4-15-2020

Educational Equity and Informal STEM Field Trip Programming

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Educational Equity and Informal STEM Field Trip Programming

A Thesis Proposal Presented to
The Faculty of the School of Education
International and Multicultural Education Department

In Partial Fulfillment
Of the Requirements for the Degree
Master of Arts in International and Multicultural Education

by
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May 2020

Educational Equity and Informal STEM Field Trip Programming

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MASTER OF ARTS

in

INTERNATIONAL AND MULTICULTURAL EDUCATION

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May 2020

UNIVERSITY OF SAN FRANCISCO

Under the guidance and approval of the committee, and approval by all the members, this thesis has been accepted in partial fulfillment of the requirements for the degree.

Approved:

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Instructor/Chairperson

18 May 2020
Date

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ACKNOWLEDGEMENTS

I would like to appreciate the past, current, and future caretaking by the Ramaytush Ohlone and Chochenyo Ohlone of the land that nurtured me while working on this thesis.

The International and Multicultural Education program has been a place of encouragement and stretching. I have grown so much from the skill and wisdom of all the faculty and classmates. For the guidance that later turned into this thesis, thank you to Professors Cann, Camangian, Jimenez, Yalini Dreams, and especially Blundell, who got me through the finish line.

I want to appreciate my mama Eileen, who would write down my school schedule in her calendar, while I would write down her chemo treatments in mine. You kicked cancer while I kicked this master's degree, we did it!

I am extremely fortunate to have an extended chosen family, including some I have biological ties to. I can’t begin to thank everyone but just a few examples of the support it took to get me through this process; celebrating the end of every semester, letters of recommendation, walks around the lake, remembering to ask me how school is going, feeding me, standing outside of bathrooms a lot (it's a longer story), study hangouts, and so much more. Thank you all!

I would like to especially thank my sweetheart Marella, who wouldn’t let me give up, no matter how often I wanted to. I can’t wait for more adventures with you.

ABSTRACT

Informal STEM field trip programming is a large, yet under-researched area of the education landscape. Informal STEM education providers are often serving a more privileged section of society, leading to a risk of perpetuating inequalities seen throughout the education landscape. In an attempt to address the lack of research, this thesis explores the relationship between educational equity and informal STEM field trips. The intention was to collect data using a critical ethnography approach to the methods of qualitative questionnaire and interviews of informal STEM educators. A change in circumstances from the global pandemic of COVID-19 caused a shift in this research plan. A combination of a Critical Pedagogy theoretical framing, review of existing literature, themes from the limited data, and reflection from the pandemic, creates an argument for an increased focus on educational equity within informal science education field trip programming. This thesis particularly highlights the need to address white supremacy in informal education. The hope is that this thesis can serve as an instigator for future research and a resource for informal education practitioners.

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CHAPTER I
INTRODUCTION

Statement of the Problem

Walking through a STEM museum on any given school field trip day, you can hear young people shouting *look-look I have an idea, check this out*, with background sounds of laughter and the loud buzz of enthusiasm. Over 55 million students attend school field trips to museums within a school year in the US, not including the countless other excursions outside of classrooms that teachers take students on (American Alliance of Museums, 2018). This expansive educational opportunity is minimally researched, leaving many unanswered questions. Specifically, there has not been any significant exploration in the ways that field trip experiences interact with societal and educational inequities.

The missions of Informal STEM Education Institutions (ISEIs) usually involve engaging the public in Science, Technology, Engineering, and Math (STEM) learning. However, the visitorship to STEM museums tends to be from the most privileged sections of society, creating the risk that these institutions are perpetuating inequities instead of moving towards equity (Feinstein & Meshoulam, 2014). Field trips are an opportunity for informal STEM education (ISE) providers to engage a more diverse population than their general visitors, with some research on field trips showing evidence of learning, with a possible increase in benefit for students who have less access to enrichment programs (Whitesell, 2016; Kisial, 2014; Holmes, 2011). However, the history of the field of science and the positioning of ISE institutions in society has led to problems of exclusion and lack of relevance for marginalized communities in their spaces (Davidson, Passmore, & Anderson, 2009; Dawson, 2014, Feinstein and Meshoulam,

2014; Djonko-Moore, et al., 2018). Many students may experience this same exclusion on their field trip.

Efforts to address educational equity and cultural relevance in learning are generally focused on in school classroom settings (Ladson-Billings, 1995; Djonko-Moore, et al., 2018). The educational system in the US has not benefited students of color, students from lower-income communities, or other marginalized populations (Kumashiro, 2000). The history, structures, and funding of schools maintain the power of the few within our society (Lipman, 2011). If the US education system is going to change course to positively impact students, there needs to be major reforms and significant effort from all educational settings involved in young people's learning (Kumashiro, 2000). Additionally, the current moment of the global COVID-19 pandemic is creating yet to be determined challenges within school and informal learning. In order for ISE providers to participate in the process of shifting the educational landscape towards equitable outcomes for young people, research is needed on the interventions and practices within informal learning settings. Specifically, field trip programming must adapt and focus on equitable outcomes, or be at risk of perpetuating the inequities of school and the exclusionary experiences of ISE institutions.

Background and Need

The need for this study comes from a lack of focus on this specific educational setting. Some limited research has shown general evidence of learning on field trip experiences. For example, Whitesell (2016) found a small positive effect of ISE field trips on science test scores, with the largest effect found to be with low-income and Latinx students. Additionally, Holmes (2011) found an initial increase in motivation and achievement for some ISE field trip

experiences. There is limited research examining the unique opportunities of ISE field trip experiences, with one example being the work of Kisial (2014). Kisial states that experiences at ISEIs can uniquely support STEM learning in a way that is not possible in classroom settings, and argues that alignment between the school and ISE providers may increase the ability for ISE institutions to have a positive impact on students' learning.

In addition to these studies, the need for more culturally relevant experiences in informal learning environments has been demonstrated by Davidson, Passmore, and Anderson (2009), Dawson (2014), Feinstein and Meshoulam (2014) and Djonko-Moore, et al. (2018). Related to this, Mayo (2013) makes an argument for Critical Pedagogy in museum learning. However, the practices of cultural relevance in learning environments and STEM education generally focused on school spaces, and research that addresses the relationship between field trip programming at ISE providers and educational equity is limited (Ladson-Billings, 1995; Morales-Doyle, 2017).

Purpose of the Study

The intended purpose of this critical ethnography is to investigate the relationship between ISE field trip programming and educational equity. This is an attempt to understand the ways in which ISE educators (a) understand their field in relation to educational equity, (b) engage in educational equity in their practice, and (c) promote educational equity in their programs. By using the transformative worldview, that suggests that research is a place to instigate and make a change, I planned to use this thesis to support a movement of the field towards equitable praxis. In response to the COVID-19 pandemic, this thesis shifted to respond to the change in circumstances and within the field of ISE. These shifts are described in more detail in Chapter 3.

Research Questions

Building off of a research question in the Feinstein & Meshoulam (2014) study of equity work in ISE providers, this study asked; how are ISE educators similar or different in the ways they conceptualize equity and the practices they identify as equity work within field trip programming? More specifically this thesis attempted to explore;

1. How do informal science educators understand their field in relation to educational equity?
2. What strategies do informal science educators use to engage in educational equity in their practice?
3. What processes are used by practitioners to promote educational equity in their programs within informal science education institutions?

As part of the ethnographic methodology, I was responsive to research participants and adapted questions and focus as needed (Pole & Morrison, 2003).

Theoretical Framework

The primary theory that framed this thesis is Critical Pedagogy (CP) developed by Freire (1970). Freire states that liberatory education may be used to develop critical consciousness and the freedom of oppressed people. He defined the *banking model* of education, in which teachers act as the holders of knowledge to disseminate to students. According to Freire, the *banking model* maintains societal inequities. In order to engage in humanist education and for the development of peoples' critical consciousness, Freire named a system of teaching and learning called *problem-posing.* In *problem-posing education* teachers and learners are engaged in action and reflection on the world around them, leading oppressed people to liberate ourselves.

Other authors who have added to the field of CP theory include hooks (1994), Ladson-Billings (1995), Yasso (2005), and Kumashiro (2000). In *Teaching to Transgress: Education as the Practice of Freedom*, hooks brings the ideas of CP to life through personal narratives, as well as expanding CP theory in the context of racism, sexism, and classism in higher education. hooks developed and advocated for what she calls *engaged pedagogy*, where students and teachers collaboratively engage in all parts of classrooms and society. Focused on school-aged students, Ladson-Billings developed a framework called *culturally relevant pedagogy*, with a focus on students (a) experiencing academic success, (b) developing or maintaining cultural competence, and (c) developing critical consciousness which challenges the status quo. Yasso expanded on this work developing a model of *cultural capital* and defining categories of *cultural wealth* that students bring into educational settings. Additionally, Kumashiro developed a *theory of anti-oppressive education* focused on the school structures that outlining the different frameworks that the education field can engage around oppressed people or *the other*. This framework includes four types of engagement referred to as (a) education for the other, (b) education about the other, (c) education that is critical of 'privileging' and 'othering', and (d) education that changes students and society.

