned and executed. It also involves questioning how educators can create safe, affirming spaces for all students. This entails a continuous process of education, reflection, and action to dismantle the normalized practices that serve to reinforce racial hierarchies and exclusion.

As educators and students grapple with such omissions, they are called to question the content of their textbooks, curriculum, and the broader societal narratives that determine which stories are told and which are silenced. This awareness begins the necessary process of critically examining how the stories educators tell are framed and understood, urging a shift towards equitable approaches to geoscience education. The study underscores the need for a curriculum that acknowledges and prioritizes the diverse and often overlooked narratives of environmental resistance, thereby challenging the existing power structures and ushering in a more equitable educational landscape.

The examination of the limitations of this study's current scope underscores the need for future research to adopt a more expansive approach to studying whiteness in geoscience education. By integrating a more comprehensive range of voices and experiences, subsequent studies can build upon the foundational insights provided by faculty narratives to construct a richer understanding of the complexities of challenging racial inequities.

The findings revealed that to interrogate whiteness, participants had first to acknowledge whiteness. This acknowledgment arose through moments of professional and student resistance, leading to personal discomfort. In moments of discomfort, participants reflected on those experiences, which catalyzed modifying their understanding, resulting in a positive change.

To close, I would like to borrow a page from one of the participant's playbooks, and this research study on a positive note and use the remaining space to heed their advice. Disrupting and challenging whiteness is complicated and creates a lot of space to make mistakes. However, every misstep offers each of us an opportunity for growth and reflection, ultimately strengthening our resolve to confront and dismantle systems of oppression. The participants' perspectives encourage us to embrace the iterative nature of our journey toward equity,

recognizing that progress often entails navigating obstacles and setbacks along the way. While acknowledging our limitations and imperfections is critical to the work, we should remain steadfast in our commitment to anti-racist work. By doing so, we continue moving forward with resilience, determination, and a renewed sense of purpose, knowing that our collective efforts are helping to contribute to a more just and equitable world.

This shit has everything to do with geology.

APPENDIX A

List Serv Recruitment Email Template

Subject Line: Invitation to Participate in Geoscience Education Research on Interrogating whiteness in the Geoscience Curriculum: A Faculty's Perspective

Research Study Participants Needed!

I hope this email finds you well. My name is James Hobbs, a doctoral candidate at the University of Texas at Arlington, and I'm conducting research that explores the interrogation of whiteness in geoscience educational curriculum.

Your experience as a geoscience educator makes your perspective invaluable to this research. I would be honored if you would consider participating in this study. Your involvement would include ***two*** online interviews, each lasting about 45-60 minutes. Along with interviews, I would be asking for course documents such as syllabi, lectures, and other course materials that highlight the work you are currently doing or have done.

If you are interested or would like to learn more, please click on this link to provide some basic information and confirm your eligibility: https://forms.office.com/r/y8xtsHvVui

Thank you for considering this invitation. I deeply value the expertise and insights that experienced educators like you bring to the geoscience community, and I believe your input can significantly enrich this research.

Primary Research Questions:

1. How are faculty members interrogating whiteness in the designing and delivering of geoscience curricula?
2. What are faculty members' strategies, challenges, and successes in interrogating whiteness in the designing and delivering of geoscience curricula?

Rationale: The primary motivation behind this study is to address the predominant whiteness in geoscience education, which marginalizes alternative ways of knowing, limiting the discipline's inclusivity and diverse growth potential.

Key Points of Significance Include:

- Diversity and Inclusivity in Geoscience Education.
- Societal Context.
- Faculty as Change Agents.

In summary, this study aims to further the dialogue on anti-racist practices, inclusivity, and diversity in geoscience education.

Inclusion Criteria: Participants must meet specific criteria to be eligible for the study.

If you meet these criteria or have any questions, please don't hesitate to reach out to me at james.hobbs@mavs.uta.edu. Your insights and experiences can contribute significantly to advancing our understanding of geoscience education.

Thank you for your time and consideration.

IRB # 2024-0094

Best regards,
James Hobbs
PhD Candidate
University of Texas at Arlington
james.hobbs@mavs.uta.edu

APPENDIX B

Participant Recruitment Fliers

General Particapant Flier

Twitter Participant Flier

Instagram Participant Flier

APPENDIX C

Question Pro Faculty Interest Survey

IRB # 2024-0094

You are invited to participate in a dissertation study focusing on geoscience educators' efforts to interrogate whiteness within undergraduate curricula. This study aims to explore how professional geoscience educators challenge the dominance of whiteness in the geoscience curriculum. Participation in this study is voluntary; you can choose to end your participation at any time.

