IDENTIFYING THE USE OF CULTURALLY RESPONSIVE TEACHING STRATEGIES IN OUT OF SCHOOL TIME STEM CLASSROOMS

By

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A Thesis

Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Arts

in Science Teaching

Northern Arizona University

April 2021

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ABSTRACT

IDENTIFYING THE USE OF CULTURALLY RESPONSIVE TEACHING STRATEGIES IN OUT OF SCHOOL TIME STEM CLASSROOMS

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This study sought to understand how culturally responsive teaching strategies occur in out-of-school time settings and how a high-quality STEM curriculum may influence these strategies. Two educators with unique backgrounds were observed in two different out-of-school time (OST) programs in the U.S. Because of their unique backgrounds, their use of culturally responsive teaching strategies manifested themselves differently among the two programs. Using a previously developed, high-quality STEM curriculum, we were able to classify and interpret how they were implementing cultural relevance in their classrooms and understand the impact of the curriculum. Observations, interviews, and implementation logs were coded and analyzed through quantitative and qualitative means.

While this study was part of a more extensive study funded by NASA to develop middle school STEM OST curriculum, we were able to find some unique results. We discovered that OST educators might significantly differ in how they enact culturally responsive teaching practices in an OST classroom, perhaps because of their teaching background and experiences. Another result indicates that because OST educators come from various teaching experiences, a curriculum that could implement culturally responsive teaching (CRT) strategies may allow educators to connect with their youths in more profound, more meaningful ways. Because OST programs across the country hold different youth goals, teaching moves that encourage cultural relevance could be a robust strategy that allows the OST program to enrich youth experience.

Acknowledgments

Above all, praises and thanks to God for His numerous blessings guiding my research to a successful completion.

I would like to extend further gratitude to my thesis committee chair, Dr. Ron Gray. Ron, you led both Evan and I to a side of education and academia we did not know existed. Without your leadership, guidance, and mentoriship we would not have been able to produce our research.

To my committee members, Dr. Nena Bloom and Joelle Clark. Without you two phenomenal mentors, I would not have achieved the level of professionalism I have today. Thank you for taking me in on the PLANETS project and helping me develop as an emerging researcher. Your influence has changed my career path, and I will forever be grateful for my experience with you both.

I would like to express my deepest gratitude to my husband, Evan, who has pushed me to excel in this type of work. Without you, Evan, I would not be where I am today. Thank you for holding me to such a high standard, challenging me, and loving me well through this process.

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Preface

The manuscript chapters are written to appear as articles in two different journals. For the first manuscript, the piece intends to be published in the Afterschool Matters Journal. This article will be submitted in fall 2021 and hopefully published in spring 2022. Afterschool Matters is not currently accepting manuscripts but historically holds a call for submissions each fall. If they do not open up their call for proposals, we will look for similar journal options. This article will highlight the research and its findings.

The second article was written as a practitioner article which will be submitted to the National Science Teaching Association's "Connected Science Learning" journal. This special journal issue is titled "Preparing and Supporting STEM Educators in Informal and Formal Settings" and highlights educators' learning approaches in informal settings. The full-length article will be published under the sections "Research to Practice, Practice to Research." Submissions for this issue are due November 15, 2021, and the work will be published in March-April 2022. Because of this thesis's journal format, some redundancy will result from combining these articles within the university formatting requirements.

CHAPTER 1: INTRODUCTION

In education, we often focus on "formal school time" and have expanded on solutions to reach youths of various backgrounds in many ways. However, it is just as important to consider these ideas in a context outside the formal classroom. Out-of-school time (OST) offers youths a place to engage in intellectual, emotional, and social opportunities that the traditional school day does not always encourage. Programming includes options like Boys and Girls Clubs, YMCAs and YWCAs, parks and recreation departments, after-school programs, libraries, and museums. OST programs are called "intermediary spaces" because youths have the freedom to form an identity, make choices, and resolve crises in their home life (Noam & Tillinger, 2004). Literature surrounding OST has focused on content and skill-based learning and on the learning process's social and emotional aspects. High-quality OST programs are positively associated with improved academic outcomes, self-esteem, interpersonal skills, initiative, communication, leadership, and connection to community for their participants (Strobel et al., 2008). The OST setting has traditionally held goals different than that of the formal classroom and seems to align well with culturally responsive pedagogical ideals.

Gay (2002) defines culturally responsive teaching as "using the cultural characteristics, experiences, and perspectives of ethnically diverse youths as conduits for teaching them more effectively" (p. 107). This definition links academic skills and knowledge to lived experiences from the youths. When this happens, youths experience more meaning, have higher interest, and learn more easily (Gay, 2002). Because of this, ethnically diverse youths will prosper and improve in their school achievements if they are educated in ways in which their own culture and experiences become relatable (Au & Kawakami, 1994).

Culturally responsive teaching (CRT) has primarily focused on formal classroom time. Therefore, there seems to be a gap in aligning CRT with OST, especially when CRT is in some ways dependent on the social and emotional learning opportunities that OST emphasizes. Culturally responsive pedagogy (CRP) is an almost interchangeable term to CRT, but with a slightly different research approach. In the literature, CRT is studied with classroom applicability and designed with a more effectively (Gay, 2002). It is based on the assumption that when academic knowledge and skills are situated within the lived experiences and frames of reference of youths, they are more personally meaningful, have higher interest appeal, and are learned more efficiently and thoroughly (Gay, 2000).practitioner approach. Strategies seen in the literature include designing culturally responsive curricula, demonstrating cultural caring in the classroom via learning communities, cross-cultural communications, and cultural congruity in classroom instruction (Gay, 2002). Few studies have implemented the CRT or CRP theoretical lenses into OST programming. Therefore, I seek to address this gap. For continuity and sake of this study, we will refer to this research approach in the context of CRT.

Historically, there has been an opportunity gap in science, technology, engineering, and math (STEM) learning and career paths (Afterschool Alliance, 2011a). There is a widespread need for STEM learning and ability in the modern world (National Academies, 2007). OST programs look to close opportunity gaps. Participation statistics in OST show these programs are reaching large numbers of ethnic minority youth; therefore, STEM learning in OST can be a powerful means to providing enriching opportunities to those underrepresented in the field (Afterschool Alliance, 2014a). STEM practices in OST can represent ideas of CRT through centering youth through the identities, values, and experiences of youth; challenging elite STEM

practices, epistemologies, and representations; supporting young people's critical STEM agency; and respecting and valuing young people's identities in STEM (Archer et al., 2020).

Additionally, research has found curriculum can help develop youth identity, agency, and culture (Wortham, 2003). Curriculum has also been recognized as a critical link in OST connections between educator and youth (Llopart & Esteban-Guitart, 2018). A STEM curriculum that exists to orient youths toward their culture and identity formation opens up a unique opportunity at the OST level (Llopart & Esteban-Guitart, 2018).

Research involving either OST and CRT has been more pronounced in literature; however, few studies have examined them together. The same is true with STEM learning. Because of the nature of thr study, the work is grounded in critical race theory. According to Dodo (2018), "the use of culturally responsive pedagogy and critical race theory as a pedagogical model and analytical tool, respectively, in science education is minimal" (p. 93). While CRT is an established multicultural education model in many academic contexts, it has yet to be widely used in science education (Dodo Seriki, 2018).

Theoretical Framework

This work is grounded in critical theory as it rests on the idea that the multicultural foundation of education holds the potential to be improved. In education, critical theories can encourage youths to "engage in culturally mediated activities specific to their own experiences" (Rodriguez et al., 2004, p. 2). Critical theory helps solve a significant issue in education, involving the preparation of teachers who can effectively teach youths whose cultural backgrounds are different from their own (Brown-Jeffy & Cooper, 2011; Gay, 2000). Ladson-Billings (1995) initially argued for a critical theory of race in education related to the one created in legal scholarship, thus creating critical race theory in education. Critical race theory has been

used to explain social inequities exhibited in classrooms and institutions based on racism's underlying theme (Brown-Jeffy & Cooper, 2011). According to Solorzano and Yosso (2000), critical race theory in education can be defined as:

> …a framework or set of basic perspectives, methods, and pedagogy that seeks to identify, analyze, and transform those structural, cultural, and interpersonal aspects of education that maintain the marginal position and subordination of youths. Critical Race Theory asks such questions as: What roles do schools, school processes, and school structures play in the maintenance of racial, ethnic, and gender subordination?(pp. 40-42)

Using critical race theory in educative research practices may lead to equitably innovative ways to design curriculum and deliver instruction. Therefore, culturally responsive teaching design and research should rest on this theory because it creates space for marginalized groups and cultures to make meaning out of their lived experiences inside the classroom (Brown-Jeffy & Cooper, 2011).

Dodo (2018) states that critical theories and culturally responsive teaching practices are important yet severely underutilized. The importance of using this type of theory allows the research to spotlight youths of various and minority cultures during the teaching and learning process. While critical race theory supplies the framework for analyzing certain educational practices, CRT can offer a model of this theory to practice and examples of how instruction is delivered in a real classroom. When theory and practice are related, the “centrality of race to American culture is acknowledged” (Brown-Jeffy & Cooper, 2011, p. 71).

According to Brown-Jeffy and Cooper (2011), research has revealed several universal truths that are believed to apply to all cultural groups and could lead to developing a conceptual model of pedagogical strategies with wide application. These include five major themes of

culturally responsive pedagogies and teaching strategies. These themes are as follows: identity and achievement, equity and excellence, developmental appropriateness, teaching the whole child, and youth-teacher relationships. These principles will help guide this research by relating CRT to critical race theory.

Purpose of Study

The purpose of this study is first to identify and acknowledge ways in which educators are enacting culturally responsive teaching pedagogies in OST classrooms. Then, we sought to understand how a high-quality curriculum may relate to these strategies. CRT has been centered in studies that analyze the formal classroom. Using a multisite mixed-methods case study, the data reveal the ways educators use CRT while enacting quality curriculum. This approach allows CRT patterns to emerge within and across cases while using various data sources and analyses. The analysis includes using a protocol historically used for formal classroom settings that have been well established in the literature. Overall, the goal is to understand better the educators' use of these specific pedagogies in the context of OST learning.

This work is part of a more extensive study investigating how educators encouraged habit-of-mind practices in an OST STEM learning environment (Bloom et al., 2019). During this past study, a high-quality engineering curriculum was designed and implemented in two OST sites in the United States. For the current study, we used data assembled as part of the earlier work and examined it in new ways with a distinct perspective and approach. By analyzing observational data from the two sites, I characterize the educators' use of the CRT strategies and further CRT conversation in OST STEM programs.

The research questions of my study include:

1. How are educators using culturally responsive teaching strategies in out-of-school time?
2. What is the curriculum's impact on the practices of culturally responsive teaching enacted in OST?

This study addresses a gap in literature while offering a critical view of two case studies. The work will be framed in a mixed methods multi-case study to provide different CRT perspectives in OST (Creswell & Creswell, 2017). This study will offer an in-depth analysis of two OST programs implementing high-quality STEM curriculum. Without comparing to formal classrooms, the research will attempt to unravel which CRT practices educators may be leveraging regardless of being formally trained. Finally, I include possible implications for OST STEM educators on potential CRT pathways in their OST programs.

CHAPTER 2: LITERATURE REVIEW

Introduction

Enrollment in OST programs has dramatically increased over the last twenty years (Afterschool Alliance, 2014). Additionally, the United States demographics have led to(Afterschool Alliance, 2014a). Additionally, the United States demographics have allowed more youths with diverse backgrounds to be among the educated population (Richards et al., 2007). OST programming functions to bridge the gap between formal school time and everyday life, often meeting diverse populations' needs. Because of these increases, literature has shown the importance of relating and educating diverse youths through their culture, background, and language. This review of the literature discusses the theory and practice of culturally responsive teaching in OST, emphasizing science and engineering learning and curriculum.

Culturally Responsive Teaching

Education requires a lot from teachers to understand, respect, and work with youths of varying cultures, language, abilities, and other characteristics (Gollnick & Chinn, 2002). Dramatic demographic shifts have occurred in the United States within the past few decades. The U.S. Department of Education's National Center of Education Statistics (NCES) predicts enrollment of minority youths in the nation's elementary and secondary schools to increase. In contrast, enrollment of non-minority youths has been expected to decrease (U.S. Department of Education, 2012). This shift appears within the public-school system, where issues arise with equity and fair education (Brown, 2007). The inevitable changing demographics are forcing educators to respond differently in their classrooms.

Recently, research has dealt with schools finding creative ways to address increasing diversity and respond with culturally inclusive methods that encourage proper education (Phuntsog, 1998). Consequently, teachers must create a classroom culture where all youths, regardless of their culture and background, are welcomed, supported, and provided with an equal opportunity to learn (Richards et al., 2007). Therefore, educators need to bridge the gap between youths' home life and school life to increase their academic success (Allen & Boykin, 1992). A culturally centered or responsive environment creates a space for youths to adjust to this discontinuity (Ladson-Billings, 1995). These ideas have been phrased differently in the literature, including culturally compatible, culturally congruent, culturally responsive, and culturally responsive teaching (Jordan, 1985, Au & Kawakami, 1994, Ladson-Billings, 1995). Although not all the same, these ideas are important because they support each other and have allowed for the field of culturally responsive teaching to expand. For the sake of this study, we will use culturally responsive teaching (CRT).

Defining Culturally Responsive Teaching

According to Gay (2002), culturally responsive teaching is defined as "using the cultural characteristics, experiences, and perspectives of ethnically diverse youths as conduits for teaching them more effectively" (p. 107). This definition links academic skills and knowledge to lived experiences of the youths. When this happens, youths experience more meaning, have higher interest, and learn more easily (Gay, 2002). Because of this, ethnically diverse youths will prosper and improve in their school achievements if they are taught using their own culture and experiences in relatable ways (Au & Kawakami, 1994). Cultural characteristics include values,

traditions, and language and extend to include ideas such as communication, learning styles, and relationships (Gay, 2002).

Culturally responsive pedagogy includes three dimensions: institutional, personal, and instructional (Richards et al., 2007). According to Richards (2007), the institutional dimension reflects the administration and its values. The personal dimension refers to the cognitive and emotional processes teachers must engage in to become culturally responsive. Finally, the instructional dimension includes materials, strategies, and activities that form the basis of instruction. All three dimensions are incredibly impactful in the teaching and learning process and are critical in understanding how culturally responsive pedagogy functions (Richards et al., 2007). Because of this study's nature and its work within small classrooms, we will focus on instructional and personal.

Theoretical Basis of Culturally Responsive Teaching

CRT theory rests on the belief that the "academic achievement of youths from culturally diverse backgrounds will improve if schools and teachers attempt to ensure that classroom instruction is conducted in a manner responsive to the youth's home culture" (Phuntsog, 1998, p. 1). A theoretical backing to this perspective has been argued through two lines of thinking, one focused on overall pedagogy, based on Gloria Ladson-Billings' work, and the other on teaching, based on the work of Geneva Gay. Although this study will focus on culturally responsive teaching, it is crucial to understand each.

Ladson-Billings (2009) explained that teachers should use their learning about youths and their families to formulate curriculum design methods, hence, culturally responsive pedagogy (CRP). Ladson-Billings (2009) noted that CRP is an approach that empowers youths to critically

evaluate their learning and then make connections outside of school using what they have been taught. Three central elements of CRP are conceptualized for high-quality curriculum creation: academic achievement, sociopolitical consciousness, and cultural competence (Ladson-Billings 2009). These three are intended for use inside formal classroom time. Ladson-Billings' ideas regarding CRP were further used through classroom instruction, during teacher education, and as a framework for educational research. More modern work with CRP considers global identities, including developments in art, literature, music, athletics, and film (Murray & Milner, 2015).

Gay (2002) focused on the responsibility the educator has to instruction and emphasized the importance of getting to know the culture of youths before engaging in CRT. Gay (2002, p. 107) says, "culture encompasses many things, some of which are more important for teachers to know than others because they have direct implications for teaching and learning." As Gay has described, CRT has rich practical uses that have been evolving within the literature in the last few decades.

According to Aronson and Laughter (2016),

> If we truly wish to teach our diverse youth populations effectively, we need to invest in quality teachers prepared and equipped with necessary tools to promote youth success and counter educational reforms that consider youths' education secondary to return on investment. (p. 199)

To enhance learning for all youths, classrooms must be continually transformed by progressive policies and practices (Gay, 2002). Gay (2006) believed that there were four actions essential to implementing culturally responsive teaching. The first required removing bias from any youth group or culture the educator may inherit. The second action claims that teachers must understand how counterintuitive culturally responsive teaching is within the public education

system and that they may be fighting an uphill battle to implement CRT into their classroom. Third, teachers need to understand that culturally responsive teaching looks different with diverse groups, classrooms, ages, etc. Finally, Gay (2000) noted how teachers must make pedagogical connections within the context in which they are teaching.

Role of Culturally Responsive Teaching

Previous studies support the claim that CRT influences youth outcomes and affects learning (Sleeter, 2012). Studies have shown that a culturally enriching curriculum can help youths understand concepts while also valuing their peer's perspectives (Fulton, 2009). Most of the CRT studies have been case studies, ethnographies, or descriptive methodologies (Morrison et al., 2008). Milner (2011) found teachers using CRT in their classroom reported the ability to build cultural confidence in their youths and themselves. Additionally, teachers can recognize identities in their youths. Some studies have shown overall score increases in pre/post testing from CRT (Rodriguez et al., 2004). Overall, literature has backed the use of CRT in formal classroom environments to increase youth connection, interest, and achievement.

Out of School Time

Since the 1880s, OST programming has existed, although the debate for its inherent need for youths has ebbed and flowed (Bodilly & Beckett, 2018). More recently, learning that takes place after formal school time has been necessary for youth growth and development (Carnegie Council on Adolescent Development, 1994). Today, OST programs are present in every state and range in structure and formatting. Programs may offer ways to encourage specific academic interests or only emphasize certain hobbies (Bodilly & Beckett, 2018). Because OST can be a loose term, it is essential to note that this study and literature review focus on school-aged youths

engaging in a semi-structured OST environment. According to “America After 3 pm” (Afterschool Alliance, 2014a), OST attendance across the United States has reached an all-time high, with over 10 million youths taking part in programs each year. Additionally, reports have found that most youths enrolled in an after-school program come from an underserved background (Afterschool Alliance, 2014a).

OST offers youths a way to engage in productive, emotional, and social opportunities that the formal school day does not always encourage. Programming includes options like Boys and Girls Clubs, YMCAs and YWCAs, parks and recreation departments, after-school programs, libraries, and museums. OST programs have been termed “intermediary spaces” because youths have the freedom to form an identity, make choices, and resolve crises in their home life (Noam & Tillinger, 2004). These types of spaces often bridge the gap between home life and school by bringing in opportunities to discuss family, culture, and hobbies (Noam & Tillinger, 2004).