CP will be used to frame this critical ethnography because it allows for an exploration of power dynamics and social inequities. The established theory and practices of CP grounds this thesis in the liberatory purpose and position of educational work within society. Additional connections between CP and the underlying assumptions of this research can be found in the Chapter 2 Review of Literature.

Methodology

This qualitative thesis employed a transformative worldview and made use of critical ethnography. Critical ethnography is focused on "...unmasking dominant social constructions and the interests they represent, studying society with the goal of transforming it, and freeing individuals from sources of domination and repression continues to make any discussion of validity, as defined by both positivist and interpretivist researchers, difficult." (Anderson, 1989, p.254; Crenshaw, 2017). This thesis used critical ethnography in order to address the existing power dynamics in ISE field trip programs.

The method employed by this critical ethnography was a combination of an online qualitative questionnaire and interviews. The criteria for participation included being an informal STEM educator who spends at least forty percent of their time directly working with young people through field trip programming. The brief qualitative questionnaire form was sent out broadly, with a total of 14 responses and a total of two follow up half-hour phone interviews conducted with informal science educators. Participation in this study was voluntary, with a convenience sample recruited through my professional networks and contacts listed on ISEI websites. In order to protect the participants and organizations, the names of people and any identification of organizations were hidden in this publication. All data was stored on password-protected devices. In keeping with critical ethnographic ideals, interview questions continued to emerge as the interviews were conducted. The change of circumstance brought on by the COVID-19 pandemic limited the number of interviews and removed the observation component of this thesis. The data collected from the questionnaire and interviews were categorized to pull out themes and are presented within Chapter 3.

Limitations of the Study

This thesis was limited by several factors. The planned number of participants was limited due to the time restriction for completing this study with a single researcher working within the confines of one semester, as well as the exploratory nature of qualitative research. With the onset of the COVID-19 global pandemic, additional limitations arose. Chapter 3 discusses this in more detail. Additionally, it is important to note that my positionality is impacted by being a practitioner in the field being researched, and that I have biases and perspectives that may influence my interpretation of the data collected. As well as my idenities influencing my analysis of power and inequalities including being white, nonbinary, queer, a US and Israeli citizen, and middle-class. Finally, the results of this study will not be able to be extended to the population of ISE practitioners, due to the small sample size typical of qualitative research.

Significance of the Project

The primary significance of this study is the start of a critical ethnography on a more narrow demographic. There is little research on the specific field trip programming demographics in relation to equity work in ISE. This limited critical ethnography may hold significance for practitioners, researchers, students, and ISE programs. For other ISE practitioners, this thesis may serve as a tool for improvement. For other researchers, it might help in narrowing and defining future research in the field. For the students who attend ISE programs, it might improve their experience and outcomes. Finally, funders/policymakers in the field may find this thesis useful for decisions on setting the direction of the field.

CHAPTER II

REVIEW OF THE LITERATURE

This review of current literature attempts to address the problem of the unknown relationship between informal science education field trip experiences and pedagogy that addresses educational equity. There is a large diversity of field trip programming structures and pedagogies within Informal STEM Education Institutions (ISEIs), and they all aim in some way to have a positive impact by engaging the public in STEM learning. The existing theories and research suggest evidence of a unique opportunity for learning during field trip experiences, but the lack of specific research on the topic leaves many questions to address. In an attempt to contextualize informal STEM education (ISE) field trips, this literature review takes a wide net to the existing material and covers several areas of theory and research.

The claim of worth for this literature review is that it is necessary for educational equity to become a central focus for ISE field trip programming in order to have a positive impact. The theoretical base for this thesis is Critical Pedagogy and an argument is made that Critical Pedagogy is the ideal framework to support the improvement of ISE field trips praxis. In addition, four sets of reasons justify this claim, including (a) public schools tend to produce inequitable outcomes for different students, (b) specifically STEM education is also not providing equitable outcomes to young people, (c) ISE field trip programs have a unique, but under-researched, opportunity within the education landscape, and (d) in order for ISE institutions to address social inequities, race and racism must be a central focus. Joint reasoning is used to justify the claim that it is necessary for educational equity to become a central focus for ISE field trip programming in order to have a positive impact because the individual sets of

reasons cannot stand alone. However, when the sets of reasons are added together, they warrant the final conclusion. A visual representation of the logic equation is as follows: $(R_1, + R_2 + R_3)$ $\therefore$ C (Machi & McEvoy, 2012, p. 97).

Critical Pedagogy

This thesis proposes the use of the Critical Pedagogy theoretical frameworks to support the analysis and improvement of current ISE field trip praxis. In order to do this, it is important to define the Critical Pedagogy tenants and contextualize Critical Pedagogy within its history and development. Critical Pedagogy claims that education can be a transformative process for oppressed people (hooks, 1994). This section includes a brief history of Critical Pedagogy which includes (a) Freire's (1970) original scholarship which articulates *problem-posing education,* (b) the work of Ladson-Billing (1995) that describes *culturally relevant education,* (c) Yosso's (2005) definition of *cultural wealth,* and (c) the ideas developed by Kumashiro (2000) for *anti-oppressive education*. This progression of thought is important because it demonstrates the development of Critical Pedagogy in different educational contexts and as a framework for analyzing educational experiences.

The foundational works that define Critical Pedagogy include the writings of Frieire (1970), most notably the *Pedagogy of the Oppressed*. This original scholarship is important because it lays out a framework for understanding the relationship between marginalized people and education. It encourages the contextualization of education within its historic context and inside an unjust society. Freire defines the normalized model of education as the *banking model*, in which teachers are the holders of knowledge and students are empty vessels ready to receive this information. The banking model is problematic in that students are taught to regurgitate

information, as opposed to questioning or engaging in society. Freire's solution for this issue is *problem-posing education,* in which critical thinking and direct engagement with politics are central to the learning process. In the years since his original work was published, others have expanded on this seminal work.

Building on Freire's (1970) foundation of Critical Pedagogy, Ladson-Billings (1995) further investigates transformative learning, including the role of culture. Ladson-Billings' research on Black students in the United States conceptualizes three criteria for *culturally relevant pedagogy.* She stated that students must (a) experience academic success, (b) develop or maintain cultural competence, and (c) develop critical consciousness that challenges the status quo. This is related to the work of Freire because of its focus on *critical consciousness* and the liberatory goal of supporting learners to become change agents. Different from Freire, Ladson-Billings advocated for an education model that highlights the importance of marginalized students' ability to succeed in society through success within academia. Ladson-Billings' (1995) *culturally relevant pedagogy* is an important framework to analyze the educational experiences of students and use students' cultural knowledge.

Building off this work, Yosso (2005) developed the *cultural wealth* model to define the knowledge and experiences young people bring to educational settings. This model specifically moves away from a deficit model and instead focuses on valuing the richness of experiences that students of color bring into spaces that are functioning under white supremacy. Yosso identifies the five types of cultural wealth as aspirational, linguistic, familial, social, navigational, and resistance. Within the ISE field trip context, students bring a wide range of cultural capital.

Addressed in a later section are the cultural norms of ISEIs and research on culture within the ISEI context.

Another progression in Critical Pedagogy is represented by Kumashiro (2000) who articulates the relationship between education and identity of *the other*, meaning people outside of dominant culture and privileged in society. It differs from the work of Lanson-Billing (1995) and Yosso (2005) in that it focuses on the broad approach and dynamic that educational spaces take towards oppressed people. Kumashiro (2000) categorizes these approaches as; (a) education for the other, (b) education about the other, (c) education that is critical of privileging and othering, and (d) education that changes students and society. ISEI field trips spaces employ a broad range of these approaches and this framework may be helpful in understanding the potential of various programs to design and implement problem-posing educational experiences (Friere, 1970).

In summary, Critical Pedagogy proposes that education should aim to reduce the suffering of oppressed people. This is done by supporting students' ability to transform the conditions which create and maintain inequities. This body of work includes (a) Freire's (1970) *problem-posing* education for the goal of creating *critical consciousness* (b) Ladson-Billings's (1995) *culturally relevant pedagogy* to support a shift in education's relationship to culture and academic success, (c) Yosso's (2005) *cultural capital* model and (d) Kumashiro's (2000) *anti-oppressive education* to engage how education relates to the concept of *the other*. Related to this is a body of research that demonstrates the relationship between Critical Pedagogy and ISE field trips. The following sections describe this research and justify the claim that it is

necessary for Educational Equity to become a central focus for ISE field trip programming in order to have a positive impact.