Please complete the following survey to help determine if you qualify to participate in this research endeavor.

All the information you share will remain confidential to the fullest extent of the law. Your expertise and experiences are invaluable to this research, and your insights can contribute significantly to reshaping the future of geoscience education.

I appreciate your time and consideration in potentially joining this important conversation. If you have any further questions or concerns regarding this study, please contact James Hobbs at james.hobbs@mavs.uta.edu

Note: You must be 18 years old or older to participate in this study. Please print or save a copy of this form for your notes. To continue, please click the continue button below.

Questions 1: What is today's date?

First Name

Last Name

Email Address

Phone (optional)

Geographic Location

Question 3: In which city and state is your current educational institution located?

Question 4: Please specify your current position at your institution.

1. Full-time faculty member
2. Part-time faculty member
3. Adjunct faculty member
4. Other

Question 5: If other, please specify below.

Question 6: Please specify the type of institution where you currently teach.

1. 2-Year Institution
2. 4-Year Institution
3. Other

Question 7: If other, please specify below:

Question 8: Please indicate which introductory geoscience course(s) you currently teach or have taught. You may select more than one option.

1. Earth Science
2. Physical Geology
3. Historical Geology
4. Environmental Science/Geology
5. Oceanography
6. Other

Question 9: If a course was not listed, please provide the course taught in other below.

Question 10: Please specify how many years you have been teaching geoscience.

1. Less than 5 years
2. Between 5 to 10 years
3. Between 10 to 15 years
4. More than 15 years

Question 11: Please specify your experience with (re)designing a curriculum that integrates diverse epistemologies. This refers to the process of either creating a new curriculum from scratch (designing) or making changes and improvements to an existing curriculum (redesigning).

This can involve activities such as:

- Reviewing and updating course objectives or outcomes.
- Introducing new teaching methods or materials.
- Making adjustments based on feedback from students or peers.
- Incorporating current research and best practices into the course content.

Adapting the curriculum to better include diverse perspectives, particularly in this study's context by challenging traditional, predominantly white-centered narratives.

This study is particularly interested in curriculum (re)design efforts that prioritize inclusivity, diversity, and equity, especially in the geoscience domain.

1. I have (re)designed a curriculum
2. Inspired to (re)design a curriculum
3. I have not (re)designed a curriculum

Question 12: If chosen to participate in this research study, would you be open to sharing specific course materials, such as your course syllabus, lecture presentations, and assignments/documents as it pertains to (re)designing the curriculum? This will provide valuable context to understand the approaches and methods used in decentering whiteness within the geoscience curriculum.

1. Yes, I would be willing to share these materials.
2. No, I would prefer not to share these materials.
3. I would like to discuss this further before deciding.

Question 13: If you indicated a willingness to share course materials, please specify which type of documents you would be comfortable providing for the research study. You may select more than one answer choice.

1. Course Syllabus
2. Lecture Presentation/Slides
3. Assignments/Tasks
4. Assessment Tools (e.g., quizzes, exams, reports)

5. Supplementary Materials (e.g., reading lists, resource links)
6. Other

Question 14: If other, please specify below.

Question 15: The researcher for this study aims to gather a diverse range of perspectives from geoscience educators who have made efforts to interrogate whiteness within undergraduate curricula. If you know a geoscience educator who has actively worked to integrate marginalized communities' epistemologies and challenge the dominance of whiteness in their curriculum, please consider forwarding the link to this survey to them. Alternatively, you can provide their name, phone number, and email address below, and they will be contacted for potential participation in this study.[Name] [Phone Number] [Email Address]

My name is James Hobbs, and I am inviting you to participate in a UT Arlington research study titled “Interrogating whiteness in the Geoscience Curriculum: A Faculty’s Perspective.” This research study seeks to address the following questions:1. How are faculty members interrogating whiteness in the designing and delivering of geoscience curricula?2. What are faculty members' strategies, challenges, and successes in interrogating whiteness in the designing and delivering of geoscience curricula?

You are eligible to participate in this research study if you are at least 18 years old, currently a full-time faculty member at a 2- or 4-year United States Higher Education Institution, and have taught geoscience education for at least five years. I am excluding educators who are not involved in the curriculum (re)design process or those who haven't taught geoscience in the specified settings. Your participation will involve two semi-structured interviews, each lasting between 45 to 60 minutes. The total active time commitment for this study is approximately 2.5 to 3.5 hours, spread over a period of a few weeks to a month, depending on scheduling availability and the spacing between the two interviews.