Need for Out of School Time

With more children in school, OST programming's need is increasing (Bodilly & Beckett, 2018). According to “America After 3 PM”, more than 11.3 million children are without supervision from 3-6 PM (Afterschool Alliance, 2014a). Participation in OST programs has increased in the past 20 years, but there is still a large and unmet demand for this programming type. Eighty-three percent of parents agreed that OST programming helps working parents keep their jobs (Afterschool Alliance, 2014a). This same report found that although many OST programming youths are Caucasian, there was a higher probability for youths of a minority to take part, especially if programming was more accessible to parents (Afterschool Alliance,

2014a). Lack of availability of these programs can be seen in low-income areas, which creates a significant barrier and later demand on OST.

OST programs are also crucial because they counter youth involvement in troubling activities after school, such as drugs and crime (After-School Corporation, 1999). While OST programming can vary widely in terms of its goals, proponents have argued the importance of early school-aged children to have adult supervision along with access to enriching activities (Lauer et al., 2006).

Social and Emotional Learning in Out of School Time

According to Noam and Tillinger (2004), OST opportunities are a unique social endeavor, defined by what they both do and do not offer. While program content is not often unified, it can consist of opportunities that encourage leadership, place-based skills, arts, sports, and project-based learning (Noam & Tillinger, 2004). OST is often associated with the idea of social and emotional learning (SEL). Noam and Tillinger's idea supports the theory of "intermediary space" where youths are exposed to an environment that may shape them in ways that formal schooling cannot. According to Blythe (2018):

> The field of SEL emerged to help capture the process of learning a set of competencies that have been empirically demonstrated to be important for success. It is now the name applied to the movement to improve and assess those skills. (p. 21)

Because OST is often a "low-stakes" environment, youths' development can happen differently than it may in formal school time. Noam and Tillinger (2004) describe OST as a space that "holds the potential to be psychological, social, and educational; they are protective, challenging, and age-appropriate" (p. 81).

Durlak et al. found that OST programming is key to developing youths' social and personal skills (2010). Youths' importance of social and emotional development can become lost in the formal schooling environment where test scores and grades of priority (Afterschool Alliance, 2014b). In terms of evaluation and research, the social aspect of after-school learning has been underwhelming (Durlak & Weissberg, 2007). While studies have found positive outcomes of the social and emotional learning development in OST, there is much to explore. Durlak and Weissberg (2007) conducted an evidence-based assessment and meta-analysis on social learning in OST. They found that youth who participate in OST programming significantly improve their overall attitudes, behavior, and school performance. They noted the importance of incorporating the large body of research based on youths' behavior and attitude from formal schooling into the after-school context. They agree that OST programming is a "worthwhile social investment" for youths and communities.

A 2013 PDK-Gallup poll of American adults found that 95% of respondents agreed that schools should teach social and critical thinking skills (Bushaw & Lopez, 2013). The general public's view of the importance of social skills in adults can reflect youth's need to develop those same skills. Because OST was founded on youth development that focuses on creating environments in which youth can drive their growth and success, incorporating social and emotional learning is critical (Devaney & Moroney, 2018).

Researchers distinguish the learning process in formal school time and the learning process in OST. There are specific material and content to administer via state and district standards in traditional school time. However, OST offers youths a way to make deeper connections with their individual experiences through learning (Blyth, 2018). Larson and Walker (2018) note how learning theories have changed through time and how collaborative learning

experiences that support social well-being between learner and leader can help youths better understand ideas and concepts. Learning theories in literature have progressed toward a deeper understanding of social and emotional learning. Because of the nature of OST and its potential to tap into experiential learning, it is an ideal place to foster social and emotional learning (Blyth, 2018). Historically, opportunities have been given to youth in clubs, groups, and camps. That allows for individual growth and expression, leading to an emotional form of learning and development (Blyth, 2018).

Culturally Responsive Teaching in Out of School Time

There is minimal literature that evaluates instruction implementation in OST settings, especially within a science, technology, engineering, and mathematics (STEM) context (National Institute on Out-of-School Time, 2007). Often, professionals who enter the OST field miss the importance of encouraging youth development and social and emotional learning. As a result, the program's facilitation can resemble traditional classroom teaching styles (National Institute on Out-of-School Time, 2007). Programs employ OST staff from various backgrounds, often not formally educated in the role of teaching. However, this can cause issues of under-preparation of educators, affecting the youth they serve (Dennehy & Noam, 2005). While a mix of educator backgrounds has positively changed youth outcomes, research strongly suggests more formal training for STEM OST (National Institute on Out-of-School Time, 2007). Allen et al. (2007) found that most staff lack backgrounds in science or engineering, and it may be critical for programs to seek out staff with specific credentials to ensure higher gains in youth STEM ability. Staff training and care in OST settings have been argued in literature to be critical in a program’s quality (G. Noam et al., 2008).

Another issue with staffing OST programs besides inconsistent backgrounds is the high turnover rate (Dennehy & Noam, 2005). The high turnover rate in staffing can affect educator and youth relationships, which has drawbacks on youth outcomes (National Institute on Out-of-School Time, 2007). Youth outcomes, in terms of science education within OST, include what Archer and Dawson (2020) describe as content that "successfully engages and supports young people from traditionally underrepresented communities to develop an identification with science and achieve expansive outcomes" (p. 2). Studies suggest the importance of crucial principles in supporting youth STEM outcomes from an educator perspective. These include: centering youth through the identities, values, and experiences of youth; challenging elite STEM practices, epistemologies, and representations; supporting young people's critical STEM agency; and respecting and valuing young people's identities in STEM (Archer et al., 2020, p. 2). Fortunately, OST teaching does not come with a fixed set of outcomes, and equitable outcomes can range in different teaching styles (Archer et al., 2020). Educators may lack formal training and make up for quality instruction by nurturing trustworthy and respectful relationships with youths (B. M. Miller, 2003).

Culturally Responsive Teaching in Out of School Time

Culturally responsive strategies are essential to integrate into OST settings. OST programs have been seen to play an integral role in youth development (Murray & Milner, 2015). OST settings can supply cultural, social, and emotional development where formal school settings cannot (Murray & Milner, 2015). Additionally, research has shown a positive relationship between OST and constructive adult-child relationships, influencing the youth's quality of life (Woodland, 2008). High-quality OST programming can incorporate these aspects

and create a space where youth feel safe and valued for who they are and what they can contribute (Mahoney et al., 2009). The importance of mentoring in OST is well studied and can link to youth being understood better on a cultural level (Mitchell et al., 2002). Unfortunately, little work in the literature has aimed toward high-quality and culturally responsive activities in OST settings (Simpkins et al., 2017). However, by building off the culturally responsive pedagogy framework developed by Ladson-Billings (2009), OST research in outcomes and case studies appears in recent years.

OST programming can serve to build relationships and expose youth to enriching opportunities they may not experience in formal school time (Halpern, 2003). Additionally, programming can bridge the culture gap often seen in formal teaching instruction. Cultural competence is the ability to work and respond to acknowledge and respect individuals' culturally-based beliefs, attitudes, behaviors, and customs (Williams, 2001). Research on incorporating cultural competence with youth has shown how culturally responsive strategies are significant assets in OST programs (Kennedy et al., 2007). Simpkins et al. (2017) found culturally responsive OST activities are best when co-created by both youth and educators. Strategies seen in the literature include designing culturally responsive curricula, demonstrating cultural caring in the classroom via learning communities, cross-cultural communications, and cultural congruity in classroom instruction (Gay, 2002). Designing culturally responsive organized activities involves considering cultural responsiveness in all components of this system, including program structure, staff, and youth involvement (Shivers et al., 2011).

According to Simpkins et al. (2017), creating culturally responsive social norms at the programmatic level includes providing opportunities to experience diverse cultural practices and traditions, grounding activity norms in youth voice, and documenting these norms. Staff can help

achieve these outcomes by providing youth with equality, inclusion, and respect in their interactions. Activities that support meaningful experiences for youth while emphasizing positive identity, motivation, and achievement are also culturally responsive ways of supporting OST (Eccles & Gootman, 2002). Activities that foster sociopolitical consciousness by involving youth in social-change projects create opportunities for youth to feel involved in their community (Diversi & Mecham, 2005).

Disparities and Gaps in Culturally Responsive Out of School Time Programming

Halpern (2003) argues for a deeper look into OST programming in the way it has served low-income youths for over 100 years. Halpern discusses the unique form and function of OST and how it can link cultural relevance to minority and low-income youths to pursue a goal of personal development (Halpern, 2003). Scholars have even argued how OST organizations should expect to support and cultivate the kinds of experiences that help youths understand oppression, racism, and other forms of discrimination (Murray & Milner, 2015). Current research suggests there still may be some gaps in how racial and socioeconomic disparities exist in outcomes associated with OST (McNamara et al., 2020). These gaps come from deeply rooted systemic issues, such as fewer enrichment opportunities offered to low-income areas and school districts than high-income areas (Dearing et al., 2009).

Another disparity exists in the type of OST programming influenced by youths' racial identities. Some programs that primarily target African American youth may focus on academic remediation, while a program of predominantly white youths may concentrate on higher-achieving opportunities (Vandell et al., 2005). These gaps are termed *opportunity gaps* in the literature and refer to inequitable experiences and resources based on racial and socioeconomic

status (Eccles & Gootman, 2002; McNamara et al., 2020; Vandell et al., 2005). These disparities enforce the need to foster culturally responsive techniques when planning for and to carry out OST programming (Ladson-Billings, 2006).

Out of School Time and STEM learning

Historically, there has been another opportunity gap in STEM learning and career paths (Afterschool Alliance, 2011b). Additionally, there is a widespread need for STEM learning and ability in the modern world (National Academies, 2007). OST programs look to close opportunity gaps, as mentioned previously. Participation statistics in OST show that these programs are reaching large numbers of ethnic minority youth. Therefore STEM learning in OST can be a powerful means to providing enriching opportunities to those underrepresented in the field (Afterschool Alliance, 2014b). Recent research outcomes have shown that STEM learning benefits in OST are positive and unique compared to other subjects. Outcome themes include improved attitudes toward STEM careers, increased STEM knowledge, and a higher likelihood of pursuing a STEM career (Afterschool Alliance, 2011a).

STEM learning outcomes in OST are underdeveloped in literature (Afterschool Alliance, 2011a). Tai et al. (2006) found that STEM interest was a more prominent predictor of future STEM career paths than high science and math test scores for youths in 8th grade. Early interest in STEM is vital for youths to seek higher-level skills and rigor of classwork to progress them toward a STEM career (Afterschool Alliance, 2011b). Levels of exposure to STEM content also matter, and having specific direction beyond the traditional classroom can help youths excel in STEM careers (Wai et al., 2010). In 2009, the National Research Council released a report titled

"Learning Science in Informal Environments," noting the importance of STEM exposure to girls and minority groups as well as recognizing the importance of STEM learning in OST (2007).

OST programming has been shown to increase the overall attitude toward STEM content. Several programs have documented increased youth interest in STEM subject matter by supplying unique and engaging curricula that spark curiosity (San Antonio-Tunis et al., 2019). These programs provide youth-led learning opportunities that promote teamwork and problem-solving skills (Afterschool Alliance, 2011b). Hands-on learning experiences have been correlated with positive STEM outcomes for youths (Campbell et al., 2004). In addition to engaging content, interests can increase with proper mentorship strategies and interaction with real-world STEM professionals (Molloy & Aronson, 2005). Studies have found that youth from minority groups tend to flourish in environments focused on encouraging hands-on research with qualified mentors who also serve as role models (Mcclure et al., 2007).

The University of Michigan Institute for Research on Women and Gender conducted a 17-year data collection on girls' attitudes and STEM abilities. Data showed that overall low STEM interests due to the lack of belief and self-empowerment. STEM content that can align real experiences with youth feelings can offer ways to combat this problem, often seen in minority groups (Steeh, 2003). Several studies have also discussed an overall confidence increase for youth given opportunities to engage in scientific discovery, build on pre-existing knowledge banks, and make connections to the real world (Basu & Barton, 2007; Mcclure et al., 2007). Fancsali (2002) suggests STEM interest in OST programming can increase by creating local partnerships for youths to engage in field trips. Partnerships with local colleges, museums, and labs can help youths see how STEM careers look in the real world.

Other key outcomes of STEM learning in OST have increased content knowledge and drive toward STEM-related careers. Programs can offer youth ways to extend their knowledge and engage with content differently than formal school time. Additionally, youth can develop skills that are in high demand for STEM careers. The 4-H science initiative, which is offered by 4-H clubs nationwide, provides programming that spans from plant biology to renewable energy (National 4-H Council, 2010). Youth evaluation surveys showed improvements in recording data, creating graphs, and using results to answer questions.

Additionally, a high percentage showed plans for pursuing a STEM-related major in college (National 4-H Council, 2010). Literature findings suggest high-quality STEM curriculum and STEM education programs encourage youths to pursue STEM-related careers (Baran et al., 2019; Guzey et al., 2014). Integrating real-world problems and STEM programming tools can create a meaningful presentation of STEM careers (Khanaposhtani et al., 2018). Large percentages of youths who graduated from a STEM OST program have shown the more significant impact their experiences have had on their college path and career goals (Afterschool Alliance, 2011b). While informal STEM learning experiences help understand this study's importance, another critical feature is the educator's role in OST.

The Influence of Curriculum on CRT and in OST

Research has found curriculum can act as a resource in developing youth identity, agency, and culture (Wortham, 2003). Curriculum has also been recognized as a critical link in OST connections between educator and youth (Llopart & Esteban-Guitart, 2018). A STEM curriculum that exists to orient youths toward their culture and identity formation opens up a unique opportunity at the OST level (Llopart & Esteban-Guitart, 2018). Curriculum that

integrates culturally relevant pedagogies has been shown to pave ways for youths to achieve academically and personal growth (Rosa & Orey, 2010). Because STEM learning objectives can often be more rigid through universal facts, the curriculum can be viewed as free of any culture and not considered a social discipline (Lee, 2003). As a result, research has developed to incorporate aspects of culture and identity formation to allow historically disadvantaged youths to connect to STEM disciplines (Rosa & Orey, 2010). Studies have furthered this field by expanding culturally relevant pedagogies into OST, but only a few studies have evaluated curriculum with those specific goals (Aronson & Laughter, 2016; J. L. Young et al., 2019).

Summary

In summary, literature has revealed gaps in which this study seeks to address with a fresh perspective. This includes how CRT is used in STEM OST and the role? of curriculum in that process. The literature on both OST and CRT has been well defined, yet it has not often been linked in studies. STEM learning in OST has been relatively new in its practices and outcomes. While the influence of a high-quality curriculum is well established in research, this study will take a unique look using the existing literature.

CHAPTER 3: METHODS

For this mixed-methods study, a multiple case study methodology was used to address the culturally responsive discourses educators may make in the out-of-school-time (OST) classroom. A multiple case study approach allows for an analysis of the complexities of teaching observed in both sites. Specifically, case study research involves "conducting an empirical investigation of a contemporary phenomenon within its natural context using multiple sources of evidence" (Yin, 2017, p. 3). This methodology allows flexibility with a discovery-oriented approach to answering the research questions. We chose a multiple case study design to enable complex theories grounded in specific examples related to OST context and teaching styles.

According to Eisner (2017), qualitative studies often include research in classrooms and are often guided through the researcher's lens. Data was collected and interpreted from the researcher's perspective in an attempt to describe each case's unique features. For Creswell (2017), the aspects of an unfolding research study make it difficult to predict precisely how the research model will hold. My data collection and data analysis processes evolved as I furthered my study. This investigation will adopt the multiple case study approach (Yin, 2017) to examine two OST educators with different teaching backgrounds implementing the same curriculum. The methodology will include details on the program setting, the participants, the curriculum used, and the data collection procedure. We also further discuss data analysis and procedures.

Program Setting

This study involved comparing two OST programs located in different settings and regions of the U.S. Site 1 was a summer camp program for youth housed in a small city in the

Southwest. Site 2 was an after-school STEM club that met in a Catholic school located in a large city in the Northeast. The site representatives and educators both provided consent to participate in the study. This exploratory study was part of a larger NASA-funded project called PLANETS. PLANETS (Planetary Learning that Advances the Nexus of Engineering, Technology, and Science) is a partnership for developing and disseminating NASA out-of-school time curricular and educator resource modules that integrate planetary science, technology, and engineering, particularly with underrepresented audiences (Bloom et al., 2019).

The programs were selected using the following criteria: educators and a majority of youth were willing to be part of the study; program leaders were ready to implement the curriculum during the spring of 2018; and youth in the programs represented a diversity of learners from different backgrounds, cultures, socioeconomic statuses, and grade levels within the middle school age range. The study gave each educator the same instructional unit (described below) consisting of eight activities to use in their classroom. Activities were administered in order, but sites differed by program time, which resulted in the summer camp site one site administering several activities at once (Site 1). In contrast, the other site (2) integrated one activity per meeting session.

Each educator had prior experience pilot-testing similar units. Once formally recruited, both site educators received the supplies needed to teach the unit to middle-school-age youth. Supplies included the educator's guide, a set of engineering journals, and a materials kit. Site educators were also asked to play a supportive role in recruiting a group of age-appropriate youth and encouraging them to attend consistently across the eight activities. While teaching schedules varied across sites, the Site 2 educator taught the activities weekly, taking roughly eight to ten weeks to finish. The educator for site 1 taught the activities during a one-week camp setting.

Participants

Participants were selected as part of the larger research project described above. The IRB approval is placed in Appendix A. Participants included the OST instructor and their youths at each site. Table 1 provides a summary of participants and their demographics.

Site 1: The Site 1 educator was a male of Hispanic heritage who worked as an OST educator in a community organization in the rural Southwest who was in his twenties. For the study, we will refer to this educator with the pseudonym, "Steve." He had ten years of experience working with youth and two years in an OST program with youth grades K-8. He had completed some college-level STEM courses but had no formal training in education. Steve previously taught related engineering curricula for two years and participated in professional development (PD) related to the current curricular program. Much of his OST program experience worked with ethnically and racially diverse youth of low socioeconomic status (SES). The youths at Site 1 were a combination of 10 boys and seven girls, 5 of which were from groups underrepresented in STEM fields and from majority groups, and almost all from low SES and middle-class families.

Site 2 Educator: The Site 2 educator was female, identified as White, and was an experienced classroom teacher at a school in an urban area in the Northeast. For the study, we will refer to this educator with the pseudonym, "Mary." She had limited experience taking science or engineering courses at the college level and noted "two or three days" of PD. Mary had taught science and engineering at the middle school level for five years and had piloted a previous version of the OST engineering curriculum. The OST program was an afterschool club held twice a week for four weeks. Some of the youth participants were her current youths, and all participating youth were from majority groups.

Table 1

Site Demographic Data

Site	Number of Attendees[1]	Grade level	URM[2] in STEM	Gender
1	17	6th-8th	5 (41%)	59% M/ 41% F
2	10	6th-8th	0 (0%)	50% M/ 50% F

[1]*Defined as attending one or more out of 8 activities*
[2]*Underrepresented minority*

Curriculum

Engineering Curriculum for OST

Educators at the two sites were asked to implement a hands-on Engineering is Elementary (EiE) engineering OST unit: Testing the Waters: Engineering a Water Reuse Process (water resource engineering). The curriculum was developed with NASA funding by the PLANETS project in collaboration with curriculum development professionals from Museum of Science Boston and Northern Arizona University and with planetary scientists from the United States Geological Survey. EiE® is the award-winning curricula division of the Museum of Science, Boston, which develops research-based curricula. These classroom-tested programs empower children to become lifelong STEM learners and passionate problem solvers (San Antonio-Tunis et al., 2019). The curriculum this study used was developed as an EiE curriculum specifically for middle school-aged youth in the OST setting. Both classroom and OST EiE units are grounded in a sociocultural perspective on learning, which assumes that as youth work collaboratively with peers and educators, they begin to develop fluency in engineering's epistemic practices (Lachapelle & Brennan, 2018).