Educational Equity

Research demonstrates that public schools are not providing an equitable education to students. Evidence of this includes (a) research that illustrates and contextualizes a large gap in marginalized students' achievement, (b) studies that highlight the role and inequity of culture in education, and (c) research that focuses on the importance of how this inequitable cultural representation is specifically connected to STEM education and ISE experiences. This literature review claims that the educational program work of ISE field trips should be focused on educational equity. This body of research is important to this claim because it articulates and highlights the need for prioritization of educational equity due to the issues in education at large.

To begin, similar to the theories of Critical Pedagogy, many researchers have concluded that schools are not equitably serving students and often perpetuating racial and economic inequities. One historic example of schools taking a role in oppression is the ways that public schools in the United States were used as a tool for removing the cultural knowledge and community ties of Native American children (Spring, 2006). Racial segregation of schools was officially ended in the 1950s with the case of *Brown v. Board of Education,* but the majority of schools today are still racially homogeneous and the funding and resources for schools are extremely inequitable (Alexander, 2012). Evidence of schools failing Black students, can be seen in a large *achievement gap* and the *school-to-prison pipeline,* with some cities public schools having more Black male teens heading to prison than to college (Alexander, 2012; Dumas, 2014). Neoliberal values and white supremacy have created and maintain an education system

that is maintaining inequities in society (Lipman, 2011). These failings of public schools are a signal that education needs a transformation towards equity.

As part of addressing this need, culture has been identified as an essential issue and potential space for intervention. Ladson-Billing (1995) states that most researchers and administrators are generally looking for a nonexistent single magic bullet to fix the achievement gap, and although culture is a complex multifaceted element of the education landscape, it is key to addressing the inequalities in education. A piece of this evidence comes from analysis of the culture of education showing that "for much of U.S. educational history, Euro-American culture has been the unquestioned basis of education" (Leonardo & Grubb, 2014, p.40). The cultural norms of public schools, and at large, have a huge impact on the inequitable outcomes in society. In efforts to address this, Ladson-Billings used culture as a lens to analyze the problem of schools failing Black students through interviews with teachers on how they effectively support marginalized students. Ladson-Billings' findings supported a critique of the culture of schools and curriculum, and the possibility of teachers being an avenue to address this achievement gap.

Unfortunately, Ladson-Billings' call has gone largely unanswered in STEM education and there is limited research on the cultural dynamics of STEM education and ISE. In STEM education, there are findings of a lack of culturally relevant science learning opportunities in underserved communities (Djonko-Moore, et al., 2018; Lee, O. & Buxton, C., 2010). One piece of evidence is that there is a shift in schools that serve youth from dispossessed communities towards teaching reading, and away from STEM learning (Djonko-Moore, et al., 2018). ISE field trips may be an opportunity to enhance science learning that is missed in classrooms or schools. In some research on ISE experiences, cultural relevance, or institutional culture is

referred to through different terms. For example in one study about field trips to zoos, there is an emphasis on the importance of connecting learning to *everyday experience* (Davidson et al., 2009). However, it did not refer to this directly as culture or cultural relevance and since everyday experiences can be culturally bound, there is the possibility that the choice of these everyday experiences will reinforce cultural norms. For example, if a focus on an everyday experience was coming from a white cultural experience this could inadvertently normalize whiteness while excluding or missing learning opportunities for students of color.

It is worth noting that there has been some research attempting to relate culturally relevant pedagogy in STEM education. In one example, Djonko-Moore, et al. (2018) directly demonstrated the practical application of Ladson-Billings's (1995) theory. The purpose of this study was to develop and research a week-long STEM summer camp that included hands-on experiences and field trips. The key findings include a small positive impact on children's learning, engagement, and interest in science, with the participating children preferring the field trips and hands-on portion of the camp. The study also found the activities and field trips supported students' content knowledge and scientific vocabulary. Findings from the Djonko-Moore, et al. study suggest that field trips may be used in conjunction with educational programming to create culturally relevant learning experiences. This study also suggested that for successful culturally relevant field trips, students may need their school and/or teacher to prioritize STEM cultural relevance.

In summary, research demonstrates that public schools and education are inequitable in its service and outcomes. This includes (a) research that illustrates the history and current gap in services and achievement of students, (b) research that articulates the impact of cultural

representation and values of culture in education on outcomes, and (c) research that connects these cultural inequities to STEM education and ISE. Taken together, this body of research justifies that equity should be a focus for all education work, including ISE field trip programming. Related to this is more specifics on the inequity of the field of science and STEM education.

STEM Education and Equity

In this context of an inequitable educational system, it is not surprising that learning in the subjects of STEM also have largely inequitable outcomes. Evidence of this includes (a) research that articulates inequity in the field of STEM, (b) research that demonstrated inequities in STEM education, (c) examples of culturally relevant STEM education, and (d) research related to access and relevance of ISE field trips. This body of research is an important component of the claim that is necessary for educational equity to become a central focus for ISE field trip programming in order to have a positive impact because it illustrates the need for change within STEM education.

To understand STEM education it is important to first examine the history and culture of the STEM field at large. Scientific practices are core to the human way of investigating and communicating knowledge about the universe. Lee and Buxton (2010) described the mainstream scientific community as having a set of rules and cultural norms in the effort to develop *scientific truth*. They describe this culture of *universalist science,* explained as;

> Universalist science is the view that because the natural world follows a consistent set of rules, and because science is a quest to understand and explain the rules, then science must be practiced in the same way no matter where or by whom it is done. There is no

> place in universalists science for one's race, ethnicity, culture, language, gender, or other external factors to influence science practices. (p.24)

Scientists use this culture of universalism as a way to avoid addressing science's history of oppression. Scientific research and priorities are yet another place where power is held in our society. Kumashiro (2001) describes this issue by stating;

> Throughout history and even today, science asks only certain questions, and as a result, is used in ways that primarily benefit certain racial and socioeconomic groups in society. Depending on what it finds (or chooses not to find) and publicizes (or chooses not to publicize), science can have different political and material consequences on different populations, justifying the privileging of certain groups and the marginalization of others, as happened with the AIDS epidemic when the science community refused to devote significant time and resources until the "problem" changed from an African/gay disease to a virus that can spread to mainstream America. (p.4)

Science education in most cases maintains the scientific community mentality of universalism. "Universalist science becomes a de facto gatekeeping device for determining what can be included in science curriculum and what cannot." (Lee & Buxton, 2010, p.24) Additionally, 'science' has been used as a tool to justify education policies of discrimination and segregation (Nieto, 2005). This research implies science education maintains this false idea of being void of culture and does not address the reality of the hidden curriculum and culture of science education.

As an example of the need for transformation STEM education, Finson (2002) examined the relationship between students and science representation. This research continued the over

50-year old research practice of asking students to draw a picture of scientists and analyzing students' representation. These drawings generally confirm that young people think of scientists as white men and the work of science as involving lab coats and/or chemistry equipment. Researchers have shown that interventions can influence images by exposing students to female scientists and/or scientists of color (Finson, 2002). Overall there is a lack of interest in science by most American students with the potential for ISE to improve engagement in science (Holmes, 2011). Evidence shows that this perception of science and scientists may have a particularly negative impact on the number of students of color and females that go into STEM majors in college (Lee & Buxton, 2010).

The practices of science include skills that exist as cultural capital in many communities but are not explicitly related to science outside of a eurocentric context (Nava & Lara, 2016). For example, Emdin (2011) conducted research in the field of urban education with students of color that identified with hip-hop cultures and found that the skill of developing an argument in hip-hop lyrics could be used as cultural capital in a science classroom. He noted;

> With the absence of communication and argumentation, the achievement gaps in science persist because students never get to the point where the subject matter becomes important enough to engage in with the same passion and excitement they express in hip-hop. (p.8)

This example of culturally relevant STEM learning that uses cultural capital, functions as evidence of the possibility for an improved STEM education environment in multiple contexts. However, in the absence of such improvements, there exists an ongoing lack of diversity in the *science pipeline,* which is the path to students studying STEM in college and

going into STEM careers (Dawson, 2014). Without inclusive practices in both school and out-of-school science learning, the science pipeline will continue to be primarily white, male, and class privileged.

A final body of research is evidence of the opportunity and inequity of enrichment experiences, such as field trips. Economic pressures on schools can lead to schools eliminating field trips, for example in 2012 a third of school administrators canceled field trips for the year due to economic pressure (Ellerson, 2012). Parents generally want schools to provide more enrichment experiences for their children, but with schools' limited resources and funding they tend to focus efforts on what they perceive will impact test scores (Whitesell, 2016). Studies have found a small positive effect of ISE field trips on science test scores, with the largest difference with low-income and Latinx students, and this suggests that field trips can be an attainable and effective tool in addressing achievement gaps (Whitesell, 2016).

In summary, evidence that STEM education is not equitably serving young people is reasoned through this section. This includes evidence that there is inequity in the field of STEM and STEM education, examples of STEM education addressing this issue through culturally relevant pedagogy, and inequities in access to STEM education enrichment. Taken together, this body of research justifies that a focus on educational equity is needed for ISE field trip programming. Related to this is the following section in more detail about the educational experiences of ISE institutions and field trips.