Reasons you might consider participating include sharing your expertise and experiences related to curriculum development in geoscience. You might opt out if you are uncomfortable discussing your teaching and curriculum design methods or if you cannot commit to the total time requirement. Your choice to participate is voluntary. Choosing not to participate or discontinue at any point will have no negative repercussions on your professional or academic standing. The research team is deeply committed to upholding your rights and privacy. While the findings might be published or presented, your identity will remain confidential. Absolute confidentiality

cannot be guaranteed, but all measures will be taken to protect your personal and professional details. If you have any inquiries regarding the study, please contact me at james.hobbs@mavs.uta.edu. For questions about your rights or to report grievances, please contact the UTA Research Office at 817-272-3723 or regulatoryservices@uta.edu.

You are indicating your initial voluntary agreement to participate by submitting this form. Upon selection, an official consent form will be sent to you via email.
Please type your full name to indicate your voluntary agreement to participate in the following study.

APPENDIX D

Participant Follow-up Email

Dear [Participant's Name],

Thank you for your response and your interest in participating in my research on interrogating whiteness in geoscience educational curriculum. I greatly appreciate your willingness to contribute to this important study.

I'd like to provide you with more details about the interview process and the steps ahead:

Interview Process:

1. **Semi-Structured Interviews:** The research will involve two semi-structured interviews, each lasting approximately 45-60 minutes. These interviews will be conducted via Microsoft Teams, a secure online meeting platform.
2. **Scheduling:** To schedule the interviews, I've set up an online scheduling tool for your convenience. You can select a date and time that works best for you by visiting the following link: [Insert Scheduling Link]. Please choose a time slot that fits your schedule.

Microsoft OneDrive for Document Sharing: I've also created a secured folder for our research on Microsoft OneDrive. This folder will serve as a secure space for you to upload any course documents, such as syllabi, lectures, or other relevant materials that highlight your work in geoscience curriculum. You can access the folder using the following link: [Insert OneDrive Folder Link].

Pseudonym Selection: In the OneDrive folder, you'll find a section where you can select a preferred pseudonym or code name that you would like to use for the study. This pseudonym will be used to protect your identity throughout the research process. Feel free to choose a name that you're comfortable with.

Please know that all the information you provide and share will be treated with the utmost confidentiality and will be used exclusively for research purposes. If you encounter any issues with scheduling or accessing the OneDrive folder, or if you have any questions or concerns, please don't hesitate to reach out to me at james.hobbs@mavs.uta.edu. I'm here to assist and ensure a smooth and comfortable process for you.

Once again, thank you for your willingness to participate in this study. Your insights and experiences are highly valuable and will contribute significantly to advancing our understanding of geoscience education.

Best regards,
James Hobbs
PhD Candidate
University of Texas at Arlington
james.hobbs@mavs.uta.edu

APPENDIX E

Semi-structured Interview Protocol 1

Faculty Experiences Interrogating Whiteness in Geoscience Curriculum

Date: _____ Time & Place: _____

Interviewer: _____ Interviewee: _____

Pre-Interview Information & Procedures

Introduction: Thank you for agreeing to participate in this interview. This interview seeks to gain insights into your experiences and perspectives related to geoscience curricula design, especially around the intention of decentering whiteness and including diverse perspectives. This interview will last roughly 45-60 minutes.

Study Purpose & Applications: Collected data will be instrumental in informing curriculum development practices, guiding faculty pedagogical approaches in geoscience, and contributing to broader conversations about inclusivity and diversity in educational settings.

Treatment of the Data: Please know that all your responses will remain confidential.

The data collected during this research will be managed and securely stored using encrypted digital storage solutions via UTA's Microsoft OneDrive. After a retention period of five years, in adherence to research ethical standards, all data will be permanently disposed of to ensure the continued privacy and protection of the participants' information.

Other Questions of Concerns: Do you have any questions or concerns before we begin?

Y/N: Comments: _____

Consent & Approval: With your permission, I'd like to record this interview to ensure I capture your responses accurately. May I begin the recording?

Yes: _____ No: _____

Opening the Interview Session

General Questions:

Q1. Introductory Question: *Tell me briefly about your current role within your organization? (How long, courses taught, etc.)*

Q2. Introductory Question: *Can you describe what brought you to geoscience education?*

Follow-up*: What is your teaching philosophy?*

Key Interview Questions. Section A: *Interrogating Whiteness in Curriculum*

Q3. Content (DW): *In your own words, how would you define the term "interrogating whiteness" in the context of geoscience curriculum design? Can you provide a specific instance where you've made efforts to address this?*

- Probe: *What strategies have you employed to acknowledge white privilege within your curriculum?*

- Probe: (RD): *How do you handle situations or moments of racial discomfort, if any arise, while teaching or designing your geoscience curriculum?*