The EiE OST unit used in this study contained eight 60-minute activities intended to be taught to youth arranged into groups of 3-4. The activities assume no prior experience with

engineering; therefore, the units begin with a set of "prep activities" that provide the groundwork for a common understanding of engineering and technology among participating youth. The remaining six activities build upon each other and allow youths to experience unique parts of the engineering design process. These parts include youth learning about a problem, exploring available materials, planning a design, creating and testing it, improving it, and sharing their designs as a showcase activity. Through these steps of the "Engineering Design Process," youth learn that these practices are frequently used non-sequentially during the engineering design process—at the same time, focusing on engineering design, youth experience age-appropriate science content, emphasizing planetary science (Bloom et al. 2019). See Table 2 for a detailed unit map.

The curriculum units foster opportunities for middle-school children in OST settings to act as engineers and solve problems that are identified as "personally meaningful and globally relevant"(San Antonio-Tunis et al., 2019, p. 4). Each unit has been developed to include fourteen curricular design principles for inclusivity and has been identified through previous research studies to support youth learning in four overarching categories (Cunningham, 2018). While the units are based on the design principles developed for the classroom units, the same principles do not always hold true for the OST units. These categories include: 1) set learning in a real-world context, 2) present design challenges that are authentic to engineering practice, 3) scaffold youth work and 4) demonstrate that everyone can engineer.

Table 2

Overview of "Testing the Waters" Engineering Unit Activities

Lesson	Purpose of Lesson
Prep 1	Youth are introduced to the Engineering Design Process as they work together to engineer a tower to support a model water tank
Prep 2	Youth will play a quiz game to define the "technology" and learn that

	engineers design technologies to solve problems
Activity 1	Youth investigate how using water for various tasks can impact the water's quality
Activity 2	Youth investigate the properties of filter materials and create their water filters to remove or treat contaminants from a water sample
Activity 3	Youth apply what they learned about filters and water quality to re-pipe a model house to reuse as much water as possible
Activity 4	Youth work in groups to plan, create and test their water reuse processes designed for an extreme environment scenario
Activity 5	Youth work in groups to improve their water reuse process to meet the criteria in their extreme environment better
Activity 6	Youth communicate their ideas about designing a water reuse process in the Engineering Showcase

Note. Adapted from "Engineering interest and attitude development in out-of-school time," by C. San Antonio-Tunis, J. Clark, C.M., Cunningham, & C.P. Lachapelle, 2019, *ASEE Annual Conference and Exposition, Conference Proceedings*.

Data Collection

Data sources included online implementation forms completed by the two educators after teaching each activity and a video recording and transcription of each exercise. The implementation form was given to each educator online through Qualtrics. It consisted of 59 questions that asked the educators to reflect on their classroom experience. For this study's purpose, only four questions were directly related to CRT, so the others were omitted. Each question was given to the educator after each of the eight activities were completed. Questions asked the educator how they felt about their enactment of the specific curriculum and asked them to provide an example when they may have gone off the curriculum for some portion of the class. See Appendix B for the complete implementation form used.

Each of the eight lessons taught with a camera focused on the educator. There were 32 videos, each approximately 30 minutes in length. Each video was transcribed verbatim, with youth talk selectively transcribed to provide context for interpretation

Data Analysis

Culturally Responsive Instruction Observation Protocol

The Culturally Responsive Instruction Observation Protocol *(*CRIOP) (Correll et al., 2015) was used to code the educators' degree of cultural responsiveness within each lesson. The CRIOP contains six holistic dimensions of culturally responsive teaching rated on a 4-point scale (1 - Not at all, 2 - Occasionally, 3 - Often, 4 - To a great extent). The CRIOP's six main elements include classroom relationships, assessment practices, instructional practices, critical discourse, family collaboration, and socio-political consciousness. A summary of the CRIOP protocol's coding categories can be found in Table 3. Table 4 expands upon one type, "Classroom Relationships," and provides examples from the protocol. The entire protocol can be found in Appendix C. The protocol offers examples for "generally effective practices" and "culturally responsive practices" distinguishing a higher culturally responsive teaching move. When coding the videos and transcripts, both practices were coded for under the same general code and category. Previous studies have used this protocol, but these studies focus on elementary teachers and the effectiveness of the CRIOP. These studies also suggest using CRIOP as a tool for professional development opportunities (Chambers Cantrell et al., 2012; Correll et al., 2015; Powell et al., 2016). According to Chambers-Cantrell (2012), the CRIOP is grounded in research on culturally responsive instruction and has been designed to be a tool for guiding practitioners in their development as culturally responsive educators**.** The main pillars of the CRIOP are based on the large body of work established by Ladson-Billings and have recently been used as a guide for teacher professional development (Chambers Cantrell et al., 2012; Correll et al., 2015; Powell et al., 2016).

For this study, the "family collaboration" pillar was excluded from data analysis because the CRIOP procedure calls for a family interview, which was not used in this analysis. For each item, the CRIOP contains responsive and non-responsive teaching instructional examples (see Table 4), which are used when coding. Videos and transcriptions of both sites were coded using MAXQDA software, which allowed codes and categories to be assigned to specific classroom observations. If a particular classroom example could fall under multiple CRIOP codes, the instance was coded for more than one CRIOP pillar.

After video transcriptions were coded, the protocol tool was used to assign a holistic score in each domain of the CRIOP and each lesson/activity provided by the curriculum. A second researcher validated the coding of transcriptions. This second researcher participated in an observer training where they viewed classroom instruction videos and scored the instructional practices using the CRIOP. At first, some coding trouble emerged in which it was difficult to distinguish. After another round of coding and agreement on which codes were appropriate to use, the interrater agreement on final observations was 80%.

Table 4

CRIOP Categories and Subcodes Used for Coding Video Observations

CRIOP Pillar	CRIOP Subcode
Classroom Relationships	The teacher demonstrates an ethic of care (e.g., equitable relationships, bonding)
	The teacher communicates high expectations for all youths
	The teacher creates a learning atmosphere that engenders respect for one another and toward diverse populations
	Youths work together productively
Assessment Practices	Formative assessment practices are used that provide information throughout the lesson on individual youth understanding
	Youths are able to demonstrate their learning in a variety of ways
	Authentic assessments are used frequently to determine youths' competence in both language and content.
	Youths have opportunities for self-assessment

Instructional Practices	Instruction is contextualized in youths' lives, experiences, and individual abilities Youths engage in active, hands-on, meaningful learning tasks, including inquiry-based learning The teacher focuses on developing youths' academic language The teacher uses instructional techniques that scaffold youth learning Youths have choices based upon their experiences, interests and strengths
Discourse	The teacher promotes active youth engagement through discourse practices The teacher promotes equitable and culturally sustaining discourse practices The teacher provides structures that promote academic conversation The teacher provides opportunities for youths to develop linguistic competence
Critical Consciousness	The curriculum and planned learning experiences provide opportunities for the inclusion of issues important to the classroom, school and community The curriculum and planned learning experiences incorporate opportunities to confront negative stereotypes and biases The curriculum and planned learning experiences integrate and provide opportunities for the expression of diverse perspectives

Note. The Expanded CRIOP protocol with all codes, subcodes, and examples can be found in Appendix C.

Table 5

Expanded Code and Category with Examples for Classroom Relationships Code

Classroom Relationship Subcode	Example
The teacher demonstrates an ethic of care (e.g., equitable relationships, bonding)	Generally Effective Example: Teacher conveys interest in youths' lives and experiences Culturally Responsive Example: There is a "family-like" environment in the classroom; there is a sense of belonging; youths express care for one another in a variety of ways
The teacher communicates high expectations for all youths	Generally Effective Example: There is an emphasis on learning and higher-level thinking; challenging work is the norm Culturally Responsive Example: There are group goals for success as well as individual goals (e.g., goals and

	charts posted on walls); every youth is expected to achieve
The teacher creates a learning atmosphere that engenders respect for one another and toward diverse populations	Generally Effective Example: Youths interact in respectful ways and know how to work together effectively Culturally Responsive Example: Positive and affirming messages and images about youths' racial and ethnic identities are present throughout the classroom
Youths work together productively	Generally Effective Example: Youths are continuously viewed as resources for one another and assist one another in learning new concepts

Note. The expanded CRIOP protocol with all codes, subcodes, and examples can be found in Appendix C.

Analysis Procedure

This study employed MAXQDA software for observational and transcription coding. The interviews were transcribed and analyzed to assign coded segments using the CRIOP protocol for classroom observations. After videos were transcribed, the transcriptions were read through several times. Additionally, observational videos were watched multiple times before coding. Once the research committee validated the protocol, the coding process began. The coding process involved watching the videos with matching transcriptions and noting any areas that qualify under one of the CRIOP protocol's main pillars. Initial coding was performed and then checked with a second evaluator to check for coding validity. The inter-related reliability was confirmed at 80%, and thus coding was continued. Throughout the coding process, instances were noted in which educators and youth were interacting at higher levels than usual. Notes were made when the data revealed an excellent example or non-example of CRT practices.

For qualitative analysis, the MAXQDA coding platform allowed the researcher to pull out specific examples based on coding criteria. For instance, coded segments that had multiple

codes attached were analyzed and then used for further qualitative analysis. The researcher also allowed space for other patterns in the data and coding to emerge that may not have been coded explicitly for using the CRIOP. The codes that resulted from individual case analyses were then used to compare cases. Since the study employs a multi-site analysis structure, the code examples that aided in qualitative research and discussion were compared to site educators while understanding the educators' different backgrounds.

After the cases were studied against each other, the same coding protocol was employed for the curriculum. Because the curriculum would not have a specific video or observation attached to it, the curriculum document was directly coded. Codes were assigned to the curriculum when particular instructions were asked of the educator. For instance, if the curriculum asked for the educator to ask the youth if they could relate a scientific concept to something in their lives, it would be coded for as "Classroom Relationships." For data visualization, MAXQDA software was used to produce code maps using the code overlapping visualization tool.

Next, the implementation logs and educator interviews were used to allow any themes to emerge that may match the CRIOP codes. These data elements were not directly coded for, but matched with what was observed in the OST program and the educator moves throughout the lessons.

Several quantitative data analysis tools were used in this study. Descriptive statistics were produced and summarized using Statistical Package for Social Sciences (SPSS) version 24. Tables were created using both SPSS and Microsoft Excel. Raw data on coded segments were translated into holistic CRIOP Likert scores using Microsoft Excel. These scores were used for further descriptive statistics in SPSS.

CHAPTER 4: MANUSCRIPT 1

Understanding Educator's Use of Culturally Responsive Teaching through High-Quality STEM Curriculum in Out-of-School Time

Abstract

This study sought to understand how culturally responsive teaching strategies occur in out-of-school time settings and how a high-quality STEM curriculum may influence these strategies. Two educators with unique backgrounds were observed in two different out-of-school time (OST) programs in the U.S. Because of their unique backgrounds, their use of culturally responsive teaching strategies manifested themselves differently among the two programs. Using a previously developed, high-quality STEM curriculum, we were able to classify and interpret how they were implementing cultural relevance in their classrooms and understand the impact of the curriculum. Observations, interviews, and implementation logs were coded and analyzed through quantitative and qualitative means.

While this study was part of a more extensive study funded by NASA to develop middle school STEM OST curriculum, we were able to find some unique results. We discovered that OST educators might significantly differ in how they enact culturally responsive teaching practices in an OST classroom, perhaps because of their teaching background and experiences. Another result indicates that because OST educators come from various teaching experiences, a curriculum that could implement culturally responsive teaching (CRT) strategies may allow educators to connect with their youths in more profound, more meaningful ways. Because OST programs across the country hold different youth goals, teaching moves that encourage cultural relevance could be a robust strategy that allows the OST program to enrich youth experience.

Introduction

Out of School Time

In education, we often focus on "formal school time" and have expanded on ways to reach youths of various backgrounds in many ways. However, it is just as important to consider these ideas in a context outside the formal classroom and school time. Out-of-school time (OST) offers youths a way to engage in productive, emotional, and social opportunities that the traditional school day does not always encourage. Programming includes options like Boys and Girls Clubs, YMCAs and YWCAs, parks and recreation departments, after-school programs, libraries, and museums. OST programs have been termed "intermediary spaces" because youths have the freedom to form an identity, make choices, and resolve crises in their home life (Noam & Tillinger, 2004). Literature on OST is focused less on content and skill-based learning and more on the learning process's social and emotional aspects. High-quality OST programs are positively associated with improved academic outcomes, self-esteem, interpersonal skills, initiative, communication, leadership, and connection to community for their participants (Strobel et al., 2008). The OST time setting has traditionally held goals different than that of the formal classroom and seems to align well with culturally responsive pedagogical ideals.

Culturally Responsive Teaching

According to Gay (2002), culturally responsive teaching is defined as "using the cultural characteristics, experiences, and perspectives of ethnically diverse youths as conduits for teaching them more effectively" (p. 107). This definition links academic skills and knowledge to lived experiences from the youths. When this happens, youths experience more meaning, have higher interest, and learn more easily (Gay, 2002). Because of this, ethnically diverse youths will

prosper and improve in their school achievements if they are taught using their own culture and experiences in relatable ways (Au & Kawakami, 1994). Culturally responsive teaching (CRT) has been primarily focused within formal classroom settings. Therefore, there seems to be a gap in aligning CRT with OST, especially when CRT is dependent on the social and emotional learning opportunities that OST emphasizes. Culturally responsive pedagogy (CRP) is an almost interchangeable term to CRT, but with a slightly different research approach. It is based on the assumption that when academic knowledge and skills are situated within the lived experiences and frames of reference of youths, they are more personally meaningful, have higher interest appeal, and are learned more quickly and thoroughly (Gay, 2000). Strategies seen in the literature include designing culturally responsive curricula, demonstrating cultural caring in the classroom via learning communities, cross-cultural communications, and cultural congruity in classroom instruction (Gay, 2002). Few studies have implemented the CRT or CRP theoretical lens in OST learning. Therefore, I seek to address this gap. For continuity and sake of this study, we will refer to this research approach in the context of CRT.

CRT in STEM

Historically, there has been an opportunity gap in science, technology, engineering, and math (STEM) learning and career paths (Afterschool Alliance, 2011a). There is a widespread need for STEM learning and ability in the modern world (National Academies, 2007). OST programs look to close opportunity gaps. Participation statistics in OST provide evidence that these programs are reaching large numbers of ethnic minority youth; therefore, STEM learning in OST can be a powerful means to providing enriching opportunities to those underrepresented in the field (Afterschool Alliance, 2014a). STEM practices in OST can represent ideas of CRT

through centering youth through the identities, values, and experiences of youth; challenging elite STEM practices, epistemologies, and representations; supporting young people's critical STEM agency; and respecting and valuing young people's identities in STEM (Archer et al., 2020).

Additionally, research has found curriculum can help develop youth identity, agency, and culture (Wortham, 2003). Curriculum has also been recognized as a critical link in OST connections between educator and youth (Llopart & Esteban-Guitart, 2018). A STEM curriculum that exists to orient youths toward their culture and identity formation opens up a unique opportunity at the OST level (Llopart & Esteban-Guitart, 2018).

While research around either OST and CRT is well defined in the literature, few studies have combined both, especially in the curriculum context. The same is true with STEM learning. According to Dodo (2018), "the use of culturally responsive pedagogy and critical race theory as a pedagogical model and analytical tool, respectively, in science education is minimal" (p. 93). While CRP is an established multicultural education model in many academic contexts, it has yet to be widely used in science education (Dodo Seriki, 2018).

Theoretical Framework

This work is grounded in critical theory as it rests on the idea that the multicultural foundation of education can be improved. In education, critical approaches can encourage youths to "engage in culturally mediated activities specific to their own experiences" (Rodriguez et al., 2004). Critical theory helps solve a significant issue in education, involving the preparation of teachers who can effectively teach youths whose cultural backgrounds are different from their own (Brown-Jeffy & Cooper, 2011; Gay, 2000). Ladson-Billings (1995) initially argued for a

critical theory of race in education related to the one created in legal scholarship, thus making critical race theory in education. Critical race theory has been used to explain social inequities exhibited in classrooms and institutions based on racism's underlying theme (Brown-Jeffy & Cooper, 2011). According to Solorzano and Yosso (2000), critical race theory in education can be defined as:

> …a framework or set of basic perspectives, methods, and pedagogy that seeks to identify, analyze, and transform those structural, cultural, and interpersonal aspects of education that maintain the marginal position and subordination of youths. Critical Race Theory asks such questions as: What roles do schools, school processes, and school structures play in the maintenance of racial, ethnic, and gender subordination? (pp. 40-42)

Using critical race theory in educative research practices may lead to innovative ways to design curriculum and deliver instruction. Therefore, culturally responsive teaching design and research should rest on this theory because it creates space for marginalized groups and cultures to make meaning out of their lived experiences inside the classroom (Brown-Jeffy & Cooper, 2011).

Dodo (2018) states that critical theories and culturally responsive teaching practices are important yet underutilized. The importance of using this type of theory allows youths of various and minority cultures to be positioned during the teaching and learning process and research. While critical race theory supplies the framework for analyzing certain educational practices, CRT can offer a model of this theory to practice and examples of how the instruction can be delivered in a real classroom. When the theory and practice are related, the "centrality of race to American culture is acknowledged" (Brown-Jeffy & Cooper, 2011, p. 71).

According to Brown-Jeffy and Cooper (2011), research has revealed several universal truths that are believed to apply to all cultural groups and could lead to developing a conceptual

model of pedagogical strategies with wide application. These include five major themes of culturally responsive pedagogies and teaching strategies. These themes are as follows: identity and achievement, equity and excellence, developmental appropriateness, teaching the whole child, and youth-teacher relationships. These principles will help guide this research by relating CRT to critical race theory.

The purpose of this study is first to identify and acknowledge ways in which educators are enacting culturally responsive teaching pedagogies in OST classrooms. Then, we sought to understand how a high-quality curriculum may relate to these strategies. Culturally responsive teaching (CRT) has been studied primarily in the formal classroom setting. Using a multisite mixed methods case study reveals the ways educators use CRT while enacting quality curriculum. This approach allows patterns of CRT to emerge within and across cases. The analysis includes utilizing a protocol historically used for formal classroom settings and noting CRT principles that may appear in an OST setting. Overall, the goal is to understand better the educators' use of these specific pedagogies in the context of OST learning.

This work is part of a more extensive study that looked at how educators encouraged habit-of-mind practices in an OST STEM learning environment (Bloom et al., 2019). A high-quality engineering curriculum was created and implemented in two OST sites in the United States. By analyzing observational data from the two sites, I hope to identify educators' use of the CRT strategies to further CRT conversation in OST STEM programs.