ISE Field Trips in the Educational Landscape

Similar to the discussion of STEM education and equity in education, there is a body of research that discusses the unique setting of ISE experiences and field trips, and their

relationship to issues of equity in education. This includes (a) research that illustrates the dynamics between school and informal STEM learning, (b) research that attempts to measure the learning on ISE field trips, and (c) research that articulates the role of ISE educators. This is an important body of evidence that supports the claim made by this literature review because it illustrates and contextualizes the current understanding of ISE field trips.

Research investigating learning on field trips articulates the differences between ISE institutions and school spaces. For example, Kisial (2014) found that although teachers and museum staff were all interested in the same categories of success on a field trip, they prioritized them differently; teachers' highest-rated success category was *student learning* while museum staffs' was a *positive student experience.* These differences in priorities impact the ways in which the groups engage and perceive each other during the field trip experience. The analysis also showed that their primary focus related to education equity included giving underserved students access to the ISE experience, development of an interest in the institution, or added enrichment opportunities. Kisial states that this perspective appears to come from a deficit model that does not acknowledge the social capital and priorities of the communities that students are a part of. In other studies, it has also been found that the learning on field trips is strongly influenced by the sociocultural context of the classroom and how much that context relates to the field trip experience (Davidson et al., 2009). This suggests that it is important for informal educators to work closely with teachers to set shared goals and support classroom activities. These findings suggest that an essential piece of the research of field trips is the relationship between the culture and priorities of students' schools and field trip providers.

Another body of research illustrates that field trips to ISE providers have shown to

support students learning in schools, although there is no research on the extent of the impact and direct mechanism of the impact. In particular, there is evidence that ISE field trips make a significant impact on marginalized students' test scores in science (Whitesell, 2016). However, focusing on test scores too heavily may encourage ISE providers to prioritize academic outcomes too heavily while ignoring opportunities to provide students with experiences with authentic science activities that students may not experience in classrooms (Djonko-Moore, et al., 2018). Some research is showing a shift towards focusing on emotional engagement and physical engagement as indicators of learning, and away from specific content learning (Shaby, et al., 2018).

In an attempt to focus on a different way of measuring impact, Holmes (2011) explored students' visit to ISE providers in order to measure a change in motivation and achievement in science classes. In this study, 228 sixth graders were tested, pre and post-trip, and randomly assigned to different types of engagement on their field trip; control, exhibit, lesson, and exhibit/lesson. The key findings include (a) an initial increase in motivation from students that experienced the lesson treatment, (b) an initial increase in achievement and motivation from students that experienced the exhibit treatment, and (c) no significant long-term impact for any treatment group (Holmes, 2011). This research demonstrates that there is potential to measure and influence students learning in the classroom without test-based measurements.

Taking yet another focus, Davidson, Passmore, and Anderson (2009) researched the intersection of *agendas and practices* on field trip experiences. A problem in all education is the lack of student feedback and input, and this research included asking students directly about their field trip experiences. This study compared 11 to 12-year-old students' goals and perceptions on

a field trip to a zoo, with teachers and informal educators. The researchers examined pre, during, and post-field trips through surveys, interviews, observations, and student work. Some of the key results included that students' relationship with the social aspects of the trip, such as being with friends, was the most important component of their field trip experience. This study is related to the work developed by Freire (1974) because Davidson et al. (2009) demonstrates the practical application of the theory of Freire by using key themes from critical pedagogy including the power dynamics of students learning, young people being the key stakeholders in their own learning, and learning environments shaping people's understanding of the world. The authors suggest increased use of Critical Pedagogy in informal education programs.

Another body of research examines the role of informal educators in the ISE experience. Some studies suggest that the influence of museum educators is small to non-existent (Shaby, et al., 2018; Davidson, et al., 2009). For example, the limited study of Davidson et al. concluded that learning from a field trip was not influenced by the goals of informal educators. The dynamics and research on the topic are complex, with the type of field trip experience and the role of educators in those experiences having a wide range.

One area with minimal research is the learning taking place during unstructured instruction at ISE field trips. The Shaby et al. (2018) study observed, documented, and categorized interactions that happened at a science museum exhibits between students on a field trip and informal educators. The key findings include that informal educators primarily engage in technical support of exhibits and did not include many scientific explanations. Shaby et al. (2018) assume that sharing scientific content/explanations is the most important component of the field trip experience. Other researchers had different hopes for the role of museum educators.

Tran and King (2007) point out that informal educators tend to facilitate didactic learning which does not lead to the best outcomes in ISE spaces. Take more of Critical Pedagogy lens, Mayo (2013) suggests;

> The process should be one in which the educator does not treat the visitor as an empty receptacle to be filled with images and knowledge, and therefore as an object of the cultural transmission process. This is not to suggest, however, that the visitor is ever a passive recipient of knowledge. Neither should one assume that the visitor requires a critical museum educator to engage in a critical reading of the texts on display, which could possibly come across as patronizing. Many visitors do this irrespective of any pedagogic promptings. (Mayo, 2013, p.149)

This range in expectations and influence of informal educators makes it challenging to determine what is the ideal role for informal educators.

Tran and King (2007), argue that the role of ISE educators lacks professional preparation and consistent best practices, and this may harm the educational opportunity in informal settings. Also arguing that informal educators have increasingly become a distinct profession with its own skill set that needs specific training for that context, or it can be at risk of perpetuating pedagogies that are not effective. Tran and King outlines 6 complements of knowledge that makes the informal educators work unique; (a) context of multi-dimensional learners, (b) free-choice learning and motivation, (c) navigating inquiry of objects with visitors, (d) depth of content knowledge to guide exploration, (e) enacting constructivist learning theories, and (f) emphasis on verbal and non-verbal communication. The tension between studies on ISE educators seems to relate to different theoretical foundations on the values and impacts of field

trips, and perhaps the purpose of education more generally. Taken together there is (a) no unifying theory of what or how ISE fits in the education landscape, (b) inconclusive measurements for success of facilitation, and (c) a need for continued exploration of best practices.

In summary, research demonstrates that informal science education field trips are not well understood. This includes (a) a body of research addressing the relationship between schools and informal STEM learning, (b) research that examines the educational outcomes of field trips, and (c) research that examines the role of informal education. Taken together, this body of research justifies a claim that educational equity should be a focus of ISE field trip programs by showing a lack of understanding of the impacts and practices of the field. More specifically, the role of race in education is a necessary emphasis in ISE.

White Supremacy and ISE

Similar to the research demonstrating education and inequity, there is a body of evidence demonstrating that in order for ISE institutions to address social inequities, race and racism must be a central focus of the work. This includes (a) work that illustrates the role of race and racism in society, education, and STEM and (b) research that highlights the impacts of race specifically in ISE settings. Critical Pedagogy is a strong framework for social justice in our society, but because of the strength of white supremacy and my positionality as a white scholar, it is necessary to contextualize the work of educational equity within Critical Race Theory and white supremacy.

To begin, Omi and Winant (2015) state that race is the *master category* in society making it the most impactful identity on individuals and society. In *The foundations of critical race*

theory in education, Taylor (2016) argues that racism, white supremacy and hegemony are generally invisible to white people and that whites cannot understand the world we have made. Science's use of universalism is similar to other strategies used to maintain white privilege. For example, whiteness is often centralized and creates an image of white culture as cultureless, while allowing white people to pretend to be *colorblind* (Leonardo & Porter, 2010). Universalism also functions as a way to erase the oppressive history of science, similar to the concept of Tuck and Yang's (2012) concept of *settlers move to innocenc*e, the strategies that attempt to relieve settlers/oppressor of guilt or responsibility. In addition to the universalist ideas of science, in classrooms the experiences and knowledge of white students are privileged, while the cultural capital of Students of Color is devalued. (Leonard & Grubb, 2014). Morales-Doyle (2017) stated:

> Developing an analysis of white supremacy is important because science is often positioned as objective even as the "theoretical retrofitting of scientific racism" has worked to justify oppression from slavery and colonialism through current educational inequality. (p.1037)

This highlights the importance of ISE providers addressing race and culture in science and education.

The ISEI's role in society is to serve as a public education provider (Feinstein & Meshoulam, 2014). Many ISE providers have a mission to create access to scientific knowledge to the public and have a positive impact on inequities, but are at risk of working against their mission if they are not actively acknowledging and working against injustices that impact the general public. ISE institutions have the potential to perpetuate inequities in STEM by (a)

primarily serving audiences that have historically benefited from STEM (Dawson, 2014), (b) functioning under an assimilation theory of progress for underserved communities (Dawson, 2014), and (c) providing content that does not challenge visitors to think outside of social norms (Tinning, 2018).