- Probe: *Can you share a specific instance where you encountered such discomfort, and how it became a catalyst for change (personal change or change in your students' perceptions)?*

Key Interview Questions. Section B: *Incorporating Diverse Epistemologies and Experiences*

Q4. Content (DP): *Can you describe how you have intentionally redesigned your curriculum to incorporate perspectives and epistemologies of historically marginalized communities?*

- Probe: *Can you provide a specific example that particularly stands out?*

Q5. Content (SC): *How has your curriculum acted as a vehicle for promoting social change, especially in terms of racial inclusivity and equity?*

Key Interview Questions. Section C: *Transformative Learning & Inclusive Teaching*

Q6. Content (DD): *Have you faced significant challenges in aiming for a curriculum that disrupts whiteness? How did you navigate these challenges?*

Q7. Content (RG): *How do you engage in ongoing critical reflection about your teaching practices and curriculum design, especially in relation to inclusivity?*

- Probe: *Are there specific routines, resources, or practices you rely on for this reflection?*

Q8. Content (TM): *Can you describe any transformative moments or shifts in your perspective towards more inclusive teaching in geoscience?*

Concluding the Interview

Q9. Concluding Question: *Reflecting on your journey, what do you see as your major successes and challenges in creating an inclusive curriculum? Do you have any advice for peers aiming for similar curricular goals?*

Researcher Script: *To capture any final thoughts, is there anything else you would like to tell me or share regarding today's topic?*

Thank You & Follow Up Reminder

Researcher Script: *Thank you so much for your time and insights. I will follow up with you in a few days to ask for documents as they relate to your curricular efforts to interrogate whiteness in your class and to schedule a follow up interview. The second interview will be approximately two weeks from now. Your experiences and perspectives are invaluable to this research. Please do not hesitate to email me if you have any additional thoughts. Again, thank you for your contribution, and look forward to talking again soon.*

APPENDIX F

Semi-structured Interview Protocol 2

Faculty Experiences & Curriculum Artifacts

Date: _____ Time & Place: _____

Interviewer: _____ Interviewee: _____

Pre-Interview Information & Procedures

Introduction: Thank you for sharing your course materials and for making the time today for this follow-up interview. Our conversation will revolve around the artifacts you've provided, aiming to further our understanding of your design decisions and the broader intentions behind your geoscience curriculum, particularly in terms of interrogating whiteness and integrating diverse epistemologies. This session should take approximately 45-60 minutes.

Study Purpose & Applications: This deeper exploration into your materials, complemented by our conversation, will be pivotal for offering nuanced recommendations for curriculum development in geoscience. This effort not only aids faculty in their teaching strategies but also enriches the discourse on diversity and inclusivity in academic environments.

Treatment of the Data: Confidentiality is paramount. The materials and our discussion will be securely safeguarded using encrypted digital storage methods, specifically via UTA's Microsoft OneDrive. To uphold the highest ethical standards, all data, including your course materials and our discussion records, will be disposed of permanently after a retention window of five years. This ensures the ongoing privacy and protection of the information you've entrusted to this study.

Other Questions or Concerns: Before we delve into the materials, do you have any questions or thoughts you'd like to share?

Y/N: Comments: _____

Consent & Approval: For accurate representation and to ensure no detail is overlooked, I'd like to record our conversation. Are you comfortable if I begin the recording now?

Yes: _____ No: _____

	Artifact/Type Provided	Syllabus	Lecture	Course Material
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Section A: Review of Syllabus

Q1. Course Objectives & Outcomes: *In your syllabus, how do the objectives and outcomes reflect your efforts to disrupt whiteness?*

- Probe: *Are there particular objectives that directly address or incorporate historically marginalized communities' epistemologies?*

Q2. Reading & Resource Selection: *I noticed you've included [**specific reading/resource**]. How does this contribute to embracing diverse voices in the course?*

- Probe: *How do you ensure a balance between mainstream and marginalized voices in the reading list?*

Section B: Examination of Lectures

Q3. Lecture Themes & Topics: *Looking at the topics covered in your lectures, how do you weave in narratives or information that disrupt whiteness?*

- Probe: *Can you describe a specific lecture where this was a primary focus?*

Q4. Class Activities & Discussions: *Can you elaborate [**identify specific activity**] classroom activities or discussion prompts that aim to engage students with diverse epistemologies and experiences?*

- Probe: *How have students responded to these activities?*

Section C: Scrutiny of Course Assignments & Materials

Q5. Assignment Design: *I've noticed in [specific assignment] that there's an emphasis on [specific topic/technique]. How does this assignment design help in addressing the [research question]?*