The research questions of my study include:

1. How are educators using culturally responsive teaching strategies in out-of-school time?
2. What is the curriculum's impact on the practices of culturally responsive teaching enacted in OST?

This study addresses a gap in literature while offering a critical view of two case studies. The work will be framed in mixed methods, multi-case study to provide different CRT perspectives in OST. It will give an in-depth analysis of two OST programs implementing a high-quality STEM curriculum. Without comparing to formal classrooms, the research will attempt to unravel which leveraging CRP educators' practices may be used regardless of being formally trained. Finally, I include possible implications for OST STEM educators on potential pathways to having CRT in their OST programs.

Methods

For this mixed-methods study, a multiple case study methodology was used to address the culturally responsive discourses educators make in the out-of-school-time (OST) classroom. A multiple case study approach allows for an analysis of the complexities of teaching observed in both sites. Specifically, case study research involves “conducting an empirical investigation of a contemporary phenomenon within its natural context using multiple sources of evidence” (Yin, 2017, p. 2). This methodology allows flexibility with a discovery-oriented approach to answering the research questions. A multiple case study design was chosen to enable complex theories grounded in specific examples related to OST context and teaching styles.

Data were collected and interpreted from the researcher's perspective in an attempt to describe the unique features of each case. According to Creswell, the aspects of an unfolding research study make it difficult to predict precisely how the research model will hold (Creswell & Creswell, 2017). My data collection and data analysis processes evolved as I furthered my study. This investigation adopts the multiple case study approach (Yin, 2017) to examine two OST educators with different teaching backgrounds implementing the same curriculum. The

methodology will include details on the program setting, the participants, the curriculum used, and the data collection procedure. Data analysis will also be discussed.

Program Setting

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The programs were selected using the following criteria: educators and a majority of youth were willing to be part of the study; programs were keen to implement the curriculum during the time of the study; and youth in the programs represented a diversity of learners from different backgrounds, cultures, socioeconomic statuses, and grade levels within the middle school age range. Each educator was provided the same instructional unit (described below) consisting of eight activities to use in their classroom. Activities were administered in order, but sites differed by classroom time, which resulted in one site administering several activities at once (Site 1). In contrast, the other site (2) integrated one activity per meeting session.

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Participants

Participants were selected as part of the larger research project described above. Participants included the OST instructor and their youths at each site. A summary of participants can be found in Table 1.

Site 1 educator: The Site 1 educator was a male of Hispanic heritage in his twenties who worked as an OST educator in a community organization in the rural Southwest. For this study's purpose, this educator will be identified by the pseudonym “Steve.” He had ten years of experience working with youth and two years in an OST program with youth grades K-8. Steve had completed some college-level STEM courses but had no formal training in education. He previously taught related engineering curricula for two years and participated in professional development (PD) related to the current curricular program. Much of his OST programs experience worked with ethnically and racially diverse youth of low socioeconomic status (SES). The youth at Site 1 were a combination of ten boys and seven girls, five of which were from groups underrepresented in STEM fields and from majority groups, and almost all from low Socio-economic-status or middle-class families.

Site 2 Educator: The Site 2 educator was female, identified as White, and was an experienced classroom teacher at a school in an urban area in the Northeast. For this study's purpose, this educator will be identified by the pseudonym “Mary.” She had limited experience taking science or engineering courses at the college level and noted “two or three days” of PD.

Mary had taught science and engineering at the middle school level for five years and had piloted a previous version of the OST engineering curriculum. The OST program was an afterschool club held twice a week for four weeks. She had training as a formal educator. Some of the youth were her current youths, and all youth were from majority groups.

Curriculum

Educators at the two sites were asked to implement a hands-on Engineering is Elementary (EiE) engineering unit: Testing the Waters: Engineering a Water Reuse Process (water resource engineering). The curriculum was developed with NASA funding by the EiE project in collaboration with curriculum development professionals from Northern Arizona University and scientists from the United States Geological Survey. EiE® is the award-winning curricula division of the Museum of Science, Boston, which develops research-based. These classroom-tested programs empower children to become lifelong STEM learners and passionate problem solvers (San Antonio-Tunis et al., 2019). This study's curriculum was developed specifically for middle school-aged youth in the OST setting. EiE units are grounded in a sociocultural perspective on learning, which assumes that as youth work collaboratively with peers and educators, they begin to develop fluency in engineering's epistemic practices (Lachapelle & Brennan, 2018).

The unit contained eight 60-minute activities intended to be taught to youth arranged into groups of 3-4. The activities assume no prior experience with engineering; therefore, the units begin with a set of "prep activities" that provide the groundwork for a common understanding of engineering and technology among participating youth. The remaining six activities build upon each other and allow youths to experience unique parts of the engineering design process. These parts include youth learning about a problem, exploring available materials, planning a design,

creating and testing it, improving it, and sharing their designs as a showcase activity. Through the "Engineering Design Process," youth learn that these practices are frequently used non-sequentially during the engineering design process—at the same time, focusing on engineering design, youth experience age-appropriate science content, emphasizing planetary science (Bloom et al. 2019).

The curriculum units foster opportunities for middle-school children in OST settings to become engineers and solve problems identified as "personally meaningful and globally relevant" (San Antonio-Tunis et al., 2019). Each unit has been developed to include fourteen curricular design principles for Inclusivity and has been identified through previous research studies to support youth learning in four overarching categories (Cunningham 2018). These categories include: 1) set learning in a real-world context, 2) present design challenges that are authentic to engineering practice, 3) scaffold youth work and 4) demonstrate that everyone can engineer. The curricular design principles can be found in Figure 3.

Data Collection

Data sources included online implementation forms completed by the two educators after teaching each activity and a video recording and transcription of each activity. The implementation form was given to each educator online through Qualtrics. It consisted of 59 questions that asked educators to reflect on their classroom experience. For this study's purpose, only four questions were directly related to CRT, so the others were omitted. Each question was given to the educator after each of the eight activities were completed. Questions asked the educator how they felt about their enactment of the specific curriculum and to provide an example when they may have gone off the curriculum for some portion of the class.

Each of the eight lessons was recorded with a camera focused on the educator. A total of 32 videos, each 30 minutes in length, were included in the data and further analysis. Each video was transcribed verbatim, with youth talk selectively transcribed to provide context for interpretation.

Data Analysis

Culturally Responsive Instruction Observation Protocol

The Culturally Responsive Instruction Observation Protocol (CRIOP) (Correll et al., 2015) was used to code the educators' degree of cultural responsiveness within each lesson. The CRIOP contains six holistic dimensions of culturally responsive teaching rated on a 4-point scale (1 - Not at all, 2 - Occasionally, 3 - Often, 4 - To a great extent). The CRIOP's six main elements include classroom relationships, assessment practices, instructional practices, critical discourse, family collaboration, and socio-political consciousness. A summary of the CRIOP protocol's coding categories can be found in Table 3. Table 4 expands upon one type, "Classroom Relationships," and provides examples from the protocol. Within the protocol, examples are given for "generally effective practices" and "culturally responsive practices," distinguishing a higher culturally responsive teaching move. When coding the videos and transcripts, both practices were coded for under the same general code and category.

Previous studies have used this protocol, but the research that has used it centers on elementary teachers. CRIOP has also been researched in the literature for professional development opportunities (Chambers Cantrell et al., 2012; Correll et al., 2015; Powell et al., 2016). According to Chambers-Cantrell (2012), The CRIOP is grounded in research on culturally responsive instruction and is designed to be a tool for guiding practitioners in their development as culturally responsive educators. The main pillars of the CRIOP are based on the large body of

work that Ladson-Billings established and has recently been used as a guide for teacher professional development (Chambers Cantrell et al., 2012; Correll et al., 2015; Powell et al., 2016).

For this study, the "family collaboration" pillar was excluded from data analysis because the CRIOP procedure calls for a family interview, which was not provided in our data set. The CRIOP contains responsive and non-responsive teaching instructional examples used when coding for each item. Videos and transcriptions of both sites were coded using MAXQDA software, which allowed codes and categories to be assigned to specific classroom observations. If a particular classroom example could fall under multiple CRIOP codes, the instance was coded for more than one CRIOP pillar.

After video transcriptions were coded, the protocol tool was used to assign a holistic score in each domain of the CRIOP and each lesson/activity provided by the curriculum. A second researcher validated the coding of transcriptions. This second researcher participated in an observer training where they viewed classroom instruction videos and scored the instructional practices using the CRIOP. At first, some coding trouble emerged in which it was difficult to distinguish. After another round of coding and agreement on which codes were appropriate to use, the interrater agreement on final observations was 80%.

Analysis Procedure

This study employed MAXQDA software for observational and transcription coding. The observations were transcribed and analyzed to assign coded segments using the CRIOP protocol for classroom observations. After videos were transcribed, the transcriptions were read through several times. Additionally, observational videos were watched multiple times before coding. Once the research committee validated the protocol, the coding process began. The coding

process involved watching the videos with matching transcriptions and noting any areas that qualify under one of the CRIOP protocol's main pillars. Initial coding was performed and then checked with a second evaluator to check for coding validity. The inter-related reliability was confirmed at 80%, and thus coding was continued. Throughout the coding process, instances were noted in which educators and youth were interacting at higher levels than usual. When the data revealed an excellent example or non-example of CRT practices, it was recorded.

Next, the implementation logs and educator interviews were used to allow any themes to emerge that may match the CRIOP codes. These data elements were not directly coded for, but matched with what was observed in the OST program and the educator moves throughout the lessons.

For qualitative analysis, the MAXQDA coding platform allowed the researcher to pull out specific examples based on coding criteria. For instance, coded segments that had multiple codes attached were able to be analyzed and then used for further qualitative analysis. The researcher also allowed space for other patterns in the data and coding to emerge that may not have been coded explicitly for using the CRIOP. The codes that resulted from individual case analyses were then used to compare cases. Since the study employs a multi-site analysis structure, the code examples that aided in qualitative research and discussion were compared to site educators while understanding the educators' different backgrounds.

After the cases were studied against each other, the same coding protocol was employed for the curriculum. Because the curriculum would not have a specific video or observation attached to it, the curriculum document was directly coded. Codes were assigned to the curriculum when particular instructions were asked of the educator. For instance, if the curriculum asked for the educator to ask the youth if they could relate a scientific concept to

something in their lives, it would be coded for as "Classroom Relationships." For data visualization, MAXQDA software was used to produce code maps using the code overlapping visualization tool.

Several quantitative data analysis tools were used in this study. Descriptive and inferential statistics were produced and summarized using Statistical Package for Social Sciences (SPSS) version 24. Tables were created using both SPSS and Microsoft Excel. Raw data on coded segments were translated into holistic CRIOP Likert scores using Microsoft Excel. These scores were used for further descriptive statistics in SPSS.

Results

To answer the first research question on assessing the use of culturally responsive teaching strategies in OST, we conducted analyses of sites 1 and 2. A total of 843 specific segments were identified and coded as described above across both sites. Of these, 289 (34%) came from site 1 and 554 (66%) from site 2. Figure 1 displays that in both sites, the categories of discourse, instructional practices, and classroom relationships are among the highest categories. Figure 1 also shows how frequently discourse and classroom relationships were coded.

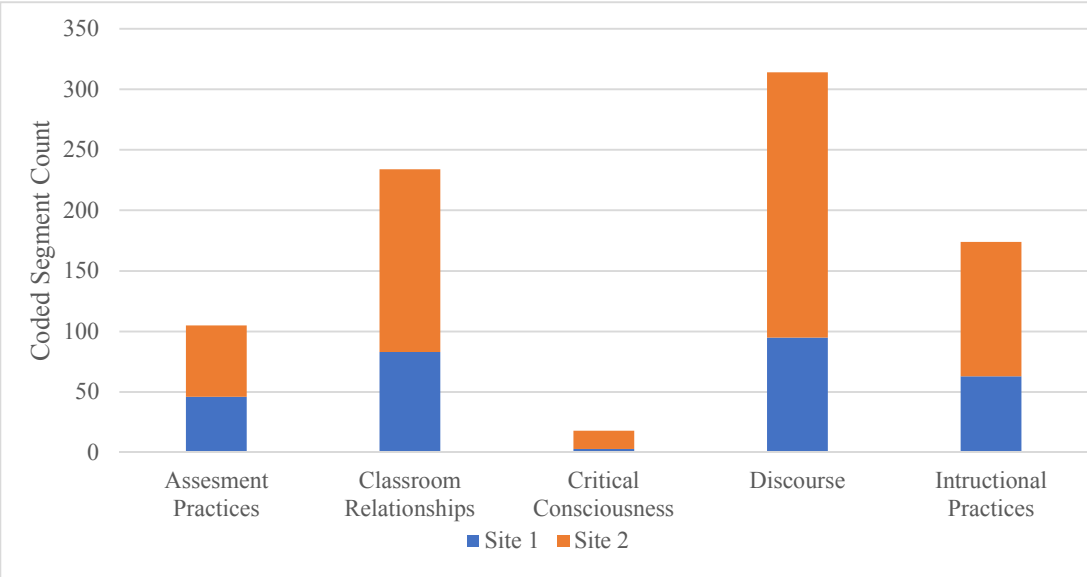

Figure 1
Total code usage is broken down by CRIOP code pillar and by site difference

The CRIOP protocol calls for the raw coded data to be transformed into a Likert score between 0-4, which we will call the CRIOP holistic score. Beyond holistic scores for the five pillars (e.g., discourse, instructional techniques, etc.), the CRIOP protocol allows for a holistic mean score to be calculated for each site. The CRIOP holistic score is based on a Likert scale from 0 (never) to 4 (consistently). Site 1 had a mean score of 1.53 (SD= 1.11) and site 2 2.2 (SD= 1.39). A Levene's test showed that the variances for scores in sites 1 and 2 were not equal, $F(1,78) = 4.56$, $p = 0.015$. A Welch two-samples t-test showed that the differences in code count between site 1 and site 2 was statistically significant, $t(74.4) = -2.5$, $p < 0.015$. Since the two sites were significantly different in terms of holistic CRIOP codes, we will explore further dissection of the two.

Culturally Responsive Teaching Strategies

For both sites, quantitative data on codes will be presented along with qualitative examples observed in classroom observations. Combining these data provides insight into the different CRT uses between each site educator.

Site 1

Through all eight activities, an analysis of Steve's transcripts resulted in a total of 289 coded segments. For the first three activities, Steve used between seven and 21 CRT practices per activity (Figure 3). However, by the last three activities, he consistently used over 45 CRT practices in each activity, averaging 36 CRT practices across all activities. Additionally, he increased his code usage through each lesson (Figure 3). A trend line was added to Figure 3 to show each educator's overall pattern. Steve's trendline shows a positive correlation of his code

usage through each lesson. In terms of the five CRIOP code pillars, he most often used discourse and classroom relationship strategies to connect with youths using CRT practices. Table 1 provides examples from frequently coded segments for both site educators. Interestingly, Steve used discourse to refer to the youths for answers or resources. For example, when a youth asks about a water contaminant represented as a tea leaf, he responded,

> *"What do the tea leaves even mean? Is that just like leaves from outside? Probably? Okay."*

Additional data were examined from the implementation log to understand Steve's classroom intention on a more reflective level. He noted that he spent approximately 15-20 minutes preparing for each activity. The implementation log asked a question about connecting the activities to youth's daily lives, classified as an "instructional practices" CRIOP code. In response to this, the educator did take time to note some connections. For example, about activity 6,

> *"The youth were talking with their parents about how these filters could be used in their own homes".*

While this may not have been explicitly coded for in the transcript and video analysis, it provides more insight into CRT practices for educator 1. When asked if the educator had connected with youths' home culture, the educator responded "no" to all activities. However, in the educator interview Steve mentioned how water use connects to the youths lives. Below are excerpts from Steve's interview when asked about the relevance of the unit activities.

> ***Steve:*** *"I felt it was relevant to where we live, in the desert. I mean, high desert, but still desert, and it's something that the kids can relate to every day…. They might not really*

ever use those in their day-to-day life, but they come in contact with water every day, so it's very easy for them to see the importance of good water and how to get good water."

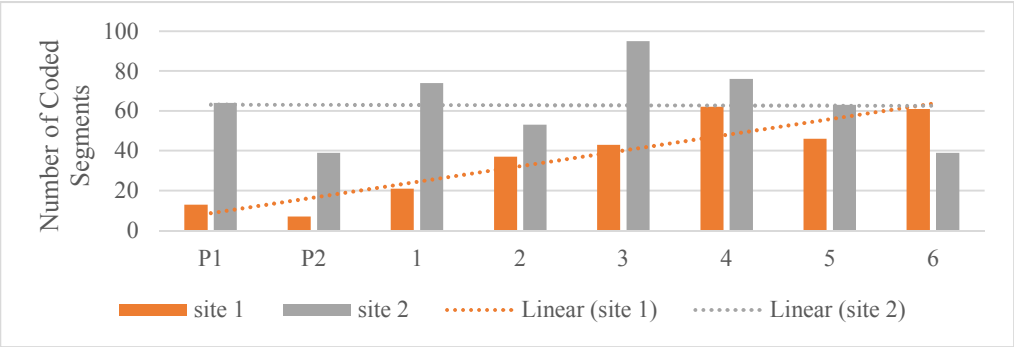

Figure 2
Codes used by the site through each lesson. Trend line added for visual purposes.

Site 2

Through each of the eight activities, an analysis of Mary's transcripts resulted in a total of 554 coded segments. For each activity, Mary consistently used at least 39 CRT practices and averaged 63 CRT practices across the eight activities. The mean CRIOP score for site 2 across all activities was 2.2, representing an overall "sometimes" CRT usage on the CRIOP scale. Mary seemed to draw on CRT strategies consistently and had a diverse range of identified codes. Her consistent scores through the lessons could suggest a "ceiling effect" to her practices. Like Steve, Mary also frequently used discourse and classroom relationship strategies outlined by the CRIOP. Table 1 summarizes subcodes of discourse and classroom relationships with corresponding examples from both sites.

The educator implementation log noted that Mary spent approximately 25 minutes preparing for each activity by reading the educator guide and the curriculum's youth notebook. Mary allowed for more culturally relevant teaching practices, including subcodes of assessment practices. These subcodes include opportunities for youths to demonstrate their learning in a

variety of ways, formative assessment practices that provide information throughout the lesson on individual youth understanding, and the opportunities for youth self-assessment. By asking the youth to engage in a sketch of their ideas, the youth had opportunities for self-assessment and the ability to demonstrate their learning in various ways. When asked to reflect about connections to youth's lives, she responded during prep activity 1,

> *"We talked about water towers we had seen, including one on a hill above the school. We discussed the fact that making mistakes often helps you learn better than being successful does."*

When asked explicitly about referencing youths' home cultures at any point during the activities, she responded during activity 1,

> *"We talked about the 3 different types of water, where you find it, and what it is used for."*

This reflection was matched with transcripts but was not coded as a cultural connection to youths' home lives.