Dawson (2014), in an exploratory ethnographic study, explains how low-income and marginalized ethnic groups experience ISE institutions. The key implications include (a) the expectations were that ISEIs where not an inclusive space, (b) learning opportunities at ISEIs were not accessible, (c) not feeling welcomed including language inaccessibility, (d) negative ISEI staff interactions, and (e) class and cultural relationship to recreation and free time. Opportunities for increased inclusion include that participants made their own cultural connections to content referred to as *cross-cultural meaning-making*. The benefits of ISEI experience were primarily seen as social, and not related to academic learning. Dawson (2014) also demonstrates that there is a lack of research on equity at ISE institutions and that museum research visits are primarily focused on current attendants of ISEIs. With the demographics and audience of ISE visitors being more privileged than the general public, skewing white and class privileged. There is a need for research on the experience of people that are not attending ISEIs especially with organizations being skewed towards white white-ness in its staffing, culture, and content presented (Feinstein & Meshoulam, 2014).

In their research, Feinstein and Meshoulam (2014) highlights the important work of ISEI learning from each others' practice and collectively shifting the role/expectations of ISEI within community and education. Feinstein and Meshoulam (2014) address the issue that although the goal of ISEIs is to provide science education/resources to the general public, the demographic

they serve is often less diverse than their location. This case study uses an institutional theory perspective which states that it is not a single organization but a field-wide endeavor to transform the practices and role of ISEI within equitable education. The study includes interviews of ISE staff from around the country on their equitable practice. Feinstein and Meshoulam (2014) found that the key variation in the equity work of ISEI was based on their use of a *client logic,* placing themselves as separate from the diverse communities, or *cooperative logic,* positioning themselves as part of their diverse communities. Additional key results of the Feinstein and Meshoulam (2014) survey include documentation of areas that ISEI are or would like to take action toward increasing equity in the field. The researchers found that there is no agreed-upon strategy or language in ISE equity work.

In summary, research demonstrates that addressing white supremacy and racism is a necessary part of educational equity work. This includes (a) research that race and racism are key factors in society and STEM and (b) research demonstrating the racial inequities of ISE institutions. Taken together, this body of research justifies that educational equity, with a focus on race, is necessary, to improve the influence of ISE field trip programming.

Summary

This literature review claims it is necessary for educational equity to become a central focus for ISE field trip programming in order to have a positive impact. There is little direct research on Critical Pedagogy in STEM, and even less within ISE institutions. Evidence that supports the claim for this literature review include bodies of research that demonstrate that (a) public schools are not providing equal or equitable education, (b) STEM education does not provide equitable outcomes, (c) ISE field trip is an under-researched opportunity for educational

equity, and (d) race and racism must be a central part of the work. This claim and body of evidence address the problem of the unknown relationship of ISE field trip experiences with equitable praxis. With this thesis, I proposed to engage ISE educators in a dialogue to understand, engage, and promote educational equity in the field. Within this moment of crisis of the COVID-19 pandemic, it is equally important that we re-evaluate and imagine the role of our work in a larger context.

CHAPTER THREE

REFLECTION

The goal of this thesis was to address the problem of a lack of research on Informal STEM Education (ISE) field trip programming related to educational equity by conducting a research study. However, due to the global pandemic of COVID-19, this thesis took a shift that is described in this chapter. This reflection chapter includes the following sections: (a) partial thesis; (b) reflective narrative; (c) conclusion. The partial thesis section includes the original research plan, the factors that impacted this plan, the response to the change in circumstances, and a summary and analysis of the data collected. The reflective narrative section describes the relevant insights gathered through the change in circumstances, opportunities to re-imagine, and a discussion of potential next steps. The conclusion offers a summary of key findings and insights related to improving practices within ISE field trip programming.

Partial Thesis

Original Research Plan

The original plan for this thesis included conducting a critical ethnography to address the lack of research on equity in ISE field trip programming. This included an online qualitative questionnaire and phone interviews with informal field trip educators. I was able to collect 14 questionnaire responses and do two interviews before a change in circumstances halted data collection. Although I did not take demographic or context data from participants, I could tell from responses that participants included some diversity in types of programs, size of programs and organization context. The original plan included additional interviews, as well as engaging in

observations of field trip programming. The hope was to use a robust data set as part of an evolving critical ethnography to directly address the stated research questions;

1. How do informal science educators understand their field in relation to educational equity?
2. What strategies do informal science educators use to engage in educational equity in their practice?
3. What processes are used by practitioners to promote educational equity in their programs within informal science education institutions?

With a complete data set there may have been findings that help address the stated problem of a lack of research on ISE field trips and equity. The larger hope was that this thesis could potentially have helped the field of ISE in developing more equitable practices for field trip programming.

Change in Circumstances

While conducting my research, unforeseeable changes caused a halt to data collection and a shift in the context of the research. The primary cause of these changes was the global COVID-19 pandemic. In response to the pandemic schools, museums, and field trip programs across the US started closing at the end of the month of March, 2020. This fell in the middle of the semester this research was to take place. This made it impossible to access educators for additional interviews or conduct observations of field trip programming. Additionally, the informal education field has seen some changes that may impact the long-term context of this thesis, including factors such as reduced staffing and funding. Schools, and education more broadly, may also suffer lasting consequences from this moment as well. Although it is

impossible to predict the exact long-term impact to formal and informal educational programming, the COVID-19 pandemic changed the immediate context of this thesis. In response, I am submitting a partial thesis and attempting to adjust to what may now have potential relevance for the field of ISE.

On a personal note, the science museum that I work for has been closed due to the social distancing requirements of the state-wide shelter-in-place order. This closure has put the organization in a challenging financial situation, causing many staff to be furloughed or laid off. There is a level of unprecedented uncertainty for the institution, unlike any other time in the institution's 50 year history; I assume this is true for most informal education organizations. The stable environment, full of possibility, in which began this research, seems long gone. As my organization works through new social distancing requirements and financial unknowns, I expect that ISE field trips may see dramatic shifts in capacity and priorities for years to come.

Response to Change in Circumstances

In response to this change in circumstances, I decided to prematurely end all data collection. As an alternative, I summarized and analyzed the data I had already collected. Once ISE field trip programs reengage their programing, my hope is that this summary and analysis may support those programs to include agendas of educational equity as a central component of their programming. The original intention of this research project was to be part of a transformative worldview, which is needed in order to move the ISE field towards equitable an praxis. Anecdotal evidence collected from my experience thus far suggests that the pandemic is exacerbating pre-existing inequities within society; I make these shifts to my original research plan in order to maintain the goals of critical ethnography to "...unmasking dominant social

constructions and the interests they represent" (Anderson, 1989, p. 254; Crenshaw, 2017). With the temporary closure of my museum, my professional work has shifted during this time towards reflection, regrouping, and reimagining. I am using the data I was able to collect for this study to frame this work. My hope is that this thesis may guide others who find themselves in the possession of a similar opportunity to reimagine informal educational programs.

Summary and Analysis of Collected Data

Data for this critical ethnography was gathered through an online qualitative questionnaire and phone interviews. The online qualitative questionnaire received 14 responses, with two of the responses leading to phone interviews. The intention was to continue to collect data, but the global pandemic of COVID-19 ended data collection resulting in a limited amount of data. I took the results of the limited data set and organized quotes by themes that emerged through a process of categorization (Lecompte & Schensul, 2010). The data gathered in the qualitative questionnaire and interviews can be organized according to the following themes: (a) access to field trips; (b) inclusion on field trips; (c) relevance to students' lives; (d) role of informal educators; (e) engagement outside of field trip day. These themes primarily consist of examples of the strategies used within ISE field trip programs and begin to address the second research question of this thesis related to practices. Additional interviews would ideally have addressed the other two research questions more directly.

Below is a summary of the themes with example quotes from the field notes and sub-themes when appropriate. Although there is some useful data and examples within this data, what is equally important is the themes and categories that did not emerge from the data. Since part of the goal of this thesis was to engage educators in developing a critical lens, I attempt a

critical analysis of the responses in each section by posing questions for other ISE practitioners to consider. The end of this section also includes some noteworthy points from the field notes that begins to address all three research questions.

Results and Analysis Theme One: Access to Field Trips

Responses included a range of answers that related to addressing and expanding access to field trip programming. For the purpose of this category, *access* refers to all potential barriers for an individual or group to participate in the ISE field trip. Some participants mentioned accessibility as an open-ended or broad goal for their work, but these responses lacked enough detail to analyze further. Examples of these comments can be found in Table 1. However, I believe these comments are important to note because of their lack of specificity. I do not know more about the intention of those that shared these specific comments, but these comments can serve as a reminder for the field; it is important to ensure that *accessibility* becomes a reality among Informal STEM Education Institutions (ISEIs), and not simply a talking point for funding. Referring to accessibility without action may allow ISEIs to appear to be addressing equity while actually perpetuating the same educational inequities. Additionally, if taking too broad of an approach there is a risk that ISE providers are not addressing their own structural failings for those that are not able to access their programming.