- Probe: *Are there assignments that students have particularly resonated with or found challenging in the context of inclusivity?*

Q6. Assessment & Feedback: *How do your assessment criteria and feedback mechanisms ensure that students are grappling with and understanding the importance of diverse voices and experiences?*

- Probe: *Can you share an instance where feedback led to a significant learning moment for a student regarding these themes?*

Concluding the Interview

Q7. Self-evaluation & Future Iterations: *Based on the materials you've shared, what are areas you feel most proud of, and what areas do you see as needing revision or further development in future iterations of the course?*

- Probe: *How do student feedback and outcomes influence these revisions?*

Researcher Script: *As we wrap up, is there any additional context or insights you'd like to provide regarding the materials you've shared or your broader approach to curriculum design in this context?*

Thank You and Follow Up Reminder

Researcher Script: *First and foremost, I'd like to extend my heartfelt appreciation for the time, effort, and insight you've shared with me today. Your contributions are invaluable to this research and will undoubtedly shed light on important facets of geoscience curricula.*

As we move forward with analyzing the data, I hope you understand that clarity is crucial. Thus, there might be instances where I need further understanding or elaboration on some points you've made. If this arises, I hope you won't mind if I reach out for brief clarifications regarding your responses.

Once again, thank you for your collaboration and your commitment to furthering knowledge in this field. I'm grateful for your involvement.

APPENDIX G

A Priori Coding Table

Framework	a priori Code	Definition
Critical whiteness Studies	Resistance to white normativity	Faculty members actively resist the normativity of whiteness in geoscience curricula by challenging racial biases, white perspectives, and privilege. This includes efforts to interrogate whiteness and address systemic biases within the curriculum.
Critical whiteness Studies	Conscious Effort to Acknowledge Privilege	Faculty intentionally acknowledge their privilege and the privileges embedded in the curriculum. This includes consciously recognizing and addressing power dynamics and privilege with geoscience education.
Critical whiteness Studies	Embracing Racial Discomfort	Faculty members engage in moments of racial discomfort as part of their teaching practices. This includes acknowledging and addressing discomfort related to discussions of race and racism within geoscience education.
Curriculum Theory	Intentional Redesign of Geoscience Curriculua	Faculty members intentionally redesigned the curriculum to challenge whiteness. This includes changes in course structure, content, assessments, and teaching methods.
Curriculum Theory	Curriculum as a Vehicle for Social Change	Faculty members view the geoscience curriculum as a powerful tool for driving social change. This perspective includes using the curriculum to address broader societal issues, fostering critical thinking, and promoting inclusivity within the curriculum.
Critical Transformative Learing Theory	Embracing Disorienting Dilemmas	Faculty members actively engage with disorienting dilemmas in their teaching practice, encouraging students to confront challenging perspectives and experiences. This includes creating opportunities for transformative learning by challenging preconceptions.
Critical Transformative Learing Theory	Engaging in Ongoing Critical Reflections	Faculty members engage in ongoing critical reflection about their teaching practices and their own biases. This involves continuous self-awareness and exploration of how their teaching aligns with equity.
Critical Transformative Learing Theory	Inclusive Teaching Practices	Faculty members actively incorporate inclusive teaching practices that consider multiple perspectives, experiences, and accessibility. This includes innovative methods to create inclusive learning environments in the geosciences.

APPENDIX H

Coding Matrix

a priori Coding	Second-Order Coding	Themes	Findings
Conscious effort to Acknowledge privilege	Privilege awareness, Historical contextualization, Systemic bias identification, Discomfort, Resistance to change, Reflective practice, Decolonization efforts	Recognition	Acknowledging and Challenging Whiteness
Resistance to white normativity	Curriculum critique, Resource distributions, Cultural competance, Racial microagression, Transparent dialogue, Decenered whiteness, Inclusive pedagogy	Representation	
Curriculum as a vehicle for social change	Diverse voices, Interdisciplinary, Community collaboration, Ethical reflection, Service learning, Social justice, Critical consciousness	Reconciliation	
Embracing racial discomfort	Vulnerable conversations, Professional development, Self-examination, Safe space, Curriculum reevaluation, Support networks	Personal and Professional Discomfort	Navigating Discomfort and Resistance
Embracing disorienting dilemmas	Classroom dynamics, Critical inquiry, Learning through conflict, Adaptive teaching strategies, Experiential learning	Student Resistance and Engagement	
Engaging in ongoing critical reflections	Reflective practice, Community feedback, Accountability, Improvements, Growth, Peer collaboration, Teacher-Student dialogue, Curriculum evaluation	Building Supportive Learning Environments	

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