Table 1

The most frequently observed code categories with subcategories and corresponding examples

Code	Subcode	Site	Example
Discourse	The teacher promotes active youth engagement through discourse practices	*1*	*"So what was the point of the Jeopardy game?"*
Discourse	The teacher promotes active youth	*2*	*"So, how is our design limited? Does anybody have any thoughts?"*

	engagement through discourse practices		
Discourse	The teacher promotes equitable and culturally sustaining discourse practices	*1*	*"Was there anything else anyone had to say? Lilly did you have something? Groundwater is a good question."*
Discourse	The teacher promotes equitable and culturally sustaining discourse practices	*2*	*"Did things work out the way you thought they were going to? Definitely not, so what does that mean? No one wants to just say it didn't work out but you don't know how?"*
Discourse	The teacher provides structures that promote academic conversation	*1*	*"So let's look at this. Maybe they're just cheesecloth. No, five cotton balls work pretty good. This doesn't change your classification right?"*
Discourse	The teacher provides structures that promote academic conversation	*2*	*"Communicate and plan. So what does she mean by that? Who are you going to communicate with? Your group members. And what are you going to plan?"*
Discourse	The teacher provides opportunities for youths to develop linguistic competence	1	No examples coded
Discourse	The teacher provides opportunities for youths to develop linguistic competence	2	*"A thingy up top.' Is that a technical term? [Youth: That's our scientific term.] Is it? Okay then. I would like a little more precision in your language."*
Classroom Relationships	The teacher demonstrates an ethic of care (e.g., equitable relationships, bonding)	*1*	*"So besides your crazy combo, which ones did you guys like?"*
Classroom Relationships	The teacher demonstrates an ethic of care (e.g., equitable relationships, bonding)	*2*	*"Okay, there's time to figure this out, everybody finds different things. You've all done a really good job today. You've all made progress."*
Classroom Relationships	The teacher communicates high expectations for all youths	*1*	*"So as we go forward with this game keep that in mind when we ask you for a technology that it might be more than just a computer."*
Classroom Relationships	The teacher communicates high expectations for all youths	*2*	*"And always improve, over and over and over again. It's like writers, they don't just write once and they're done. They have to keep improving."*

Classroom Relationships	The teacher creates a learning atmosphere that engenders respect for one another and toward diverse populations	*1*	*"you guys definitely are engineers in my eyes. I hope you guys see yourselves as engineers too because you definitely are"*
Classroom Relationships	The teacher creates a learning atmosphere that engenders respect for one another and toward diverse populations	*2*	*"We're all listening to each other, right? This is the communication part. You were able to fix yours by adding a paper towel but that's not what happened for you, is that correct?"*
Classroom Relationships	Youths work together productively	*1*	*"if you wanna go look at other tables and see what theirs looks like, how it's different from yours."*
Classroom Relationships	Youths work together productively	*2*	*"Talk with your fellow engineers and design an improvement to the process you already have".*

Impact of OST Curriculum on Educators CRT Practices

To answer the second research question concerning the curriculum's impact on the practices of culturally responsive teaching enacted in OST, we examined the OST curriculum's impact on the educators' CRT practices. To align the curriculum with observed data based upon the CRIOP protocol, we first conducted a coarse analysis to observe overall trends. A more fine-grained analysis includes specific examples from both sites that compare CRT exhibited in the curriculum and the classroom.

Large Scale Analysis

The curriculum was coded for using the same CRIOP protocol used for site 1 and site 2. Table 2 lists the number of coded segments in each site and curriculum. The coded segment count for the curriculum was often lower than either of the two observed sites. The curriculum data show a consistent trend of code counts through each lesson, with neither an increase nor a

decrease from the prep activities to the last activity. As previously mentioned, code categories of discourse and classroom relationships were consistently high among both sites and shown in Table 2.

Table 2

Total segments coded for the curriculum and both sites. The table is organized first by activity and then by the CRIOP code pillars.

Activity	CRIOP Pillar	Curriculum	Site 1 (Steve)	Site 2 (Mary)
P1	Classroom Relationships	4	4	27
	Assessment Practices	6	2	4
	Instructional Practices	6	1	12
	Discourse	6	5	16
	Critical Consciousness	2	1	5
P2	Classroom Relationships	2	2	10
	Assessment Practices	1	0	0
	Instructional Practices	2	3	6
	Discourse	6	2	22
	Critical Consciousness	3	0	1
1	Classroom Relationships	1	4	12
	Assessment Practices	4	3	7
	Instructional Practices	8	4	21
	Discourse	10	10	33

	Critical Consciousness	0	0	1
2	Classroom Relationships	4	4	12
	Assessment Practices	6	1	4
	Instructional Practices	4	9	14
	Discourse	6	23	23
	Critical Consciousness	0	0	0
3	Classroom Relationships	2	5	36
	Assessment Practices	6	12	7
	Instructional Practices	6	12	16
	Discourse	9	14	32
	Critical Consciousness	0	0	4
4	Classroom Relationships	4	14	28
	Assessment Practices	3	17	6
	Instructional Practices	6	9	18
	Discourse	5	21	22
	Critical Consciousness	1	1	2
5	Classroom Relationships	8	18	19
	Assessment Practices	4	10	6
	Instructional Practices	2	9	14
	Discourse	5	9	24
	Critical Consciousness	0	0	0
6	Classroom Relationships	10	32	7
	Assessment Practices	1	4	2

	Instructional Practices	3	13	8
	Discourse	5	11	22
	Critical Consciousness	1	1	0

Note. CRIOP: Culturally responsive instructional observation protocol

In addition to this visualization, the curriculum's mean and standard deviation for both sites were computed and analyzed—tables 3 and 4 outlines the results. In Table 3, the mean CRIOP holistic score is calculated by site and curriculum and by the CRIOP pillar. In Table 4, the CRIOP holistic score means and standard deviations were calculated across lessons. The bolded numbers in each table show notable scores that aided in specific results.

Table 3

CRIOP holistic score mean and SD by sites and CRIOP pillar.

		Curriculum		Site 1 (Steve)		Site 2 (Mary)	
		Mean	SD	Mean	SD	Mean	SD
CRIOP Pillar	Classroom Relationships	1.25	0.46	1.88	1.25	**2.88**	0.99
	Assessment Practices	1.25	0.46	2.38	1.19	**3.88**	0.35
	Instructional Practices	1.00	0.00	1.38	0.92	1.13	0.64
	Discourse	1.13	0.35	1.63	0.52	**2.63**	0.92
	Critical Consciousness	0.50	0.53	0.38	0.52	0.63	0.52

Table 4

CRIOP holistic score Mean and SD by sites and lesson.

		Curriculum		Site 1 (Steve)		Site 2 (Mary)	
		Mean	SD	Mean	SD	Mean	SD
Lesson	P1	1.00	0.00	1.00	0.00	2.20	1.30
	P2	1.00	0.00	0.60	0.55	1.60	1.52
	1	1.20	0.84	1.00	0.71	2.60	1.34
	2	0.80	0.45	1.60	1.52	2.00	1.58
	3	**1.00**	0.71	**1.60**	**1.14**	**2.80**	**1.30**
	4	**1.00**	0.00	**2.60**	**1.14**	**2.60**	**1.52**
	5	1.00	0.71	1.80	1.10	2.20	1.64
	6	1.20	0.45	2.00	1.22	1.80	1.48

Here, we can see how the curriculum consistently provided a baseline for CRT practices, with values varying only 0.4 through the lessons, mostly hovering around the value of 1. The range of values varied across lessons, and higher mean holistic CRIOP scores are associated with specific lessons. Lessons 3 and 4 had calculated mean values higher than many other lessons across both sites and the curriculum. Lessons 3 and 4 were considered the bulk of the unit, in which youths are designing, testing, and assessing their engineering designs.

Mean holistic CRIOP scores did not change through each lesson in the curriculum. Similarly, Mary's scores were higher than both the curriculum and Steve in most lessons and remained consistently higher through each lesson. Figure 3 shows a visual representation of the data used to calculate Table 4. This figure shows the frequency of coded segments through each

lesson by the different educators. Steve exhibits a pattern in which the code usage increases through each lesson across time. By the last activity, Steve produced higher CRT scores than Mary.

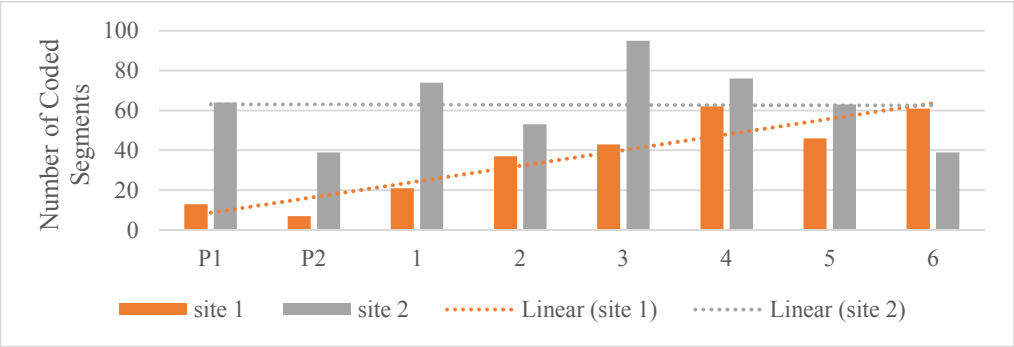

Figure 2
Codes used by each site through all lessons. Trend line added for visual purposes.

In-Depth Analysis

For a more fine-grained analysis, specific classroom examples of CRT strategies were identified in the curriculum and compared to educator implementation. The examples offer a look into how the curriculum may have provided a baseline for both educators to launch their CRT practices in practice. This example is from the beginning of the unit in prep activity one. It is classified as a 5-minute introduction in the educator curriculum. Specific CRIOP codes are included in bold.

<u>Curriculum:</u>

> 2. Explain to youth that they have been hired as engineers to solve a problem in the city of Watertown ***[INSTRUCTIONAL PRACTICE]***. The town wants to help its residents save water. They have decided to design a water tower for the roof of city hall to collect rainwater.
>
> 3. The town is not sure how to design the water tower so they have hired this group of youth to engineer a model water tower as an example for them **[CLASSROOM RELATIONSHIPS]**.

Educator 1 response:

> *Educator 1: "We're gonna learn a bit about our challenge today. And today I need your guys' help building a water tower.* ***[INSTRUCTIONAL PRACTICE]*** *Okay? A water tower. A small water tower. Sure. Maybe a water tower for ants. You never know….*
>
> *I'm just going to show you guys.* **[CLASSROOM RELATIONSHIPS]** *My book for some reason has some pictures of water towers if you guys need some inspiration"*

Educator 2 response:

> *Educator 2: The town wants to help its residents save water. They've decided to design a water tower for the roof of City Hall to collect rainwater. This is kind of an idea of what a water tower looks like. There are different shapes.* ***[INSTRUCTIONAL PRACTICE]*** *They look sort of like this. Where is there one nearby? Anybody know?... Yes?* ***[INSTRUCTIONAL PRACTICE & DISCOURSE]***
>
> [Youth: There's one by George-- I think it's near Edward's field and the Taco Bell and KFC]
>
> *Educator 2: Right. There's a lot of them. There's one up on top of Christian Hill.* ***[INSTRUCTIONAL PRACTICE]*** *Water towers need to be placed up high so that the water can roll downwards to where it needs to be used.* **[CLASSROOM RELATIONSHIPS]**.*"*

Steve's response to the curriculum involves a brief mention of the activity. This segment was coded as an instructional practice, precisely one that communicates an active, hands-on, and meaningful learning task. Steve places a sense of meaning on the lesson by asking for help from the youth, giving them agency. However, instead of asking for examples of water towers as the curriculum encourages, he decides to forgo discussion and show youth examples outright. The curriculum guide provided photos of water towers given to youth directly.

Mary's response to the curriculum for prep activity 1 includes a more in-depth discussion for youth and their experiences. The first coded segment shows her using instructional techniques to scaffold youth learning. Mary drew shapes on the board to get youth to start brainstorming. Additionally, she asks if any youths know where a water tower may be located.

This segment was coded as both discourse and instructional practices as it involves active youth engagement through discourse practices and instructional practices that are contextualized in youths' lives.

The last underlined segment in bold was an additional instructional technique coded for that also encouraged instruction involving youths' lives. Mary tried to connect the unit's intention to their own lives and experiences. She also used more dialogue and general discourse practices than Steve in this excerpt. Additionally, multiple youth voices were used and involved in this classroom during this time. This example supports how the curriculum provided a baseline for educators' to draw from that were coded for cultural relevance. Steve was able to match the coding of the curriculum. At the same time, Mary was able to delve deeper with the youths, producing an overall higher CRIOP score and diversity of codes. This pattern repeatedly appears through the unit.

According to the implementation log, Mary responded with one addition to the curriculum because of additional time. When referring to Prep Activity 1, Mary replied,

> Implementation Log: “Because we had time to spare, I asked youth to sketch improvements that they would make to their designs….I felt that drawing out the ideas they had for improvement would reinforce the idea that improvements are necessary and are part of a successful outcome when using the Engineering Design Process.”

In addition to the specific classroom examples, Steve mentions how his use of the curriculum may have become more comfortable over time. The following examples are excerpts from the educator’s post-instructional interview upon the program's commencement.

> Educator Interviewer: *(When referring to implementing the engineering curriculum): Do you feel more knowledgeable, more comfortable?*

> 11:42 Educator: *No, yeah, definitely after doing this three times, I know how the routine goes. I know two prep activities, six activities. I know the last one's a showcase, and this and that. So it makes it easier for me to plan when I know what to expect.*
>
> ….. *"it was a little bit daunting at first, looking at it, but then having a lot of stuff prepped when I got there, it was just, I could focus more of my attention on actually teaching it."*

According to the educator implementation log, Steve noted two occasions in which the curriculum was modified or extended for classroom activity. When reflecting on his implementation of activity 3, Steve said the youths made some modifications to the activity as he felt comfortable for the youth to do it independently.

> "I did not make these modifications the kids did, but they created the "No Filter Challenge" and the "No Crossing Pipes Challenge." These were away for them to test their knowledge by adding these constraints."

The second modification included switching around the showcase to allow parents to have more time viewing the youth's projects. When talking about this modification, the educator reflected,

> "I felt the core aspect of this activity was the demonstration, so I wanted to make sure we got as much for that as possible".

Discussion and Implications

The purpose of this study was two-fold. First, we reveal which CRT strategies may be implemented in an OST setting. Secondly, we investigate the impact of a high-quality curriculum on the use of culturally responsive teaching strategies. Both goals use two out of school time programs and their educators to distinguish individual results. Through observations and interviews, we attempted to interpret the educators' use of culturally responsive pedagogies in the OST classroom and decipher how they may have used the curriculum to support that. Using the

framework of culturally responsive pedagogies (Ladson-Billings, 1995), two research questions were addressed:

1. How are educators using culturally responsive teaching strategies in out-of-school time?
2. What is the curriculum's impact on the practices of culturally responsive teaching enacted in OST?

Educators Use of Culturally Responsive Teaching Strategies

An essential premise of CRT refers to teachers' beliefs about cultural diversity. CRT is indeed not only a set of teaching pedagogies, but it requires teachers holding beliefs that consider cultural diversity as a positive attribute and valuable resource in teaching and learning (Gay, 2010). Our findings showed Mary (site 2) using significantly more culturally responsive teaching strategies than Steve across the unit. It may not be surprising that she had higher coded segments because she is a formally trained educator. Literature has shown teachers require more training to better understand and relate to diverse youths' race, culture, and class, especially youths from low-income backgrounds (Hoy, 2012).

More specifically, Mary relied heavily on discourse and classroom relationship codes from the CRIOP protocol. These codes are seen frequently in formal classroom settings with formally trained teachers. Experience in the classroom may make these codes easier to connect with youths. Thus, educators with more teaching years may become comfortable with cultural relevance (Milner, 2006, 2011). Research on culturally responsive teaching strategies in formal classrooms has also found similar results of higher classroom relationships, discourse, and instructional practices pillar categories (Powell et al., 2016).

The use of CRT during activity 6 should also be discussed. Activity 6 was a showcase event in which the youth were able to display their work to families. In theory, this event should

have produced more CRT codes because the activity itself would be a culturally responsive event. Involving family members is an essential component of the CRIOP, however, for this study we chose to exclude the family connections category in the CRIOP because the data were not set up to provide family interviews. Therefore, it is important to point out that activity 6 may have been favorable to CRT startegies among both educators, yet the data do not show that accurately. This may be an issue with the CRIOP itself or may lend itself to the nature of the data.

Connections Between Educator's use of Culturally Responsive Strategies and Out-of-School-Time

OST programs can play an integral role in youth development and supply cultural, social, and emotional development where formal school settings often struggle (Murray & Milner, 2015). The degree of culturally responsive teaching and teachers' cultural diversity beliefs has been found to differ across teachers, so the results are not surprising (Civitillo et al., 2019). The educators consistently used high levels of discourse and classroom relationships, indicating that these strategies could be more accessible in an OST setting. OST programs' goals vary, and perhaps explicitly identified outcomes of programs could correlate with an increase of classroom relationships between youth and educator. Therefore, the presence of such codes in these two sites may indicate ways OST educators and programs could "capitalize" on cultural relevance, perhaps by letting these types of codes guide their principles and pillar for their programs.

In terms of the specific identified examples from the results, Mary consistently showed examples of youth-educator interaction that could be seen in a formal school setting. Researchers make a clear difference between the learning process in traditional school time and the learning process in OST. There are specific material and content to administer via state and district

standards in formal school time. However, OST offers youths a way to make deeper connections with their individual experiences through learning (Blyth, 2018). That being said, Mary created a classroom environment similar to that of formal schooling.

In contrast, Steve (site 1) consistently interacted with youths more casually. These examples were based on the educator placing himself in a space equal to his youths and entering into dialogue. Both the youth and educator were learning from one another and Steve was using his youths as resources. The classroom environment existed on a more level footing, creating an equitable climate between youth and educator. OST programming can build relationships and expose youth to enriching opportunities they may not experience in regular school (Halpern, 2003). In contrast, Mary seemed to establish a hierarchy in educator-youth relationships and was the "leader" of the classroom, often keeping youths on task and in line.

Because OST is often a "low-stakes" environment, youths' development can happen differently than it may in formal school time. Noam and Tillinger (2004) describe OST as a space that "holds the potential to be psychological, social, and educational; they are protective, challenging, and age-appropriate" (p. 81). When there was extra time in the classroom, Steve allowed the youth to engage further by playing games unrelated to the curriculum. However, Mary took any spare time to further the youths' learning on the engineering topics.

These examples are reflected upon in the educator implementation log and offer insight into the educator's youth and classroom management goals. Because Mary would use the time for furthering youth understanding of the curriculum, there were more codes relating to the CRIOP. She would continue to push the youth further into knowledge and exploration with inquiry-based learning techniques they most likely use in their formal classroom. Often, professionals who enter the OST field miss the importance of encouraging youth development

and social and emotional learning. Lack of these skills can result in their facilitation of the program resembling the formal classroom teaching styles (National Institute on Out-of-School Time, 2007).