Table 1

Example Quotes on Open-Ended Accessibility

Subcategory	Example Quotes
N/A	"I relate field trips and educational equity mainly with access, striving to ensure that the museum is accessible to all children."
	"... As a public institution, we aim to create a diverse and open building with accessible programming and hands-on offerings to help every learner be successful."
	“Not so much social justice, our real focus, and I guess I’ll re-frame it, is that we really look at accessibility to the collections. What we're trying to build are bridges of accessibility. When I say that, it's not just for those that we'd be like ADA...accessibility standards, but also accessibility for people that would not ordinarily have access to a museum.”

Outside of these broader comments on access, there was a range of noteworthy sub-themes related to access based on (a) financial barriers; (b) needs of students; (c) amount of access. These sub-themes are not meant to be a complete list of access points that ISE field trips providers should address, but rather are some areas that emerged from the data collected for this thesis. These sub-themes may serve as a starting place for reflecting on points of access for specific programs. Each sub-theme is described below in more detail with example quotes that have been broken into additional sub-categories.

A major sub-theme emerged related to the financial barriers of ISE field trip programs. Almost all research participants included comments that would fall under this sub-category. In comparison to all of the barriers mentioned from research participants, the financial barrier seemed to be more likely referenced with specific strategies to eliminate the barrier. Examples of

these comments from the field notes can be found in Table 2. Many of the comments referred to the cost of the field trip programming, as well as the financial cost of transportation to a field trip. Additional comments mentioned financial need related to the income of the community to which visitors belong, or the school students attend. It appeared in these comments that educators acknowledge the relationship between income and access, and that this may lead to broader structural or socioeconomic barriers within programs. Overall, research participants seemed to acknowledge and attempt to address the financial barriers of field trips to their programs.

Table 2

Example Quotes on Accessibility Based on Financial Barriers

Subcategory	Example Quotes
Cost of Field Trip Program	"We additionally write grants to make our programming accessible to all students regardless of their ability to pay..."
	"....education is always free, and equitable, and accessible to the public community irregardless of whether you have base access or not. "
	“The museums are free to the public and that is one of the great equalizers I feel of the system.”
Cost of Transportation	“We don't charge anything... I mean a school can come in with 100 kids, spend the day on campus and do some planetarium work, an observatory session, a weather station session, a museum session, lunch, go home, and the cost of their trip was whatever it cost, you know, the buses to get them there.”
	"We offer bus grants to teachers based on need, to get all students out to the Reserve!"
	"We have a line item in our budget for transportation assistance for programs that have 75% or more of their children who qualify for free or reduced lunch.”

Income Level	"...This includes offering financial scholarships to schools with 35% free or reduced lunch rates to ensure those students with less economic support are able to attend a field trip to the museum."
	"The schools and community programs we partner with usually serve a majority of students who come from low socioeconomic backgrounds...."
	“Oftentimes, field trips from public schools have a random sampling of all socioeconomic strata and families representing the community."

Another sub-theme emerged from comments related to access, based on the needs of field trip students. Comments put within this category are based broadly on barriers students have to engage with the ISE field programming. Example quotes that fit in this sub-theme can be found in Table 3. Generally, these comments show evidence of an intention by educators to give all students access to engage the ISE field trip experience. Some research participants referenced meeting the needs of students with disabilities, with some comments directly referring to the legal requirements based on the Americans with Disabilities Act (ADA). Other quotes referenced designing programs to meet students' needs based on age or grade level, previous content knowledge, and languages spoken by students. Although these subcategories have important differences, I put them all under this sub-theme of access. They are based on students' needs and highlight similar challenges experienced by, and strategies employed by, ISE field trips attempting to eliminate these barriers. The nature of one-day field trip programs often means that ISEIs may know little to nothing about the needs of students they are trying to support. This sub-set of comments show an interest in understanding and preparing for the needs of diverse student participants and the importance for ongoing work to address this barrier.

Table 3

Example Quotes on Access Based on Needs of Students

Subcategory	Example Quotes
Disability	"...I've shared some ideas with my team about things we might communicate with teachers who have students with disabilities."
	"More than anything else we're just looking at the access on the ADA compliance side of things at this point, and we're looking at both vision, low vision and hearing, the challenges within that collection… and try to see what we can do to help develop our materials and access in some of our programming...."
Age Level	"...we work on creating accessible programming that can be tailored to multiple ages and abilities, with a variety of entry points, so that students can participate at a level that is comfortable to them."
	"We offer grade-level specific rotations for all our students."
Content Knowledge	"...design curriculum that supports learners with less prior science knowledge."
	"We try to never assume that a student knows the basic background behind whatever topic we are discussing and we never shame students for not having the vocabulary or knowledge of their peers."
	"We always start our programs with a baseline of understanding and try not to assume that students have pre-existing knowledge about the locations we are visiting or the activities we are leading for them."
Languages Spoken	"we offered bi-lingual field trips for elementary-aged students…"
	"I also make sure to try and get any written documents translated in order to make the transfer of information easier for families whose primary language is not English. If possible, I partner with colleagues who also speak languages that serve the community."
	"Many times we're able to meet groups where they are language-wise, which is cool. I mean whether it's a group that's a Chinese immersion school or more Hispanic leaning urban school or whatever it might be. We're able to meet them at their place of entry, which is an interesting way to be able to do that."

A final access sub-theme includes comments related to the amount of access experienced by students or communities. This included comments that specifically address an *underserved* audience and others focused on the amount of service or enrichment opportunities students receive more broadly. Examples of these comments from the field notes can be seen in Table 4. Although this sub-theme may relate to other barriers, such as financial barriers, it focuses on the prolonged and multigenerational experience of being denied services and could begin to address large structural problems with access to education and ISE. It is important to note that these comments sometimes articulate a deficit mindset, in which students and communities are framed as lacking; not all informal educators have the understanding and vocabulary to frame access in terms of community and cultural wealth. From my own experience as an ISE educator, the term *underserved* is coded language for lower-income communities or communities of color. The problem that I see with this term and usage is that it can lack recognition of the historic and/or structural reasons behind the issue. It also fails to recognize the long-standing traditions of human right advocacy and activism, maintained at an incredible cost, that exist among people who are identified as *dispossessed*, *historically underserved*, *marginalized*, *disinvested.* It is true that some communities have been historically denied access to ISE for a variety of structural reasons. I ask that my colleagues in the ISE field take an active role in disrupting these systemic inequities.

Table 4

Example Quotes on Accessibility Based on Amount of Access

Subcategory	Example Quotes
'Underserved'	"We are the number one provider of programming... serving predominantly underserved schoolchildren in afterschool programs."
	"We receive many underserved visitors but the demographics in the area are steadily getting less diverse."
'Lacking Opportunities'	"When determining which outreach events to participate at, I prioritize events in communities that lack outdoor education service..."
	"...the only way that these children have access to this technology is through these field trips."
	"...I think field trips are advancing equity because institutions… are providing experiences to kids with fewer opportunities."
	"At my agency, we focus our outreach in communities that reflect demographics that have less access to educational opportunities."

This larger theme of *access* includes several sub-themes consisting of access based on (a) financial barriers; (b) needs of students; (c) amount of access. Together these *access* subthemes demonstrate the varied ways that informal educators are thinking about, and enacting strategies to remove barriers for individuals or groups who wish to attend ISE field trips. What was often missing from these comments was the acknowledgment of the reason these barriers exist, including the components for which ISEIs are responsible. I believe that all students have access needs of some sort, but we have normalized the access needs of certain students. To address this theme of access, I pose some questions to myself and the fields. These include: (a) What are the barriers for young people accessing ISE field trips? (b) What is the historic and structural reason for these barriers? (c) In what ways am I, or my organization, responsible for these barriers? (d)

What are the opportunities to address these barriers today? (e) What are some long term strategies we can take to address these barriers?

Results and Analysis Theme Two: Inclusion on Field Trips

A second category emerged from the data pointing to a focus on inclusive praxis within the field trip experience. This theme of inclusion is focused on learning practice and theory related to participation. Examples of quotes that referred to this theme can be found in Table 8. I categorized several sub-themes from the field notes on this theme. This includes comments related to peer interactions, the structure of programs, and an awareness of educators' biases. Yet another set of comments mentioned specific learning/design frameworks or approaches.

There are many overlaps between the theme of *access* and the theme of *inclusion*. It is worth noting that many of these quotes could have been put in either category, especially the ones that fell within the access sub-theme of the needs of students in Table 3. However, I felt that it was important to separate issues of access to ISE programs from issues of access within ISE programs. To explore this further, I ask the following questions of my colleagues in the field: (a) What are the hopes for what young people get out of their field trip experience? (b) What strategies create opportunities for students to guide or participate in their own learning process? (c) How do the structures or pedagogies of the field trip program align with creating a more equitable experience for students?