Connections Between High-Quality Curriculum and Educators Use of Culturally Responsive Teaching Practices

Studies suggest that a culturally enriching curriculum can help youths gain a deeper understanding of concepts while also valuing their peers' perspectives (Fulton, 2009). As Steve's use of the curriculum and experience grew, so did the CRT coded segments. This finding indicates how applicable curriculum may be for OST programs, especially those that employ untrained educators to lead their classrooms. Research has found that while afterschool programs engage in culturally related activities, there is a lack of awareness and intentionality to institute the tenets of culturally responsive pedagogy (C. Miller & Merriweather, 2020).

Steve's demeanor with his youths mimics a sense of "belonging" with his youths, as he often let youths lead within activities and allowed for time to be loosely managed. Simpkins and Riggs (2017) assessed how cultural competence could foster a sense of belonging among youths in afterschool programs. While there are a gap in out-of-school time or afterschool time studies that examine CRT practices (Bennett, 2015), these findings can link future studies and implications using this theoretical lens in this type of program.

Code Occurrence in CRT

Studies have found that youth voice and culture are vital outcomes in a successful OST program incorporating cultural relevance (C. Miller & Merriweather, 2020). More specifically,

these studies have pointed out the importance of staff-youth relationships (Witt & Caldwell, 2018). Affirming classroom relationships encourages youth to foster social growth, promote academic skill development, and other outcomes related to culturally responsive theory (Durlak et al., 2010; Kataoka & Vandell, 2013). The study found both educators using classroom relationships consistently, but also in conjunction with other codes and educator moves. Young (2010) identified a critical trait of a culturally competent educator is building relationships with youths. Therefore, if classroom relationships seemed to be something that both trained and untrained educators could "latch" onto in their instruction of an afterschool program, it may be a really integral link to bolstering OST educator's cultural competency.

According to work by Bloom et al. (2019) on the same data, OST educators are not likely to seek deep pedagogical content knowledge for a specific curriculum. As a result, even experienced educators may need support to further the science principles within the curriculum. The data in this study revealed these educators may be attempting to connect with youths in congruence with instructional practices, discourse moves, etc. but are not maintaining an overall "competent" cultural score according to the CRIOP. Therefore, Bloom et al. (2019) suggested some general guidance educators may use for developing certain engineering habits of mind and 21st-century skills. This study offers a further need for educator support but highlights what ally ways may be accessible through, i.e., classroom relationships.

Connections Between STEM learning and OST CRT

Recent research outcomes have shown that STEM learning benefits in OST are positive and unique compared to other subjects. Outcome themes include improved attitudes toward STEM careers, increased STEM knowledge, and a higher likelihood of pursuing a STEM career

(Afterschool Alliance, 2011b). Because this study utilized a high-quality STEM curriculum, we can see the curriculum's overall impact with the data presented.

One key result from site 1 was Steve's increase of codes used over time. This data was cross-examined with the educator implementation data in which Steve felt like the curriculum became more comfortable over time. This example may mean that an educator with no training may have used the curriculum as landing points in how they connected with youths culturally. According to Masingila and Doerr (2002), a critical difficulty for inexperienced teachers is to understand how to use youth thinking in teaching STEM courses. Research has shown educators face problems implementing culturally responsive teaching in subjects like science and math (Bonner & Adams, 2011; Debnam et al., 2015). However, a recent review of the literature suggested that culturally responsive teaching in science and math could be implemented by raising critical analysis and socio-political consciousness in educators through professional development (Aronson & Laughter, 2016).

Conclusions

We sought to understand how culturally responsive teaching strategies may occur in out of school time settings for this project. Using Ladson-Billings sociocultural teaching theory lens, we developed a process to gain insight into these questions (1995). While this study was part of a more extensive study funded by NASA to create a middle school STEM OST curriculum, we could find some unique results. One key result was that OST educators might significantly differ in how they enact culturally responsive teaching practices in an OST classroom, perhaps because of their teaching background and experiences. Another result indicates that because OST

educators come from various backgrounds, a curriculum that could implement CRT strategies may allow educators to connect with their youths in more profound, more meaningful ways.

Because OST programs across the country hold different youth goals, teaching moves that encourage cultural relevance could be a robust strategy that allows the OST program to enrich youth experience. In conclusion, culturally responsive teaching styles and pedagogies may be necessary for informal STEM learning opportunities to encourage youth voice and identity. CRT principles offer educators a unique way to create relationships with their youths that help fill gaps often seen in STEM learning. While these examples and cases can only provide a limited perspective, there are many ideas still to be explored that would add value to this.

CHAPTER 5: MANUSCRIPT 2

Making Out of School Time STEM Programs Culturally Responsive

Abstract

This paper sought to understand how culturally responsive teaching strategies could be integrated into our of school time programming. Using a previously developed, high-quality STEM curriculum, we were able to classify and interpret how they were implementing cultural relevance in their classrooms and understand the impact of the curriculum. Observations, interviews, and implementation logs were coded and analyzed through quantitative and qualitative means.

While this study was part of a more extensive study funded by NASA to develop middle school STEM OST curriculum, we were able to find some unique results. We discovered that OST educators might significantly differ in how they enact culturally responsive teaching practices in an OST classroom, perhaps because of their teaching background and experiences. Another result indicates that because OST educators come from various teaching experiences, a curriculum that could implement culturally responsive teaching (CRT) strategies may allow educators to connect with their youths in more profound, more meaningful ways. Because OST programs across the country hold different youth goals, teaching moves that encourage cultural relevance could be a robust strategy that allows the OST program to enrich youth experience.

Introduction

Out-of-school time (OST) offers youths a place to engage in productive, emotional, and social opportunities that the formal school day may not always encourage. OST programs have been termed “intermediary spaces” because youths have the freedom to form an identity, make

choices, and resolve crises in their home life (Noam & Tillinger, 2004). High-quality OST programs are positively associated with improved academic outcomes, self-esteem, interpersonal skills, initiative, communication, leadership, and connection to community for their participants (Strobel et al., 2008). The OST setting has traditionally held goals different from those of the formal classroom and aligns well with and provides culturally responsive teaching space.

According to Gay (2002), culturally responsive teaching is defined as "using the cultural characteristics, experiences, and perspectives of ethnically diverse youths as conduits for teaching them more effectively" (p. 107). This definition links academic skills and knowledge to lived experiences of the youths. When this happens, youths experience more meaning, have higher interest, and learn with greater ease (Gay, 2002). Because of this, ethnically diverse youths will prosper and improve in their school achievements if they are taught using their own culture and experiences in relatable ways (Au & Kawakami, 1994). Culturally responsive teaching (CRT) has traditionally been used in formal classroom settings. However, there seems to be an excellent opportunity to explore the use of these principles in OST settings.

While research around theory and application of both OST and CRT are well defined in the literature, few studies have examined both, much less in the context of STEM learning. According to Dodo (2018), "the use of culturally responsive pedagogy and critical race theory as a pedagogical model and analytical tool, respectively, in science education is minimal" (p. 93). While CRT is an established multicultural education model in many academic contexts, it has yet to be widely used in science education (Dodo Seriki, 2018).

To gain deeper insight into how culturally responsive principles and pedagogies may manifest themselves in OST time, we pulled data from a previous study. This study revealed how educators encouraged habit-of-mind practices in an OST STEM learning environment using a

high-quality engineering curriculum (Bloom et al., 2019). While this study alone addressed critical gaps in informal learning, we pushed even further into cultural relevance and offered real-world examples with practical solutions to this gap. We used two informal learning programs in the United States as observational case studies for culturally responsive pedagogies. These programs were observed using a well-established protocol in CRT research, known as the CRIOP (Correll et al., 2015). A summary of codes can be found in Table 1 below.

Table 1

CRIOP Categories and Subcodes Used for Coding Video Observations

CRIOP Pillar	CRIOP Subcode
Classroom Relationships	The teacher demonstrates an ethic of care (e.g., equitable relationships, bonding) The teacher communicates high expectations for all youths The teacher creates a learning atmosphere that engenders respect for one another and toward diverse populations Youths work together productively
Assessment Practices	Formative assessment practices are used that provide information throughout the lesson on individual youth understanding Youths are able to demonstrate their learning in a variety of ways Authentic assessments are used frequently to determine youths' competence in both language and content. Youths have opportunities for self-assessment
Instructional Practices	Instruction is contextualized in youths' lives, experiences, and individual abilities Youths engage in active, hands-on, meaningful learning tasks, including inquiry-based learning The teacher focuses on developing youths' academic language The teacher uses instructional techniques that scaffold youth learning Youths have choices based upon their experiences, interests and strengths
Discourse	The teacher promotes active youth engagement through discourse practices The teacher promotes equitable and culturally sustaining discourse practices The teacher provides structures that promote academic conversation The teacher provides opportunities for youths to develop linguistic competence

Critical Consciousness	The curriculum and planned learning experiences provide opportunities for the inclusion of issues important to the classroom, school, and community The curriculum and planned learning experiences incorporate opportunities to confront negative stereotypes and biases The curriculum and planned learning experiences integrate and provide opportunities for the expression of diverse perspectives

Collected data included educator observations, educator interviews, and implementation logs for educators to reflect on their classroom experiences after each lesson. In the sections that follow, we summarize several examples from the observations that exhibit examples of culturally responsive strategies in OST STEM classrooms. In sharing results, we also draw from educator implementation logs and educator interviews to provide evidence of how each educator felt about their teaching implementation. We then address some of the differences between the two educators, as one formally trained educator and one with little experience. Finally, we conclude with the importance of this data and highlight several practices that may enrich informal learning with a more profound cultural relevance between educator and youth. To preserve individuals' privacy, we have assigned pseudonyms to each of the site educators.

The curriculum unit fosters opportunities for middle school children in OST settings to become engineers and solve problems identified as “personally meaningful and globally relevant” (San Antonio-Tunis et al., 2019). It was developed to include fourteen curricular design principles for inclusivity and was identified through previous research studies to support youth learning in four overarching categories (Cunningham 2018). These categories include: 1) set learning in a real-world context, 2) present design challenges that are authentic to engineering practice, 3) scaffold youth work and 4) demonstrate that everyone can engineer. Table 2 provides an outline for each activity and its purpose.

Table 2

Overview of "Testing the Waters" Engineering Unit Activities

Lesson	Purpose of Lesson
Prep 1	Youth are introduced to the Engineering Design Process as they work together to engineer a tower to support a model water tank
Prep 2	Youth will play a quiz game to define the "technology" and learn that engineers design technologies to solve problems
Activity 1	Youth investigate how using water for various tasks can impact the water's quality
Activity 2	Youth investigate the properties of filter materials and create their own water filters to remove or treat contaminants from a water sample
Activity 3	Youth apply what they learned about filters and water quality to re-pipe a model house to reuse as much water as possible
Activity 4	Youth work in groups to plan, create, and test their water reuse processes designed for an extreme environment scenario
Activity 5	Youth work in groups to improve their water reuse process to better meet the criteria in their extreme environment
Activity 6	Youth communicate their ideas about designing a water reuse process in the Engineering Showcase

Note. Adapted from "Engineering interest and attitude development in out-of-school time," by C. San Antonio-Tunis, J. Clark, C.M., Cunningham, & C.P. Lachapelle, 2019, *ASEE Annual Conference and Exposition, Conference Proceedings*.

Culturally Responsive STEM Learning With a Trained Science Educator

Mary was a formally trained science educator who led an afterschool program at a private middle school in Boston, MA. Most of the youths at this site were not from a minority background. Mary seemed to be very structured as she implemented each activity across the engineering unit. Results from coding her program using the CRIOP showed Mary relied heavily on discourse moves, instructional practices, and classroom relationships. Mary used culturally responsive pedagogies consistently, although the way she conducted the classroom seemed similar to a formal learning environment. Table 3 provides a few examples and their code category for Mary's classroom.

Table 3

Culturally Responsive Examples in Mary's OST classroom

Code	Examples	
Discourse	"A thingy up top.' Is that a technical term? [Youth: That's our scientific term.] Is it? Okay then. I would like a little more precision in your language."	"Communicate and plan. So what does she mean by that? Who are you going to communicate with? Your group members. And what are you going to plan?"
Classroom Relationships	"We're all listening to each other right? This is the communication part. You were able to fix yours by adding a paper towel but that's not what happened for you, is that correct?"	"Talk with your fellow engineers and design an improvement to the process you already have".
Assessment Practices	Could sketch what you would do to improve your design. Just so you can have that extra level. What would you do to improve your design?"	Could you decide to fold them or not fold them? Were you able to do those things? Okay. Anything else?
Instructional Practices	There are different shapes. They look sort of like this. Where is there one nearby?	"scientists do not work in a vacuum it's always important for a scientist to be able to communicate his or her results to other scientists so that they can learn from them and so that they can repeat them"
Critical Consciousness	Well maybe not necessarily wrong. You had an unexpected outcome and you have to try something else. You're doing fine, but you've encountered a problem so now what do you do about that? That's what makes you an engineer. That's what makes you a scientist too.	"the average person uses eighty to one hundred gallons of water per day.' We're lucky to live in a country where that's possible. There are lots of countries where there' not that much clean water to use. And it's a huge problem."

Mary would also take the time to assess youth understanding using formative assessment practices. Her consistent assessment style with youths resulted in including and encouraging multiple voices in a classroom-wide discussion. She also would repeatedly address youth failure and whether or not youths viewed themselves as scientists. From these instances, she would often take a moment to discuss failure in science and as scientists and why it is crucial to view failure as a success. An example from the OST program in which Mary engages with the youth about failure is seen below.

> *Youth: I feel like we did something wrong.*
>
> ***Educator****: No, no. Nope. You know what you're doing. If it doesn't work does that mean you're a failure?*
>
> *Youth: No.*
>
> ***Educator:*** *What does it mean?*
>
> *Youth: You did something wrong and you have to try again.*
>
> ***Educator:*** *Well maybe not necessarily wrong. You had an unexpected outcome and you have to try something else. You're doing fine, but you've encountered a problem so now what do you do about that? That's what makes you an engineer. That's what makes you a scientist too.*
>
> *Youth: I'm not good at science.*
>
> ***Educator****: Yes you are, you're very good at science.*

In terms of cultural relevance in the classroom, this example exemplifies Mary's use of classroom relationships and critical consciousness. Mary was able to empower the youths by connecting with them during their times of failure and success, a strategy often discussed among culturally responsive teaching techniques.

Culturally responsive STEM Learning with an Untrained Science Educator

Steve is a twenty-something paid employee for a week-long STEM summer camp to enroll youth in the Southwest. Steve implemented each of the activities across the unit with a looser structure, often giving the youth time to engage in the material in ways different from how the curriculum was written. In terms of cultural relevancy, Steve heavily relied on moves such as "discourse" and "classroom relationships," oftentimes using both techniques simultaneously. Steve seemed to be hesitant to interact with youths at first but became more comfortable as the summer camp progressed and as his familiarity with how the units were run grew. Results show that Steve increased his usage of CRT principles throughout the unit. Table 4 shows some examples of Steve's CRT usage.

Table 4

Culturally Responsive Examples in Steve's OST classroom

Code	Examples	
Discourse	"So let's look at this. Maybe they're just cheesecloth. No, five cotton balls work pretty good. This doesn't change your classification right?"	"Was there anything else anyone had to say? Lilly did you have something? Groundwater is a good question."
Classroom Relationships	"You guys definitely are engineers in my eyes. I hope you guys see yourselves as engineers too because you definitely are"	"So as we go forward with this game keep that in mind when we ask you for a technology that it might be more than just a computer."
Assessment Practices	What parts did you struggle with on this activity? And again what would you do to improve?	What are you most proud of doing? In your groups?

Instructional Practices	Before we talk about how we reuse water I want to ask you guys how do you just use water in general?	As we go into the next activity we're gonna be learning and getting our hands a little dirty figuring out about greywater
Critical Consciousness	WHY do you consider yourself an engineer? Not IF you do, but WHY you do.	

After completing the unit, Steve mentioned his comfort level with the material and youths increased through time. His mention of this comfort is significant because it matches CRT results. Toward the beginning of the unit, Steve tended to rely more on discourse cultural relevance such as "teacher promoting active youth engagement through discourse practices." However, as Steve became more comfortable and gained experience, he increased his use of classroom relationships such as "teacher creates a learning atmosphere that engenders respect for one another and towards diverse populations." Below is an excerpt from Steve's interview reflecting his experience with the curriculum.

> ***Educator Interviewer:*** *(When referring to implementing the engineering curriculum): Do you feel more knowledgeable, more comfortable?*
>
> *11:42 Educator: No, yeah, definitely after doing this three times, I know how the routine goes. I know two prep activities, six activities. I know the last one's a showcase, and this and that. So it makes it easier for me to plan when I know what to expect.*
>
> *….. "it was a little bit daunting at first, looking at it, but then having a lot of stuff prepped when I got there, it was just, I could focus more of my attention on actually teaching it."*

Lastly, at several points, Steve seemed to place himself on equal ground as the youths rather than encourage a hierarchical teacher-youth relationship. During activities, Steve would engage with youth in ways that referred to them as sense makers, giving them agency in their engineering decisions. Steve would also question youth in ways that seemed like both educator and youth were learning from one another. These were coded consistently under the CRIOP as

classroom relationships and instructional techniques. Below is an excerpt from Steve's implementation log. The question asks him to reflect on if he had made any changes to the lesson and why he made those changes. He points out that it was not him but the youth who led the modification and let them take charge of their ideas. By Steve allowing the youth to make their modifications to the lesson, he instills critical consciousness and increases classroom relationships.

> *"I did not make these modifications the kids did, but they created the "No Filter Challenge" and the "No Crossing Pipes Challenge." These were away for them to test their knowledge by adding these constraints."*

What We Learned About Culturally Responsive Teaching in Out-of-School Time

The OST programs' observations provided valuable insights in terms of culturally responsive strategies. While it is not surprising that the formally trained teacher conducted her classroom similar to that of a formal learning environment, her connections with youths did seem well-intended. They resulted in many instances of youth growth and self-reflection in STEM learning. Durlak et al. found that OST programming is critical in developing youths' social and personal skills (2010). Youths' social and emotional development can become lost in the formal schooling environment where test scores and grades of priority (Afterschool Alliance, 2014b). Mary's use of social and emotional learning may have been more similar to that of a formal classroom. However, Mary did take time to address youth failure and overcoming failures as scientists. By doing so, she managed youth identity and encouraged them through classroom relationship pedagogies.

For Steve, a key result is his overall positive growth in culturally responsive strategies. His ability to feel comfortable with the STEM material allowed for more culturally responsive teaching practices to present themselves through the unit. Steve's observations enable us to see a link between being comfortable with content and educator ability to connect with youths. Research has shown a positive relationship between OST and constructive adult-child relationships, influencing the youth's quality of life (Woodland, 2008). Educators can incorporate positive relationships and create space where youth feel safe and valued for who they are and their ability to contribute (Mahoney et al., 2009). Steve's ability to "become" one of the youths may have created a space for youth to feel safe, especially if they come from a minority background.