Table 5

Example Quotes of Inclusion on Field Trips

Sub-themes	Example Quotes
Peer Interactions	"Our programs also begin with ice breaker activities so we can get to know the group, which also provides opportunities for students to break from their usual group of friends so that they may learn more about each other."
Opportunities to Participate	"I am conscious of giving all children equal opportunity to ask questions or make comments."
	"I personally try to be aware of my learned biases and try to engage as many different students as possible."
Specific Approaches	"Universal Design for Learning UDL is the basis of our approach to our clientele"
	"I utilize teachable moments to engage students who are interested in an exhibit to get guests to explore the concepts in play more. I use the 'Notice, Try, Remind' technique where I ask guests what do they notice, what can they try, and what does the result remind them of? I just talk to people and expand on their interests."
	"Treating all students with equal dignity, free from authoritative practices."

Results and Analysis Theme Three: Relevance to Students' Lives

A third theme emerged from the data that could broadly relate to the relevance of ISE field trips to students' lives. Several examples of quotes that fit within this theme are found in Table 6. This includes comments that relate to the types of knowledge and content that are part of a field trip experience. Within knowledge and content, there is the opportunity to emphasize the knowledge of communities that are devalued and to bring up issues that disproportionately impact communities that experience generational civic disinvestment, such as climate change. Additional comments specifically mention the intentional choice of materials and representation.

Taking a critical lens, most of the responses organized in this theme lacked a focus on feedback from students or centered on their experience. The majority of interactions between ISE field trip providers and the students they serve is relatively short. In this moment of COVID-19 and school closures, it brings up the question such as “How can informal education providers adapt in moments of crisis?” It is especially important to prioritize the relevance ISE experiences to students of color, as discussed in Chapter Two. In response to this theme of relevance to student’s lives I pose the following questions to my ISE colleagues: (a) How can ISE center the voices and feedback of young people? (b) How does the field trip support students’ lives at this moment and in the future? (c) What are the opportunities to highlight the cultural wealth of the students coming on field trips?

Table 6

Example Quotes of Cultural Relevance to Students’ Lives

Sub-themes	Example Quotes
Knowledge and Content	"I have been co-leading a project to bring Indigenous voices back into our spaces... "
	"...To promote the topic's relevance to their lives, we end the field trip by inviting students to discuss the following question when they return to the classroom: "What responsibility do we, as a society, have to protect us and the environment from climate change?..."

Materials and Representation	"...we started including materials that were more appealing to girls, in an effort to make them feel more comfortable and excited in participating in design challenges.”
	"...One is a young white male, the other a young woman of color. We hope that these (super inspiring) videos will encourage them to act on behalf of climate change in their own communities."
	“Sometimes it might be even having them view some little video about other people who have been at the museum, just to kind of help make them comfortable… We have some social stories that… we'll just send out to the people to be comfortable with what's going to happen when they arrive.”
Feedback from Students	"I was very vocal to my team and supervisor about a lesson where the teacher left with 3 kids of color and didn’t come back. I wanted everyone’s feedback on what we might do to support more successful interactions..."

Results and Analysis Theme Four: Engagement Outside of Field Trip Day

This fourth theme included comments that refer to ISE institutions engaging audiences outside of the field trip day. Example quotes in this theme can be found in Table 7. One sub-theme includes pre-field trip communication with teachers. The extent of this communication ranges in depth, but it may be a key area to explore in future research. Responses in this category also included the ways that ISEIs advertised or conducted outreach. Additional comments in this theme included mention of community programming and partnerships outside of field trip days. Some of this programming specifically targets communities that an institution is not currently engaging and/or adult learners.

In order to fully engage in programming with an educational equity lens, I believe ISEs must consider the holistic support of the real lives and experiences of students, their families, and their communities. In order to reflect on this relationship with ISEIs and communities, I ask myself and the field these questions: (a) How are teachers and schools supported in building a

relationship with the ISEI? (b) In what ways are teachers and all adults encouraged in their own learning? (c) What are opportunities to partner, or be advised, from community members/groups?

Table 7

Example Quotes for Engagement Outside of Field Trip Day

Sub-Themes	Example Quotes
Communication with Teachers	"...you are really dependent on the leaders of the field trip and the students, and the staff of these field trips to help engage… with their students as we are all trying to teach them science-based learning in such a short amount of time, like two to three hours to get as much science and fun into these activities as possible in a way that is kind and compassionate, empathetic. It's challenging. I feel like the guided participation and engaging in enthusiasm with the adult leaders is the best way to do so."
	"What we do is we have an online form that a teacher will fill out... Some of them have been coming to us for the last 10 years, we know exactly what we're going to do with them, or it's somebody brand new and then we take a fair amount of time kind of communicating with them before they come."
Advertising and Outreach	"We advertise this program in various ways, to ensure that schools with low income families can take advantage of it."
	"We do a lot of outreach to Title 1 schools. They then invite them to the Free Museums that are open to the public and the museum education is always free, and equitable, and accessible to the public community irregardless of whether you have base access or not."
Community Programming and Partners	"...create accessibility and community engagement with incarcerated parents and their children, to provide transportation and provide a neutral facility in which the children have feelings of self-authority and self-worth, and choice… they get to interact and learn together."
	"Outside of field trips, we offer free days at least once a month for families to come and learn at the museum… and offer discounts for families with a food assistance card."
	"We partner with… social service agencies...programming that's done for adult learners… when you begin to bring in the English language learning program, you're bringing in adults who have children who would never have actually seen a museum. Then all of a sudden they realize it's free and

	I can go and I didn't have a terrible time and I could bring a child and they seemed really okay with all that..."
Engaging Adult Learners	"...as much as we're working with the kids, the classes, the students, much of the work we're also doing is with the adults, the caretakers and/or teachers, chaperones, whatever you want to call them, the adults that are with them. Much of our work is also addressing their needs without that group explicitly knowing that we're doing that. Our explicit work is with the student groups that are coming in. Our other layer of work is to help develop the adults in their understanding of science. We do actually make that a focus of our work and we evaluate what happens with the adults while we're working with the students."

Results and Analysis Theme Five: Role of Informal Educator

A fifth theme that emerged from the data was drawn from responses that focused on the role of the field trip informal educator. Example quotes that fall within this theme are included in Table 8. Some quotes from this theme include a focus on diversity among the educators working with field trip students. Another element of this discussion is the type and amount of training that educators can access, related to informal education and including training related to issues of equity. An additional noteworthy sub-theme discusses the types of support that educators receive from the ISEI. Although there were few responses in this sub-theme, I believe it is essential to think about the professional and personal wellbeing of the field trip educators. None of the research participants mentioned this directly, but I believe it is important for ISEIs to have equitable employment practices.

The educators working directly with students on field trips are key to the outcomes of ISE experience. I have experienced the ways that educators' identities, including my own, can create opportunities to connect with students as well as create unforeseen challenges such as microaggressions. The short duration and limited number of the interactions between informal

educators and field trip participants can make addressing bias and microaggressions difficult. In my work I have seen how for informal educators, especially educators of color, this can be repetitive and harmful part of their work. I pose these questions to consider, related to equity with informal educators: (a) Do the field trip educators match the demographics of the students coming in? (b) What opportunities are there for creating equitable teaching practices? (c) How are field trip educators supported with issues of bias and microaggressions? (d) What do field trip educators gain personally and professionally for their labor?

Table 8

Example Quotes Related to Role of Informal Educators

Sub-themes	Example Quotes
Diversity	"...we try to recruit a diverse pool of volunteers and staff so that students on field trips feel represented and safe when they interact with museum personnel on their visit."
	"Our staff and volunteers are multi racial, gender, and generational"
	“students who work in the museum, they speak at least two of them, three, four, or five languages. Many times we're able to meet groups where they are language-wise...”
Training	“I feel like maybe there should be more training, maybe gradual training. Have them come to outreach programs first and then come in and teach.”
	“We have an informal opportunity to talk about our practice while we're designing this professional development for teachers. I personally haven't been to a professional development for informal science educators ever”
	“One is all of our training with the students that work with the groups that come in has a foundation that is dependent upon kind of an understanding of the nature of science and the seven components that are part of the nature of science.”

Equity Training	“We also participated in a diversity, equity, inclusion training to start the school year.”
	“Well, they include communication design courses for us that they suggest that we take a racial and social justice program… Otherwise, we take various workshops and then we also go to various museums to take various workshops as well and to learn from educators.”
Support	"Our agency recently hosted a gathering for environmental educators of color…"
	"I personally try to be aware of my learned biases..."