Recommendations on Using CRT to Enhance STEM Learning in Informal Environments

OST programming can build relationships and expose youth to enriching opportunities they may not experience in formal school (Halpern, 2003). Additionally, programming can bridge the culture gap often seen in formal teaching instruction. Research on incorporating cultural competence, which includes respecting individuals' culturally-based beliefs, attitudes, and behaviors with youth, has shown how culturally responsive strategies are significant assets in OST programs (Kennedy et al., 2007). Critical outcomes of STEM learning in OST include increased content knowledge and drive toward STEM-related careers. Programs can offer youth ways to extend their knowledge and engage with content differently than formal school time. While informal STEM learning experiences help understand this study's importance, another critical feature is the educator's role in OST. Therefore, we encourage informal and OST

programming to enrich and provide a thoughtful discussion of their programming structure and their educators. Recommendations from this work include:

- Culturally responsive pedagogies may be helpful when developing STEM curriculum within informal learning;
- Professional development of educators, trained or untrained, on principles of cultural relevance; and
- Incorporating the pillars of cultural relevance into the goals of the program.
- Assessing whether or not CRT should be a design principle in OST.

These recommendations are based on the case studies we observed and are open to further research and discussions. According to Bloom et al. (2019), OST educators are not likely to seek deep pedagogical content knowledge for a specific curriculum on the same data. As a result, even experienced educators may need support to further the science principles within the curriculum. Therefore, Bloom et al. (2019) suggested some general guidance educators may use for developing certain engineering habits of mind and 21st-century skills. The results of this study revealed these educators may be attempting to connect with youths in congruence with instructional practices, discourse moves, etc. but are not maintaining an overall "competent" cultural score according to the CRIOP. This study presents a further need for educator support but highlights what means it may be accessible through, i.e., classroom relationships.

In conclusion, culturally responsive teaching styles and pedagogies may be necessary for informal STEM learning opportunities to encourage youth voice and identity. CRT principles offer educators a unique way to create relationships with their youths that help fill gaps often seen in STEM learning. The observations collected and discussed only provide so much insight

into this perspective, although there is a vast amount of ideas still to be explored that would add value to this.

CHAPTER 6: OVERALL DISCUSSION OF RESULTS AND CONCLUSIONS

The purpose of this study was to investigate the impact of a high-quality curriculum on the use of culturally responsive teaching strategies in two OST programs. Through observations, interviews, and educator implementation logs, we attempted to interpret the educators' use of culturally responsive strategies in the OST classrooms and decipher how they may have used the curriculum to support that use. Using the lens of culturally responsive pedagogies (Ladson-Billings, 1995), two research questions were addressed:

1. How are educators using culturally responsive teaching strategies in out-of-school time?
2. What is the curriculum's impact on the practices of culturally responsive teaching enacted in OST?

Educators Use of Culturally Responsive Teaching Strategies

The mean holistic CRIOP scores for site 1 and site 2 across the unit were 1.53 and 2.2, respectively. If rounded to the nearest whole number, both would be a “2” on the Likert scale, which according to the CRIOP matches with “occasional” use of CRT strategies. Both sites existed below the “frequent” (score 3) and “consistent” (score of 4) use of CRT strategies. Research has shown that teachers who expressed their beliefs of incorporating youth background into daily classroom instructions adopted culturally responsive teaching only to a small extent (Civitillo et al., 2019). These teachers think they may be enhancing a culturally responsive classroom but are not effectively doing it based on CRT principles and the CRIOP protocol. Therefore assessing CRT practices in OST is a significant limitation to be discussed.

An essential premise of CRT refers to teachers' beliefs about cultural diversity. CRT is indeed not only a set of teaching strategies, but it requires teachers holding beliefs that consider

cultural diversity as a positive attribute and valuable resource in teaching and learning (Gay, 2010). Our findings showed Mary (site 2) using significantly more culturally responsive teaching strategies than Steve across the unit. It may not be surprising that she had higher numbers of coded segments because she is a formally trained educator. Literature has shown teachers require more training to better understand and relate to diverse youths' race, culture, and class, especially youths from low-income backgrounds (Hoy, 2012).

More specifically, Mary relied heavily on discourse and classroom relationship codes from the CRIOP protocol. These codes are seen frequently in formal classroom settings with formally trained teachers. Experience in the classroom may make these codes easier to connect with youths. Research on culturally responsive teaching strategies in formal classrooms has also found similar results of higher classroom relationships, discourse, and instructional practices pillar categories (Powell et al., 2016).

Connections Between Educator's use of Culturally Responsive Strategies and Out-of-School-Time

OST programs can play an integral role in youth development and supply cultural, social, and emotional development where formal school settings often struggle (Murray & Milner, 2015). The degree of culturally responsive teaching and teachers' cultural diversity beliefs has been found to differ across teachers, so the results are not surprising (Civitillo et al., 2019). The educators consistently used high levels of discourse and classroom relationships may indicate that these strategies could be more accessible in an OST setting. OST programs' goals vary, and perhaps explicitly identified outcomes of programs could correlate with an increase of classroom relationships between youth and youth and educator. Therefore, the presence of such codes in these two sites may indicate ways OST educators and programs could, in a way, "capitalize" of

cultural relevance, perhaps by letting these types of strategies guide their principles and pillar for their programs.

In terms of the specific identified examples from the results, Mary consistently showed youth-educator interaction models that could be seen in a traditional school setting. Researchers make a clear difference between the learning process in a formal school time and the learning process in OST. There are specific material and content to administer via state and district standards in traditional school time. However, OST offers youths a way to make deeper connections with their individual experiences through learning (Blyth, 2018). That being said, Mary created a classroom environment similar to that of formal schooling.

In contrast, Steve (site 1) consistently interacted with youths to not exemplify a formal school time classroom. These examples were based on the educator placing himself in a space equal to his youths and entering into dialogue. Both the youth and educator learned from one another, and Steve was using his youths as resources. The classroom environment existed on a more level footing, which created an equitable climate between youth and educator. OST programming can build relationships and expose youth to enriching opportunities they may not experience in a regular school environment (Halpern, 2003). In contrast, Mary seemed to establish a hierarchy in educator-youth relationships and was the "leader" of the classroom, often keeping youths on task and in line.

Because OST is often a "low-stakes" environment, youths' development can happen differently than it may in formal school time. Noam and Tillinger (2004) describe OST as a space that "holds the potential to be psychological, social, and educational; they are protective, challenging, and age-appropriate" (p. 81). When there was extra time in the classroom, Steve

allowed the youth to engage further by playing games unrelated to the curriculum. However, Mary took any spare time to further the youths' learning on the engineering topics.

These examples are reflected upon in the educator implementation log and offer insight into the educator's goals for youth and classroom management. Because Mary would use the time for furthering youth understanding of the curriculum, there were more codes relating to the CRIOP. She would continue to push the youth further into knowledge and exploration with inquiry-based learning techniques they most likely use in their formal classroom. Often, professionals who enter the OST field miss the importance of encouraging youth development and social and emotional learning. As a result, their facilitation of the program can resemble the formal classroom teaching styles (National Institute on Out-of-School Time, 2007).

Connections Between High-Quality STEM Curriculum and Educators Use of Culturally Responsive Teaching Practices

Recent research outcomes have shown that STEM learning benefits in OST are positive and unique compared to other subjects. Outcome themes include improved attitudes toward STEM careers, increased STEM knowledge, and a higher likelihood of pursuing a STEM career (Afterschool Alliance, 2011b). Because this study utilized a high-quality STEM curriculum, we can see the curriculum's overall impact with the data presented.

One key result from site 1 was Steve's increase of codes used over time. This data was cross-examined with the educator implementation data in which Steve felt like the curriculum became more comfortable over time. Steve's example offers that an educator with no training may have use curriculum as landing points in the ways they connected with youths culturally. According to Masingila and Doerr (2002), a critical difficulty for inexperienced teachers is to understand how to use youth thinking in teaching STEM courses. Research has shown educators

face problems in implementing culturally responsive teaching in subjects like science and math (Bonner & Adams, 2011; Debnam et al., 2015). However, a recent literature review suggested that culturally responsive teaching in science and math could be implemented by raising critical analysis and socio-political consciousness in educators through professional development (Aronson & Laughter, 2016).

Studies also suggest that a culturally enriching curriculum can help youths gain a deeper understanding of concepts while also valuing their peer's perspectives (Fulton, 2009). As Steve's use of the curriculum and experience grew, so did the CRT coded segments. This finding indicates how functional curriculum may be for OST programs, especially those that employ untrained educators to lead their classrooms. Research has found that while afterschool programs engage in culturally related activities, there is a lack of awareness and intentionality to institute the tenets of culturally responsive pedagogy (C. Miller & Merriweather, 2020). Steve's demeanor with his youths mimics a sense of "belonging" with his youths, as he often let youths lead within activities and allowed for time to be loosely managed. Simpkins and Riggs (2017) assessed how cultural competence could foster a sense of belonging among youths in afterschool programs. While there are a gap in out-of-school time or afterschool time studies that examine CRT practices (Bennett, 2015), these findings can link future studies and implications using this theoretical lens in this type of program.

Limitations & Conclusions

The results regarding the use of CRT strategies in OST programs should be interpreted in light of several caveats and scalability assumptions. Out-of-School time educators vary significantly in their background, familiarity with the content, and youth interaction (G. G. Noam & Tillinger, 2004). Additionally, the CRIOP protocol was developed as a tool to assess formal

school time learning, using formally trained educators (Powell et al., 2016). We can assume that we would find less CRT strategies coded for by the CRIOP protocol in OST settings because of these conditions. Lastly, the curriculum was designed without the intention of cultural responsiveness, instead of with design principles of inclusivity (Bloom et al., 2019). This study was executed as a branch of the original research design. With these assumptions in mind, we can further discuss the results.

This study inherently holds several limitations to key results and findings. As formerly mentioned, OST programming has a variety of goals unique to the specific program. OST goals exist at the youth enrollment level and can range from remediation to enrichment outcomes. The two programs examined in this study existed within entirely different locations with quite different educators and youth. Without a clear goal for all of OST programming, there are many variables at play with this type of research. The curriculum was created with design principles involved other than cultural responsiveness. Also, the CRIOP protocol was developed for formal school time observational studies. Because of the nature of OST, this may be problematic in how we address educators' culturally responsive practices, and perhaps there needs to be a different set of standards when studying OST.

It is also worth considering how the use of CRT could have been increased within these sites and across the educators. Certain adaptations may need to be made to allow for the protocol to essentially “pick up” on proper cultural responsiveness in OST.

Teacher self-reflection is a crucial component for creating culturally responsive teaching practices (Howard, 2003; Ladson-Billings, 2009). While this study did not assess self-reflection based on culturally responsive practices, future studies could draw links. Additionally, the use of youth's native language, confronting stereotypes, and dealing with sensitive classroom issues are

central in CRT and the CRIOP. In this study, there were few examples of explicit cultural connection, which presents a challenge for the data. Similar challenges for implementing these two dimensions of the CRIOP were identified in previous studies (Powell et al., 2016). Future investigations should further explore how cultural diversity beliefs may support different but related dimensions of CRT.

We sought to understand how culturally responsive teaching strategies may occur in out of school time settings for this project. Using Ladson-Billings sociocultural teaching theory lens, we developed a process to gain insight into these questions (1995). While this study was part of a more extensive study funded by NASA to create a middle school STEM OST curriculum, we could find some unique results. One key result was that OST educators might significantly differ in how they enact culturally responsive teaching practices in an OST classroom, perhaps because of their teaching background and experiences. Another result indicates that because OST educators come from various backgrounds, a curriculum that could implement CRT strategies may allow educators to connect with their youths in more profound, more meaningful ways. Because OST programs across the country hold different youth goals, teaching moves that encourage cultural relevance could be a robust strategy that allows the OST program to enrich youth experience.

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Appendix A: IRB Approval

NORTHERN ARIZONA UNIVERSITY Office of Regulatory Compliance

Institutional Review Board
Human Research Subjects Protection Program

805 S Beaver St
Building 22, Room 215
PO Box: 4062
Flagstaff AZ 86011
928-523-9551
http://nau.edu/Research/Compliance/Human-Subjects/Welcome

To:	Joelle Clark, MS
From:	NAU IRB Office
Date:	December 29, 2017
Project:	Phase 3: Planetary Learning that Advances the Nexus of Engineering, Technology and Science (PLANETS): Funded by NASA: NNX16AC53A
Project Number:	1059491-3
Submission:	Amendment/Modification
Review Level:	Expedited Review
Action:	APPROVED WITH CONDITIONS
Project Status:	Active - Open to Enrollment
New Approval Expiration Date:	June 25, 2018
Review Category/ies:	**Condition of Approval:** Permissions to conduct the research from school districts/principals must be submitted to and acknowledged by the IRB prior to conduct of human research at those sites. **Expedite Approval (45 CFR 46.110 Category 5):** Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis). **Expedite Approval (45 CFR 46.110 Category 6):** Collection of data from voice, video, digital, or image recordings made for research purposes. **Expedite Approval (45 CFR 46.110 Category 7):** Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. **Vulnerable Population - Children (45 CFR 46.404 and 21 CFR 50.51):** As documented in the file, research involving not greater than minimal risk and adequate provisions are made for soliciting the assent of the children and permission of their parents or guardians, as set forth is 45 CFR 46.408 and 21 CFR 50.55. **Waiver of One Parental Signature (45 CFR 46.408(b) and 21 CFR 50.55(e)(1)):** permission of one parent is sufficient as it is research involving not greater than minimal risk as defined in 45 CFR 46.404.

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Appendix B: Educator Implementation Log

Name_____ Date_____ Activity Number_____

Goals

Please identify the STEM learning goal for the activity. How did you support youth in meeting this learning goal?

Preparation

About how many minutes did you spend reading the Educator Guide for this activity? _____

About how many minutes did you spend reading the Youth Notebook for this activity? ____

Reflection on Implementation

Describe any modifications or extensions you made to this Activity. If you made changes, please explain your reasons for these changes.

Were there any components you omitted from this Activity? If so, why did you omit those activities?

Recognizing success
In this activity:

Where did you see youth engaged and challenged?
Do you feel you had a role in making this happen? If so, what was your role?

Where did you see youth persisting through difficulties?
Do you feel you had a role in making this happen? If so, what was your role?

Did you see youth doing most of the talking and sharing ideas with each other?
Do you feel you had a role in making this happen? If so, what was your role?

Where did you see youth valuing their engineering work as a process (not just the end result)?
Do you feel you had a role in making this happen? If so, what was your role?

Youth development goals
Did you help youth connect this activity with their everyday lives? Yes___ No___
If yes, please give examples:

Did you help youth connect this activity with their home culture? Yes___ No___
If yes, please give examples:

Did you help youth connect their learning to issues in the community? Yes___ No___
If yes, please give examples:

Did you help youth connect this activity with STEM careers? Yes___ No___
If yes, please give examples:

Did you help youth make choices about their learning? Yes___ No___
If yes, please give examples:

Did you help youth take leadership (ownership) of their learning? Yes___ No___
If yes, please give examples:

Did you help youth build relationships with peers/within teams? Yes___ No___
If yes, please give examples:

Did you help youth make sense of their learning? Yes___ No___
If yes, please give examples:

Youth learning

From your perspective, what were the youths' most important learning outcome of the activity today?
Please briefly describe what the youths said or did that let you know.

Do you have any particularly memorable moments or anecdotes to share?

Thank you for completing this Implementation Form!

Appendix C: CRIOP Protocol

Culturally Responsive Instruction Observation Protocol
Fourth Revised Edition (January 2017)

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School (use assigned number):_____ Teacher (assigned number): ___

_____

Observer:_____ Date of Observation: _____ # of Youths in

Classroom: _____

Academic Subject: _____ Grade Level(s):

_____

Start Time of Observation: _____ End Time of Observation:_____ Total Time of Obs: ___

_____

DIRECTIONS

After the classroom observation, review the field notes for evidence of each "pillar" of Culturally Responsive Instruction. If an example of the following descriptors was observed, place the field notes line number on which that example is found. If a "non-example" of the descriptors was observed, place the line number on which that non-example is found.

Then, make an overall/holistic judgment of the implementation of each component. To what extend and/or effect was the component present?

4 – Consistently
3 – Often
2 – Occasionally
1 – Rarely
0 – Never

Transfer the holistic scores from pp. 2 through 9 to the table below.

CRI Pillar	Holistic Score

CRI Pillar	Holistic Score

I. CLASS	
II. FAM	
III. ASMT	

IV. INSTR	
V. DISC	
VI. CRITICAL	

I. CLASS CLASSROOM RELATIONSHIPS **Holistic score 4 3 2 1 0**

Consistently Often Occasionally Rarely Never

CRI Indicator	For example, in a responsive classroom:	For example, in a non-responsive classroom:	Field notes: Time or line(s) of example	Field notes: Time or line(s) of non-example	Field notes: No example (✓)	SCORE for Indicator
1. The teacher demonstrates an ethic of care (e.g., equitable relationships, bonding)	Generally Effective Practices: • Teacher refers to youths by name, uses personalized language with youths • Teacher conveys interest in youths' lives and experiences Practices that are Culturally Responsive: • There is a "family-like" environment in the classroom; there is a sense of belonging; youths express care for one another in a variety of ways • Teacher promotes an environment that is safe and anxiety-free for all youths, including culturally and linguistically diverse youths; youths seem comfortable participating in the classroom • Teacher differentiates patterns of interaction and management techniques to be culturally congruent with the youths and families s/he serves (e.g., using a more direct interactive style with youths who require it)	• Teacher permits and/or promotes negativity in the classroom, e.g., criticisms, negative comments, sarcasm, etc. • Teacher does not address negative comments of one youth towards another • Teacher stays behind desk or across table from youths; s/he does not get "on their level" • Teacher does not take interest in youths' lives and experiences; is primarily concerned with conveying content • Teacher does not seem aware that some youths are marginalized and are not participating fully in classroom activities • Some youths do not seem comfortable contributing to class discussions and participating in learning activities • Teacher uses the same management techniques and interactive style with all youths when it is clear that they do not work for some				
2. The teacher communicates high expectations for all youths	Generally Effective Practices: • There is an emphasis on learning and higher-level thinking; challenging work is the norm • Youths do not hesitate to ask questions that further their	• Teacher has low expectations , consistently giving work that is not challenging or frustrating youths by giving them tasks that are unreasonably difficult • Teacher does not call on all youths				

	learning; there is a "culture of learning" in the classroom • Teacher expects every youth to participate actively; youths are not allowed to be unengaged or off-task • Teacher gives feedback on established high standards and provides youths with specific information on how they can meet those standards Practices that are Culturally Responsive: • There are group goals for success as well as individual goals (e.g., goals and charts posted on walls); every youth is expected to achieve • Youths are invested in their own and others' learning ; they continuously assist one another • Teacher takes steps to assure that emerging bilinguals understand directions and have access to the same content and learning as native speakers	consistently • Teacher allows some youths to remain unengaged, e.g., never asks them to respond to questions, allows them to sleep, places them in the "corners" of the room and does not bring them into the instructional conversation, etc. • Teacher does not establish high standards; evaluation criteria require lower-level thinking and will not challenge youths • Teacher feedback is subjective and is not tied to targeted learning outcomes and standards • Teacher expresses a deficit model, suggesting through words or actions that some youths are not as capable as others • Teacher does not explicitly assist emerging bilinguals to assure they understand directions and content				
3. The teacher creates a learning atmosphere that engenders respect for one another and toward diverse populations	Generally Effective Practices: • Teacher sets a tone for respectful classroom interaction and teaches respectful ways for having dialogue and being in community with one another • Teacher implements practices that teach collaboration and respect, e.g., class meetings, modeling and reinforcing effective interaction, etc. • Youths interact in respectful ways and know how to work together effectively • Teacher and youths work to understand each other's perspectives Practices that are Culturally	• Teacher shows impatience and intolerance for certain youth behaviors • Lack of respectful interaction amongst youths may be an issue • Teacher establishes a competitive environment whereby youths try to out-perform one another • Teacher does not encourage youth questions or ridicules youths when they ask for clarification • Posters and displays do not show an acknowledgement and affirmation of youths' cultural and racial/ethnic/linguistic identities • Classroom library and other available materials promote ethnocentric positions and/or ignore				

	Responsive: • Positive and affirming messages and images about youths' racial and ethnic identities are present throughout the classroom • Teacher affirms youths' language and cultural knowledge by integrating it into classroom conversations • Teacher encourages youths to share their stories with one another and to have pride in their history and linguistic and cultural identities • Classroom library and other available materials contain multicultural content that reflect the perspectives of and show appreciation for diverse groups • Classroom library (including online resources) includes bilingual texts that incorporate youths' native languages	human diversity • Classroom resources do not include any bilingual texts • Teacher never affirms youths' native languages				
4. Youths work together productively	Generally Effective Practices: • Youths are continuously viewed as resources for one another and assist one another in learning new concepts • Youths are encouraged to have discussions with peers and to work collaboratively	• Youths are discouraged from assisting their peers • Youths primarily work individually and are not expected to work collaboratively; and/or youths have a difficult time collaborating • Teacher dominates the decision-making and does not allow for youth voice • The emphasis is on individual achievement • Classroom is arranged for quiet, solitary work, with the teacher being "center stage"				

II. FAM FAMILY COLLABORATION **Holistic score 4 3 2 1 0**

Consistently **Often**

Occasionally **Rarely** **Never**

NOTE: When scoring this component of the CRIOP, the family collaboration interview should be used in addition to field observations.

Observations alone will not provide adequate information for scoring.

CRI Indicator	For example, in a responsive classroom:	For example, in a non-responsive classroom:	Field notes: Time or line(s) of example	Field notes: Time or line(s) of non-example	Field notes: No example (✓)	SCORE for Indicator
1. The teacher establishes genuine partnerships (equitable relationships) with parents/ caregivers	Generally Effective Practices: • Parents'/caregivers' ideas are solicited on how best to instruct the child; parents are viewed as partners in educating their child • There is evidence of conversations with parents/caregivers where it's clear that they are viewed as partners in educating the youth Practices that are Culturally Responsive: • Teacher makes an effort to understand families and respects their cultural knowledge by making a concerted effort to develop relationships in order to learn about their lives, language, histories, and cultural traditions • Teacher makes an effort to communicate with families in their home languages (e.g.,learning key terms in the youth's home language, translating letters, using translation tools involving a family liaison, etc.)	• Parents'/caregivers are never consulted on how best to instruct their child, and/or their suggestions are not incorporated in instruction • No effort made to establish relationships with caregivers • There is evidence of a "deficit perspective" in which families and caregivers are viewed as inferior and/or as having limited resources that can be leveraged for instruction • All communication with families is in English.				

2. The teacher reaches out to meet parents in positive, non-traditional ways	Generally Effective Practices: • Teacher conducts home visit conferences • Teacher makes "good day" phone calls and establishes regular communication with parents Practices that are Culturally Responsive: • Teacher plans parent/family activities at locations within the home community • Teacher meets parents in parking lot or other locations that may be more comfortable for them	• Communication with parents/caregivers is through newsletters or similar group correspondence,, where they are asked to respond passively (e.g., signing the newsletter, versus becoming actively involved in their child's learning) • Teacher conducts phone calls, conferences, personal notes to parents for negative reports only (e.g., discipline)				
3. The teacher encourages parent/family involvement	Generally Effective Practices: • Parents are encouraged to be actively involved in school-related events and activities • Parents/caregivers are invited into the classroom to participate and share experiences Practices that are Culturally Responsive: • Parents from diverse linguistic and cultural backgrounds are invited to share their unique experiences and knowledge (e.g., sharing their stories, reading books in their native language, teaching songs and rhymes in their native language, etc.)	• Parents/caregivers are never involved in the instructional program • There is no evidence of home/family connections in the classroom				
4. The teacher intentionally learns about families' linguistic/cultural knowledge and expertise to support youth learning	Practices that are Culturally Responsive: • Teacher identifies families' "funds of knowledge" so it can be used to facilitate youth learning (e.g., through home visits; social events for families where information is solicited; conversations with parents and youths about their language, culture, and history; attending community events; home literacy projects; camera projects etc.)	• Families' "funds of knowledge" are never identified				

III. ASMT ASSESSMENT PRACTICES **Holistic score 4 3 2 1 0**

Consistently Often Occasionally Rarely Never

CRI Indicator	For example, in a responsive classroom:	For example, in a non-responsive classroom:	Field notes: Time or line(s) of example	Field notes: Time or line(s) of non-example	Field notes: No example (✓)	SCORE for Indicator
1. Formative assessment practices are used that provide information throughout the lesson on individual youth understanding	Generally Effective Practices: • Teacher frequently assesses youths' understanding throughout instruction and uses assessment data throughout the lesson to adjust instruction • Youths are able to voice their learning throughout the lesson • Informal assessment strategies are used continuously during instruction, while youths are actively engaged in learning, and provide information on the learning of every youth (e.g. "talking partners," whiteboards, journal responses to check continuously for understanding) • Teacher modifies instruction or reteaches when it's clear that youths are not meeting learning targets	• Assessment occurs at the end of the lesson • Assessment is not embedded throughout instruction • Assessment is regarded as a set of evaluation "tools" that are used to determine what youths have learned (e.g., exit slips, quizzes, etc. that are administered after instruction has occurred versus examining youths' cognitive processing during instruction) • Teacher follows the lesson script even when it's clear that youths are not meeting learning targets • The goal is to get through the lesson and cover the content versus assuring youth understanding				
2. Youths are able to demonstrate their learning in a variety of ways	Generally Effective Practices • Divergent responses and reasoning are encouraged; youths are able to share the processes and evidence they used to arrive at responses versus simply providing "the" correct answer Practices that are Culturally Responsive: • Youths with limited English proficiency and/or limited literacy can show their conceptual learning	• Most or all tests are written and require reading/writing proficiency in English • Teacher expects youths to tell "the" answer • Youths have a narrow range of options for demonstrating competence (e.g., multiple choice tests, matching, etc.)				

	through visual or other forms of representation (e.g., drawing, labelling, completing graphic organizers etc. depending upon their level of English language acquisition)					
3. Authentic assessments are used frequently to determine youths' competence in both language and content.	Generally Effective Practices: • Youths' written and oral language proficiency is assessed while they are engaged in purposeful activity • Teacher primarily uses authentic, task-embedded assessments (e.g., anecdotal notes, targeted observation, rubrics/analysis of youths' written products, math charts/journals, etc.) Practices that are Culturally Responsive: • Teacher assesses both academic language and content	• Assessments measure discrete, isolated skills and/or use short, disconnected passages • Youths' linguistic competence is never assessed, or is evaluated solely through standardized measures • Assessments are "exercises" that youths must complete versus meaningful, purposeful work				
4. Youths have opportunities for self-assessment	Generally Effective Practices: • Youths are encouraged to evaluate their own work based upon a determined set of criteria • Youths are involved in setting their own goals for learning • Youths are involved in developing the criteria for their finished products (e.g., scoring rubrics)	• Assessment is always teacher-controlled				

IV. INSTR INSTRUCTIONAL PRACTICES **Holistic score 4 3 2 1 0**

Consistently Often Occasionally Rarely Never

CRI Indicator	For example, in a responsive classroom:	For example, in a non-responsive classroom:	Field notes: Time or line(s) of example	Field notes: Time or line(s) of non-example	Field notes: No example (✓)	SCORE for Indicator
1. Instruction is contextualized in youths' lives, experiences, and individual abilities	Generally Effective Practices: • Learning activities are meaningful to youths and promote a high level of youth engagement • Materials and real-world examples are used that help youths make connections to their lives • Learning experiences build on prior youth learning and invite youths to make connections Practices that are Culturally Responsive: • Teacher uses instructional methods/activities that provide windows into youths' worlds outside of school (e.g., "All About Me" books, youth-created alphabet walls, camera projects, etc.) • Teacher views youths' life experiences as assets and builds on youths' cultural knowledge, linguistic knowledge, and "cultural data sets," making connections during instruction in the various content areas • Materials and examples are used that reflect diverse experiences and views • Families' "funds of knowledge" are integrated in learning experiences when possible; parents are invited into the classroom to share their knowledge	• Learning tasks and texts reflect the values and experiences of dominant ethnic and cultural groups • No attempt is made to link youths' realities to what is being studied; learning experiences are disconnected from youths' knowledge and experiences • Skills and content are presented in isolation (never in application to authentic contexts) • Teacher follows the script of the adopted curriculum even when it conflicts with her own or the youths' lived experiences • Learning experiences are derived almost exclusively from published textbooks and other materials that do not relate to the classroom community or the larger community being served • Families "funds of knowledge" are never incorporated in the curriculum; parents are never invited to share their knowledge				

2. Youths engage in active, hands-on, meaningful learning tasks, including inquiry-based learning	• Learning tasks allow youths to practice and apply concepts using hands-on activities and manipulatives • Learning activities promote a high level of youth engagement • Exploratory learning is encouraged • Teacher engages youths in the inquiry process and learns from youths' investigations (e.g., inquiry-based and project-based learning) • Youths are encouraged to pose questions and find answers to their questions using a variety of resources • Youth-generated questions form the basis for further study and investigation	• Youths work passively at their seats on teacher-directed tasks • Passive youth learning is the norm (e.g., listening to direct instruction and taking notes, reading the textbook, seatwork, worksheets, etc.) • Exploratory learning is discouraged • Teacher is the authority • Youths are not encouraged to challenge or question ideas or to engage in further inquiry • Youths are not encouraged to pose their own questions • All knowledge/ideas are generated by those in authority (e.g., textbook writers, teachers)				
3. The teacher focuses on developing youths' academic language	Generally Effective Practices: • There is an emphasis on learning academic vocabulary in the particular content area • Youths are taught independent strategies for learning new vocabulary • Key academic vocabulary and language structures are identified prior to a study or investigation Practices that are Culturally Responsive: • Teacher develops language objectives in addition to content objectives, having specific goals in mind for youths' linguistic performance • Teacher articulates expectations for language use (e.g "I want you to use these vocabulary words in your discussion; I expect you to reply in a complete sentence" etc.) • Teacher scaffolds youths' language development as needed (sentence frames, sentence starters, etc.) • Academic language is taught	• Little attention is paid to learning academic vocabulary in the content area • New words are taught outside of meaningful contexts • Youths are not taught independent word learning strategies • Teacher does not articulate expectations for language use • The teacher does not establish language objectives for youths; only content objectives are evident • Teacher does not scaffold youths' language development • No attention is given to the language used in particular disciplines; academic language is not addressed • Youths are evaluated on their use of academic discourse but it is never taught explicitly				

	explicitly (identifying it in written passages, dissecting complex sentences, using mentor texts, creating "learning/language walls," etc.)					
4. The teacher uses instructional techniques that scaffold youth learning	• Teacher uses a variety of teaching strategies to assist youths in learning content (e.g., demonstrations, visuals, graphic organizers, reducing linguistic density, etc.) • Teacher models, explains and demonstrates skills and concepts and provides appropriate scaffolding • Teacher uses "comprehensible input" (e.g., gestures, familiar words and phrases, slower speech, etc.) to facilitate understanding when needed • Teacher builds on youths' knowledge of their home languages to teach English (e.g., cognates, letter-sound relationships, syntactic patterns)	• Teacher primarily uses traditional methods for teaching content (e.g., lecture, reading from a textbook) with few scaffolding strategies • Teacher does not always model, explain and demonstrate new skills and concepts prior to asking youths to apply them • Teacher does not use visuals, comprehensible input etc. to facilitate understanding • Teacher does not build upon youths' home languages to teach terms, skills and concepts in English				
5. Youths have	• Youths have multiple opportunities	• Teacher selects texts, writing				

choices based upon their experiences, interests and strengths	to choose texts, writing topics, and modes of expression based on preferences and personal relevance • Youths have some choice in assignments • Youths have some choice and ownership in what they are learning	topics, and modes of expression for youths • All assignments are teacher-initiated • Youths have no choice or ownership in topic of study or questions that will be addressed				

V. DIS DISCOURSE **Holistic score 4 3 2 1 0**

Consistently Often Occasionally Rarely Never

CRI Indicator	For example, in a responsive classroom:	For example, in a non-responsive classroom:	Field notes: Time or line(s) of example	Field notes: Time or line(s) of non-example	Field notes: No example (✓)	SCORE for Indicator
1. The teacher promotes active youth engagement through discourse practices	• Teacher employs a variety of discourse protocols to promote youth participation and engagement (e.g., call and response, talking circles, read-around, musical shares, etc.) • All youths have the opportunity to participate in classroom discourse • Teacher uses various strategies throughout the lesson to promote youth engagement through talk (e.g., partner share, small group conversation, interactive journals, etc.)	• The main form of classroom discourse is Initiate-Respond-Evaluate (IRE) where the teacher poses a question and individual youths respond • The teacher controls classroom discourse by assigning speaking rights to youths • Not all youths have the opportunity to participate in classroom discussions • Some youths are allowed to dominate discussions				

2. The teacher promotes equitable and culturally sustaining discourse practices	Generally Effective Practices: • Youths use collaborative, overlapping conversation and participate actively, supporting the speaker during the creation of story talk or discussion and commenting upon the ideas of others • Teacher uses techniques to support equitable participation, such as wait time, feedback, turn-taking, and scaffolding of ideas Practices that are Culturally Responsive: • Youths speak in their home language/dialect when it is situationally appropriate to do so • There is an emphasis on developing proficiency in youths' native language as well as in Standard English; bilingualism/ multilingualism is encouraged (e.g., youths learn vocabulary in their native languages; youths read/write in their native languages; youths learn songs and rhymes in other languages, etc.)	• Discourse practices of various cultural groups are not used during instruction • Youths are discouraged from using their home language or dialect and communicating in culturally specific ways, even when it is situationally appropriate to do so • Emerging bilingual youths are discouraged from using their native language, both inside and outside of school • Youths are discouraged from communicating in a language other than English • There is no evidence of attempts to promote bilingualism/multilingualism				
3. The teacher provides structures that promote academic conversation	Generally Effective Practices: • Youths engage in genuine discussions and have extended conversations • Teacher explicitly teaches and evaluates skills required for conducting effective academic conversations Practices that are Culturally Responsive: • Teacher provides prompts that elicit extended conversations and dialogue (e.g. questions on current issues; questions that would elicit differing points of view)	• Youths are discouraged from talking together, or conversations are limited to short responses • Teacher rarely asks questions or provides prompts that would elicit extended dialogue • Teacher does not teach skills required for academic conversations				

4. The teacher provides opportunities for youths to develop linguistic competence	Generally Effective Practices: • Teacher provides many opportunities for youths to use academic language in meaningful contexts • Youths are engaged in frequent and authentic uses of language and content (drama, role play, discussion, purposeful writing and communication using ideas/concepts/vocabulary and syntactic structures from the field of study) Practices that are Culturally Responsive: • Youths are taught appropriate registers of language use for a variety of social contexts and are given opportunities to practice those registers in authentic ways	• Youths' use of language is limited and they do not use language in authentic ways • Youths are not taught about the registers of language use; they are expected to use Standard English in all social contexts				

VI. CRITICAL CRITICAL CONSCIOUSNESS **Holistic score 4 3 2 1 0**

Consistently Often Occasionally Rarely Never

CRI Indicator	For example, in a responsive classroom:	For example, in a non-responsive classroom:	Field notes: Time or line(s) of example	Field notes: Time or line(s) of non-example	Field notes: No example (✓)	SCORE for Indicator
1. The curriculum and planned learning experiences provide opportunities for the inclusion of issues important to the classroom, school and community	Generally Effective Practices: • Youths are engaged in experiences that develop awareness and provide opportunities to contribute, inform, persuade and have a voice in the classroom, school and beyond • Community-based issues and projects are included in the planned program and new skills and concepts are linked to real-world problems and events Practices that are Culturally Responsive: • Youths explore important contemporary issues (poverty, racism, global warming, human trafficking, animal cruelty, etc.) • Teacher encourages youths to investigate real-world issues related to a topic being studied and to become actively involved in solving problems at the local, state, national, and global levels	• The focus of literacy and content instruction is to teach the skills and information required to "pass the test"; learning occurs only as it relates to the standard curriculum • Teacher does not encourage critical thought or questioning of contemporary issues • Teacher does not encourage application to real-world issues; accepts or endorses the status quo by ignoring or dismissing real life problems related to the topic being studied				
2. The curriculum and planned learning experiences incorporate opportunities to confront negative	Practices that are Culturally Responsive: • Teacher facilitates youths' understanding of stereotypes and biases • Teacher encourages youths to examine biases in popular culture that youths encounter in their daily lives (TV shows, advertising, popular songs, etc.) • Teacher makes intentional use of	• Teacher does not encourage youths to examine biases in instructional materials or popular texts; texts are considered to be "neutral" • Teacher never addresses issues related to human differences • Teacher makes prejudicial statements to youths (e.g., girls are emotional; immigrants don't				

stereotypes and biases	multicultural literature to facilitate conversations about human differences • As appropriate to the grade level being taught, teacher helps youths to think about biases in texts (e.g., "Who has the power in this book? Whose perspectives are represented, and whose are missing? Who benefits from the beliefs and practices represented in this text?" etc.) • As appropriate to the grade level being taught, teacher challenges youths to deconstruct their own cultural assumptions and biases both in the formal and informal curriculum	belong here; etc.), and/or fails to challenge prejudicial statements of youths				
3. The curriculum and planned learning experiences integrate and provide opportunities for the expression of diverse perspectives	Generally Effective Practices: • Youths are encouraged to challenge the ideas in a text and to think at high levels Practices that are Culturally Responsive: • Texts include protagonists from diverse backgrounds and present ideas from multiple perspectives • Youths are encouraged to explore alternative viewpoints • Opportunities are plentiful for youths to present diverse perspectives through class discussions and other activities • Youths are encouraged to respectfully disagree with one another and to provide evidence to support their views	• The conventional, dominant point of view is presented and remains unchallenged • Few texts are available to represent diverse protagonists or multiple perspectives • Biased units of study are presented that show only the conventional point of view (e.g., Columbus discovered America) or that ignore other perspectives (e.g., a weather unit that does not include a discussion of global warming) • No or very few texts are available with protagonists from diverse cultural, linguistic, and/or socioeconomic backgrounds • No opportunities are provided for youths to learn about or to present diverse views				