Additional Analysis and Summary

It is worth noting a few additional points of analyses that relate to these research questions one and three. Only a very few comments related directly to race. Of these, most addressed race as part of a larger list of demographics. It appears that the issue of white supremacy and racism is not central to the way informal educators talk about the field becoming more equitable. Discussions of race were also missing from the conversations related to curriculum design and the cultural wealth of students. This may be related to factors outside the scope of this thesis such as the racial identity of ISE educators or the number and frequency of the opportunities afforded to ISE educators to talk about how race and identity relate to their work. As expressed in Chapter Two, in order to address inequality, racial justice must become a central component of the work of educational equity in ISE field trip programming. To address this, I ask the following questions of myself and other practitioners: (a) Are students of color on a field trip experiencing culturally relevant content and pedagogies? (b) What is my personal and institutional ability to address the ways that white supremacy is impacting field trip students and educators?

An additional topic is related to sustaining the motivation of educators and ISEIs as they address inequities in the field. Some responses in the field notes specifically expressed a lack of effort related to creating more equitable outcomes in field trip programming. Others described the challenge of staying *non-political* at their organization. To consider this further, I pose the following questions: (a) How are issues of equity part of the impact model of the field trip program? (b) What room is there to adapt current programming priorities towards education equity? (c) How can I ensure that addressing the inequalities of students' lives is central to the ongoing work of my organization?

In conclusion, the incomplete findings from this critical ethnography can be organized according to five themes including; (a) access to field trips programming; (b) inclusion on field trips; (c) relevance to students' lives; (e) engagement outside of field trip; (d) role of informal educators. Some additional interpretation led to questions about racial justice, and increasing the motivation and longevity commitments to educational equity work. These themes most directly address the second research question. These themes focused on strategies related to educational equity, with an analysis of the collected data suggesting several possible interventions that may create more equitable outcomes in ISE field trip programming. Additionally, because each ISE context has unique circumstances, audiences, and opportunities, I suggest that each informal education provider engage in a homegrown process to prioritize and actualize equitable programming. Through my critical analysis, I responded to each theme through a series of questions. A complete list of themes, sub-themes, and questions to consider can be found in Table 9.

Table 9

Themes Pulled From Partial Critical Ethnography with Questions to Consider

Themes	Sub-Themes	Critical Questions to Consider
Access to Field Trips	Financial Barrier Needs of Students Amount of Access	What are the barriers for young people accessing ISE field trips? What is the historic and structural reason for these barriers? In what ways am I, or my organization, responsible for these barriers? What are the opportunities to address these barriers today? What are some long term strategies we can take to address these barriers?
Inclusion on Field Trips	Peer Interactions Opportunities to Participate Specific Approaches	What are the hopes for what young people get out of their field trip experience? What strategies create opportunities for students to guide or participate in their own learning process? How do the structures or pedagogies of the field trip program align with creating a more equitable experience for students?
Relevance to Students' Lives	Knowledge and Content Materials and Representation Feedback from Students	How can ISE center the voices and feedback of young people? How does the field trip support students' lives at this moment and in the future? What are the opportunities to highlight the cultural wealth of the students coming on field trips?
Engagement Outside of Field Trips	Communication with Teachers Advertising and Outreach Community Programming and Partner	How are teachers and schools supported in building a relationship with the ISEI? In what ways are teachers and all adults encouraged in their own learning? What are opportunities to partner, or be advised, from community members/groups?
Role of Informal Educators	Diversity Training Equity Training Support	Do the field trip educators match the demographics of the students coming in? What opportunities are there for creating equitable teaching practices? How are field trip educators supported with issues of bias and microaggressions? What do field trip educators gain personally and professionally for their labor?

Additional Analysis	Centering Racial Justice Sustaining Motivations	Are students of color on a field trip experiencing culturally relevant content and pedagogies? What is my personal and institutional ability to address the ways that white supremacy is impacting field trip students and educators? How are issues of equity part of the impact model of the field trip program? What room is there to adapt current programming priorities towards education equity? How can I ensure that addressing the inequalities of students' lives is central to the ongoing work of my organization?

Reflective Narrative

The change in circumstances caused by COVID-19 has placed this thesis in an unknown context. As I write this now, I have been home (except for essentials) for six weeks due to a shelter-in-place ordered by the govenor of my state. This was put into effect to prevent the spread of the virus, and to reduce the strain on medical and social services. I have the privilege of being healthy and safe during this time. As I finalize this partial thesis, it is impossible to know what the next few weeks, months, and years will bring. Here I present a few thoughts on how this moment may relate to creating more equitable ISE field trip programming in the future. The following sections focus on insight I have gained and articulate opportunities to re-imagine ISE programming.

Insights

The impact of the COVID-19 pandemic has allowed me some new insight to the context of educational equity in ISEIs. For example, this pandemic is highlighting some of the global and local inequalities that existed before the crisis. For example, Black and Latinx Americans are more likely to be dying from COVID-19 which relates to existing health disparities among communities of color (Blow, 2020). We have also seen an increase in racist rhetoric and violence

against Asian-Americans due to this pandemic (Tavernise & Oppel, 2020). In addition, the shelter-in-place experience seems to have varied remarkably, based on income and race. Higher income earners, who tend to identify as White, are more likely to experience job security and/or work-from-home at this moment (Tankersley, 2020). Additionally, within the realm of education, school closures have highlighted the digital divide in which lower-income and more rural families are less likely to have access to devices and high-speed internet (Kinnard & Dale, 2020). Although this pandemic will most likely come to an end at some point, historical precedent suggests that these economic inequalities will remain or get worse (Fisher & Bubola, 2020). In addition, global crises, such as climate chaos, will continue and as educators, we must do all we can to prepare young people and to support them to develop resilience in the face of crisis.

It is also worth noting that science has taken on a particular role within this crisis. Healthcare workers and doctors are on the frontlines of caring for people, and huge investments and amounts of hope are being put into scientists developing a vaccine (Thompson, 2020). In order to support an inclusive STEM pipeline, and to foster the types of critical inquiry necessary for addressing global issues such as climate change and pandemics, it is essential that ISEIs reach students more equitably. It is not only trained scientists that are using the skills of science to respond to the crisis. Every day people are innovating, problem-solving, and using technical skills to do things like sew face masks for essential workers, support food banks, and concoct hand sanitizer (Enrich et al., 2002). ISE field trips should embrace their role in preparing students for active engagement in their lives and communities. These new insights may help reimagine the role of ISE field trip programming as we move forward into the unknown.

Re-imagining

There is no way to tell what direction education and ISE will take after this pandemic. However, some interesting shifts have happened in response to COVID19 that may create opportunities to re-image the work of ISE field trips. One re-imagining I propose is that ISEIs take a more active role to respond to the needs of their local community. For example, some ISE organizations have reallocated resources to creating personal protective equipment for healthcare workers and to support virtual learning for teachers and parents adapting to school closures (American Science and Technology Centers, 2020; Center for Advancement of Informal Science Education, 2020). I see these examples as a starting place for how informal education providers can become more adaptive and work in solidarity with their community. With in-person education currently at a halt, this is a moment that also provides ISE programs with an opportunity to reflect and plan how they might reopen with an increased or more rigorous focus on equity, inclusion, and solidarity.

Next Steps

Again, the current moment of uncertainty makes it challenging to make recommendations for future research. However, this thesis argues that research on the subject of educational equity and ISE field trip programming holds the power to transform the field. Currently, schools are attempting distance learning on a large scale and this may shift the relationship between technology, school, and learning. This also raises questions related to ISEIs engagement in this new educational landscape, as well as the role field trips may take within an increasingly digital world. I would argue that the social and hands-on learning that takes place in field trips may be more important than ever. Personally, as a practitioner within informal STEM education, I plan

to apply this thesis to a reimagining of my own practices using the findings and theory in the literature review, the data collected during my brief critical ethnography, and the critical questions I pose in this chapter. I hope to begin by developing an advisory group of teachers and community members to set the priorities and direction of ISE field trips. Additionally, I will share this thesis in hopes to inspire, inform, and challenge my colleagues through informal and formal channels, such as emails to my networks and re-writing in the form of a blog or article. As well as my continued goal to have the opportunity to learn from the young people I work with and creative educators reaching for equitable outcomes.

Conclusion

Although a change in circumstances impacted the critical ethnography research component of this thesis, a combination of a theoretical framing, review of literature, results from the limited data, and reflection from the pandemic creates an argument for an increase in focus on educational equity within informal science education field trip programming. The limited data collected included some starting themes for practitioners and researchers including; (a) access to field trips programming; (b) inclusion on field trips; (c) relevance to students' lives; (e) engagement outside of field trips; (d) role of informal educators. Additional points included the importance of addressing white supremacy and racism, as well as creating sustaining motivation for ongoing work towards equitable education.

Additional insights brought upon by the pandemic includes the way that existing inequalities are being surfaced at this moment and a possible reevaluation of the role that ISEIs can take in building students' capacity for STEM skills and resilience in crisis. I hope that this thesis can serve as a resource and instigator of dialogue among informal education practitioners,

with aspirations that we can have critical reflection and reimagining of programming that works in solidarity with local and global communities.

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